



## *Parameter Reference Guide*

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# ***Unidrive M200***

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### *Open-Loop Mode*

# About Parameter Reference Guide

The manufacturer accepts no liability for any consequences resulting from inappropriate, negligent or incorrect installation or adjustment of the optional operating parameters of the equipment or from mismatching the variable speed drive with the motor.

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## Parameter mm.000

*Parameter mm.000* (mm.000) is one parameter that can be accessed from every drive menu so that the user can initiate various actions by setting a value in this parameter and then performing a drive reset. If the action is completed successfully parameter mm.000 is cleared when the action is complete. If the action is not started because the value does not correspond to an action, or because the action is not allowed (i.e. an attempt is made to load defaults and the drive is enabled), parameter mm.000 is not cleared. If the action is started and then fails a trip is produced and parameter mm.000 is not cleared.

There could be some conflict between the actions of *Parameter mm.000* (mm.000) and *Parameter Cloning* (11.042) when the drive is reset. If *Parameter Cloning* (11.042) has a value of 1 or 2 and a valid action is required from the value of parameter mm.000 then only the action required by parameter mm.000 is performed, but on successful completion of the action both parameters are cleared. If *Parameter Cloning* (11.042) has any other value it is not affected.

The table below shows the possible actions that can be initiated with *Parameter mm.000* (mm.000).

| <b>Parameter mm.000 (mm.000) value</b> | <b>Action</b>  | <b>Possible failures</b>  |
|--|--|---|
| 1001                                   | Save drive user save parameters to non-volatile memory. Power-down save parameters are saved when the drive enters the under voltage state.  | No action if the drive is in the under voltage state  |
| 1000                                   | Save drive parameters to non-volatile memory. It should be noted that power-down save parameters are also saved which will result in one background task scan being extended to 200ms. |   |
| 1070                                   | Reset all option modules   |   |
| 1233                                   | Load 50Hz defaults   | No action if the drive is enabled   |
| 1234                                   | Load 50Hz defaults to all menus except option module menus (i.e 15 to 20 and 24 to 28)   | No action if the drive is enabled   |
| 1244                                   | Load 60Hz defaults   | No action if the drive is enabled   |
| 1245                                   | Load 60Hz defaults to all menus except option module menus (i.e 15 to 20 and 24 to 28)   | No action if the drive is enabled   |
| 1299                                   | Reset <i>Stored HF</i> trip.   |   |
| 2001                                   | Create a boot file on a non-volatile media card based on the present drive parameters including all Menu 20 parameters   | Non-volatile media card trips   |
| 4xxx                                   | NV media card: Transfer the drive parameters to parameter file xxx   | Non-volatile media card trips   |
| 5xxx                                   | NV media card: Transfer the onboard user program to onboard user program file xxx  | Non-volatile media card trips   |
| 6xxx                                   | NV media card: Load the drive parameters from parameter file xxx or the onboard user program from onboard user program file xxx  | No action if the drive is enabled<br>Non-volatile media card trips  |
| 7xxx                                   | NV media card: Erase file xxx  | Non-volatile media card trips   |
| 8xxx                                   | NV Media card: Compare the data in the drive with file xxx   | Non-volatile media card trips   |
| 9555                                   | NV media card: Clear the warning suppression flag  | Non-volatile media card trips   |
| 9666                                   | NV media card: Set the warning suppression flag  | Non-volatile media card trips   |
| 9777                                   | NV media card: Clear the read-only flag  | Non-volatile media card trips   |
| 9888                                   | NV media card: Set the read-only flag  | Non-volatile media card trips   |
| 9999                                   | NV media card: Erase and format the NV media card  | Non-volatile media card trips   |
| 12000                                  | Only display parameters that are different from their default value. This action does not require a drive reset.   |   |
| 12001                                  | Only display parameters that are used to set-up destinations (i.e. DE format bit is 1). This action does not require a drive reset.  |   |
| 59999                                  | Deletes an onboard user program if a program is present.<br><br>Note: Any parameter changes that have not been saved will be lost during this action.                                  | No action if the drive is enabled.<br>No action if there is no program present.<br>No action if the user program is enabled (i.e. <i>Onboard User Program: Enable</i> (11.047) = 1) |

*Parameter mm.000* (mm.000) values from 1 to 14 are equivalent to other values as shown in the table below to allow easy access to some commonly used functions. For 0 and each of these values the keypad provides a string as shown.

| Value | String             | Equivalent value | Action  |
|-------|--------------------|------------------|---|
| 0     | [No Action]        | 0                |   |
| 1     | [Save parameters]  | 1000             | Save drive parameters to non-volatile memory  |
| 2     | [Load file 1]      | 6001             | Load the data from file 1 on a non-volatile media card into the drive provided it is a parameter file |
| 3     | [Save to file 1]   | 4001             | Store the drive parameters in file 1 on a non-volatile media card                                     |
| 4     | [Load file 2]      | 6002             | Load the data from file 2 on a non-volatile media card into the drive provided it is a parameter file |
| 5     | [Save to file 2]   | 4002             | Store the drive parameters in file 2 on a non-volatile media card                                     |
| 6     | [Load file 3]      | 6003             | Load the data from file 3 on a non-volatile media card into the drive provided it is a parameter file |
| 7     | [Save to file 3]   | 4003             | Store the drive parameters in file 3 on a non-volatile media card                                     |
| 8     | [Show non-default] | 12000            | Only display parameters that are different from their default value                                   |
| 9     | [Destinations]     | 12001            | Only display parameters that are used to set-up destinations  |
| 10    | [Reset 50Hz defs]  | 1233             | Load 50Hz defaults  |
| 11    | [Reset 60Hz defs]  | 1244             | Load 60Hz defaults  |
| 12    | [Reset modules]    | 1070             | Reset all option modules  |

### Saving drive parameters

User-save and power-down save drive parameters are stored in non-volatile memory within the drive. Any values that have changed are copied to this memory under the following conditions.

| Parameter type                            | Conditions for copy to non-volatile memory  |
|---|---|
| User-save parameter not visible in menu 0 | Drive reset with 1000 in <i>Parameter mm.000</i> (mm.000) if the drive is not in the under voltage state.<br>OR<br>A drive reset with 1001 in <i>Parameter mm.000</i> (mm.000).<br>OR<br>After parameters are transferred from a non-volatile media card.<br>OR<br>After the drive mode is changed.<br>OR<br>After default parameters are loaded.<br>OR<br>After parameters are transferred from an electronic nameplate. |
| User save parameter visible in menu 0     | Under the conditions given above for user save parameters not visible in Menu 0.<br>OR<br>If the keypad is in edit mode for a user-save parameter in Menu 0, the parameter is saved when the keypad mode is changed from edit mode.   |
| Power-down save parameter                 | A drive reset with 1000 in <i>Parameter mm.000</i> (mm.000) if the drive is not in the under voltage state.<br>OR<br>A drive reset with 1001 in <i>Parameter mm.000</i> (mm.000).<br>OR<br>On the transition into the under voltage state.<br>OR<br>After the drive mode is changed.<br>OR<br>After parameters are transferred from a non-volatile media card which results in the drive mode changing.                   |

It can take some time for parameter data to be copied to non-volatile memory, especially if there are a large number of differences between the parameter values in the drive and the values stored in the memory. Saving Power-down save parameters takes a maximum of 300ms, but saving user-save parameters can take several seconds. If the drive is powered from a 24V control supply, or from a low voltage supply, the power down time of the control system can be very short and there is a risk that either the stored values of the power-down save or user-save parameters could be corrupted. This would result in an *EEPROM Fail* trip at the next power-up. To reduce this risk, the power-down save and user-save parameters are each stored in two banks. The banks are alternated each time a save is performed and the bank pointer is only updated once the save is complete. If the new bank is corrupted a *User Save* or *Power Down Save* is initiated at the next power-up indicating an error in the user-save or power-down save data respectively, and the data from the old bank is used. The following points should be noted:

1. If a *User Save* or *Power Down Save* trip occur at power-up then parameter changes made before power down will be lost. To clear these trips a parameter save must be performed. If both the user-save and power-down save data is corrupted then a *Power Down Save* trip is produced.
2. When a Menu 0 parameter is changed its value is saved immediately to the active bank and the bank pointer is not changed. Therefore changes made via Menu 0 are not lost if a *User Save* trip occurs at power-up.

3. When the drive mode changes all the data in both banks in the non-volatile memory is cleared and the default parameters are saved in both banks. Therefore there is an extended parameter saving period immediately after a drive mode change.
4. When a new option module is fitted to the drive all the data in both banks in the non-volatile memory is cleared. The next parameter a save time is extended as the new parameter data is written to both banks.
5. Two banks are not provided in non-volatile media cards therefore the card could be corrupted if the power is removed when the drive is writing data to the card.

#### Loading defaults

A drive reset with 1233 in *Parameter mm.000* (mm.000) loads the defaults defined for each parameter. If defaults are loaded with 1244 in *Parameter mm.000* (mm.000) then the parameters in the table below have different defaults that are intended for the 60Hz regions.

| Parameter                                  | Default | Drive modes | Drive voltage rating |
|--|---------|-------------|----------------------|
| <i>Maximum reference clamp</i> (01.006)    | 60.00Hz | All         | All                  |
| <i>Standard Ramp Voltage</i> (02.008)      | 775V    | All         | 400V                 |
| <i>Motor Rated Frequency</i> (05.006)      | 60.00Hz | All         | All                  |
| <i>Motor Rated Load rpm</i> (05.008)       | 1800rpm | All         | All                  |
| <i>Motor Rated Voltage</i> (05.009)        | 460V    | All         | 400V                 |
| <i>M2 Maximum Reference Clamp</i> (21.001) | 60.00Hz | All         | All                  |
| <i>M2 Motor Rated Frequency</i> (21.006)   | 60.00Hz | All         | All                  |
| <i>M2 Motor Rated Load rpm</i> (21.008)    | 1800rpm | All         | All                  |
| <i>M2 Motor Rated Voltage</i> (21.009)     | 460V    | All         | All                  |

#### Non-volatile media card data transfer

Details of the data that can be stored on a non-volatile media card and the methods to transfer/access this data are given in Menu 11.

# Current Ratings

The tables below give the maximum output current ratings, peak current ratings and power ratings for all drive sizes and voltage ratings.

## 110V Rated Drives

| Model    | Heavy Duty    |                   |      |                        |                  | Normal Duty   |                   |    |              | Kc    |
|----------|---------------|-------------------|------|------------------------|------------------|---------------|-------------------|----|--------------|-------|
|          | Rated Current | Motor Shaft Power |      | Peak Current Open Loop | Peak Current RFC | Rated Current | Motor Shaft Power |    | Peak Current |       |
|          | A             | kW                | hp   | A                      | A                | A             | kW                | hp | A            |       |
| 01100017 | 1.7           | 0.25              | 0.33 | 2.55                   | 3.1              | 1.7           |                   |    |              | 3.74  |
| 01100024 | 2.4           | 0.37              | 0.5  | 3.6                    | 4.3              | 2.4           |                   |    |              | 5.28  |
| 02100042 | 4.2           | 0.75              | 1    | 6.3                    | 7.6              | 4.2           |                   |    |              | 9.24  |
| 02100056 | 5.6           | 1.1               | 1.5  | 8.4                    | 10.1             | 5.6           |                   |    |              | 12.32 |

## 200V Rated Drives

| Model    | Heavy Duty    |                   |      |                        |                  | Normal Duty   |                   |     |              | Kc      |
|----------|---------------|-------------------|------|------------------------|------------------|---------------|-------------------|-----|--------------|---------|
|          | Rated Current | Motor Shaft Power |      | Peak Current Open Loop | Peak Current RFC | Rated Current | Motor Shaft Power |     | Peak Current |         |
|          | A             | kW                | hp   | A                      | A                | A             | kW                | hp  | A            |         |
| 01200017 | 1.7           | 0.25              | 0.33 | 2.55                   | 3.1              | 1.7           |                   |     |              | 3.74    |
| 01200024 | 2.4           | 0.37              | 0.5  | 3.6                    | 4.3              | 2.4           |                   |     |              | 5.28    |
| 01200033 | 3.3           | 0.55              | 0.75 | 4.8                    | 5.9              | 3.3           |                   |     |              | 7.26    |
| 01200042 | 4.2           | 0.75              | 1    | 6.3                    | 7.6              | 4.2           |                   |     |              | 9.24    |
| 02200024 | 2.4           | 0.37              | 0.5  | 3.6                    | 4.3              | 2.4           |                   |     |              | 5.28    |
| 02200033 | 3.3           | 0.55              | 0.75 | 4.8                    | 5.9              | 3.3           |                   |     |              | 7.26    |
| 02200042 | 4.2           | 0.75              | 1    | 6.3                    | 7.6              | 4.2           |                   |     |              | 9.24    |
| 02200056 | 5.6           | 1.1               | 1.5  | 8.4                    | 10.1             | 5.6           |                   |     |              | 12.32   |
| 02200075 | 7.5           | 1.5               | 2    | 11.25                  | 13.5             | 7.5           |                   |     |              | 16.5    |
| 03200100 | 10            | 2.2               | 3    | 15                     | 18               | 10            |                   |     |              | 22      |
| 04200133 | 13.3          | 3                 | 3    | 19.95                  | 23.9             | 13.3          |                   |     |              | 29.26   |
| 04200176 | 17.6          | 4                 | 5    | 26.4                   | 31.7             | 17.6          |                   |     |              | 38.72   |
| 05200250 | 25            | 5.5               | 7.5  | 37.5                   | 50               | 30            | 7.5               | 10  | 33           | 55.556  |
| 06200330 | 33            | 7.5               | 10   | 49.5                   | 66               | 50            | 11                | 15  | 55           | 73.333  |
| 06200440 | 44            | 11                | 15   | 66                     | 88               | 58            | 15                | 20  | 63.8         | 97.778  |
| 07200610 | 61            | 15                | 20   | 91.5                   | 122              | 75            | 18.5              | 25  | 82.5         | 135.556 |
| 07200750 | 75            | 18.5              | 25   | 112.5                  | 150              | 94            | 22                | 30  | 103.4        | 166.667 |
| 07200830 | 83            | 22                | 30   | 124.5                  | 166              | 117           | 30                | 40  | 128.7        | 184.444 |
| 08201160 | 116           | 30                | 40   | 174                    | 232              | 149           | 37                | 50  | 163.9        | 257.778 |
| 08201320 | 132           | 37                | 50   | 198                    | 264              | 180           | 45                | 60  | 198          | 293.333 |
| 09201760 | 176           | 45                | 60   | 264                    | 308              | 216           | 55                | 75  | 237.6        | 391.111 |
| 09202190 | 219           | 55                | 75   | 328.5                  | 383.25           | 266           | 75                | 100 | 292.6        | 486.667 |

## 400V Rated Drives

| Model    | Heavy Duty    |                   |      |                        |                  | Normal Duty   |                   |     |              | Kc      |
|----------|---------------|-------------------|------|------------------------|------------------|---------------|-------------------|-----|--------------|---------|
|          | Rated Current | Motor Shaft Power |      | Peak Current Open Loop | Peak Current RFC | Rated Current | Motor Shaft Power |     | Peak Current |         |
|          | A             | kW                | hp   | A                      | A                | A             | kW                | hp  | A            |         |
| 02400013 | 1.3           | 0.37              | 0.5  | 1.95                   | 2.3              | 1.3           |                   |     |              | 2.86    |
| 02400018 | 1.8           | 0.55              | 0.75 | 2.7                    | 3.2              | 1.8           |                   |     |              | 3.96    |
| 02400023 | 2.3           | 0.75              | 1    | 3.45                   | 4.1              | 2.3           |                   |     |              | 5.06    |
| 02400032 | 3.2           | 1.1               | 1.5  | 4.8                    | 5.8              | 3.2           |                   |     |              | 7.04    |
| 02400041 | 4.1           | 1.5               | 2    | 6.15                   | 7.4              | 4.1           |                   |     |              | 9.02    |
| 03400056 | 5.6           | 2.2               | 3    | 8.4                    | 10.1             | 5.6           |                   |     |              | 12.32   |
| 03400073 | 7.3           | 3                 | 3    | 10.95                  | 13.1             | 7.3           |                   |     |              | 16.06   |
| 03400094 | 9.4           | 4                 | 5    | 14.1                   | 16.9             | 9.4           |                   |     |              | 20.68   |
| 04400135 | 13.5          | 5.5               | 7.5  | 20.25                  | 24.3             | 13.5          |                   |     |              | 29.7    |
| 04400170 | 17            | 7.5               | 10   | 25.5                   | 30.6             | 17            |                   |     |              | 37.4    |
| 05400270 | 27            | 11                | 20   | 40.5                   | 54               | 30            | 15                | 20  | 33           | 60      |
| 05400300 | 30            | 15                | 20   | 45                     | 60               | 31            | 15                | 20  | 34.1         | 66.667  |
| 06400350 | 35            | 15                | 25   | 52.5                   | 70               | 38            | 18.5              | 25  | 41.8         | 77.778  |
| 06400420 | 42            | 18.5              | 30   | 63                     | 84               | 48            | 22                | 30  | 52.8         | 93.333  |
| 06400470 | 47            | 22                | 30   | 70.5                   | 94               | 63            | 30                | 40  | 69.3         | 104.444 |
| 07400660 | 66            | 30                | 50   | 99                     | 132              | 79            | 37                | 50  | 86.9         | 146.667 |
| 07400770 | 77            | 37                | 60   | 115.5                  | 154              | 94            | 45                | 60  | 103.4        | 171.111 |
| 07401000 | 100           | 45                | 75   | 150                    | 200              | 112           | 55                | 75  | 123.2        | 222.222 |
| 08401340 | 134           | 55                | 100  | 201                    | 268              | 155           | 75                | 100 | 170.5        | 297.778 |
| 08401570 | 157           | 75                | 125  | 235.5                  | 314              | 184           | 90                | 125 | 202.4        | 348.889 |
| 09402000 | 200           | 90                | 150  | 300                    | 350              | 221           | 110               | 150 | 243.1        | 444.444 |
| 09402240 | 224           | 110               | 150  | 336                    | 392              | 266           | 132               | 200 | 292.6        | 497.778 |

## 575V Rated Drives

| Model    | Heavy Duty    |                   |     |                        |                  | Normal Duty   |                   |     |              | Kc      |
|----------|---------------|-------------------|-----|------------------------|------------------|---------------|-------------------|-----|--------------|---------|
|          | Rated Current | Motor Shaft Power |     | Peak Current Open Loop | Peak Current RFC | Rated Current | Motor Shaft Power |     | Peak Current |         |
|          | A             | kW                | hp  | A                      | A                | A             | kW                | hp  | A            |         |
| 05500030 | 3             | 1.5               | 2   | 4.5                    | 6                | 3.9           | 2.2               | 3   | 4.29         | 6.667   |
| 05500040 | 4             | 2.2               | 3   | 6                      | 8                | 6.1           | 4                 | 5   | 6.71         | 8.889   |
| 05500069 | 6.9           | 4                 | 5   | 10.35                  | 13.8             | 10            | 5.5               | 7.5 | 11           | 15.333  |
| 06500100 | 10            | 5.5               | 7.5 | 15                     | 20               | 12            | 7.5               | 10  | 13.2         | 22.222  |
| 06500150 | 15            | 7.5               | 10  | 22.5                   | 30               | 17            | 11                | 15  | 18.7         | 33.333  |
| 06500190 | 19            | 11                | 15  | 28.5                   | 38               | 22            | 15                | 20  | 24.2         | 42.222  |
| 06500230 | 23            | 15                | 20  | 34.5                   | 46               | 27            | 18.5              | 25  | 29.7         | 51.111  |
| 06500290 | 29            | 18.5              | 25  | 43.5                   | 58               | 34            | 22                | 30  | 37.4         | 64.444  |
| 06500350 | 35            | 22                | 30  | 52.5                   | 70               | 43            | 30                | 40  | 47.3         | 77.778  |
| 07500440 | 44            | 30                | 40  | 66                     | 88               | 53            | 45                | 50  | 58.3         | 97.778  |
| 07500550 | 55            | 37                | 50  | 82.5                   | 110              | 73            | 55                | 60  | 80.3         | 122.222 |
| 08500630 | 63            | 45                | 60  | 94.5                   | 126              | 86            | 75                | 75  | 94.6         | 140     |
| 08500860 | 86            | 55                | 75  | 129                    | 172              | 108           | 90                | 100 | 118.8        | 191.111 |
| 09501040 | 104           | 75                | 100 | 156                    | 182              | 125           | 110               | 125 | 137.5        | 231.111 |
| 09501310 | 131           | 90                | 125 | 196.5                  | 229.25           | 150           | 110               | 150 | 170.5        | 291.111 |

## 690V Rated Drives

| Model    | Heavy Duty    |                   |     |                        |                  | Normal Duty   |                   |     |              | Kc      |
|----------|---------------|-------------------|-----|------------------------|------------------|---------------|-------------------|-----|--------------|---------|
|          | Rated Current | Motor Shaft Power |     | Peak Current Open Loop | Peak Current RFC | Rated Current | Motor Shaft Power |     | Peak Current |         |
|          | A             | kW                | hp  | A                      | A                | A             | kW                | hp  | A            |         |
| 07600190 | 19            | 15                | 20  | 28.5                   | 38               | 23            | 18.5              | 25  | 25.3         | 42.222  |
| 07600240 | 24            | 18.5              | 25  | 36                     | 48               | 30            | 22                | 30  | 33           | 53.333  |
| 07600290 | 29            | 22                | 30  | 43.5                   | 58               | 36            | 30                | 40  | 39.6         | 64.444  |
| 07600380 | 38            | 30                | 40  | 57                     | 76               | 46            | 37                | 50  | 50.6         | 84.444  |
| 07600440 | 44            | 37                | 50  | 66                     | 88               | 52            | 45                | 60  | 57.2         | 97.778  |
| 07600540 | 54            | 45                | 60  | 81                     | 108              | 73            | 55                | 75  | 80.3         | 120     |
| 08600630 | 63            | 55                | 75  | 94.5                   | 126              | 86            | 75                | 100 | 94.6         | 140     |
| 08600860 | 86            | 75                | 100 | 129                    | 172              | 108           | 90                | 125 | 118.8        | 191.111 |
| 09601040 | 104           | 90                | 125 | 156                    | 182              | 125           | 110               | 150 | 137.5        | 231.111 |
| 09601310 | 131           | 110               | 150 | 196.5                  | 229.25           | 155           | 132               | 175 | 170.5        | 291.111 |



## Variable Minimums/Maximums

The descriptions below define the variable minimum/maximum pairs that can be used with parameters when the VM format bit is set. The variable minimum and maximum themselves can be dependent on other parameters, or the drive rating or other conditions as defined. The variable minimum and the variable maximum have a limited range and this is defined for each minimum/maximum pair.

| Identifier     | VM_AC_VOLTAGE                                    |
|----------------|--|
| Description    | Range applied to parameters showing a.c. voltage |
| Units          | V  |
| Range of [MIN] | 0  |
| Range of [MAX] | 0 to 930   |

VM\_AC\_VOLTAGE[MAX] in drive voltage rating dependent. See the table below.

| Voltage level      | 200V | 400V | 575V | 690V |
|--------------------|------|------|------|------|
| VM_AC_VOLTAGE[MAX] | 325  | 650  | 780  | 930  |

VM\_AC\_VOLTAGE[MIN] = 0

| Identifier     | VM_AC_VOLTAGE_SET                               |
|----------------|---|
| Description    | Range applied to a.c. voltage set-up parameters |
| Units          | V   |
| Range of [MIN] | 0   |
| Range of [MAX] | 0 to 765  |

VM\_AC\_VOLTAGE\_SET[MAX] is drive voltage rating dependent. See the table below.

| Voltage level                            | 200V | 400V | 575V | 690V |
|--|------|------|------|------|
| VM_AC_VOLTAGE_SET[MAX] frame size 1 to 4 | 240  | 480  | N/A  | N/A  |
| VM_AC_VOLTAGE_SET[MAX] frame size 5 to 9 | 265  | 530  | 635  | 765  |

VM\_AC\_VOLTAGE\_SET[MIN] = 0

| Identifier     | VM_ACCEL_RATE                               |
|----------------|---|
| Description    | Maximum applied to the ramp rate parameters |
| Units          | s/100Hz, s/1000Hz, s/MaxFrequency           |
| Range of [MIN] | 0.0   |
| Range of [MAX] | 0.0 to 3200.0                               |

A maximum needs to be applied to the ramp rate parameters because the units are a time for a change of speed from zero to a defined level or to maximum speed. If the change of speed is to the maximum speed then changing the maximum speed changes the actual ramp rate for a given ramp rate parameter value. The variable maximum calculation ensures that longest ramp rate (parameter at its maximum value) is not slower than the rate with the defined level, i.e. 3200.0 s/100Hz.

The maximum frequency is taken from *Maximum Reference Clamp* (01.006) if *Select Motor 2 Parameters* (11.045) = 0, or *M2 Maximum Reference Clamp* (21.001) if *Select Motor 2 Parameters* (11.045) = 1.

VM\_ACCEL\_RATE[MIN] = 0.0

If *Ramp Rate Units* (02.039) = 0:

VM\_ACCEL\_RATE[MAX] = 3200.0

Otherwise:

VM\_ACCEL\_RATE[MAX] = 3200.0 x Maximum frequency / 100.00

| Identifier     | VM_DC_VOLTAGE                                      |
|----------------|--|
| Description    | Range applied to d.c. voltage reference parameters |
| Units          | V  |
| Range of [MIN] | 0  |
| Range of [MAX] | 0 to 1190  |

VM\_DC\_VOLTAGE[MAX] is the full scale d.c. link voltage feedback (over voltage trip level) for the drive. This level is drive voltage rating dependent. See the table below.

| Voltage level                        | 200V | 400V | 575V | 690V |
|--------------------------------------|------|------|------|------|
| VM_DC_VOLTAGE[MAX] frame size 1 to 4 | 510  | 870  | N/A  | N/A  |
| VM_DC_VOLTAGE[MAX] frame size 5 to 9 | 415  | 830  | 990  | 1190 |

VM\_DC\_VOLTAGE[MIN] = 0

| Identifier     | VM_DC_VOLTAGE_SET                                  |
|----------------|--|
| Description    | Range applied to d.c. voltage reference parameters |
| Units          | V  |
| Range of [MIN] | 0  |
| Range of [MAX] | 0 to 1150  |

VM\_DC\_VOLTAGE\_SET[MAX] is drive voltage rating dependent. All values are shown in the table below.

| Voltage level          | 200V | 400V | 575V | 690V |
|------------------------|------|------|------|------|
| VM_DC_VOLTAGE_SET[MAX] | 400  | 800  | 955  | 1150 |

VM\_DC\_VOLTAGE\_SET[MIN] = 0

| Identifier     | VM_DRIVE_CURRENT                                 |
|----------------|--|
| Description    | Range applied to parameters showing current in A |
| Units          | A  |
| Range of [MIN] | -9999.99 to 0.00                                 |
| Range of [MAX] | 0.00 to 9999.99                                  |

VM\_DRIVE\_CURRENT[MAX] is equivalent to the full scale (over current trip level) for the drive and is given by *Full Scale Current Kc* (11.061).

VM\_DRIVE\_CURRENT[MIN] = - VM\_DRIVE\_CURRENT[MAX]

| Identifier     | VM_FREQ                                       |
|----------------|---|
| Description    | Range applied to parameters showing frequency |
| Units          | Hz  |
| Range of [MIN] | -1100.00                                      |
| Range of [MAX] | 1100.00                                       |

This variable minimum/maximum defines the range of speed monitoring parameters. To allow headroom for overshoot the range is set to twice the range of the speed references.

VM\_FREQ[MIN] = 2 x VM\_SPEED\_FREQ\_REF[MIN]

VM\_FREQ[MAX] = 2 x VM\_SPEED\_FREQ\_REF[MAX]

| Identifier     | VM_MAX_SWITCHING_FREQUENCY                                  |
|----------------|---|
| Description    | Range applied to the maximum switching frequency parameters |
| Units          | User units  |
| Range of [MIN] | OpenLoop: 0 (0.667kHz), RFC-A: 2 (2kHz)                     |
| Range of [MAX] | 8 (16kHz)   |

VM\_SWITCHING\_FREQUENCY[MAX] = Power stage dependent

VM\_SWITCHING\_FREQUENCY[MIN] = 0

| Identifier     | VM_MOTOR1_CURRENT_LIMIT                             |
|----------------|---|
| Description    | Range applied to current limit parameters (motor 1) |
| Units          | %   |
| Range of [MIN] | 0.0   |
| Range of [MAX] | 0.0 to 1000.0                                       |

VM\_MOTOR1\_CURRENT\_LIMIT[MAX] is dependent on the drive rating and motor set-up parameters.

VM\_MOTOR1\_CURRENT\_LIMIT[MIN] = 0.0

| Identifier     | VM_MOTOR2_CURRENT_LIMIT                             |
|----------------|---|
| Description    | Range applied to current limit parameters (motor 2) |
| Units          | %   |
| Range of [MIN] | 0.0   |
| Range of [MAX] | 0.0 to 1000.0                                       |

VM\_MOTOR2\_CURRENT\_LIMIT[MAX] is dependent on the drive rating and motor set-up parameters.

VM\_MOTOR2\_CURRENT\_LIMIT[MIN] = 0.0

| Identifier     | VM_NEGATIVE_REF_CLAMP1                                   |
|----------------|--|
| Description    | Limits applied to the negative frequency clamp (motor 1) |
| Units          | Hz   |
| Range of [MIN] | -550.00 to 0.00  |
| Range of [MAX] | 0.00 to 550.00   |

This variable maximum/minimum defines the range of the negative frequency clamp associated with motor map 1 (*Minimum Reference Clamp* (01.007)). The minimum and maximum are affected by the settings of the *Negative Reference Clamp Enable* (01.008), *Bipolar Reference Enable* (01.010) and *Maximum Reference Clamp* (01.006) as shown in the table below.

| <i>Negative Reference Clamp Enable</i> (01.008) | <i>Bipolar Reference Enable</i> (01.010) | VM_NEGATIVE_REF_CLAMP1[MIN] | VM_NEGATIVE_REF_CLAMP1[MAX] |
|---|--|-----------------------------|-----------------------------|
| 0   | 0  | 0.00                        | Pr 01.006                   |
| 0   | 1  | 0.00                        | 0.00                        |
| 1   | X  | -VM_POSITIVE_REF_CLAMP[MAX] | 0.00                        |

| Identifier     | VM_NEGATIVE_REF_CLAMP2                                   |
|----------------|--|
| Description    | Limits applied to the negative frequency clamp (motor 2) |
| Units          | Hz   |
| Range of [MIN] | -550.00 to 0.00  |
| Range of [MAX] | 0.00 to 550.00   |

This variable maximum/minimum defines the range of the negative frequency clamp associated with motor map 2 (*M2 Minimum Reference Clamp* (21.002)). It is defined in the same way as VM\_NEGATIVE\_REF\_CLAMP1 except that the *M2 Maximum Reference Clamp* (21.001) is used instead of *Maximum Reference Clamp* (01.006).

| Identifier     | VM_POSITIVE_REF_CLAMP                                    |
|----------------|--|
| Description    | Limits applied to the positive frequency reference clamp |
| Units          | Hz   |
| Range of [MIN] | 0.00   |
| Range of [MAX] | 550.00   |

VM\_POSITIVE\_REF\_CLAMP[MAX] defines the range of the positive reference clamp, *Maximum Reference Clamp* (01.006), which in turn limit the references.

| Identifier     | VM_POWER   |
|----------------|--|
| Description    | Range applied to parameters that either set or display power |
| Units          | kW   |
| Range of [MIN] | -9999.99 to 0.00   |
| Range of [MAX] | 0.00 to 9999.99  |

VM\_POWER[MAX] is rating dependent and is chosen to allow for the maximum power that can be output by the drive with maximum a.c. output voltage, at maximum controlled current and unity power factor.

$$VM\_POWER[MAX] = \sqrt{3} \times VM\_AC\_VOLTAGE[MAX] \times VM\_DRIVE\_CURRENT[MAX] / 1000$$

$$VM\_POWER[MIN] = -VM\_POWER[MAX]$$

| Identifier     | VM_RATED_CURRENT                          |
|----------------|---|
| Description    | Range applied to rated current parameters |
| Units          | A   |
| Range of [MIN] | 0.00                                      |
| Range of [MAX] | 0.00 to 9999.99                           |

VM\_RATED\_CURRENT [MAX] = *Maximum Rated Current* (11.060) and is dependent on the drive rating.

$$VM\_RATED\_CURRENT [MIN] = 0.00$$

| Identifier     | VM_SPEED_FREQ_REF                                   |
|----------------|---|
| Description    | Range applied to the frequency reference parameters |
| Units          | Hz  |
| Range of [MIN] | -550.00 to 0.00                                     |
| Range of [MAX] | 0.00 to 550.00                                      |

This variable minimum/maximum is applied throughout the frequency and speed reference system so that the references can vary in the range from the minimum to maximum clamps.

| <b>Negative Reference Clamp Enable (01.008)</b> | <b>VM_SPEED_FREQ_REF[MAX] if Select Motor 2 Parameters (11.045) = 0</b>                   | <b>VM_SPEED_FREQ_REF[MAX] if Select Motor 2 Parameters (11.045) = 1</b>                         |
|---|---|---|
| 0   | Maximum Reference Clamp (01.006)  | M2 Maximum Reference Clamp (21.001)   |
| 1   | Maximum Reference Clamp (01.006) or Minimum Reference Clamp (01.007) whichever the larger | M2 Maximum Reference Clamp (21.001) or M2 Minimum Reference Clamp (21.002) whichever the larger |

VM\_SPEED\_FREQ\_REF[MIN] = -VM\_SPEED\_FREQ\_REF[MAX].

| <b>Identifier</b> | <b>VM_SPEED_FREQ_REF_UNIPOLAR</b>     |
|-------------------|---------------------------------------|
| Description       | Unipolar version of VM_SPEED_FREQ_REF |
| Units             | Hz                                    |
| Range of [MIN]    | 0.00                                  |
| Range of [MAX]    | 0.00 to 550.00                        |

VM\_SPEED\_FREQ\_REF\_UNIPOLAR[MAX] = VM\_SPEED\_FREQ\_REF[MAX]

VM\_SPEED\_FREQ\_REF\_UNIPOLAR[MIN] = 0.00

| <b>Identifier</b> | <b>VM_SPEED_FREQ_USER_REFS</b>                 |
|-------------------|--|
| Description       | Range applied to analogue reference parameters |
| Units             | Hz   |
| Range of [MIN]    | -550.00 to 550.00                              |
| Range of [MAX]    | 0.00 to 550.00                                 |

This variable maximum is applied to *Analogue Reference 1* (01.036), *Analogue Reference 2* (01.037) and *Keypad Reference* (01.017).

The maximum applied to these parameters is the same as other frequency reference parameters.

VM\_SPEED\_FREQ\_USER\_REFS [MAX] = VM\_SPEED\_FREQ\_REF[MAX]

However the minimum is dependent on *Negative Reference Clamp Enable* (01.008) and *Bipolar Reference Enable* (01.010).

| <b>Negative Reference Clamp Enable (01.008)</b> | <b>Bipolar Reference Enable (01.010)</b> | <b>VM_SPEED_FREQ_USER_REFS[MIN]</b>   |
|---|--|---|
| 0   | 0  | If Select Motor 2 Parameters (11.045) = 0 Minimum Reference Clamp (01.007), otherwise M2 Minimum Reference Clamp (21.002) |
| 0   | 1  | -VM_SPEED_FREQ_REF[MAX]   |
| 1   | 0  | 0.00  |
| 1   | 1  | -VM_SPEED_FREQ_REF[MAX]   |

| <b>Identifier</b> | <b>VM_SUPPLY_LOSS_LEVEL</b>                |
|-------------------|--|
| Description       | Range applied to the supply loss threshold |
| Units             | V  |
| Range of [MIN]    | 0 to 1150                                  |
| Range of [MAX]    | 0 to 1150                                  |

VM\_SUPPLY\_LOSS\_LEVEL[MAX] = VM\_DC\_VOLTAGE\_SET[MAX]

VM\_SUPPLY\_LOSS\_LEVEL[MIN] is drive voltage rating dependent. See the table below.

| <b>Voltage level</b>      | <b>200V</b> | <b>400V</b> | <b>575V</b> | <b>690V</b> |
|---------------------------|-------------|-------------|-------------|-------------|
| VM_SUPPLY_LOSS_LEVEL[MIN] | 205         | 410         | 540         | 540         |

| <b>Identifier</b> | <b>VM_TORQUE_CURRENT</b>   |
|-------------------|--|
| Description       | Range applied to torque and torque producing current parameters. |
| Units             | %  |
| Range of [MIN]    | -1000.0 to 0.0   |
| Range of [MAX]    | 0.0 to 1000.0  |

| <b>Select Motor 2 Parameters (11.045)</b> | <b>VM_TORQUE_CURRENT[MAX]</b> |
|---|-------------------------------|
| 0   | VM_MOTOR1_CURRENT_LIMIT[MAX]  |
| 1   | VM_MOTOR2_CURRENT_LIMIT[MAX]  |

VM\_TORQUE\_CURRENT[MIN] = -VM\_TORQUE\_CURRENT[MAX]

| Identifier     | VM_TORQUE_CURRENT_UNIPOLAR            |
|----------------|---------------------------------------|
| Description    | Unipolar version of VM_TORQUE_CURRENT |
| Units          | %                                     |
| Range of [MIN] | 0.0                                   |
| Range of [MAX] | 0.0 to 1000.0                         |

VM\_TORQUE\_CURRENT\_UNIPOLAR[MAX] = VM\_TORQUE\_CURRENT[MAX]

VM\_TORQUE\_CURRENT\_UNIPOLAR[MIN] = 0.0

| Identifier     | VM_USER_CURRENT   |
|----------------|---|
| Description    | Range applied to torque reference and percentage load parameters with one decimal place |
| Units          | %   |
| Range of [MIN] | -1000.0 to 0.0  |
| Range of [MAX] | 0.0 to 1000.0   |

VM\_USER\_CURRENT[MAX] = *User Current Maximum Scaling* (04.024)

VM\_USER\_CURRENT[MIN] = -VM\_USER\_CURRENT[MAX]

# Menu 1 Single Line Descriptions – Frequency References

Mode: Open-Loop

| Parameter |  | Range  | Default                          | Type |     |    |    |    |    |
|-----------|--|--|----------------------------------|------|-----|----|----|----|----|
| 01.001    | Reference Selected                     | ±VM_SPEED_FREQ_REF Hz  |                                  | RO   | Num | ND | NC | PT |    |
| 01.002    | Pre-skip Filter Reference              | ±VM_SPEED_FREQ_REF Hz  |                                  | RO   | Num | ND | NC | PT |    |
| 01.003    | Pre-ramp Reference                     | ±VM_SPEED_FREQ_REF Hz  |                                  | RO   | Num | ND | NC | PT |    |
| 01.004    | Reference Offset                       | ±VM_SPEED_FREQ_REF Hz  | 0.00 Hz                          | RW   | Num |    |    |    | US |
| 01.005    | Jog Reference                          | 0.00 to 300.00 Hz  | 1.50 Hz                          | RW   | Num |    |    |    | US |
| 01.006    | Maximum Reference Clamp                | ±VM_POSITIVE_REF_CLAMP Hz  | 50Hz: 50.00 Hz<br>60Hz: 60.00 Hz | RW   | Num |    |    |    | US |
| 01.007    | Minimum Reference Clamp                | ±VM_NEGATIVE_REF_CLAMP1 Hz   | 0.00 Hz                          | RW   | Num |    |    |    | US |
| 01.008    | Negative Reference Clamp Enable        | Off (0) or On (1)  | Off (0)                          | RW   | Bit |    |    |    | US |
| 01.009    | Reference Offset Select                | 0 to 2   | 0                                | RW   | Num |    |    |    | US |
| 01.010    | Bipolar Reference Enable               | Off (0) or On (1)  | Off (0)                          | RW   | Bit |    |    |    | US |
| 01.011    | Reference On                           | Off (0) or On (1)  |                                  | RO   | Bit | ND | NC | PT |    |
| 01.012    | Reverse Select                         | Off (0) or On (1)  |                                  | RO   | Bit | ND | NC | PT |    |
| 01.013    | Jog Select                             | Off (0) or On (1)  |                                  | RO   | Bit | ND | NC | PT |    |
| 01.014    | Reference Selector                     | A1.A2 (0), A1.Pr (1), A2.Pr (2),<br>Preset (3), Pad (4), Res (5),<br>Pad.Ref (6) | A1.A2 (0)                        | RW   | Txt |    |    |    | US |
| 01.015    | Preset Selector                        | 0 to 9   | 0                                | RW   | Num |    |    |    | US |
| 01.016    | Preset Selector Timer                  | 0.0 to 400.0 s   | 10.0 s                           | RW   | Num |    |    |    | US |
| 01.017    | Keypad Control Mode Reference          | ±VM_SPEED_FREQ_USER_REFS Hz  | 0.00 Hz                          | RO   | Num |    | NC | PT | PS |
| 01.021    | Preset Reference 1                     | ±VM_SPEED_FREQ_REF Hz  | 0.00 Hz                          | RW   | Num |    |    |    | US |
| 01.022    | Preset Reference 2                     | ±VM_SPEED_FREQ_REF Hz  | 0.00 Hz                          | RW   | Num |    |    |    | US |
| 01.023    | Preset Reference 3                     | ±VM_SPEED_FREQ_REF Hz  | 0.00 Hz                          | RW   | Num |    |    |    | US |
| 01.024    | Preset Reference 4                     | ±VM_SPEED_FREQ_REF Hz  | 0.00 Hz                          | RW   | Num |    |    |    | US |
| 01.025    | Preset Reference 5                     | ±VM_SPEED_FREQ_REF Hz  | 0.00 Hz                          | RW   | Num |    |    |    | US |
| 01.026    | Preset Reference 6                     | ±VM_SPEED_FREQ_REF Hz  | 0.00 Hz                          | RW   | Num |    |    |    | US |
| 01.027    | Preset Reference 7                     | ±VM_SPEED_FREQ_REF Hz  | 0.00 Hz                          | RW   | Num |    |    |    | US |
| 01.028    | Preset Reference 8                     | ±VM_SPEED_FREQ_REF Hz  | 0.00 Hz                          | RW   | Num |    |    |    | US |
| 01.029    | Skip Reference 1                       | 0.00 to 550.00 Hz  | 0.00 Hz                          | RW   | Num |    |    |    | US |
| 01.030    | Skip Reference Band 1                  | 0.00 to 25.00 Hz   | 0.50 Hz                          | RW   | Num |    |    |    | US |
| 01.031    | Skip Reference 2                       | 0.00 to 550.00 Hz  | 0.00 Hz                          | RW   | Num |    |    |    | US |
| 01.032    | Skip Reference Band 2                  | 0.00 to 25.00 Hz   | 0.50 Hz                          | RW   | Num |    |    |    | US |
| 01.033    | Skip Reference 3                       | 0.00 to 550.00 Hz  | 0.00 Hz                          | RW   | Num |    |    |    | US |
| 01.034    | Skip Reference Band 3                  | 0.00 to 25.00 Hz   | 0.50 Hz                          | RW   | Num |    |    |    | US |
| 01.035    | Reference In Rejection Zone            | Off (0) or On (1)  |                                  | RO   | Bit | ND | NC | PT |    |
| 01.036    | Analog Reference 1                     | ±VM_SPEED_FREQ_USER_REFS Hz  | 0.00 Hz                          | RO   | Num |    | NC |    |    |
| 01.037    | Analog Reference 2                     | ±VM_SPEED_FREQ_USER_REFS Hz  | 0.00 Hz                          | RO   | Num |    | NC |    |    |
| 01.038    | Percentage Trim                        | ±100.00 %  | 0.00 %                           | RW   | Num |    | NC |    |    |
| 01.041    | Reference Select Flag 1                | Off (0) or On (1)  | Off (0)                          | RW   | Bit |    | NC |    |    |
| 01.042    | Reference Select Flag 2                | Off (0) or On (1)  | Off (0)                          | RW   | Bit |    | NC |    |    |
| 01.043    | Reference Select Flag 3                | Off (0) or On (1)  | Off (0)                          | RW   | Bit |    | NC |    |    |
| 01.045    | Preset Select Flag 1                   | Off (0) or On (1)  | Off (0)                          | RW   | Bit |    | NC |    |    |
| 01.046    | Preset Select Flag 2                   | Off (0) or On (1)  | Off (0)                          | RW   | Bit |    | NC |    |    |
| 01.047    | Preset Select Flag 3                   | Off (0) or On (1)  | Off (0)                          | RW   | Bit |    | NC |    |    |
| 01.048    | Preset Selector Timer Reset            | Off (0) or On (1)  | Off (0)                          | RW   | Bit |    | NC |    |    |
| 01.049    | Reference Selected Indicator           | 1 to 6   |                                  | RO   | Num | ND | NC | PT |    |
| 01.050    | Preset Selected Indicator              | 1 to 8   |                                  | RO   | Num | ND | NC | PT |    |
| 01.051    | Power-up Keypad Control Mode Reference | Reset (0), Last (1), Preset (2)  | Reset (0)                        | RW   | Txt |    |    |    | US |
| 01.057    | Force Reference Direction              | None (0), For (1), Rev (2)   | None (0)                         | RW   | Txt |    |    |    |    |
| 01.069    | Reference in rpm                       | ±VM_SPEED_FREQ_REF rpm   |                                  | RO   | Num | ND | NC | PT |    |
| 01.070    | Clamped Reference                      | ±VM_SPEED_FREQ_REF Hz  |                                  | RO   | Num | ND | NC | PT |    |
| 01.071    | Alternative Reference                  | ±VM_SPEED_FREQ_REF Hz  | 0.00 Hz                          | RO   | Num |    | NC |    |    |
| 01.072    | Alternative Reference Enable           | Off (0) or On (1)  |                                  | RO   | Bit | ND | NC | PT |    |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

# Menu 1 – Frequency References

Mode: Open-Loop

## References

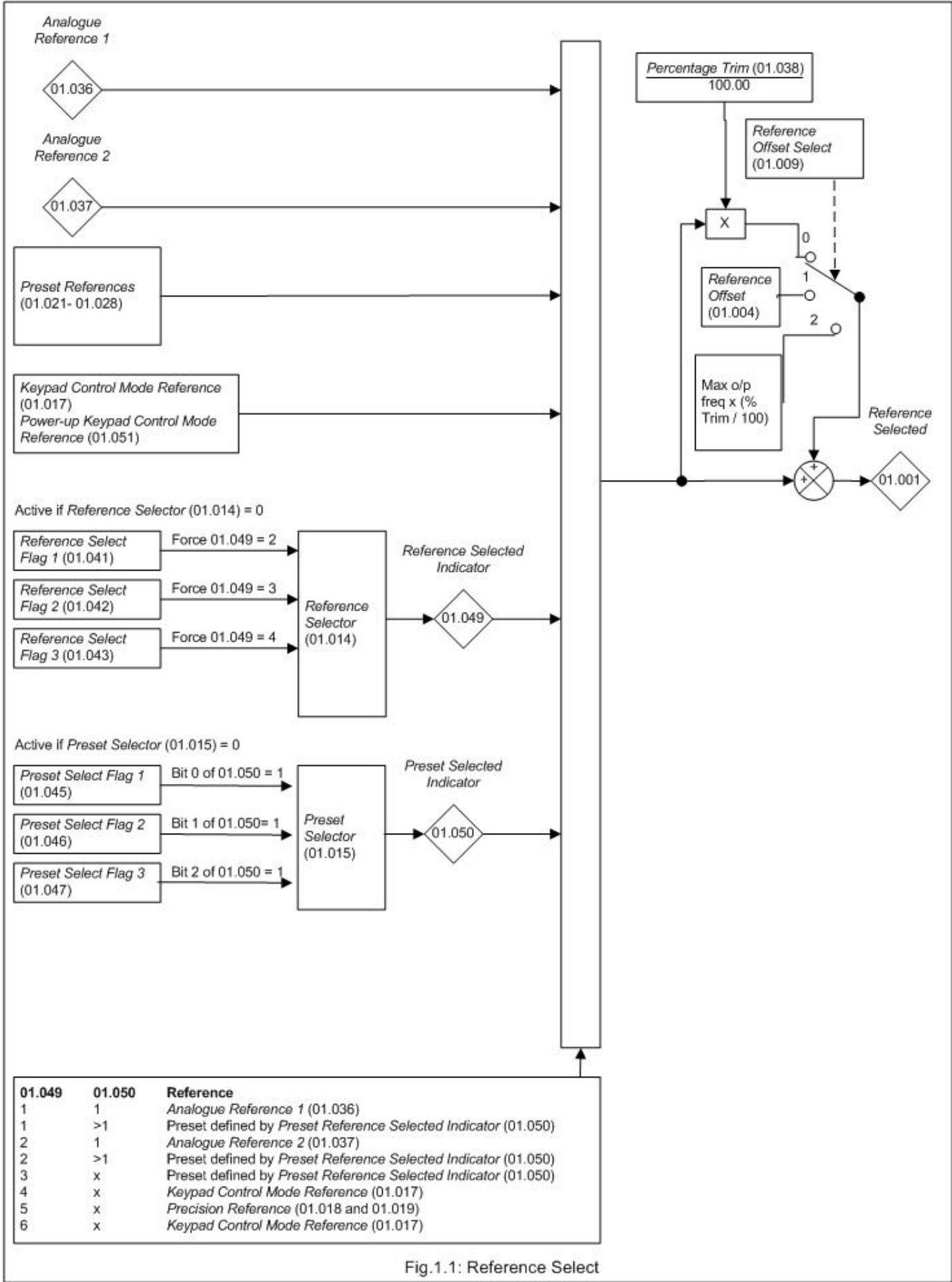


Fig.1.1: Reference Select

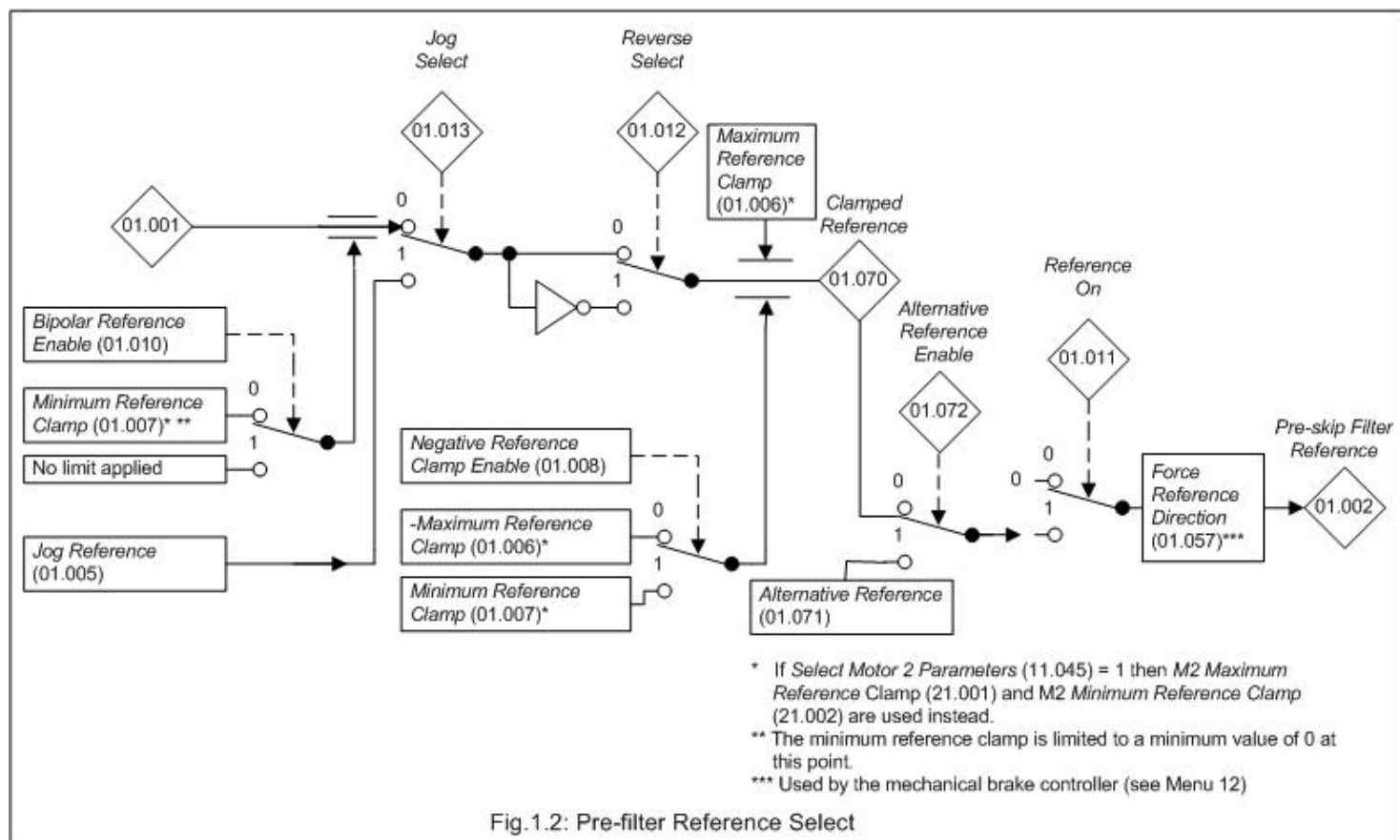


Fig.1.2: Pre-filter Reference Select

The Clamped Reference is provided as a source for the PID control contained in menu 14. The Alternative Reference is provided as a destination for the output from the PID.

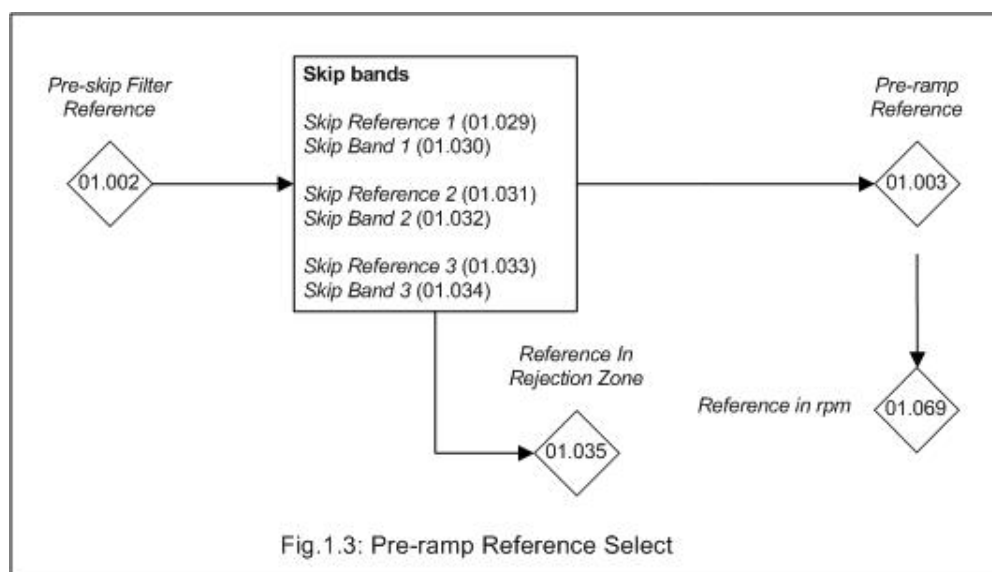


Fig.1.3: Pre-ramp Reference Select

| Parameter         | 01.001 Reference Selected  |                |                   |  |
|-------------------|--|----------------|-------------------|--|
| Short description | Displays the basic reference selected from the available sources |                |                   |  |
| Mode              | Open-Loop  |                |                   |  |
| Minimum           | -VM_SPEED_FREQ_REF   | Maximum        | VM_SPEED_FREQ_REF |  |
| Default           |  | Units          | Hz                |  |
| Type              | 32 Bit Volatile  | Update Rate    | 4ms write         |  |
| Display Format    | Standard   | Decimal Places | 2                 |  |
| Coding            | RO, VM, ND, NC, PT   |                |                   |  |

Reference Selected (01.001) is the basic reference selected from the available sources including the effect of the reference offset. See Fig.1.1.



| Parameter         | 01.002 Pre-skip Filter Reference                               |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Displays the level of the reference after the reference clamps |                |                   |
| Mode              | Open-Loop  |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF   | Maximum        | VM_SPEED_FREQ_REF |
| Default           |  | Units          | Hz                |
| Type              | 32 Bit Volatile  | Update Rate    | 4ms write         |
| Display Format    | Standard   | Decimal Places | 2                 |
| Coding            | RO, VM, ND, NC, PT   |                |                   |

| Parameter         | 01.003 Pre-ramp Reference                           |                |                   |
|-------------------|---|----------------|-------------------|
| Short description | Displays the final output from the reference system |                |                   |
| Mode              | Open-Loop   |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                                  | Maximum        | VM_SPEED_FREQ_REF |
| Default           |   | Units          | Hz                |
| Type              | 32 Bit Volatile                                     | Update Rate    | 4ms write         |
| Display Format    | Standard  | Decimal Places | 2                 |
| Coding            | RO, VM, ND, NC, PT                                  |                |                   |

Fig.1.3 shows the process from the *Pre-skip Filter Reference* (01.002) to the *Pre-ramp Reference* (01.003). The *Pre-ramp Reference* (01.003) is the final output from the Menu 01 reference system that is fed into the Menu 02 ramp system.

| Parameter         | 01.004 Reference Offset                         |                |                   |
|-------------------|---|----------------|-------------------|
| Short description | Defines the the offset applied to the reference |                |                   |
| Mode              | Open-Loop                                       |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                              | Maximum        | VM_SPEED_FREQ_REF |
| Default           | 0.00  | Units          | Hz                |
| Type              | 32 Bit User Save                                | Update Rate    | 4ms read          |
| Display Format    | Standard  | Decimal Places | 2                 |
| Coding            | RW, VM  |                |                   |

If *Reference Offset Select* (01.009) = 0 then *Reference Selected* (01.001) is the selected reference multiplied by  $[1 + \text{Percentage Trim (01.038)} / 100.00]$ .

If *Reference Offset Select* (01.009) = 1 then the *Reference Offset* (01.004) is added to the selected reference to give *Reference Selected* (01.001).

If *Reference Offset Select* (01.009) = 2 then *Reference Selected* (01.001) is the selected reference plus the maximum output frequency multiplied by  $(\text{Percentage Trim (01.038)} / 100.00)$ .

| Parameter         | 01.005 Jog Reference                      |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the reference when jog is enabled |                |          |
| Mode              | Open-Loop                                 |                |          |
| Minimum           | 0.00                                      | Maximum        | 300.00   |
| Default           | 1.50                                      | Units          | Hz       |
| Type              | 16 Bit User Save                          | Update Rate    | 4ms read |
| Display Format    | Standard                                  | Decimal Places | 2        |
| Coding            | RW, BU                                    |                |          |

| Parameter         | 01.006 Maximum Reference Clamp              |                |                       |
|-------------------|---|----------------|-----------------------|
| Short description | Defines the maximum value for the reference |                |                       |
| Mode              | Open-Loop                                   |                |                       |
| Minimum           | -VM_POSITIVE_REF_CLAMP                      | Maximum        | VM_POSITIVE_REF_CLAMP |
| Default           | See exceptions below                        | Units          | Hz                    |
| Type              | 32 Bit User Save                            | Update Rate    | Background read       |
| Display Format    | Standard                                    | Decimal Places | 2                     |
| Coding            | RW, VM                                      |                |                       |

| Region | Default Value |
|--------|---------------|
| 50Hz   | 50.00         |
| 60Hz   | 60.00         |

*Maximum Reference Clamp* (01.006) provides a limit on the maximum frequency. (If *Select Motor 2 Parameters* (11.045) = 1 then *M2 Maximum Reference Clamp* (21.001) is used instead.)

| Parameter         | 01.007 Minimum Reference Clamp              |                |                        |
|-------------------|---|----------------|------------------------|
| Short description | Defines the minimum value for the reference |                |                        |
| Mode              | Open-Loop                                   |                |                        |
| Minimum           | -VM_NEGATIVE_REF_CLAMP1                     | Maximum        | VM_NEGATIVE_REF_CLAMP1 |
| Default           | 0.00  | Units          | Hz                     |
| Type              | 32 Bit User Save                            | Update Rate    | Background read        |
| Display Format    | Standard                                    | Decimal Places | 2                      |
| Coding            | RW, VM                                      |                |                        |

If *Negative Reference Clamp Enable* (01.008) = 1 then *Minimum Reference Clamp* (01.007) is forced to be a negative value and is applied to the final reference as the negative limit. If *Negative Reference Clamp Enable* (01.008) = 0 then - *Maximum Reference Clamp* (01.006) is applied to the final reference as the negative limit. (If *Select Motor 2 Parameters* (11.045) = 1 then *M2 Minimum Reference Clamp* (21.002) is used instead.)

The minimum reference clamp is also used to provide the minimum frequency limit for uni-polar mode (i.e. *Bipolar Reference Enable* (01.010) = 0) after the *Reference Selected* (01.001) as shown in Fig.1.2.

| Parameter         | 01.008 <i>Negative Reference Clamp Enable</i>                      |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to 1 to allow the minimum reference clamp value to be negative |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

See *Minimum Reference Clamp* (01.007).

| Parameter         | 01.009 <i>Reference Offset Select</i>   |                |          |
|-------------------|---|----------------|----------|
| Short description | Enables the use of the reference offset |                |          |
| Mode              | Open-Loop                               |                |          |
| Minimum           | 0                                       | Maximum        | 2        |
| Default           | 0                                       | Units          |          |
| Type              | 8 Bit User Save                         | Update Rate    | 4ms read |
| Display Format    | Standard                                | Decimal Places | 0        |
| Coding            | RW                                      |                |          |

See *Reference Offset* (01.004).

| Parameter         | 01.010 <i>Bipolar Reference Enable</i>                    |                |          |
|-------------------|---|----------------|----------|
| Short description | Enables the minimum value of the reference to be negative |                |          |
| Mode              | Open-Loop   |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit User Save   | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW  |                |          |

See *Minimum Reference Clamp* (01.007).

| Parameter         | 01.011 <i>Reference On</i>                                       |                |           |
|-------------------|--|----------------|-----------|
| Short description | Indicates that the reference from the reference system is active |                |           |
| Mode              | Open-Loop  |                |           |
| Minimum           | 0  | Maximum        | 1         |
| Default           |  | Units          |           |
| Type              | 1 Bit Volatile   | Update Rate    | 2ms write |
| Display Format    | Standard   | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT   |                |           |

*Reference On* (01.011), which is controlled by the drive sequencer (see Menu 06) indicates that the reference from the reference system is active. Note that *Reference On* (01.011) is also used in RFC-A and RFC-S modes to enable and disable the *Hard Frequency Reference* (03.022).

| Parameter         | 01.012 <i>Reverse Select</i>                  |                |           |
|-------------------|---|----------------|-----------|
| Short description | Indicates when the reverse function is active |                |           |
| Mode              | Open-Loop                                     |                |           |
| Minimum           | 0   | Maximum        | 1         |
| Default           |   | Units          |           |
| Type              | 1 Bit Volatile                                | Update Rate    | 2ms write |
| Display Format    | Standard                                      | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                                |                |           |

*Reverse Select* (01.012), which is controlled by the drive sequencer (see Menu 06), is used to invert *Reference Selected* (01.001) or the *Jog Reference* (01.005).

| Parameter         | 01.013 <i>Jog Select</i>                  |                |           |
|-------------------|---|----------------|-----------|
| Short description | Indicates when the jog function is active |                |           |
| Mode              | Open-Loop                                 |                |           |
| Minimum           | 0   | Maximum        | 1         |
| Default           |   | Units          |           |
| Type              | 1 Bit Volatile                            | Update Rate    | 2ms write |
| Display Format    | Standard                                  | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                            |                |           |

*Jog Select* (01.013) which is controlled by the drive sequencer (see Menu 06), is used to select the *Jog Reference* (01.005).

| Parameter         | 01.014 Reference Selector            |                |          |
|-------------------|--------------------------------------|----------------|----------|
| Short description | Defines the source for the reference |                |          |
| Mode              | Open-Loop                            |                |          |
| Minimum           | 0                                    | Maximum        | 6        |
| Default           | 0                                    | Units          |          |
| Type              | 8 Bit User Save                      | Update Rate    | 4ms read |
| Display Format    | Standard                             | Decimal Places | 0        |
| Coding            | RW, TE                               |                |          |

| Value | Text    | Description  |
|-------|---------|--|
| 0     | A1.A2   | Analogue reference 1 or 2 selected by terminal input       |
| 1     | A1.Pr   | Analogue reference 1 or Presets selected by terminal input |
| 2     | A2.Pr   | Analogue reference 2 or Presets selected by terminal input |
| 3     | Preset  | Preset reference selected by terminal                      |
| 4     | Pad     | Keypad reference selected                                  |
| 5     | Res     | Reserved   |
| 6     | Pad.Ref | Keypad reference selected but no control mode              |

See *Control Word Enable* (06.043) which will take priority over *Reference Selector* (01.014).

If *Drive Configuration* (11.034) is set to 8 then *Reference Selector* (01.014) is automatically set to 4.

*Reference Selector* (01.014) defines how *Reference Selected Indicator* (01.049) is derived. If 0 *Reference Selector* (01.014) *Reference Selected Indicator* (01.049) is equal to *Reference Selector* (01.014). If *Reference Selector* (01.014) = 0 then *Reference Selected Indicator* (01.049) is controlled by the reference select flags as shown below. The higher numbered flags have priority over the lower numbered flags.

| Reference select flag states          | Reference Selected Indicator (01.049) |
|---------------------------------------|---------------------------------------|
| All reference select flags equal to 0 | 1                                     |
| Reference Select Flag 1 (01.041) = 1  | 2                                     |
| Reference Select Flag 2 (01.042) = 1  | 3                                     |
| Reference Select Flag 3 (01.043) = 1  | 4                                     |

*Preset Selector* (01.015) defines how *Preset Selected Indicator* (01.050) is derived as shown below.

| Preset Selector (01.015) | Preset Selected Indicator (01.050)   |
|--------------------------|--|
| 0                        | Controlled by the preset select flags (01.045 to 01.047)                                       |
| 1                        | 1  |
| 2                        | 2  |
| 3                        | 3  |
| 4                        | 4  |
| 5                        | 5  |
| 6                        | 6  |
| 7                        | 7  |
| 8                        | 8  |
| 9                        | Controlled by the present reference selector timer (see <i>Preset Selector Timer</i> (01.016)) |

When *Preset Selector* (01.015) = 0 then *Preset Selected Indicator* (01.050) is defined by the preset select flags as shown below.

| Preset Select Flag 3 (01.047) | Preset Select Flag 2 (01.046) | Preset Select Flag 1 (01.045) | Preset Selected Indicator (01.050) |
|-------------------------------|-------------------------------|-------------------------------|------------------------------------|
| 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                                  |

*Reference Selected Indicator* (01.049) and *Preset Selected Indicator* (01.050) then define the reference to be used as shown below.

| Reference Selected Indicator (01.049) | Preset Selected Indicator (01.050) | Reference   |
|---------------------------------------|------------------------------------|---|
| 1                                     | 1                                  | Analog Reference 1 (01.036)   |
| 1                                     | >1                                 | Preset reference defined by the value of Preset Selected Indicator (01.050) |
| 2                                     | 1                                  | Analog Reference 2 (01.037)   |
| 2                                     | >1                                 | Preset reference defined by the value of Preset Selected Indicator (01.050) |
| 3                                     | x                                  | Preset reference defined by the value of Preset Selected Indicator (01.050) |
| 4                                     | x                                  | Keypad Control Mode Reference (01.017)                                      |
| 5                                     | x                                  | Not used  |
| 6                                     | x                                  | Keypad Control Mode Reference (01.017)                                      |

If Reference Selected Indicator (01.049) = 4 the Keypad Control Mode Reference (01.017) is used and the sequencer operates in keypad mode where the start and stop functions are provided from the drive keypad. Jog Select (01.013) is always 0 when keypad mode is active.

If Reference Selected Indicator (01.049) = 6 the Keypad Control Mode Reference (01.017) is used, but keypad control mode is not active.

| Parameter         | 01.015 Preset Selector                         |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines which preset is used for the reference |                |          |
| Mode              | Open-Loop                                      |                |          |
| Minimum           | 0  | Maximum        | 9        |
| Default           | 0  | Units          |          |
| Type              | 8 Bit User Save                                | Update Rate    | 4ms read |
| Display Format    | Standard                                       | Decimal Places | 0        |
| Coding            | RW   |                |          |

See Reference Selector (01.014).

| Parameter         | 01.016 Preset Selector Timer                        |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the time between changes of preset selector |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0.0   | Maximum        | 400.0           |
| Default           | 10.0  | Units          | s               |
| Type              | 16 Bit User Save                                    | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 1               |
| Coding            | RW  |                |                 |

If Preset Selector (01.015) = 9 then Preset Selected Indicator (01.050) is incremented by one at intervals defined by Preset Selector Timer (01.016). When Preset Selected Indicator (01.050) has a value of 8 and is incremented it rolls over to 1. If Preset Selector Timer Reset (01.048) = 1 and Preset Selector (01.015) = 9, then Preset Selected Indicator (01.050) is held at 1.

| Parameter         | 01.017 Keypad Control Mode Reference       |                |                         |
|-------------------|--|----------------|-------------------------|
| Short description | Displays the value of the keypad reference |                |                         |
| Mode              | Open-Loop                                  |                |                         |
| Minimum           | -VM_SPEED_FREQ_USER_REFS                   | Maximum        | VM_SPEED_FREQ_USER_REFS |
| Default           | 0.00                                       | Units          | Hz                      |
| Type              | 32 Bit Power Down Save                     | Update Rate    | 4ms read                |
| Display Format    | Standard                                   | Decimal Places | 2                       |
| Coding            | RO, VM, NC, PT                             |                |                         |

See Reference Selector (01.014) for selection of the Keypad Control Mode Reference (01.017).

| Parameter         | 01.021 Preset Reference 1                |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Defines the value for preset reference 1 |                |                   |
| Mode              | Open-Loop                                |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                       | Maximum        | VM_SPEED_FREQ_REF |
| Default           | 0.00                                     | Units          | Hz                |
| Type              | 32 Bit User Save                         | Update Rate    | 4ms read          |
| Display Format    | Standard                                 | Decimal Places | 2                 |
| Coding            | RW, VM                                   |                |                   |

See Reference Selector (01.014).

| Parameter         | 01.022 Preset Reference 2                |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Defines the value for preset reference 2 |                |                   |
| Mode              | Open-Loop                                |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                       | Maximum        | VM_SPEED_FREQ_REF |
| Default           | 0.00                                     | Units          | Hz                |
| Type              | 32 Bit User Save                         | Update Rate    | 4ms read          |
| Display Format    | Standard                                 | Decimal Places | 2                 |
| Coding            | RW, VM                                   |                |                   |

See Reference Selector (01.014).

| Parameter         | 01.023 Preset Reference 3                |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Defines the value for preset reference 3 |                |                   |
| Mode              | Open-Loop                                |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                       | Maximum        | VM_SPEED_FREQ_REF |
| Default           | 0.00                                     | Units          | Hz                |
| Type              | 32 Bit User Save                         | Update Rate    | 4ms read          |
| Display Format    | Standard                                 | Decimal Places | 2                 |
| Coding            | RW, VM                                   |                |                   |

See Reference Selector (01.014).

| Parameter         | 01.024 Preset Reference 4                |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Defines the value for preset reference 4 |                |                   |
| Mode              | Open-Loop                                |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                       | Maximum        | VM_SPEED_FREQ_REF |
| Default           | 0.00                                     | Units          | Hz                |
| Type              | 32 Bit User Save                         | Update Rate    | 4ms read          |
| Display Format    | Standard                                 | Decimal Places | 2                 |
| Coding            | RW, VM                                   |                |                   |

See Reference Selector (01.014).

| Parameter         | 01.025 Preset Reference 5                |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Defines the value for preset reference 5 |                |                   |
| Mode              | Open-Loop                                |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                       | Maximum        | VM_SPEED_FREQ_REF |
| Default           | 0.00                                     | Units          | Hz                |
| Type              | 32 Bit User Save                         | Update Rate    | 4ms read          |
| Display Format    | Standard                                 | Decimal Places | 2                 |
| Coding            | RW, VM                                   |                |                   |

See Reference Selector (01.014).

| Parameter         | 01.026 Preset Reference 6                |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Defines the value for preset reference 6 |                |                   |
| Mode              | Open-Loop                                |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                       | Maximum        | VM_SPEED_FREQ_REF |
| Default           | 0.00                                     | Units          | Hz                |
| Type              | 32 Bit User Save                         | Update Rate    | 4ms read          |
| Display Format    | Standard                                 | Decimal Places | 2                 |
| Coding            | RW, VM                                   |                |                   |

See Reference Selector (01.014).

| Parameter         | 01.027 Preset Reference 7                |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Defines the value for preset reference 7 |                |                   |
| Mode              | Open-Loop                                |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                       | Maximum        | VM_SPEED_FREQ_REF |
| Default           | 0.00                                     | Units          | Hz                |
| Type              | 32 Bit User Save                         | Update Rate    | 4ms read          |
| Display Format    | Standard                                 | Decimal Places | 2                 |
| Coding            | RW, VM                                   |                |                   |

See Reference Selector (01.014).

| Parameter         | 01.028 Preset Reference 8                |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Defines the value for preset reference 8 |                |                   |
| Mode              | Open-Loop                                |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                       | Maximum        | VM_SPEED_FREQ_REF |
| Default           | 0.00                                     | Units          | Hz                |
| Type              | 32 Bit User Save                         | Update Rate    | 4ms read          |
| Display Format    | Standard                                 | Decimal Places | 2                 |
| Coding            | RW, VM                                   |                |                   |

See Reference Selector (01.014).

| Parameter         | 01.029 Skip Reference 1                 |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the 1st reference point to skip |                |                 |
| Mode              | Open-Loop                               |                |                 |
| Minimum           | 0.00                                    | Maximum        | 550.00          |
| Default           | 0.00                                    | Units          | Hz              |
| Type              | 32 Bit User Save                        | Update Rate    | Background read |
| Display Format    | Standard                                | Decimal Places | 2               |
| Coding            | RW                                      |                |                 |

The skip references functions are available to prevent continuous operation within a specified frequency range (i.e. where mechanical resonance may occur). When *Skip Reference 1* (01.029) = 0 Filter 1 is disabled. *Skip Reference Band 1* (01.030) defines the range either side of *Skip Reference 1* (01.029) over which references are rejected in either direction. The actual rejection band is therefore twice that defined by *Skip Reference Band 1* (01.030) with *Skip Reference 1* (01.029) as the centre of the band. When the selected reference is within the rejection band the lower limit of the band is passed through the filter so that reference is always less than demanded.

Filter 2 (*Skip Reference 2* (01.031), *Skip Reference Band 2* (01.032)) and Filter 3 (*Skip Reference 3* (01.033), *Skip Reference Band 3* (01.034)) operate in the same ways as Filter 1.

If any of the filters are active (i.e. the reference is within their rejection band) *Reference In Rejection Zone* (01.035) is set to 1, otherwise it is 0.

| Parameter         | 01.030 Skip Reference Band 1  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the range either side of skip reference 1 to be implemented |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0.00  | Maximum        | 25.00           |
| Default           | 0.50  | Units          | Hz              |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 2               |
| Coding            | RW, BU  |                |                 |

See *Skip Reference 1* (01.029).

| Parameter         | 01.031 Skip Reference 2                 |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the 2nd reference point to skip |                |                 |
| Mode              | Open-Loop                               |                |                 |
| Minimum           | 0.00                                    | Maximum        | 550.00          |
| Default           | 0.00                                    | Units          | Hz              |
| Type              | 32 Bit User Save                        | Update Rate    | Background read |
| Display Format    | Standard                                | Decimal Places | 2               |
| Coding            | RW                                      |                |                 |

See *Skip Reference 1* (01.029).

| Parameter         | 01.032 Skip Reference Band 2  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the range either side of skip reference 2 to be implemented |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0.00  | Maximum        | 25.00           |
| Default           | 0.50  | Units          | Hz              |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 2               |
| Coding            | RW, BU  |                |                 |

See *Skip Reference 1* (01.029).

| Parameter         | 01.033 Skip Reference 3                 |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the 3rd reference point to skip |                |                 |
| Mode              | Open-Loop                               |                |                 |
| Minimum           | 0.00                                    | Maximum        | 550.00          |
| Default           | 0.00                                    | Units          | Hz              |
| Type              | 32 Bit User Save                        | Update Rate    | Background read |
| Display Format    | Standard                                | Decimal Places | 2               |
| Coding            | RW                                      |                |                 |

See *Skip Reference 1* (01.029).

| Parameter         | 01.034 Skip Reference Band 3  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the range either side of skip reference 3 to be implemented |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0.00  | Maximum        | 25.00           |
| Default           | 0.50  | Units          | Hz              |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 2               |
| Coding            | RW, BU  |                |                 |

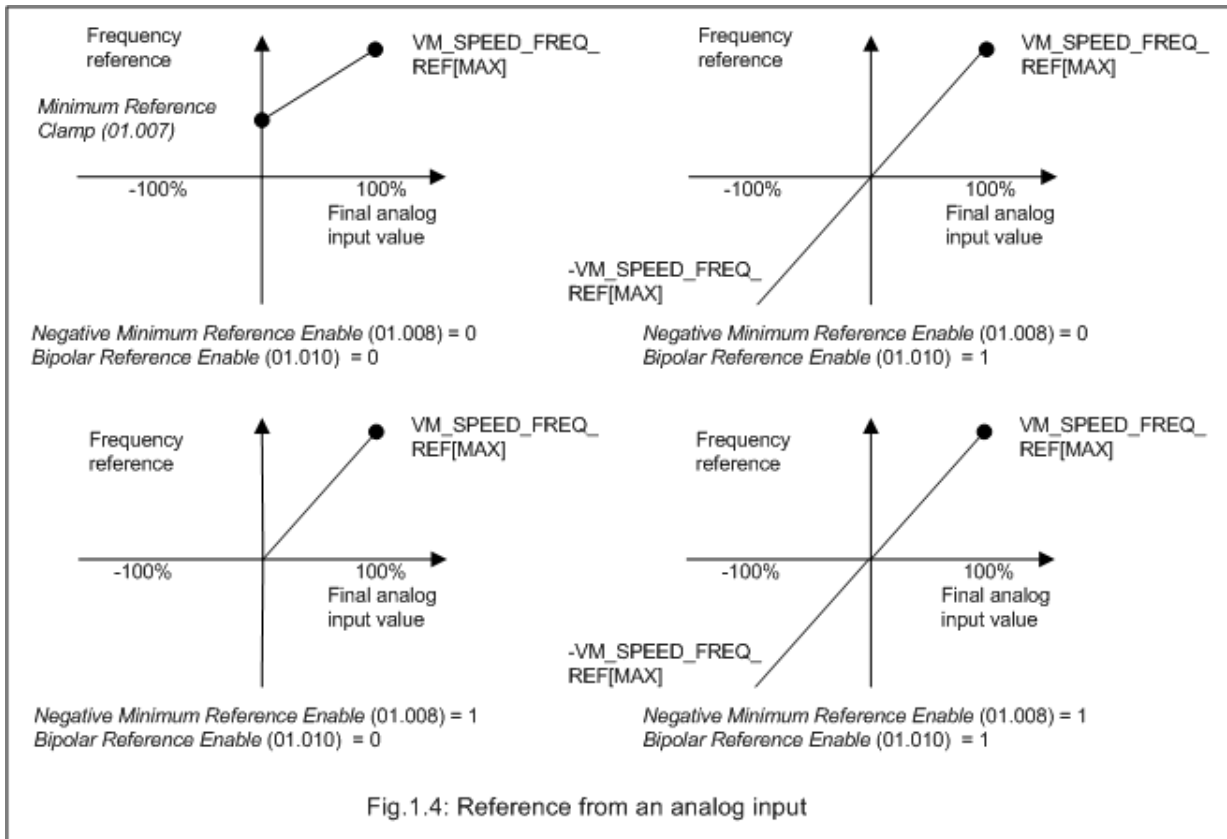
See *Skip Reference 1* (01.029).

| Parameter         | 01.035 Reference In Rejection Zone                                     |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays when the reference is in 1 of the pre-defined rejection zones |                |           |
| Mode              | Open-Loop  |                |           |
| Minimum           | 0  | Maximum        | 1         |
| Default           |  | Units          |           |
| Type              | 1 Bit Volatile   | Update Rate    | 4ms write |
| Display Format    | Standard   | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT   |                |           |

See Skip Reference 1 (01.029).

| Parameter         | 01.036 Analog Reference 1   |                |                         |
|-------------------|---|----------------|-------------------------|
| Short description | Defines the relationship between the final value from analog 1 input and the frequency or speed reference |                |                         |
| Mode              | Open-Loop   |                |                         |
| Minimum           | -VM_SPEED_FREQ_USER_REFS  | Maximum        | VM_SPEED_FREQ_USER_REFS |
| Default           | 0.00  | Units          | Hz                      |
| Type              | 32 Bit Volatile   | Update Rate    | 1ms read                |
| Display Format    | Standard  | Decimal Places | 2                       |
| Coding            | RO, VM, NC  |                |                         |

Analog Reference 1 (01.036) or Analog Reference 2 (01.037) should be used as the destinations for drive analog inputs when these provide the frequency reference. The variable maximum/minimum applied to Analog Reference 1 (01.036) or Analog Reference 2 (01.037) gives the relationship shown below between the final value from the analog input and the frequency reference.



| Parameter         | 01.037 Analog Reference 2   |                |                         |
|-------------------|---|----------------|-------------------------|
| Short description | Defines the relationship between the final value from analog input 2 and the frequency or speed reference |                |                         |
| Mode              | Open-Loop   |                |                         |
| Minimum           | -VM_SPEED_FREQ_USER_REFS  | Maximum        | VM_SPEED_FREQ_USER_REFS |
| Default           | 0.00  | Units          | Hz                      |
| Type              | 32 Bit Volatile   | Update Rate    | 4ms read                |
| Display Format    | Standard  | Decimal Places | 2                       |
| Coding            | RO, VM, NC  |                |                         |

See Analog Reference 1 (01.036).

| Parameter         | 01.038 Percentage Trim                                  |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the value of the reference trim as a percentage |                |          |
| Mode              | Open-Loop   |                |          |
| Minimum           | -100.00   | Maximum        | 100.00   |
| Default           | 0.00  | Units          | %        |
| Type              | 16 Bit Volatile   | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 2        |
| Coding            | RW, NC  |                |          |

See *Reference Offset Select* (01.009).

| Parameter         | 01.041 Reference Select Flag 1                   |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines which reference is selected by the drive |                |          |
| Mode              | Open-Loop  |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit Volatile                                   | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW, NC   |                |          |

See *Reference Selector* (01.014).

| Parameter         | 01.042 Reference Select Flag 2                   |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines which reference is selected by the drive |                |          |
| Mode              | Open-Loop  |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit Volatile                                   | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW, NC   |                |          |

See *Reference Selector* (01.014).

| Parameter         | 01.043 Reference Select Flag 3                   |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines which reference is selected by the drive |                |          |
| Mode              | Open-Loop  |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit Volatile                                   | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW, NC   |                |          |

See *Reference Selector* (01.014).

| Parameter         | 01.045 Preset Select Flag 1                   |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines which preset is selected by the drive |                |          |
| Mode              | Open-Loop                                     |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit Volatile                                | Update Rate    | 4ms read |
| Display Format    | Standard                                      | Decimal Places | 0        |
| Coding            | RW, NC  |                |          |

See *Reference Selector* (01.014).

| Parameter         | 01.046 Preset Select Flag 2                   |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines which preset is selected by the drive |                |          |
| Mode              | Open-Loop                                     |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit Volatile                                | Update Rate    | 4ms read |
| Display Format    | Standard                                      | Decimal Places | 0        |
| Coding            | RW, NC  |                |          |

See *Reference Selector* (01.014).



| Parameter         | 01.047 Preset Select Flag 3                   |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines which preset is selected by the drive |                |          |
| Mode              | Open-Loop                                     |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit Volatile                                | Update Rate    | 4ms read |
| Display Format    | Standard                                      | Decimal Places | 0        |
| Coding            | RW, NC  |                |          |

See Reference Selector (01.014).

| Parameter         | 01.048 Preset Selector Timer Reset                  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to hold the preset selected indicator at 1 |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit Volatile                                      | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, NC  |                |                 |

See Preset Selector Timer (01.016).

| Parameter         | 01.049 Reference Selected Indicator            |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays which reference is currently selected |                |           |
| Mode              | Open-Loop                                      |                |           |
| Minimum           | 1  | Maximum        | 6         |
| Default           |  | Units          |           |
| Type              | 8 Bit Volatile                                 | Update Rate    | 4ms write |
| Display Format    | Standard                                       | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                                 |                |           |

See Reference Selector (01.014).

| Parameter         | 01.050 Preset Selected Indicator            |                |           |
|-------------------|---|----------------|-----------|
| Short description | Displays which preset is currently selected |                |           |
| Mode              | Open-Loop                                   |                |           |
| Minimum           | 1   | Maximum        | 8         |
| Default           |   | Units          |           |
| Type              | 8 Bit Volatile                              | Update Rate    | 4ms write |
| Display Format    | Standard                                    | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                              |                |           |

See Reference Selector (01.014).

| Parameter         | 01.051 Power-up Keypad Control Mode Reference                                 |                |               |
|-------------------|---|----------------|---------------|
| Short description | Defines which value of keypad control mode reference is displayed at power-up |                |               |
| Mode              | Open-Loop   |                |               |
| Minimum           | 0   | Maximum        | 2             |
| Default           | 0   | Units          |               |
| Type              | 8 Bit User Save   | Update Rate    | Power-up read |
| Display Format    | Standard  | Decimal Places | 0             |
| Coding            | RW, TE  |                |               |

| Value | Text   | Description  |
|-------|--------|--|
| 0     | Reset  | Keypad reference is zero                               |
| 1     | Last   | Keypad reference is the last used value                |
| 2     | Preset | Keypad reference is copied from Preset speed 1 (01.21) |

Power-up Keypad Control Mode Reference (01.051) defines the value written to Keypad Control Mode Reference (01.017) at power-up as given below.

| Power-up Keypad Control Mode Reference (01.051) | Value written to Keypad Control Mode Reference (01.017) at power-up            |
|---|--|
| 0   | 0.0  |
| 1   | The value in Keypad Control Mode Reference (01.017) at the previous power-down |
| 2   | The value saved in Preset Reference 1 (01.021)                                 |

| Parameter         | 01.057 Force Reference Direction       |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the direction of the reference |                |          |
| Mode              | Open-Loop                              |                |          |
| Minimum           | 0                                      | Maximum        | 2        |
| Default           | 0                                      | Units          |          |
| Type              | 8 Bit Volatile                         | Update Rate    | 4ms read |
| Display Format    | Standard                               | Decimal Places | 0        |
| Coding            | RW, TE                                 |                |          |

| Value | Text |
|-------|------|
| 0     | None |
| 1     | For  |
| 2     | Rev  |

If *Force Reference Direction* (01.057) = 0 then it has no effect. If *Force Reference Direction* (01.057) is non-zero then the modulus of the reference is used and the sign is defined by the value of *Force Reference Direction* (01.057). If *Force Reference Direction* (01.057) = 1 then *Pre-skip Filter Reference* (01.002) is always positive, and if *Force Reference Direction* (01.057) = 2 then *Pre-skip Filter Reference* (01.002) is always zero or negative.

| Parameter         | 01.069 Reference in rpm                    |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Displays the value of the reference in rpm |                |                   |
| Mode              | Open-Loop                                  |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                         | Maximum        | VM_SPEED_FREQ_REF |
| Default           |  | Units          | rpm               |
| Type              | 32 Bit Volatile                            | Update Rate    | 4ms write         |
| Display Format    | Standard                                   | Decimal Places | 0                 |
| Coding            | RO, VM, ND, NC, PT                         |                |                   |

Uses the set number of poles.

| Parameter         | 01.070 Clamped Reference                                       |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Displays the reference that is provided for the PID controller |                |                   |
| Mode              | Open-Loop  |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF   | Maximum        | VM_SPEED_FREQ_REF |
| Default           |  | Units          | Hz                |
| Type              | 32 Bit Volatile  | Update Rate    | 4ms write         |
| Display Format    | Standard   | Decimal Places | 2                 |
| Coding            | RO, VM, ND, NC, PT   |                |                   |

The *Clamped Reference* (01.070) is provided as a source for the PID control in menu 14.

| Parameter         | 01.071 Alternative Reference  |                |                   |
|-------------------|---|----------------|-------------------|
| Short description | Defines the reference which is used as a destination for the output of the PID controller |                |                   |
| Mode              | Open-Loop   |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF  | Maximum        | VM_SPEED_FREQ_REF |
| Default           | 0.00  | Units          | Hz                |
| Type              | 32 Bit Volatile   | Update Rate    | 4ms read          |
| Display Format    | Standard  | Decimal Places | 2                 |
| Coding            | RO, VM, NC  |                |                   |

*Alternative Reference* (01.071) defines the routing parameter used for the source reference.

If the routing parameter is valid the *Alternative Reference Enable* (01.072) is set to 1.

| Parameter         | 01.072 Alternative Reference Enable                    |                |          |
|-------------------|--|----------------|----------|
| Short description | Indicates when the Alternative Reference is being used |                |          |
| Mode              | Open-Loop  |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           |  | Units          |          |
| Type              | 1 Bit Volatile   | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RO, ND, NC, PT   |                |          |

See *Alternative Reference* (01.071).

## Menu 2 Single Line Descriptions – Frequency Ramps

Mode: Open-Loop

| Parameter |  | Range                                       | Default   | Type |     |    |    |    |    |
|-----------|--|---|---|------|-----|----|----|----|----|
| 02.001    | Post Ramp Reference                      | ±VM_SPEED_FREQ_REF Hz                       |   | RO   | Num | ND | NC | PT |    |
| 02.003    | Ramp Hold                                | Off (0) or On (1)                           | Off (0)   | RW   | Bit |    |    |    | US |
| 02.004    | Ramp Mode Select                         | Fast (0), Std (1), Std.bst (2), Fst.bst (3) | Std (1)   | RW   | Txt |    |    |    | US |
| 02.006    | S Ramp Enable                            | Off (0) or On (1)                           | Off (0)   | RW   | Bit |    |    |    | US |
| 02.007    | Max Rate Of Change Of Acceleration       | 0.0 to 300.0 s <sup>2</sup> /100Hz          | 3.1 s <sup>2</sup> /100Hz   | RW   | Num |    |    |    | US |
| 02.008    | Standard Ramp Voltage                    | ±VM_DC_VOLTAGE_SET V                        | 110V drive: 375 V<br>200V drive: 375 V<br>400V drive 50Hz: 750 V<br>400V drive 60Hz: 775 V<br>575V drive: 895 V<br>690V drive: 1075 V | RW   | Num |    | RA |    | US |
| 02.009    | Deceleration Fail Detection Disable      | Off (0) or On (1)                           | Off (0)   | RW   | Bit |    |    |    | US |
| 02.010    | Acceleration Rate Selector               | 0 to 9                                      | 0   | RW   | Num |    |    |    | US |
| 02.011    | Acceleration Rate 1                      | ±VM_ACCEL_RATE s                            | 5.0 s   | RW   | Num |    |    |    | US |
| 02.012    | Acceleration Rate 2                      | ±VM_ACCEL_RATE s                            | 5.0 s   | RW   | Num |    |    |    | US |
| 02.013    | Acceleration Rate 3                      | ±VM_ACCEL_RATE s                            | 5.0 s   | RW   | Num |    |    |    | US |
| 02.014    | Acceleration Rate 4                      | ±VM_ACCEL_RATE s                            | 5.0 s   | RW   | Num |    |    |    | US |
| 02.015    | Acceleration Rate 5                      | ±VM_ACCEL_RATE s                            | 5.0 s   | RW   | Num |    |    |    | US |
| 02.016    | Acceleration Rate 6                      | ±VM_ACCEL_RATE s                            | 5.0 s   | RW   | Num |    |    |    | US |
| 02.017    | Acceleration Rate 7                      | ±VM_ACCEL_RATE s                            | 5.0 s   | RW   | Num |    |    |    | US |
| 02.018    | Acceleration Rate 8                      | ±VM_ACCEL_RATE s                            | 5.0 s   | RW   | Num |    |    |    | US |
| 02.019    | Jog Acceleration Rate                    | ±VM_ACCEL_RATE s                            | 0.2 s   | RW   | Num |    |    |    | US |
| 02.020    | Deceleration Rate Selector               | 0 to 9                                      | 0   | RW   | Num |    |    |    | US |
| 02.021    | Deceleration Rate 1                      | ±VM_ACCEL_RATE s                            | 10.0 s  | RW   | Num |    |    |    | US |
| 02.022    | Deceleration Rate 2                      | ±VM_ACCEL_RATE s                            | 10.0 s  | RW   | Num |    |    |    | US |
| 02.023    | Deceleration Rate 3                      | ±VM_ACCEL_RATE s                            | 10.0 s  | RW   | Num |    |    |    | US |
| 02.024    | Deceleration Rate 4                      | ±VM_ACCEL_RATE s                            | 10.0 s  | RW   | Num |    |    |    | US |
| 02.025    | Deceleration Rate 5                      | ±VM_ACCEL_RATE s                            | 10.0 s  | RW   | Num |    |    |    | US |
| 02.026    | Deceleration Rate 6                      | ±VM_ACCEL_RATE s                            | 10.0 s  | RW   | Num |    |    |    | US |
| 02.027    | Deceleration Rate 7                      | ±VM_ACCEL_RATE s                            | 10.0 s  | RW   | Num |    |    |    | US |
| 02.028    | Deceleration Rate 8                      | ±VM_ACCEL_RATE s                            | 10.0 s  | RW   | Num |    |    |    | US |
| 02.029    | Jog Deceleration Rate                    | ±VM_ACCEL_RATE s                            | 0.2 s   | RW   | Num |    |    |    | US |
| 02.030    | Acceleration Rate Selected               | 0 to 8                                      |   | RO   | Num | ND | NC | PT |    |
| 02.031    | Deceleration Rate Selected               | 0 to 8                                      |   | RO   | Num | ND | NC | PT |    |
| 02.032    | Acceleration Rate Select Bit 0           | Off (0) or On (1)                           | Off (0)   | RW   | Bit |    | NC |    |    |
| 02.033    | Acceleration Rate Select Bit 1           | Off (0) or On (1)                           | Off (0)   | RW   | Bit |    | NC |    |    |
| 02.034    | Acceleration Rate Select Bit 2           | Off (0) or On (1)                           | Off (0)   | RW   | Bit |    | NC |    |    |
| 02.035    | Deceleration Rate Select Bit 0           | Off (0) or On (1)                           | Off (0)   | RW   | Bit |    | NC |    |    |
| 02.036    | Deceleration Rate Select Bit 1           | Off (0) or On (1)                           | Off (0)   | RW   | Bit |    | NC |    |    |
| 02.037    | Deceleration Rate Select Bit 2           | Off (0) or On (1)                           | Off (0)   | RW   | Bit |    | NC |    |    |
| 02.039    | Ramp Rate Units                          | 0 to 2                                      | 0   | RW   | Num |    |    |    | US |
| 02.040    | S Ramp Percentage                        | 0.0 to 50.0 %                               | 0.0 %   | RW   | Num |    |    |    | US |
| 02.041    | S Ramp Set-up Mode                       | 0 to 2                                      | 0   | RW   | Num |    |    |    | US |
| 02.042    | Maximum Rate Of Change Of Acceleration 1 | 0.0 to 300.0 s <sup>2</sup> /100Hz          | 0.0 s <sup>2</sup> /100Hz   | RW   | Num |    |    |    | US |
| 02.043    | Maximum Rate Of Change Of Acceleration 2 | 0.0 to 300.0 s <sup>2</sup> /100Hz          | 0.0 s <sup>2</sup> /100Hz   | RW   | Num |    |    |    | US |
| 02.044    | Maximum Rate Of Change Of Acceleration 3 | 0.0 to 300.0 s <sup>2</sup> /100Hz          | 0.0 s <sup>2</sup> /100Hz   | RW   | Num |    |    |    | US |
| 02.045    | Maximum Rate Of Change Of Acceleration 4 | 0.0 to 300.0 s <sup>2</sup> /100Hz          | 0.0 s <sup>2</sup> /100Hz   | RW   | Num |    |    |    | US |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

# Menu 2 – Frequency Ramps

Mode: Open-Loop

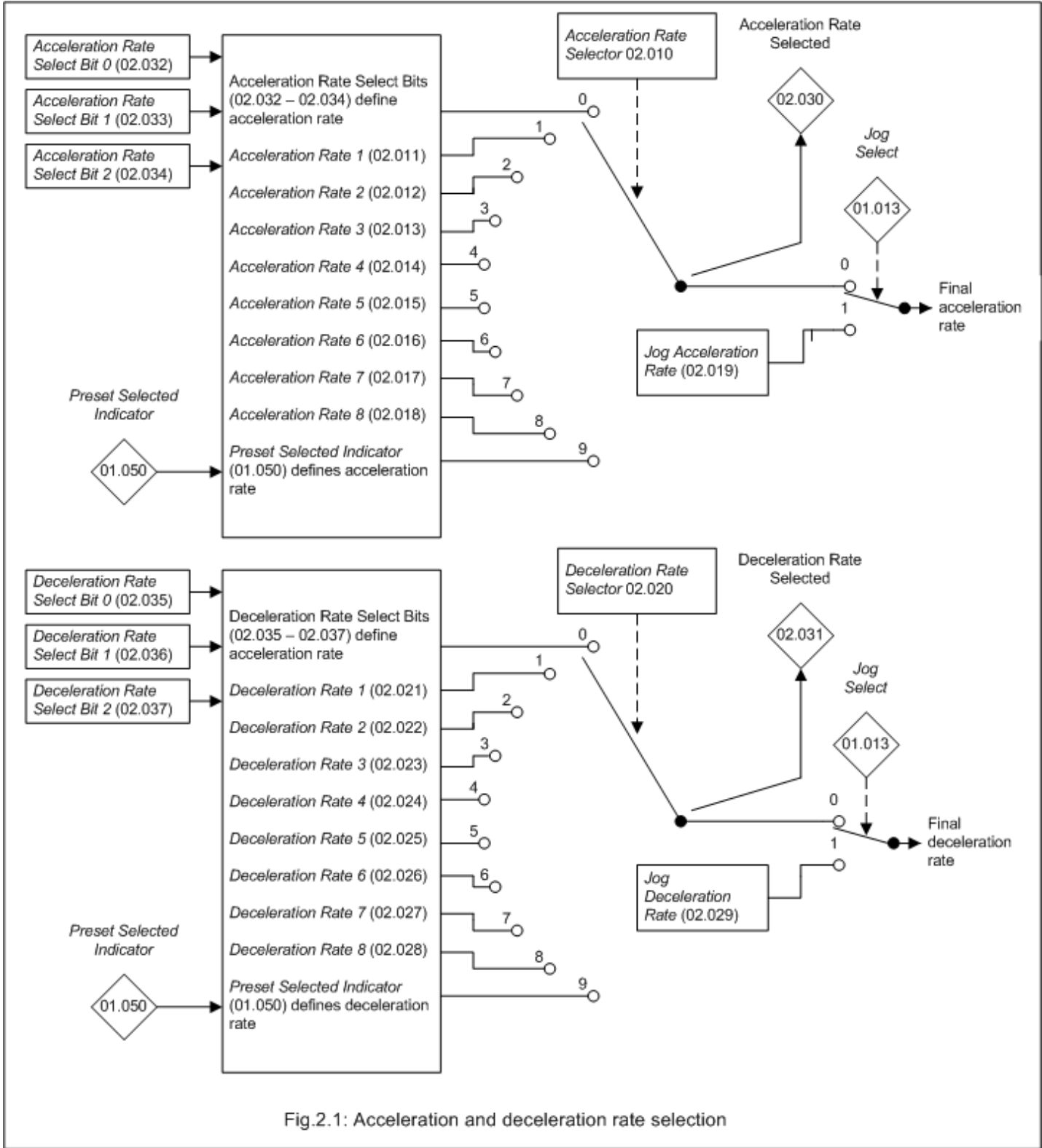
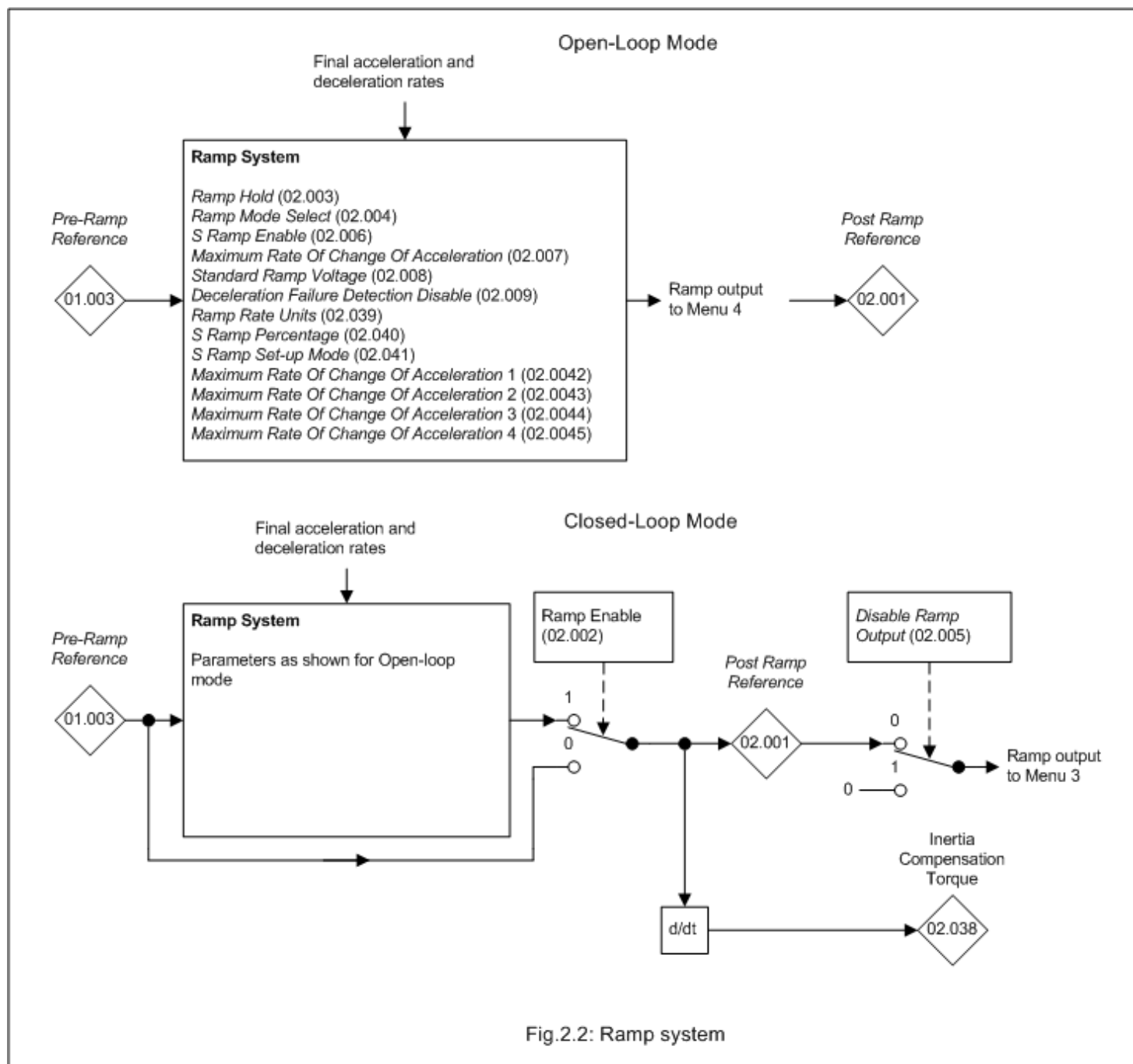


Fig.2.1: Acceleration and deceleration rate selection



| Parameter         | 02.001 Post Ramp Reference             |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Displays the output of the ramp system |                |                   |
| Mode              | Open-Loop                              |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                     | Maximum        | VM_SPEED_FREQ_REF |
| Default           |  | Units          | Hz                |
| Type              | 32 Bit Volatile                        | Update Rate    | 16ms              |
| Display Format    | Standard                               | Decimal Places | 2                 |
| Coding            | RO, VM, ND, NC, PT                     |                |                   |

The Post Ramp Reference (02.001) is combined with the slip compensation frequency to define the output frequency of the drive. The Post Ramp Reference (02.001) is defined by the output of the ramp system except when the current limits are active (see Menu 04).

| Parameter         | 02.003 Ramp Hold                                      |                |     |
|-------------------|---|----------------|-----|
| Short description | Set to 1 to hold the ramp system at its present value |                |     |
| Mode              | Open-Loop   |                |     |
| Minimum           | 0   | Maximum        | 1   |
| Default           | 0   | Units          |     |
| Type              | 1 Bit User Save                                       | Update Rate    | 1ms |
| Display Format    | Standard  | Decimal Places | 0   |
| Coding            | RW  |                |     |

If Ramp Hold (02.003) = 0 the ramp system functions normally. If Ramp Hold (02.003) is set to 1 and S Ramp Enable (02.006) = 0 the ramp system

output is held at its current level. If *Ramp Hold* (02.003) is subsequently set to 0 the ramp system output is released and continues to operate normally. If *S Ramp Enable* (02.006) = 1 when *Ramp Hold* (02.003) is set to 1 the acceleration will ramp towards zero and the frequency will change in an S curve towards a constant frequency. If a drive stop is requested (i.e. *Reference On* (01.011) = 0) the ramp hold function is disabled.

| Parameter         | 02.004 Ramp Mode Select                  |                |      |
|-------------------|--|----------------|------|
| Short description | Defines the mode used by the ramp system |                |      |
| Mode              | Open-Loop                                |                |      |
| Minimum           | 0  | Maximum        | 3    |
| Default           | 1  | Units          |      |
| Type              | 8 Bit User Save                          | Update Rate    | 16ms |
| Display Format    | Standard                                 | Decimal Places | 0    |
| Coding            | RW, TE                                   |                |      |

| Value | Text    | Description                             |
|-------|---------|---|
| 0     | Fast    | Fast ramp                               |
| 1     | Std     | Standard ramp with normal motor voltage |
| 2     | Std.bst | Standard ramp with high motor voltage   |
| 3     | Fst.bst | Fast ramp with high motor volts         |

Acceleration is defined as a positive (forward) or negative (reverse) frequency change away from zero, and deceleration is defined as a change towards zero. *Ramp Mode Select* (02.004) defines the ramp mode used for deceleration. During acceleration the frequency changes are based on the final acceleration rate only.

#### 0: Fast ramp

During deceleration the frequency changes are based on the final deceleration rate.

#### 1: Standard ramp

The standard ramp controller (shown in the diagram below) is only enabled when the *Pre-ramp Reference* (01.003) is closer to zero than the *Post Ramp Reference* (02.001), i.e. during deceleration. As the motor slows down power is fed into the d.c. link of the drive which causes the voltage to rise. When the voltage reaches the level defined by the *Standard Ramp Voltage* (02.008) the d.c. link voltage controller becomes active and provides a torque producing current reference. This system regulates the d.c. link voltage to hold it at the level defined by the *Standard Ramp Voltage* (02.008). Generally as the motor slows down the deceleration needs to be increased to provide enough power to maintain the d.c. link level. The frequency is not allowed to fall faster than the final deceleration rate, and so a point is reached where the controller de-activates itself, and the final deceleration rate is used until the motor reaches standstill. If at any point the *Pre-ramp Reference* (01.003) is equal to or further from zero than the *Post Ramp Reference* (02.001), i.e. not decelerating, the d.c. link voltage controller is de-activated.

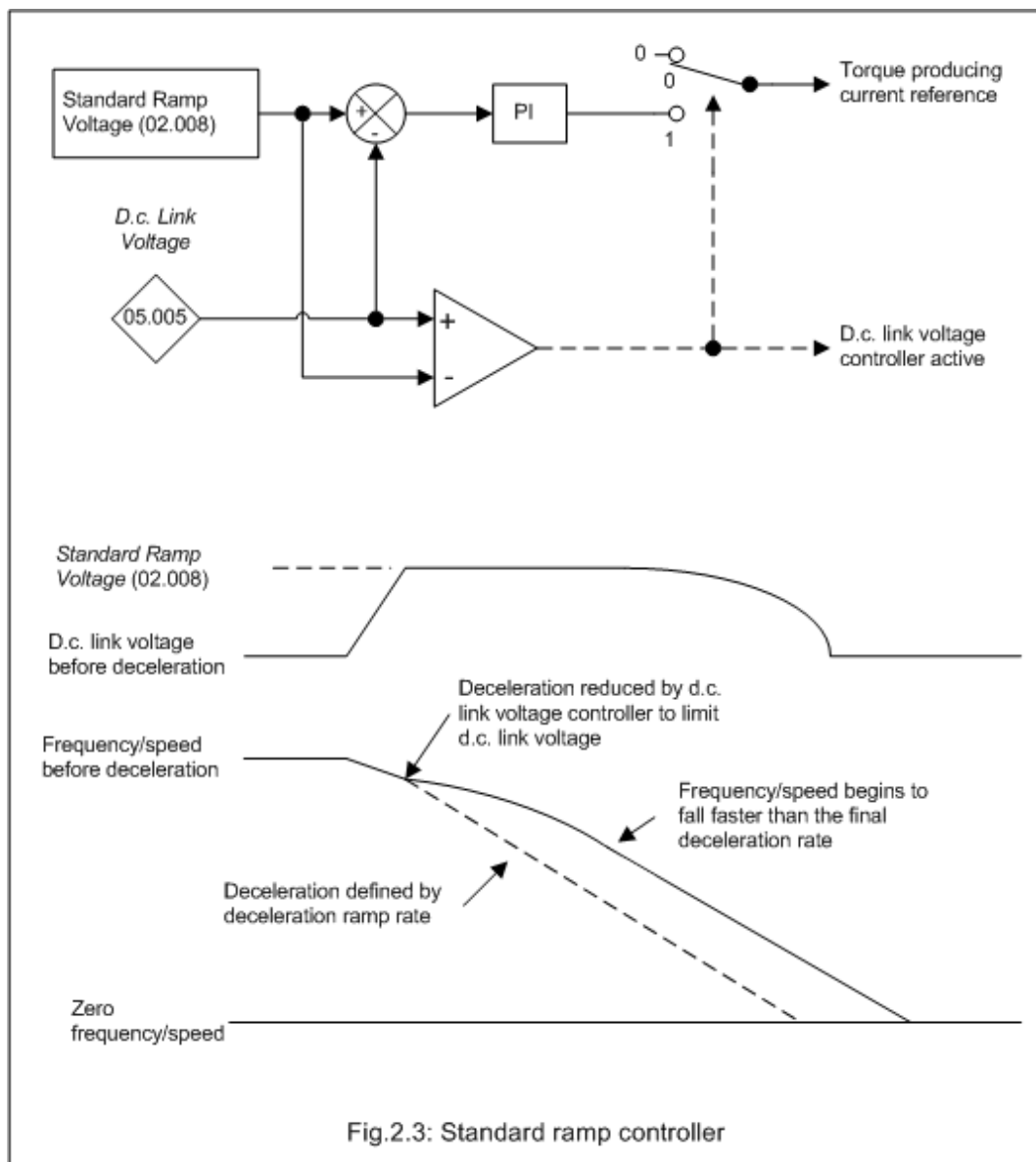
#### 2: Standard ramp with motor voltage boost

Standard ramp with motor voltage boost is the same as standard ramp mode except that the motor voltage is boosted by 20% to increase the motor losses and reduce the deceleration time.

If the *Standard Ramp Voltage* (02.008) is set to a level that is below the nominal d.c. link voltage level the motor will coast during deceleration because the torque producing current reference is limited to prevent the motor from accelerating. There are circumstances as listed below where the motor may not decelerated or even accelerate.

1. With a Synchronous machine a limited amount of motoring torque producing current is allowed to make the system operate correctly and in this case it is possible under some circumstances for the motor to accelerate slowly.
2. With a high inductance supply it is possible for the d.c. link voltage to rise as the motor frequency approaches zero, and so the motor will continue to rotate slowly and not stop.
3. An overhauling load can cause the motor to accelerate.

If *Deceleration Fail Detection Disable* (02.009) is at its default value of 0 the *Output Frequency* (05.001) is monitored. If these do not fall over a period of 10s the ramp output is forced to zero and the d.c. link voltage controller is disabled. If *Deceleration Fail Detection Disable* (02.009) = 1 this feature is disabled.



### 3: Fast ramp with motor voltage boost

Fast ramp with motor voltage boost is the same as Fast ramp mode except that the motor voltage is boosted by 20% to increase the motor losses and reduce the deceleration time.

| Parameter         | 02.006 S Ramp Enable                  |                |      |
|-------------------|---------------------------------------|----------------|------|
| Short description | Set to 1 to enable the use of S ramps |                |      |
| Mode              | Open-Loop                             |                |      |
| Minimum           | 0                                     | Maximum        | 1    |
| Default           | 0                                     | Units          |      |
| Type              | 1 Bit User Save                       | Update Rate    | 16ms |
| Display Format    | Standard                              | Decimal Places | 0    |
| Coding            | RW                                    |                |      |

If *S Ramp Enable* (02.006) = 0 linear ramps are used, but if *S Ramp Enable* (02.006) = 1 an acceleration limit is applied to give S ramps. The S ramp function is disabled during deceleration when the standard ramp voltage controller is active. When the motor is accelerated again the acceleration ramp used by the S ramp function is reset to zero.

| Parameter         | 02.007 Max Rate Of Change Of Acceleration                                  |                |                       |
|-------------------|--|----------------|-----------------------|
| Short description | Defines the maximum rate of change of acceleration used by the ramp system |                |                       |
| Mode              | Open-Loop  |                |                       |
| Minimum           | 0.0  | Maximum        | 300.0                 |
| Default           | 3.1  | Units          | s <sup>2</sup> /100Hz |
| Type              | 32 Bit User Save   | Update Rate    | Background read       |
| Display Format    | Standard   | Decimal Places | 1                     |
| Coding            | RW   |                |                       |

A rate of change of acceleration ramp (S ramp) can be applied by different methods depending on the value of *S Ramp Set-up Mode* (02.041). If *S Ramp Set-up Mode* (02.041) = 0 then the maximum rate of change of acceleration in both directions, accelerating away from or towards zero, is defined by *Max Rate Of Change Of Acceleration* (02.007).

The general equations are given below for a linear ramp and an S ramp where

$\Delta w$  is the required change of frequency.

$a_{Max}$  is the maximum allowed acceleration in units of frequency/s

$J_{Max}$  is the maximum rate of change of acceleration (i.e. jerk) in units of frequency/s<sup>2</sup>

The time for a linear ramp to give a change of frequency of  $\Delta w$  is

$$T_{Linear} = \Delta w \times a_{Max}$$

If an S ramp is used  $w_B$  is the change of frequency as the acceleration changes from zero to  $a_{Max}$ , i.e. the S shaped part of the frequency change.

$$w_B = a_{Max}^2 / 2J_{Max}$$

If the required frequency change is less than  $2w_B$ , i.e.  $\Delta w_B$ , then the acceleration never reaches its limit and the ramp does not contain a linear ramp section and the time for the ramp is given by

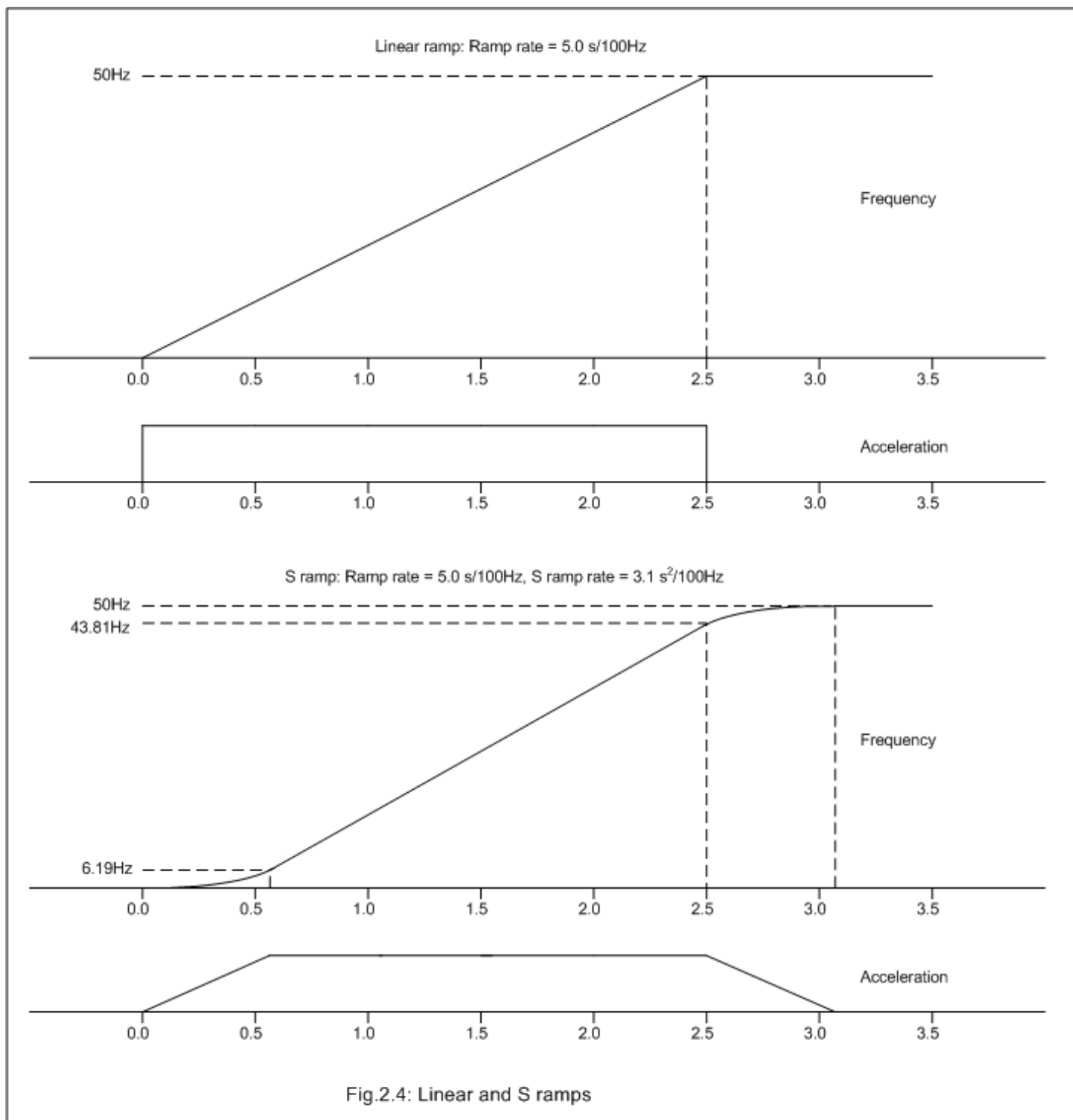
$$T_{Sramp1} = 2 \sqrt{(\Delta w / J_{Max})}$$

Otherwise

$$T_{Sramp2} = (\Delta w / a_{Max}) + (a_{Max} / J_{Max})$$

The diagram below shows a change of frequency from 0Hz to 50Hz with the ramp rate set to 5.0s / 100Hz and the *Max Rate Of Change Of Acceleration* (02.007) set to its default value of 3.1s<sup>2</sup> / 100Hz.





The required change of frequency  $\Delta\omega = 50\text{Hz}$ . The acceleration and jerk limits are converted from the parameter values as follows:

$$a_{\text{Max}} = 100 / \text{ramp rate} = 20.0 \text{ Hz/s}$$

$$J_{\text{Max}} = 100 / \text{Max Rate Of Change Of Acceleration (02.007)} = 32.3 \text{ Hz/s}^2$$

$$\text{The linear ramp time } T_{\text{Linear}} = \Delta\omega \times a_{\text{Max}} = 50.0 / 20.0 = 2.5\text{s}$$

$$\text{The frequency change for the acceleration to reach its limit } \omega_B = a_{\text{Max}}^2 / 2J_{\text{Max}} = 20.0^2 / (2 \times 32.3) = 6.19\text{Hz}$$

The required frequency change  $\Delta\omega = 50\text{Hz}$  and this is greater than  $2\omega_B$ , i.e.  $\Delta\omega > 2 \times 6.19\text{Hz}$  therefore the time for the ramp

$$T_{\text{Srampt2}} = (\Delta\omega / a_{\text{Max}}) + (a_{\text{Max}} / J_{\text{Max}}) = (50.0 / 20.0) + (20.0 / 32.3) = 2.5 + 0.62 = 3.12\text{s}.$$

Note that the default value of *Max Rate Of Change Of Acceleration (02.007)* has been chosen so that when it is combined with the default acceleration rate, the ramp is extended by approximately 25% compared to the linear ramp.

If the required change of frequency had been 5.0Hz, i.e. less than  $2 \times \omega_B$ , then the alternative equation should be used:

$$T_{\text{Srampt1}} = 2 \sqrt{(\Delta\omega / J_{\text{Max}})} = 2 \sqrt{(5.0 / 32.3)} = 0.78\text{s}.$$

| Parameter         | 02.008 Standard Ramp Voltage                              |                |                   |
|-------------------|---|----------------|-------------------|
| Short description | Defines the standard ramp voltage used by the ramp system |                |                   |
| Mode              | Open-Loop   |                |                   |
| Minimum           | -VM_DC_VOLTAGE_SET  | Maximum        | VM_DC_VOLTAGE_SET |
| Default           | See exceptions below                                      | Units          | V                 |
| Type              | 16 Bit User Save  | Update Rate    | Background read   |
| Display Format    | Standard  | Decimal Places | 0                 |
| Coding            | RW, VM, RA  |                |                   |

| Voltage | Region | Default Value |
|---------|--------|---------------|
| 110V    | All    | 375           |
| 200V    | All    | 375           |
| 400V    | 50Hz   | 750           |
| 400V    | 60Hz   | 775           |
| 575V    | All    | 895           |
| 690V    | All    | 1075          |

See Ramp Mode Select (02.004).

| Parameter         | 02.009 Deceleration Fail Detection Disable                  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to disable the deceleration fal detection function |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See Ramp Mode Select (02.004).

| Parameter         | 02.010 Acceleration Rate Selector                          |                |      |
|-------------------|--|----------------|------|
| Short description | Defines which acceleration rate is used by the ramp system |                |      |
| Mode              | Open-Loop  |                |      |
| Minimum           | 0  | Maximum        | 9    |
| Default           | 0  | Units          |      |
| Type              | 8 Bit User Save  | Update Rate    | 16ms |
| Display Format    | Standard   | Decimal Places | 0    |
| Coding            | RW   |                |      |

The *Acceleration Rate Selector* (02.010) is used to either select an acceleration rate directly or to define the method used to select an acceleration rate. If  $1 \leq \text{Acceleration Rate Selector (02.010)} \leq 8$  the acceleration rate is selected directly, i.e. 1 selects *Acceleration Rate 1* (02.011), 2 selects *Acceleration Rate 2* (02.012), etc. If *Acceleration Rate Selector* (02.010) = 0 the acceleration rate is selected with the acceleration rate select bits as shown in the table below.

| Acceleration Rate Select Bit 2 (02.034) | Acceleration Rate Select Bit 1 (02.033) | Acceleration Rate Select Bit 0 (02.032) | Acceleration rate selected          |
|---|---|---|-------------------------------------|
| 0                                       | 0                                       | 0                                       | <i>Acceleration Rate 1</i> (02.011) |
| 0                                       | 0                                       | 1                                       | <i>Acceleration Rate 2</i> (02.012) |
| 0                                       | 1                                       | 0                                       | <i>Acceleration Rate 3</i> (02.013) |
| 0                                       | 1                                       | 1                                       | <i>Acceleration Rate 4</i> (02.014) |
| 1                                       | 0                                       | 0                                       | <i>Acceleration Rate 5</i> (02.015) |
| 1                                       | 0                                       | 1                                       | <i>Acceleration Rate 6</i> (02.016) |
| 1                                       | 1                                       | 0                                       | <i>Acceleration Rate 7</i> (02.017) |
| 1                                       | 1                                       | 1                                       | <i>Acceleration Rate 8</i> (02.018) |

If *Acceleration Rate Selector* (02.010) = 9 the acceleration rate is selected based on the value of *Preset Selected Indicator* (01.050), i.e. 1 selects *Acceleration Rate 1* (02.011), 2 selects *Acceleration Rate 2* (02.012), etc.

| Parameter         | 02.011 Acceleration Rate 1                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the acceleration rate present in acceleration rate 1 |                |               |
| Mode              | Open-Loop  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 5.0  | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 16ms          |
| Display Format    | Standard   | Decimal Places | 1             |
| Coding            | RW, VM   |                |               |

See *Ramp Rate Units* (02.039) for the definition of Ramp rate frequency.

*Acceleration Rate 1* (02.011) - *Acceleration Rate 8* (02.018) can be selected to define the linear ramp rate. The acceleration rate applies when the frequency is changing away from zero.

Selecting a ramp rate that has been set to zero in Asynchronous mode disables the ramp system so that the *Post Ramp Reference* (02.001) follows the *Pre-ramp Reference* (01.003) without any delay for acceleration or deceleration. It should be noted that this also disables the standard ramp d.c. link voltage controller and the frequency based current limits.

| Parameter         | 02.012 Acceleration Rate 2                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the acceleration rate present in acceleration rate 2 |                |               |
| Mode              | Open-Loop  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 5.0  | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 16ms          |
| Display Format    | Standard   | Decimal Places | 1             |
| Coding            | RW, VM   |                |               |

See *Acceleration Rate 1* (02.011).

| Parameter         | 02.013 Acceleration Rate 3                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the acceleration rate present in acceleration rate 3 |                |               |
| Mode              | Open-Loop  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 5.0  | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 16ms          |
| Display Format    | Standard   | Decimal Places | 1             |
| Coding            | RW, VM   |                |               |

See *Acceleration Rate 1* (02.011).

| Parameter         | 02.014 Acceleration Rate 4                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the acceleration rate present in acceleration rate 4 |                |               |
| Mode              | Open-Loop  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 5.0  | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 16ms          |
| Display Format    | Standard   | Decimal Places | 1             |
| Coding            | RW, VM   |                |               |

See *Acceleration Rate 1* (02.011).

| Parameter         | 02.015 Acceleration Rate 5                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the acceleration rate present in acceleration rate 5 |                |               |
| Mode              | Open-Loop  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 5.0  | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 16ms          |
| Display Format    | Standard   | Decimal Places | 1             |
| Coding            | RW, VM   |                |               |

See *Acceleration Rate 1* (02.011).

| Parameter         | 02.016 Acceleration Rate 6                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the acceleration rate present in acceleration rate 6 |                |               |
| Mode              | Open-Loop  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 5.0  | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 16ms          |
| Display Format    | Standard   | Decimal Places | 1             |
| Coding            | RW, VM   |                |               |

See *Acceleration Rate 1* (02.011).

| Parameter         | 02.017 <i>Acceleration Rate 7</i>                            |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the acceleration rate present in acceleration rate 7 |                |               |
| Mode              | Open-Loop  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 5.0  | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 16ms          |
| Display Format    | Standard   | Decimal Places | 1             |
| Coding            | RW, VM   |                |               |

See *Acceleration Rate 1* (02.011).

| Parameter         | 02.018 <i>Acceleration Rate 8</i>                            |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the acceleration rate present in acceleration rate 8 |                |               |
| Mode              | Open-Loop  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 5.0  | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 16ms          |
| Display Format    | Standard   | Decimal Places | 1             |
| Coding            | RW, VM   |                |               |

See *Acceleration Rate 1* (02.011).

| Parameter         | 02.019 <i>Jog Acceleration Rate</i>                                     |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the acceleration rate present when the jog function is selected |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | -VM_ACCEL_RATE  | Maximum        | VM_ACCEL_RATE   |
| Default           | 0.2   | Units          | s               |
| Type              | 32 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 1               |
| Coding            | RW, VM  |                |                 |

See *Ramp Rate Units* (02.039) for the definition of Ramp rate frequency.

The *Jog Acceleration Rate* (02.019) is selected when *Jog Select* (01.013) is active and when the frequency is changing away from zero in either direction.

| Parameter         | 02.020 <i>Deceleration Rate Selector</i>                   |                |      |
|-------------------|--|----------------|------|
| Short description | Defines which deceleration rate is used by the ramp system |                |      |
| Mode              | Open-Loop  |                |      |
| Minimum           | 0  | Maximum        | 9    |
| Default           | 0  | Units          |      |
| Type              | 8 Bit User Save  | Update Rate    | 16ms |
| Display Format    | Standard   | Decimal Places | 0    |
| Coding            | RW   |                |      |

The *Deceleration Rate Selector* (02.020) operates in the same way as the *Acceleration Rate Selector* (02.010). If *Deceleration Rate Selector* (02.020) = 0 the deceleration rate is selected with the deceleration rate select bits as shown in the table below.

| <i>Deceleration Rate Select Bit 2</i><br>(02.037) | <i>Deceleration Rate Select Bit 1</i><br>(02.036) | <i>Deceleration Rate Select Bit 0</i><br>(02.035) | <i>Deceleration rate selected</i>      |
|---|---|---|--|
| 0   | 0   | 0   | <i>Deceleration Rate 1</i><br>(02.021) |
| 0   | 0   | 1   | <i>Deceleration Rate 2</i><br>(02.022) |
| 0   | 1   | 0   | <i>Deceleration Rate 3</i><br>(02.023) |
| 0   | 1   | 1   | <i>Deceleration Rate 4</i><br>(02.024) |
| 1   | 0   | 0   | <i>Deceleration Rate 5</i><br>(02.025) |
| 1   | 0   | 1   | <i>Deceleration Rate 6</i><br>(02.026) |
| 1   | 1   | 0   | <i>Deceleration Rate 7</i><br>(02.027) |
| 1   | 1   | 1   | <i>Deceleration Rate 8</i><br>(02.028) |

| Parameter         | 02.021 Deceleration Rate 1                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the deceleration rate present in deceleration rate 1 |                |               |
| Mode              | Open-Loop  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 10.0   | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 16ms          |
| Display Format    | Standard   | Decimal Places | 1             |
| Coding            | RW, VM   |                |               |

See *Ramp Rate Units* (02.039) for the definition of Ramp rate frequency

*Deceleration Rate 1* (02.021) - *Deceleration Rate 8* (02.028) can be selected to define the linear ramp rate. The deceleration rate applies when the frequency is changing towards zero.

Selecting a ramp rate that has been set to zero in Asynchronous mode disables the ramp system so that the *Post Ramp Reference* (02.001) follows the *Pre-ramp Reference* (01.003) without any delay for acceleration or deceleration. It should be noted that this also disables the standard ramp d.c. link voltage controller and the frequency based current limits.

| Parameter         | 02.022 Deceleration Rate 2                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the deceleration rate present in deceleration rate 2 |                |               |
| Mode              | Open-Loop  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 10.0   | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 16ms          |
| Display Format    | Standard   | Decimal Places | 1             |
| Coding            | RW, VM   |                |               |

See *Deceleration Rate 1* (02.021).

| Parameter         | 02.023 Deceleration Rate 3                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the deceleration rate present in deceleration rate 3 |                |               |
| Mode              | Open-Loop  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 10.0   | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 16ms          |
| Display Format    | Standard   | Decimal Places | 1             |
| Coding            | RW, VM   |                |               |

See *Deceleration Rate 1* (02.021).

| Parameter         | 02.024 Deceleration Rate 4                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the deceleration rate present in deceleration rate 4 |                |               |
| Mode              | Open-Loop  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 10.0   | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 16ms          |
| Display Format    | Standard   | Decimal Places | 1             |
| Coding            | RW, VM   |                |               |

See *Deceleration Rate 1* (02.021).

| Parameter         | 02.025 Deceleration Rate 5                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the deceleration rate present in deceleration rate 5 |                |               |
| Mode              | Open-Loop  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 10.0   | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 16ms          |
| Display Format    | Standard   | Decimal Places | 1             |
| Coding            | RW, VM   |                |               |

See *Deceleration Rate 1* (02.021).

| Parameter         | 02.026 Deceleration Rate 6                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the deceleration rate present in deceleration rate 6 |                |               |
| Mode              | Open-Loop  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 10.0   | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 16ms          |
| Display Format    | Standard   | Decimal Places | 1             |
| Coding            | RW, VM   |                |               |

See *Deceleration Rate 1* (02.021).

| Parameter         | 02.027 <i>Deceleration Rate 7</i>                            |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the deceleration rate present in deceleration rate 7 |                |               |
| Mode              | Open-Loop  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 10.0   | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 16ms          |
| Display Format    | Standard   | Decimal Places | 1             |
| Coding            | RW, VM   |                |               |

See *Deceleration Rate 1* (02.021).

| Parameter         | 02.028 <i>Deceleration Rate 8</i>                            |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the deceleration rate present in deceleration rate 8 |                |               |
| Mode              | Open-Loop  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 10.0   | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 16ms          |
| Display Format    | Standard   | Decimal Places | 1             |
| Coding            | RW, VM   |                |               |

See *Deceleration Rate 1* (02.021).

| Parameter         | 02.029 <i>Jog Deceleration Rate</i>                                     |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the deceleration rate present when the jog function is selected |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | -VM_ACCEL_RATE  | Maximum        | VM_ACCEL_RATE   |
| Default           | 0.2   | Units          | s               |
| Type              | 32 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 1               |
| Coding            | RW, VM  |                |                 |

See *Ramp Rate Units* (02.039) for the definition of Ramp rate frequency.

The *Jog Deceleration Rate* (02.029) is selected when *Jog Select* (01.013) is active and when the frequency is changing towards zero in either direction.

| Parameter         | 02.030 <i>Acceleration Rate Selected</i>      |                |      |
|-------------------|---|----------------|------|
| Short description | Indicates which acceleration rate is selected |                |      |
| Mode              | Open-Loop                                     |                |      |
| Minimum           | 0   | Maximum        | 8    |
| Default           |   | Units          |      |
| Type              | 8 Bit Volatile                                | Update Rate    | 16ms |
| Display Format    | Standard                                      | Decimal Places | 0    |
| Coding            | RO, ND, NC, PT                                |                |      |

*Acceleration Rate Selected* (02.030) shows a value between 1 and 8 that corresponds to *Acceleration Rate 1* (02.011) to *Acceleration Rate 8* (02.018) indicating which of these acceleration rates is actually being used.

*Deceleration Rate Selected* (02.031) shows a value between 1 and 8 that corresponds to *Deceleration Rate 1* (02.021) to *Deceleration Rate 8* (02.028) indicating which of these deceleration rates is actually being used.

| Parameter         | 02.031 <i>Deceleration Rate Selected</i>      |                |      |
|-------------------|---|----------------|------|
| Short description | Indicates which deceleration rate is selected |                |      |
| Mode              | Open-Loop                                     |                |      |
| Minimum           | 0   | Maximum        | 8    |
| Default           |   | Units          |      |
| Type              | 8 Bit Volatile                                | Update Rate    | 16ms |
| Display Format    | Standard                                      | Decimal Places | 0    |
| Coding            | RO, ND, NC, PT                                |                |      |

See *Acceleration Rate Selected* (02.030).

| Parameter         | 02.032 Acceleration Rate Select Bit 0                                     |                |      |
|-------------------|---|----------------|------|
| Short description | Defines which acceleration rate is used if acceleration rate selector = 0 |                |      |
| Mode              | Open-Loop   |                |      |
| Minimum           | 0   | Maximum        | 1    |
| Default           | 0   | Units          |      |
| Type              | 1 Bit Volatile  | Update Rate    | 16ms |
| Display Format    | Standard  | Decimal Places | 0    |
| Coding            | RW, NC  |                |      |

See *Acceleration Rate Selector* (02.010).

| Parameter         | 02.033 Acceleration Rate Select Bit 1                                     |                |      |
|-------------------|---|----------------|------|
| Short description | Defines which acceleration rate is used if acceleration rate selector = 0 |                |      |
| Mode              | Open-Loop   |                |      |
| Minimum           | 0   | Maximum        | 1    |
| Default           | 0   | Units          |      |
| Type              | 1 Bit Volatile  | Update Rate    | 16ms |
| Display Format    | Standard  | Decimal Places | 0    |
| Coding            | RW, NC  |                |      |

See *Acceleration Rate Selector* (02.010).

| Parameter         | 02.034 Acceleration Rate Select Bit 2                                     |                |      |
|-------------------|---|----------------|------|
| Short description | Defines which acceleration rate is used if acceleration rate selector = 0 |                |      |
| Mode              | Open-Loop   |                |      |
| Minimum           | 0   | Maximum        | 1    |
| Default           | 0   | Units          |      |
| Type              | 1 Bit Volatile  | Update Rate    | 16ms |
| Display Format    | Standard  | Decimal Places | 0    |
| Coding            | RW, NC  |                |      |

See *Acceleration Rate Selector* (02.010).

| Parameter         | 02.035 Deceleration Rate Select Bit 0                                     |                |      |
|-------------------|---|----------------|------|
| Short description | Defines which deceleration rate is used if deceleration rate selector = 0 |                |      |
| Mode              | Open-Loop   |                |      |
| Minimum           | 0   | Maximum        | 1    |
| Default           | 0   | Units          |      |
| Type              | 1 Bit Volatile  | Update Rate    | 16ms |
| Display Format    | Standard  | Decimal Places | 0    |
| Coding            | RW, NC  |                |      |

See *Deceleration Rate Selector* (02.020).

| Parameter         | 02.036 Deceleration Rate Select Bit 1                                     |                |      |
|-------------------|---|----------------|------|
| Short description | Defines which deceleration rate is used if deceleration rate selector = 0 |                |      |
| Mode              | Open-Loop   |                |      |
| Minimum           | 0   | Maximum        | 1    |
| Default           | 0   | Units          |      |
| Type              | 1 Bit Volatile  | Update Rate    | 16ms |
| Display Format    | Standard  | Decimal Places | 0    |
| Coding            | RW, NC  |                |      |

See *Deceleration Rate Selector* (02.020).

| Parameter         | 02.037 Deceleration Rate Select Bit 2                                     |                |      |
|-------------------|---|----------------|------|
| Short description | Defines which deceleration rate is used if deceleration rate selector = 0 |                |      |
| Mode              | Open-Loop   |                |      |
| Minimum           | 0   | Maximum        | 1    |
| Default           | 0   | Units          |      |
| Type              | 1 Bit Volatile  | Update Rate    | 16ms |
| Display Format    | Standard  | Decimal Places | 0    |
| Coding            | RW, NC  |                |      |

See *Deceleration Rate Selector* (02.020).

| Parameter         | 02.039 Ramp Rate Units                    |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the units used by the ramp system |                |                 |
| Mode              | Open-Loop                                 |                |                 |
| Minimum           | 0   | Maximum        | 2               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save                           | Update Rate    | Background read |
| Display Format    | Standard                                  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

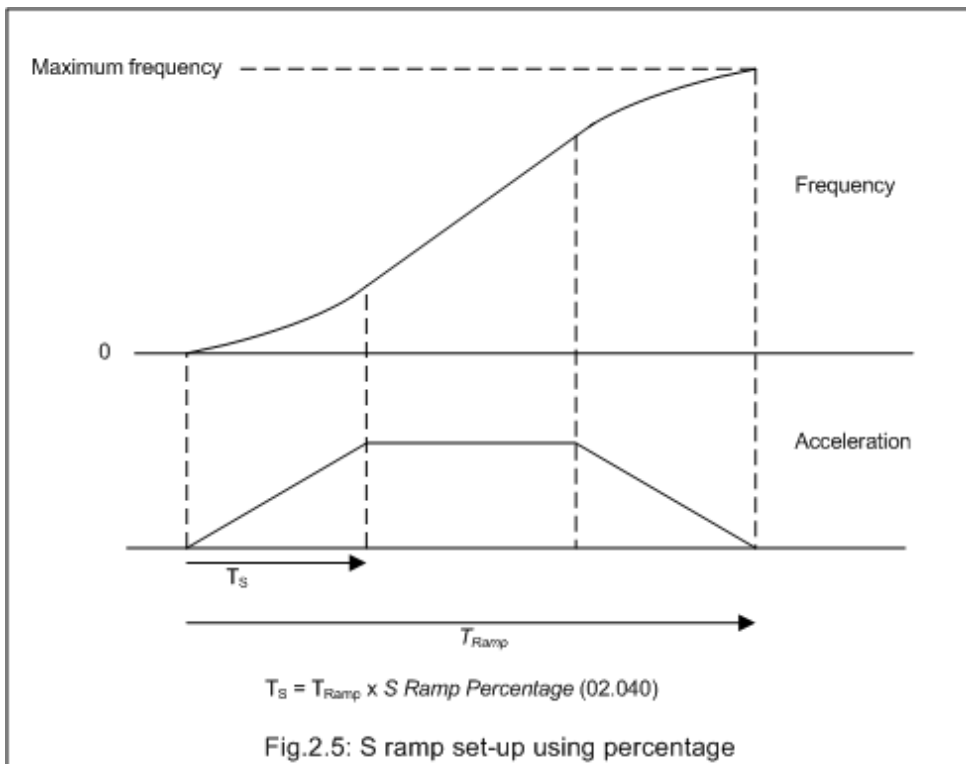
The ramp rate parameters (*Acceleration Rate 1* (02.011) - *Acceleration Rate 8* (02.018), *Jog Acceleration Rate* (02.019), *Deceleration Rate 1* (02.021) - *Deceleration Rate 8* (02.028) and *Jog Deceleration Rate* (02.029)) are specified in s / Ramp rate. Ramp rate frequency is selected with Ramp Rate Units (02.039) as defined in the table below.

| Ramp Rate Units (02.039) | Ramp rate frequency           |
|--------------------------|-------------------------------|
| 0                        | Seconds per 100Hz             |
| 1                        | Seconds per Maximum Frequency |
| 2                        | Seconds per 1000Hz            |

Maximum frequency is defined by *Maximum Reference Clamp* (01.006) if *Select Motor 2 Parameters* (11.045) = 0, or *M2 Maximum Reference Clamp* (21.001) if *Select Motor 2 Parameters* (11.045) = 1.

| Parameter         | 02.040 S Ramp Percentage                                 |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the profile of the S ramp system as a percentage |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0.0  | Maximum        | 50.0            |
| Default           | 0.0  | Units          | %               |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 1               |
| Coding            | RW   |                |                 |

If *S Ramp Set-up Mode* (02.041) = 1 the percentage of the ramp to Maximum frequency that includes half the S ramp profile can be specified with *S Ramp Percentage* (02.040) as shown in the diagram below. Maximum frequency is defined by *Maximum Reference Clamp* (01.006) if *Select Motor 2 Parameters* (11.045) = 0, or *M2 Maximum Reference Clamp* (21.001) if *Select Motor 2 Parameters* (11.045) = 1. It should be noted that the time to ramp to Maximum frequency does not change as *S Ramp Percentage* (02.040) is changed, but the maximum acceleration rate in the centre of the profile increases.





| Parameter         | 02.041 S Ramp Set-up Mode                  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the mode used by the S ramp system |                |                 |
| Mode              | Open-Loop                                  |                |                 |
| Minimum           | 0  | Maximum        | 2               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

S Ramp Set-up Mode (02.041) defines the method used to set up the S ramp function.

#### 0: Single maximum rate of change of acceleration

The maximum rate of change of acceleration in either direction, when the frequency is changing away from or towards zero, is defined by *Max Rate Of Change Of Acceleration* (02.007).

#### 1: S ramp percentage

A single maximum rate of change of acceleration is used in either direction, when the frequency is changing away from or towards zero, but this is specified as the percentage of the ramp from zero to Maximum frequency which is covered by the S shaped profile. See *S Ramp Percentage* (02.040).

#### 2: Four independent maximum rate of change of acceleration values

The maximum rate of change of acceleration can be specified as four independent values. See *Max Rate Of Change Of Acceleration* (02.007).

| Parameter         | 02.042 Maximum Rate Of Change Of Acceleration 1                                  |                |                       |
|-------------------|--|----------------|-----------------------|
| Short description | Defines the 1st maximum rate of change of acceleration used by the S ramp system |                |                       |
| Mode              | Open-Loop  |                |                       |
| Minimum           | 0.0  | Maximum        | 300.0                 |
| Default           | 0.0  | Units          | s <sup>2</sup> /100Hz |
| Type              | 32 Bit User Save   | Update Rate    | Background read       |
| Display Format    | Standard   | Decimal Places | 1                     |
| Coding            | RW   |                |                       |

If *S Ramp Set-up Mode* (02.041) = 2 it is possible to set up four independent maximum rate of change of acceleration values as shown in the diagram below. The values from 1 to 4 correspond to *Maximum Rate Of Change Of Acceleration 1* (02.042) to *Maximum Rate Of Change Of Acceleration 4* (02.045) respectively.

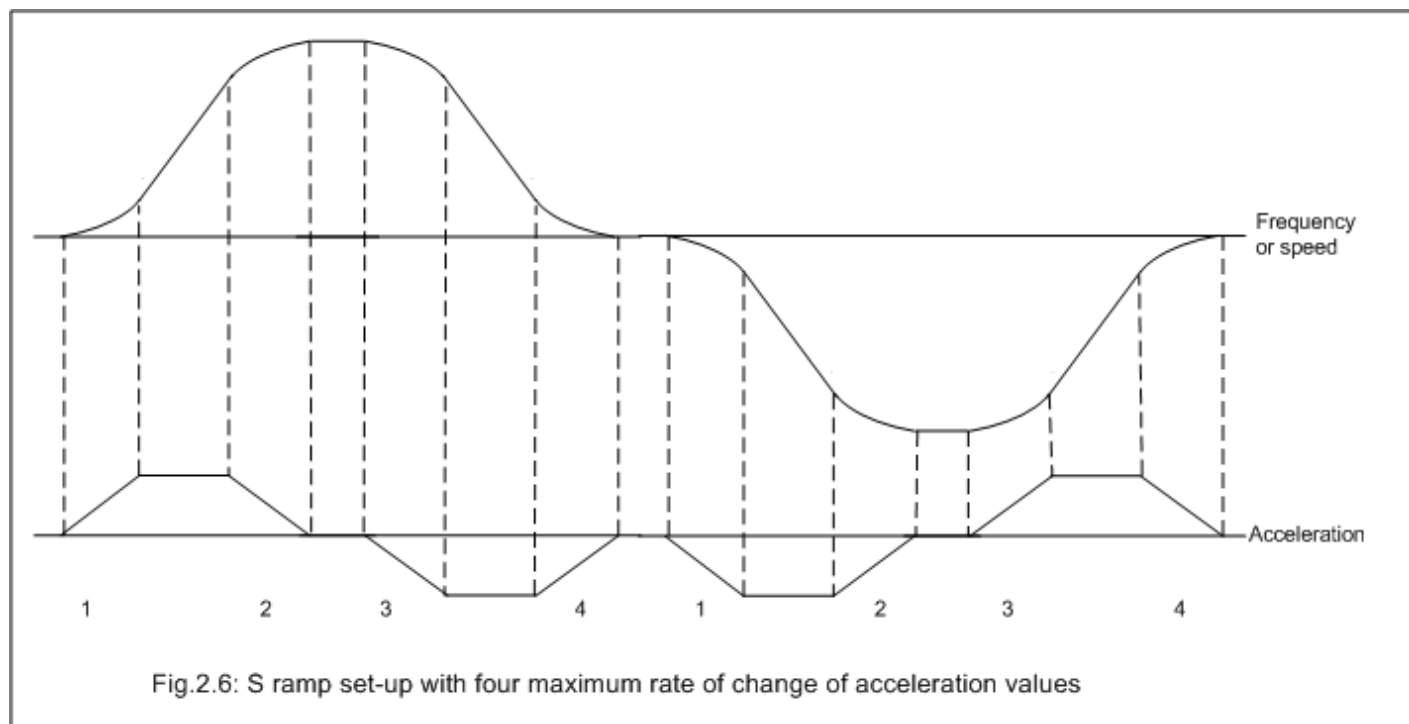


Fig.2.6: S ramp set-up with four maximum rate of change of acceleration values

| Parameter         | 02.043 Maximum Rate Of Change Of Acceleration 2                                  |                |                       |
|-------------------|--|----------------|-----------------------|
| Short description | Defines the 2nd maximum rate of change of acceleration used by the S ramp system |                |                       |
| Mode              | Open-Loop  |                |                       |
| Minimum           | 0.0  | Maximum        | 300.0                 |
| Default           | 0.0  | Units          | s <sup>2</sup> /100Hz |
| Type              | 32 Bit User Save   | Update Rate    | Background read       |
| Display Format    | Standard   | Decimal Places | 1                     |
| Coding            | RW   |                |                       |

See *Maximum Rate Of Change Of Acceleration 1* (02.042).

| Parameter         | <b>02.044 Maximum Rate Of Change Of Acceleration 3</b>                           |                |                       |
|-------------------|--|----------------|-----------------------|
| Short description | Defines the 3rd maximum rate of change of acceleration used by the S ramp system |                |                       |
| Mode              | Open-Loop  |                |                       |
| Minimum           | 0.0  | Maximum        | 300.0                 |
| Default           | 0.0  | Units          | s <sup>2</sup> /100Hz |
| Type              | 32 Bit User Save   | Update Rate    | Background read       |
| Display Format    | Standard   | Decimal Places | 1                     |
| Coding            | RW   |                |                       |

See *Maximum Rate Of Change Of Acceleration 1* (02.042).

| Parameter         | <b>02.045 Maximum Rate Of Change Of Acceleration 4</b>                           |                |                       |
|-------------------|--|----------------|-----------------------|
| Short description | Defines the 4th maximum rate of change of acceleration used by the S ramp system |                |                       |
| Mode              | Open-Loop  |                |                       |
| Minimum           | 0.0  | Maximum        | 300.0                 |
| Default           | 0.0  | Units          | s <sup>2</sup> /100Hz |
| Type              | 32 Bit User Save   | Update Rate    | Background read       |
| Display Format    | Standard   | Decimal Places | 1                     |
| Coding            | RW   |                |                       |

See *Maximum Rate Of Change Of Acceleration 1* (02.042).

## Menu 3 Single Line Descriptions – Frequency Monitoring and Speed Feedback

Mode: Open-Loop

| Parameter |  | Range                           | Default   | Type |     |    |    |    |    |
|-----------|--|---------------------------------|-----------|------|-----|----|----|----|----|
| 03.001    | Final Demand Reference                 | ±VM_FREQ Hz                     |           | RO   | Num | ND | NC | PT | FI |
| 03.005    | Zero Frequency Threshold               | 0.00 to 20.00 Hz                | 2.00 Hz   | RW   | Num |    |    |    | US |
| 03.006    | At Frequency Lower Limit               | 0.00 to 550.00 Hz               | 1.00 Hz   | RW   | Num |    |    |    | US |
| 03.007    | At Frequency Upper Limit               | 0.00 to 550.00 Hz               | 1.00 Hz   | RW   | Num |    |    |    | US |
| 03.008    | Over Frequency Threshold               | 0.00 to 550.00 Hz               | 0.00 Hz   | RW   | Num |    |    |    | US |
| 03.009    | Absolute At Frequency Select           | Off (0) or On (1)               | Off (0)   | RW   | Bit |    |    |    | US |
| 03.022    | Hard Frequency Reference               | ±VM_SPEED_FREQ_REF Hz           | 0.00 Hz   | RW   | Num |    |    |    | US |
| 03.023    | Hard Frequency Reference Select        | Off (0) or On (1)               | Off (0)   | RW   | Bit |    |    |    | US |
| 03.029    | Position                               | 0 to 65535                      |           | RO   | Num | ND | NC | PT | FI |
| 03.032    | Position Counter Reset                 | Off (0) or On (1)               | Off (0)   | RW   | Bit |    | NC |    |    |
| 03.035    | Position Scaling Numerator             | 0.000 to 1.000                  | 1.000     | RW   | Num |    |    |    | US |
| 03.036    | Position Scaling Denominator           | 0.000 to 100.000                | 1.000     | RW   | Num |    |    |    | US |
| 03.037    | Frequency Output or PWM Output Scaling | 0.000 to 4.000                  | 1.000     | RW   | Num |    |    |    | US |
| 03.038    | Maximum Output Frequency               | 1 (0), 2 (1), 5 (2), 10 (3) kHz | 5 (2) kHz | RW   | Txt |    |    |    | US |
| 03.042    | Frequency Input High Precision         | Off (0) or On (1)               | Off (0)   | RW   | Bit |    |    |    | US |
| 03.043    | Maximum Reference Frequency            | 0.00 to 100.00 kHz              | 10.00 kHz | RW   | Num |    |    |    | US |
| 03.044    | Frequency Reference Scaling            | 0.000 to 4.000                  | 1.000     | RW   | Num |    |    |    | US |
| 03.045    | Frequency Reference                    | 0.00 to 100.00 %                |           | RO   | Num | ND | NC | PT | FI |
| 03.047    | Two Point Minimum Frequency            | 0.00 to 100.00 %                | 0.00 %    | RW   | Num |    |    |    | US |
| 03.048    | Drive Reference at Minimum Frequency   | 0.00 to 100.00 %                | 0.00 %    | RW   | Num |    |    |    | US |
| 03.049    | Two Point Maximum Frequency            | 0.00 to 100.00 %                | 100.00 %  | RW   | Num |    |    |    | US |
| 03.050    | Drive Reference at Maximum Frequency   | 0.00 to 100.00 %                | 100.00 %  | RW   | Num |    |    |    | US |
| 03.072    | Motor speed percent                    | ±150.0 %                        |           | RO   | Num | ND | NC | PT | FI |

|     |                     |     |                  |     |                  |     |                  |      |                |      |                       |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

## Menu 3 – Frequency Monitoring and Speed Feedback

Mode: Open-Loop

The drive can operate under Open Loop and RFC modes with respect to frequency and current control and can drive asynchronous machines. The open loop asynchronous control is further broken down into vector and fixed boost modes

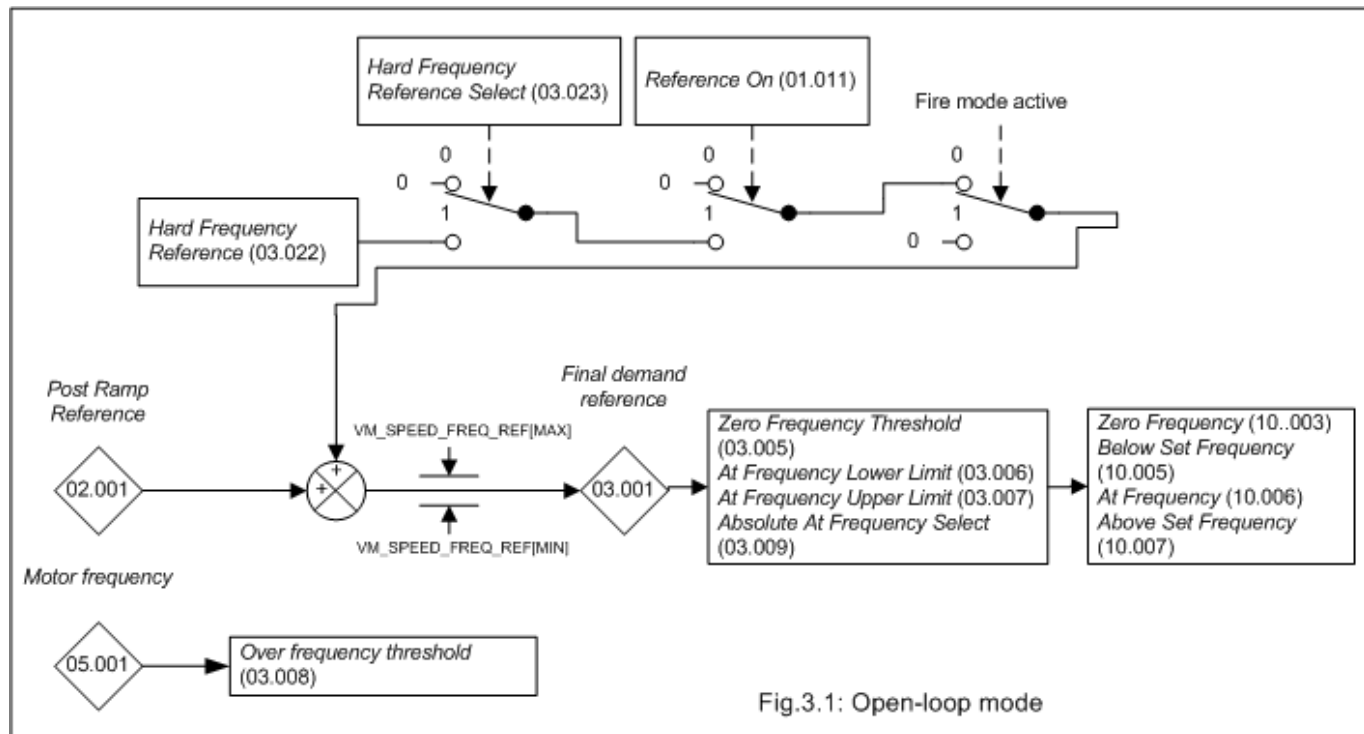
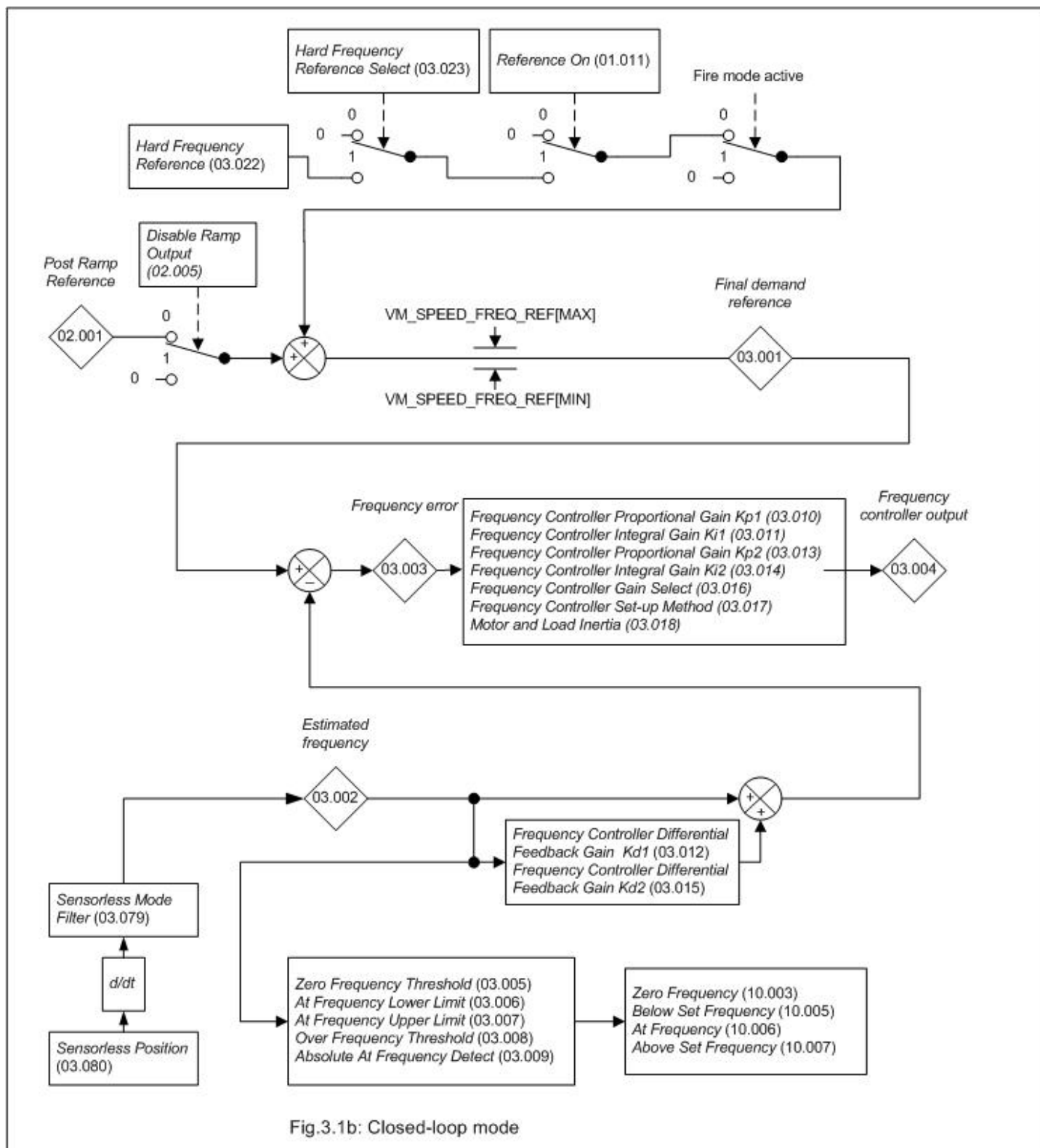


Fig.3.1: Open-loop mode



| Parameter         | 03.001 Final Demand Reference                            |                |         |
|-------------------|--|----------------|---------|
| Short description | Displays the final reference to the frequency controller |                |         |
| Mode              | Open-Loop  |                |         |
| Minimum           | -VM_FREQ   | Maximum        | VM_FREQ |
| Default           |  | Units          | Hz      |
| Type              | 32 Bit Volatile  | Update Rate    | 16ms    |
| Display Format    | Standard   | Decimal Places | 2       |
| Coding            | RO, FI, VM, ND, NC, PT                                   |                |         |

#### Open loop mode:

Final Demand Reference (03.001) shows the fundamental drive output frequency from the Post Ramp Reference (02.001) and the Hard Frequency Reference (03.022).

#### RFC modes:

Final Demand Reference (03.001) shows the reference at the input to the frequency controller, which is the sum of the Post Ramp Reference (02.001) if the ramp output is not disabled and the hard frequency reference (if enabled). If the drive is disabled Final Demand Reference (03.001) shows 0.00.

| Parameter         | 03.005 Zero Frequency Threshold                                  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the threshold for detecting the zero frequency condition |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0.00   | Maximum        | 20.00           |
| Default           | 2.00   | Units          | Hz              |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 2               |
| Coding            | RW, BU   |                |                 |

If the *Post Ramp Reference* (02.001) is at or below the level defined by this parameter in either direction *Zero Frequency* (10.003) = 1, otherwise *Zero Frequency* (10.003) = 0.

| Parameter         | 03.006 At Frequency Lower Limit                                  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the lower limit for detecting the at frequency condition |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0.00   | Maximum        | 550.00          |
| Default           | 1.00   | Units          | Hz              |
| Type              | 32 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 2               |
| Coding            | RW   |                |                 |

*At Frequency* (10.006) is set if the *Post Ramp Reference* (02.001) is on the boundaries or within the at speed window. *Above Set Frequency* (10.007) and *Below Set Frequency* (10.005) are set if the reference is above or below the window respectively.

If *Absolute At Frequency Select* (03.009) = 0 reference window mode is used.  
The "at speed" condition is true if,

$$(|\text{Pre-ramp Reference (01.003)}| - \text{At Frequency Lower Limit (03.006)}) \leq |\text{Post Ramp Reference (02.001)}| \leq (|\text{Pre-ramp Reference (01.003)}| + \text{At Frequency Upper Limit (03.007)})$$

(If the lower limit is less than zero then zero is used as the lower limit.)

If *Absolute At Frequency Select* (03.009) = 1 absolute window mode is used.  
The "at speed" condition is true if,

$$\text{At Frequency Lower Limit (03.006)} \leq |\text{Post Ramp Reference (02.001)}| \leq \text{At Frequency Upper Limit (03.007)}$$

Note: All flags are cleared if *Reference On* (01.011) is 0.

| Parameter         | 03.007 At Frequency Upper Limit                                  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the upper limit for detecting the at frequency condition |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0.00   | Maximum        | 550.00          |
| Default           | 1.00   | Units          | Hz              |
| Type              | 32 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 2               |
| Coding            | RW   |                |                 |

See *At Frequency Lower Limit* (03.006).

| Parameter         | 03.008 Over Frequency Threshold                                   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the threshold used to detect the over frequency condition |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0.00  | Maximum        | 550.00          |
| Default           | 0.00  | Units          | Hz              |
| Type              | 32 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 2               |
| Coding            | RW  |                |                 |

If *Over Frequency Threshold* (03.008) is set to a non-zero value it defines the over frequency threshold. If the *Post Ramp Reference* (02.001) exceeds this threshold in either direction an *Over Speed* trip is produced. If *Over Frequency Threshold* (03.008) is set to 0.0 the threshold is based on the variable minimum/maximum for the references and is equal to 1.2 x VM\_SPEED\_FREQ\_REF[MAX].

| Parameter         | 03.009 Absolute At Frequency Select      |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to 1 to select absolute at frequency |                |                 |
| Mode              | Open-Loop                                |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save                          | Update Rate    | Background read |
| Display Format    | Standard                                 | Decimal Places | 0               |
| Coding            | RW                                       |                |                 |

See *At Frequency Lower Limit* (03.006).

| Parameter         | 03.022 <i>Hard Frequency Reference</i>            |                |                   |
|-------------------|---|----------------|-------------------|
| Short description | Defines the value of the hard frequency reference |                |                   |
| Mode              | Open-Loop   |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                                | Maximum        | VM_SPEED_FREQ_REF |
| Default           | 0.00  | Units          | Hz                |
| Type              | 32 Bit User Save                                  | Update Rate    | 4ms               |
| Display Format    | Standard  | Decimal Places | 2                 |
| Coding            | RW, VM  |                |                   |

The *Hard Frequency Reference* (03.022) is a reference value which does not pass through the ramp system, but is added directly to the *Post Ramp Reference* (02.001). The *Hard Frequency Reference* (03.022) is only added when selected by the *Hard Frequency Reference Select* (03.023) and *Reference On* (01.011) is active.

| Parameter         | 03.023 <i>Hard Frequency Reference Select</i>              |                |     |
|-------------------|--|----------------|-----|
| Short description | Set to 1 to enable the use of the hard frequency reference |                |     |
| Mode              | Open-Loop  |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save  | Update Rate    | 4ms |
| Display Format    | Standard   | Decimal Places | 0   |
| Coding            | RW   |                |     |

See *Hard Frequency Reference* (03.022).

| Parameter         | 03.029 <i>Position</i>                                     |                |            |
|-------------------|--|----------------|------------|
| Short description | Displays the position counter in frequency or encoder mode |                |            |
| Mode              | Open-Loop  |                |            |
| Minimum           | 0  | Maximum        | 65535      |
| Default           |  | Units          |            |
| Type              | 16 Bit Power Down Save                                     | Update Rate    | Background |
| Display Format    | Standard   | Decimal Places | 0          |
| Coding            | RO, FI, ND, NC, PT, BU                                     |                |            |

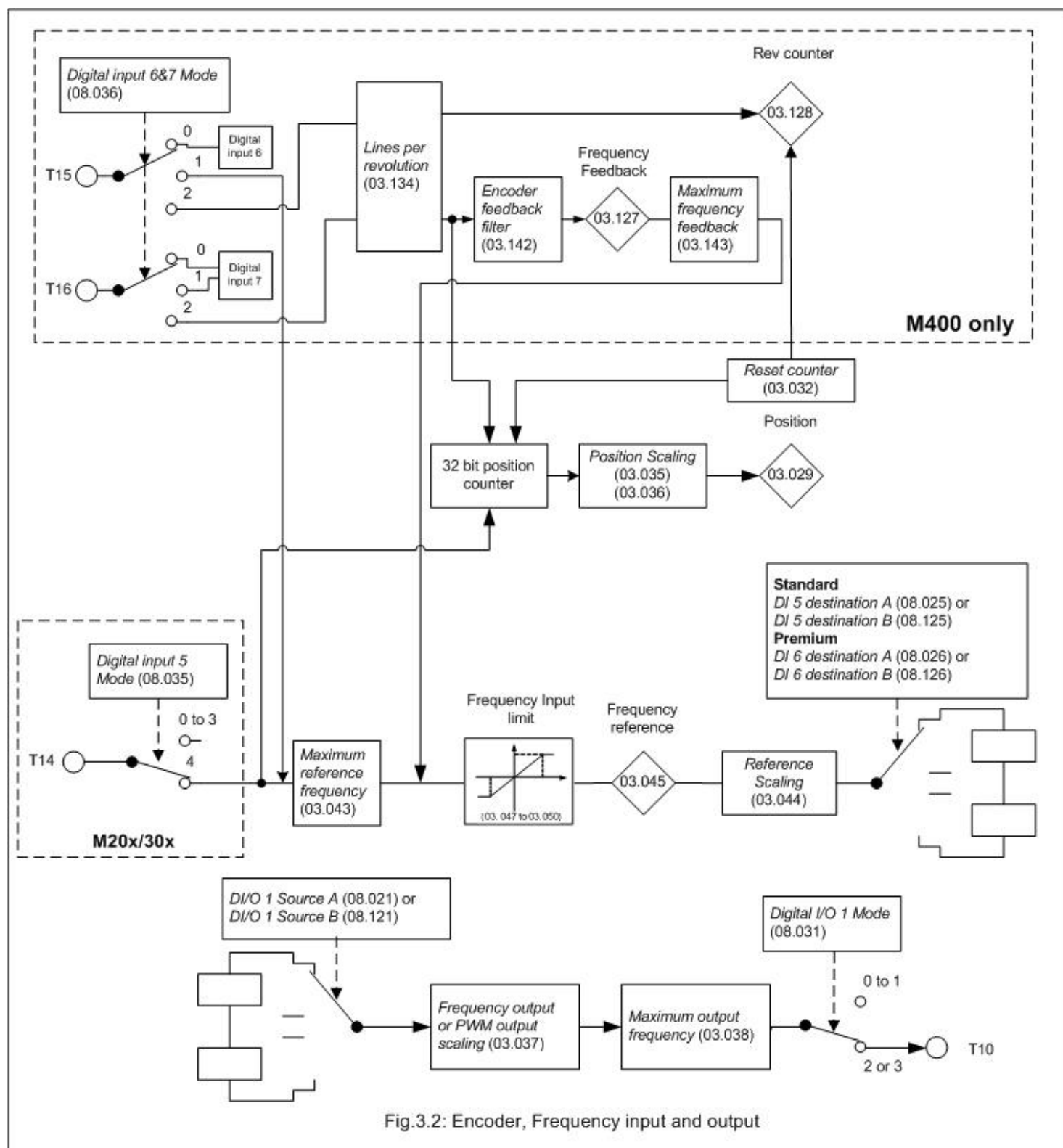


Fig.3.2: Encoder, Frequency input and output

Indicates the current value of the position counter in Frequency or Encoder mode. Position is reset to 0 if *Position Counter Reset* (03.032) is 1.

| Parameter         | 03.032 <i>Position Counter Reset</i>   |                |            |
|-------------------|--|----------------|------------|
| Short description | Set to 1 to reset the position counter |                |            |
| Mode              | Open-Loop                              |                |            |
| Minimum           | 0                                      | Maximum        | 1          |
| Default           | 0                                      | Units          |            |
| Type              | 1 Bit Volatile                         | Update Rate    | Background |
| Display Format    | Standard                               | Decimal Places | 0          |
| Coding            | RW, NC                                 |                |            |

When set, this parameter resets the position parameter (*Position* (03.029)).



| Parameter         | 03.035 Position Scaling Numerator                        |                |            |
|-------------------|--|----------------|------------|
| Short description | Defines the numerator used for scaling the pulse counter |                |            |
| Mode              | Open-Loop  |                |            |
| Minimum           | 0.000  | Maximum        | 1.000      |
| Default           | 1.000  | Units          |            |
| Type              | 16 Bit User Save   | Update Rate    | Background |
| Display Format    | Standard   | Decimal Places | 3          |
| Coding            | RW, BU   |                |            |

*Position Scaling Numerator* (03.035) and *Position Scaling Denominator* (03.036) are used to scale the pulse counter down to the required position units. The multiplying factor applied to the counter is defined as:

*Position Scaling Numerator* (03.035) ÷ *Position Scaling Denominator* (03.036)

| Parameter         | 03.036 Position Scaling Denominator                        |                |            |
|-------------------|--|----------------|------------|
| Short description | Defines the denominator used for scaling the pulse counter |                |            |
| Mode              | Open-Loop  |                |            |
| Minimum           | 0.000  | Maximum        | 100.000    |
| Default           | 1.000  | Units          |            |
| Type              | 32 Bit User Save   | Update Rate    | Background |
| Display Format    | Standard   | Decimal Places | 3          |
| Coding            | RW   |                |            |

See *Position Scaling Numerator* (03.035).

| Parameter         | 03.037 Frequency Output or PWM Output Scaling                     |                |            |
|-------------------|---|----------------|------------|
| Short description | Defines the scaling factor applied to the frequency or PWM output |                |            |
| Mode              | Open-Loop   |                |            |
| Minimum           | 0.000   | Maximum        | 4.000      |
| Default           | 1.000   | Units          |            |
| Type              | 16 Bit User Save  | Update Rate    | Background |
| Display Format    | Standard  | Decimal Places | 3          |
| Coding            | RW, BU  |                |            |

Scale factor applied to the frequency or PWM output.

| Parameter         | 03.038 Maximum Output Frequency                                |                |            |
|-------------------|--|----------------|------------|
| Short description | Defines the maximum frequency required at the frequency output |                |            |
| Mode              | Open-Loop  |                |            |
| Minimum           | 0  | Maximum        | 3          |
| Default           | 2  | Units          | kHz        |
| Type              | 8 Bit User Save  | Update Rate    | Background |
| Display Format    | Standard   | Decimal Places | 0          |
| Coding            | RW, TE, BU   |                |            |

| Value | Text | Description                 |
|-------|------|-----------------------------|
| 0     | 1    | 15.1 bit resolution at Fmax |
| 1     | 2    | 14.1 bit resolution at Fmax |
| 2     | 5    | 12.8 bit resolution at Fmax |
| 3     | 10   | 11.8 bit resolution at Fmax |

Defines the maximum frequency required at the frequency output. The choice of maximum output frequency depends on the requirement of the output. Due to limitations in the hardware, higher output frequencies do not offer the best resolution at the top end of the frequency range. 1, 2, 5, and 10kHz (0 - 3).

| Fmax (kHz) | Resolution at Fmax |
|------------|--------------------|
| 1          | 10 bit             |
| 2          | 9                  |
| 5          | 8                  |
| 10         | 7.7                |

| Parameter         | 03.042 Frequency Input High Precision         |                |            |
|-------------------|---|----------------|------------|
| Short description | Increase the frequency input measuring window |                |            |
| Mode              | Open-Loop                                     |                |            |
| Minimum           | 0   | Maximum        | 1          |
| Default           | 0   | Units          |            |
| Type              | 1 Bit User Save                               | Update Rate    | Background |
| Display Format    | Standard                                      | Decimal Places | 0          |
| Coding            | RW  |                |            |

If *Frequency Input High Precision* (03.042) = 1 then the frequency input measurement window is doubled. This doubles the accuracy of the frequency input measurement but increase the response time by two.

If *Frequency Input High Precision* (03.042) = 0 then the frequency input measurement window is similar to Commander SK with better response time.

| Parameter         | 03.043 Maximum Reference Frequency                            |                |            |
|-------------------|---|----------------|------------|
| Short description | Defines the maximum frequency expected at the frequency input |                |            |
| Mode              | Open-Loop   |                |            |
| Minimum           | 0.00  | Maximum        | 100.00     |
| Default           | 10.00   | Units          | kHz        |
| Type              | 16 Bit User Save  | Update Rate    | Background |
| Display Format    | Standard  | Decimal Places | 2          |
| Coding            | RW  |                |            |

Defines the maximum frequency expected at the frequency input. The time the frequency is measured over is defined by

Measurement Time = 2048 / Maximum reference frequency

With a maximum measurement time of 0.341 seconds.

2048 is used to give the measurement more stability. The output is 10 bits.

Maximum reference frequency of less than 6kHz will have a lower resolution.

| Parameter         | 03.044 Frequency Reference Scaling                            |                |            |
|-------------------|---|----------------|------------|
| Short description | Defines the scaling factor applied to the frequency reference |                |            |
| Mode              | Open-Loop   |                |            |
| Minimum           | 0.000   | Maximum        | 4.000      |
| Default           | 1.000   | Units          |            |
| Type              | 16 Bit User Save  | Update Rate    | Background |
| Display Format    | Standard  | Decimal Places | 3          |
| Coding            | RW, BU  |                |            |

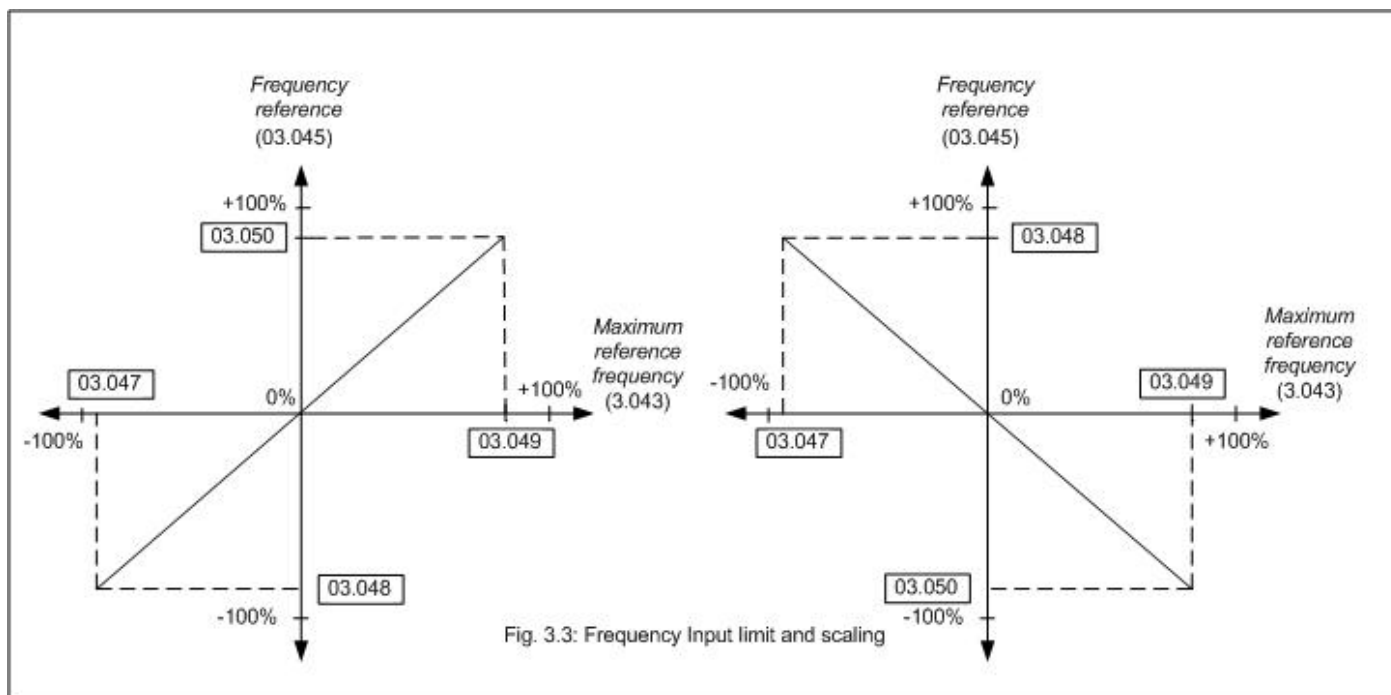
Scale factor applied to the frequency reference.

| Parameter         | 03.045 Frequency Reference       |                |        |
|-------------------|----------------------------------|----------------|--------|
| Short description | Displays the frequency reference |                |        |
| Mode              | Open-Loop                        |                |        |
| Minimum           | 0.00                             | Maximum        | 100.00 |
| Default           |                                  | Units          | %      |
| Type              | 16 Bit Volatile                  | Update Rate    | 16ms   |
| Display Format    | Standard                         | Decimal Places | 2      |
| Coding            | RO, FI, ND, NC, PT               |                |        |

Indicates the reference input if *Digital input 5 mode* (08.035) = 4.

The reference has a 16ms filter.

| Parameter         | 03.047 Two Point Minimum Frequency                            |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the minimum frequency for scaling the frequency input |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0.00  | Maximum        | 100.00          |
| Default           | 0.00  | Units          | %               |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 2               |
| Coding            | RW  |                |                 |



Frequency Reference (03.045) is scaled and limited using:

- Two Point Minimum Frequency (03.047)
- Drive Reference at Minimum Frequency (03.048)
- Two Point Maximum Frequency (03.049)
- Drive Reference at Maximum Frequency (03.050)

Parameters above can be selected to limit the range of Frequency Reference (03.045) and also scale it between the minimum and maximum reference.

| Parameter         | 03.048 Drive Reference at Minimum Frequency                                      |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the drive reference for scaling the frequency input at minimum frequency |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0.00   | Maximum        | 100.00          |
| Default           | 0.00   | Units          | %               |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 2               |
| Coding            | RW   |                |                 |

See Two Point Minimum Frequency (03.047).

| Parameter         | 03.049 Two Point Maximum Frequency                            |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the maximum frequency for scaling the frequency input |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0.00  | Maximum        | 100.00          |
| Default           | 100.00  | Units          | %               |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 2               |
| Coding            | RW  |                |                 |

See Two Point Minimum Frequency (03.047).

| Parameter         | 03.050 Drive Reference at Maximum Frequency                                      |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the drive reference for scaling the frequency input at maximum frequency |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0.00   | Maximum        | 100.00          |
| Default           | 100.00   | Units          | %               |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 2               |
| Coding            | RW   |                |                 |

See Two Point Minimum Frequency (03.047).

| Parameter         | 03.072 <i>Motor speed percent</i>  |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the final demand reference as a percentage of the reference clamp |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | -150.0   | Maximum        | 150.0            |
| Default           |  | Units          | %                |
| Type              | 16 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 1                |
| Coding            | RO, FI, ND, NC, PT   |                |                  |

*Motor speed percent* (03.072) displays the *Final Demand Reference* (03.001) as a percentage of the reference clamp.

If *Final Demand Reference* (03.001) >= 0.00Hz then

If *Maximum Reference Clamp* (01.006) = 0.00Hz then

*Motor speed percent* (03.072) = 0.0%

else

*Motor speed percent* (03.072) = *Final Demand Reference* (03.001) x 100 / *Maximum Reference Clamp* (01.006)

else

If *Negative Reference Clamp Enable* (01.008) = 1 then

If *Maximum Reference Clamp* (01.006) = 0.00Hz then

*Motor speed percent* (03.072) = 0.0%

else

*Motor speed percent* (03.072) = -*Final Demand Reference* (03.001) x 100 / *Minimum Reference Clamp* (01.007)

else

If *Maximum Reference Clamp* (01.006) = 0.00Hz then

*Motor speed percent* (03.072) = 0.0%

else

*Motor speed percent* (03.072) = -*Final Demand Reference* (03.001) x 100 / (-*Maximum Reference Clamp* (01.006))

## Menu 4 Single Line Descriptions – Torque and Current control

Mode: Open-Loop

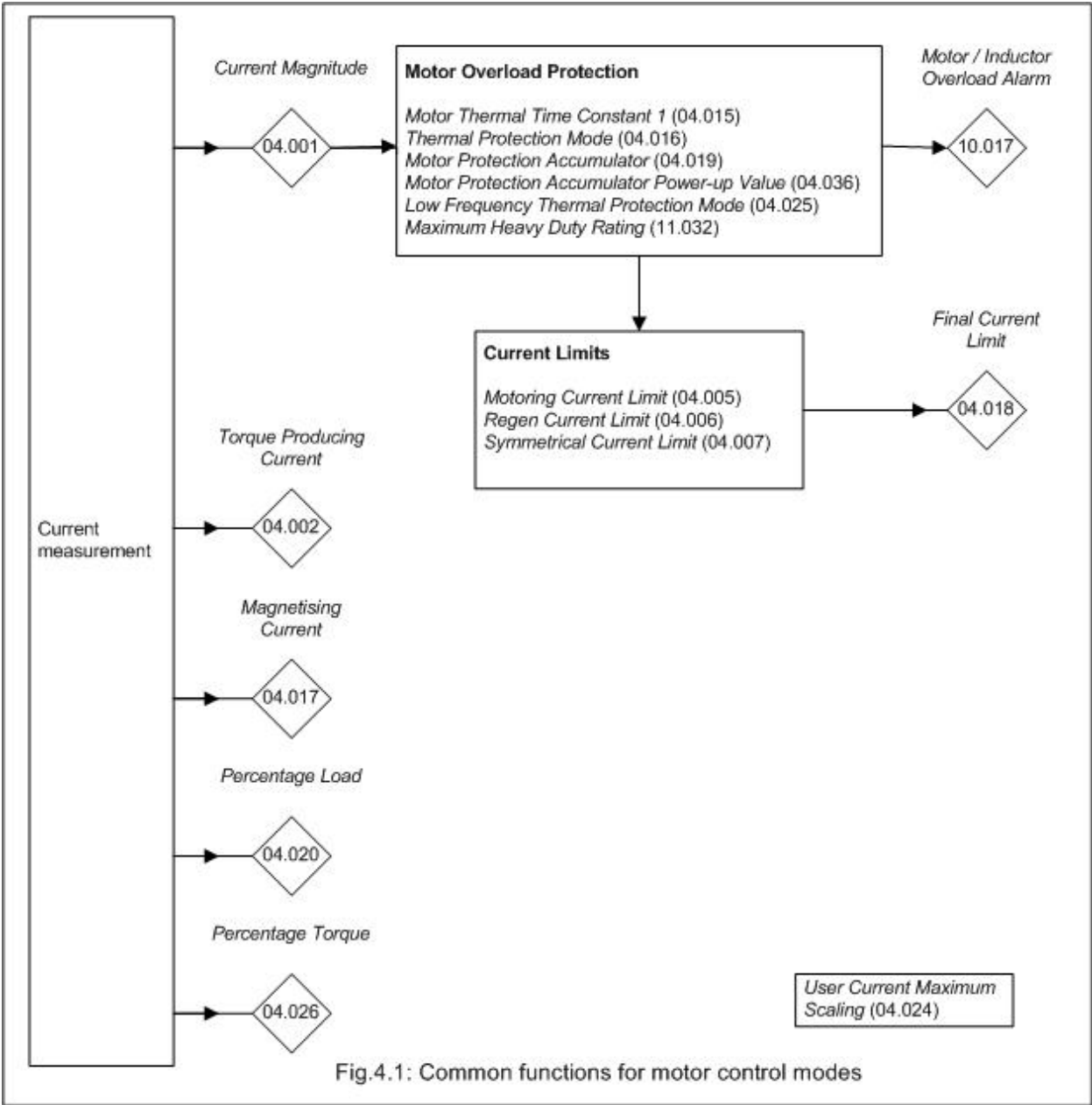
| Parameter |   | Range                         | Default   | Type |     |    |    |    |    |
|-----------|---|-------------------------------|-----------|------|-----|----|----|----|----|
| 04.001    | Current Magnitude                           | ±VM_DRIVE_CURRENT A           |           | RO   | Num | ND | NC | PT | FI |
| 04.002    | Torque Producing Current                    | ±VM_DRIVE_CURRENT A           |           | RO   | Num | ND | NC | PT | FI |
| 04.003    | Final Torque Reference                      | ±VM_TORQUE_CURRENT %          |           | RO   | Num | ND | NC | PT | FI |
| 04.004    | Final Current Reference                     | ±VM_TORQUE_CURRENT %          |           | RO   | Num | ND | NC | PT | FI |
| 04.005    | Motoring Current Limit                      | ±VM_MOTOR1_CURRENT_LIMIT %    | 165.0 %   | RW   | Num |    | RA |    | US |
| 04.006    | Regenerating Current Limit                  | ±VM_MOTOR1_CURRENT_LIMIT %    | 165.0 %   | RW   | Num |    | RA |    | US |
| 04.007    | Symmetrical Current Limit                   | ±VM_MOTOR1_CURRENT_LIMIT %    | 165.0 %   | RW   | Num |    | RA |    | US |
| 04.008    | Torque Reference                            | ±VM_USER_CURRENT %            | 0.0 %     | RW   | Num |    |    |    | US |
| 04.011    | Torque Mode Selector                        | 0 to 1                        | 0         | RW   | Num |    |    |    | US |
| 04.013    | Current Controller Kp Gain                  | 0.00 to 4000.00               | 20.00     | RW   | Num |    |    |    | US |
| 04.014    | Current Controller Ki Gain                  | 0.000 to 600.000              | 40.000    | RW   | Num |    |    |    | US |
| 04.015    | Motor Thermal Time Constant 1               | 1 to 3000 s                   | 179 s     | RW   | Num |    |    |    | US |
| 04.016    | Thermal Protection Mode                     | 00 to 11                      | 00        | RW   | Bin |    |    |    | US |
| 04.017    | Magnetising Current                         | ±VM_DRIVE_CURRENT A           |           | RO   | Num | ND | NC | PT | FI |
| 04.018    | Final Current Limit                         | ±VM_TORQUE_CURRENT %          |           | RO   | Num | ND | NC | PT |    |
| 04.019    | Motor Protection Accumulator                | 0.0 to 100.0 %                |           | RO   | Num | ND | NC | PT | PS |
| 04.020    | Percentage Load                             | ±VM_USER_CURRENT %            |           | RO   | Num | ND | NC | PT | FI |
| 04.024    | User Current Maximum Scaling                | ±VM_TORQUE_CURRENT_UNIPOLAR % | 165.0 %   | RW   | Num |    | RA |    | US |
| 04.025    | Low Frequency Thermal Protection Mode       | 0 to 1                        | 0         | RW   | Num |    |    |    | US |
| 04.026    | Percentage Torque                           | ±VM_USER_CURRENT %            |           | RO   | Num | ND | NC | PT | FI |
| 04.036    | Motor Protection Accumulator Power-up Value | Pr.dn (0), 0 (1), Real t (2)  | Pr.dn (0) | RW   | Txt |    |    |    | US |
| 04.041    | User Over Current Trip Level                | 0 to 100 %                    | 100 %     | RW   | Num |    | RA |    | US |

|     |                     |     |                  |     |                  |     |                  |      |                |      |                       |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

# Menu 4 – Torque and Current control

Mode: Open-Loop

## Common Features



## Open loop current control

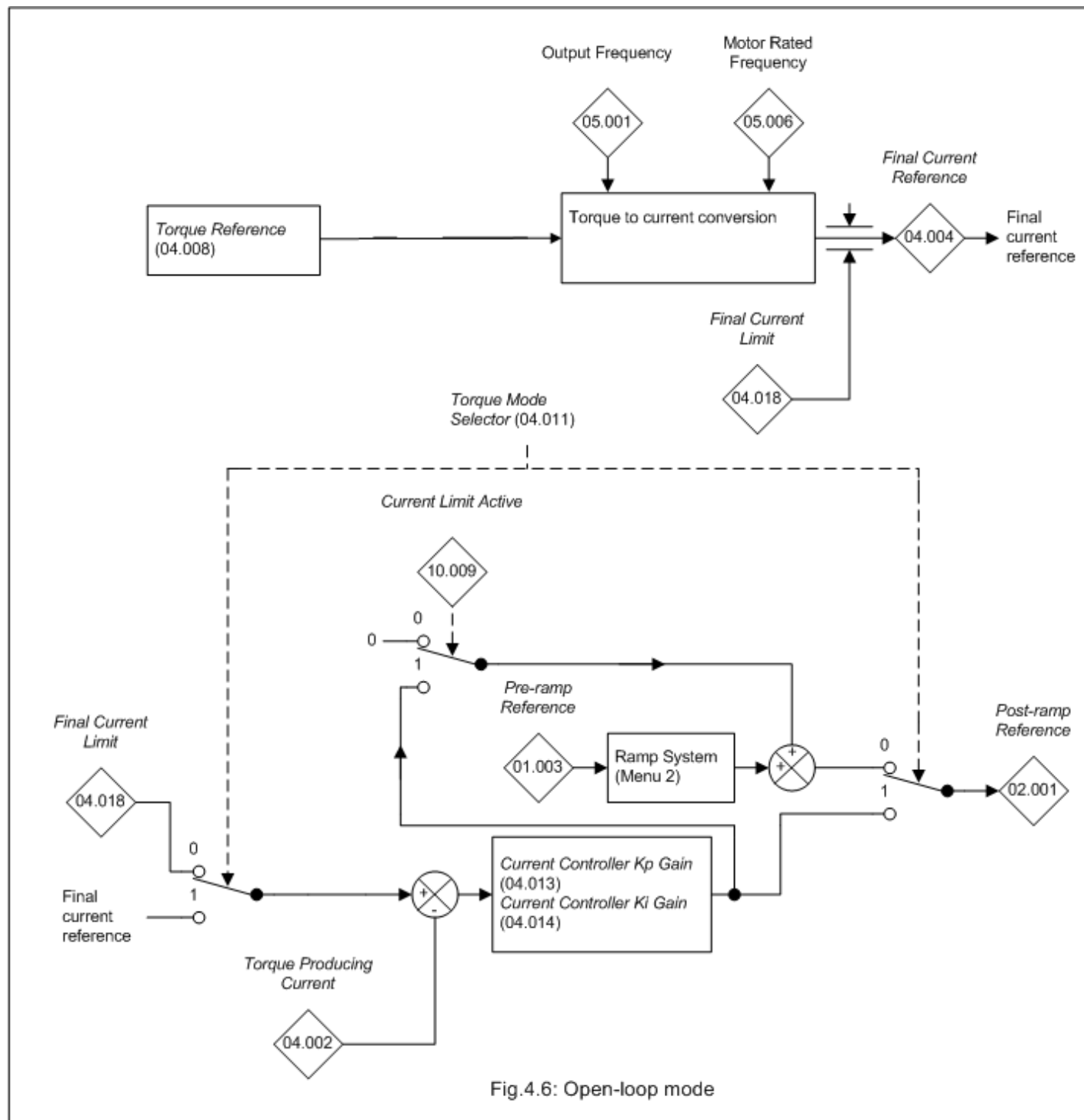


Fig.4.6: Open-loop mode

In open loop mode it is possible to control the motor frequency or the motor torque. When the frequency of the motor is controlled (**Torque Mode Selector (04.011) = 0**) the **Post Ramp Reference (02.001)** is defined by the ramp system unless the current limits are active. The **Post Ramp Reference (02.001)** can directly define the output frequency of the drive or this can be modified to compensate for motor slip. If the current limits are active (**Current Limit Active (10.009) = 1**) the ramp system remains active, but the output of the current controller is added to the ramp output so that the frequency applied to the motor is modified to try and reduce the torque producing current in the motor. For example, if the **Post Ramp Reference (02.001)** is positive (i.e. motor is running forwards) and the motor is overloaded with a motoring load a positive **Torque Producing Current (04.002)** is generated that will exceed the **Final Current Limit (04.018)**. This gives a negative error which attempts to reduce the ramp output causing the motor to slow down.

When motor torque is being controlled (**Torque Mode Selector (04.011) = 1**) The **Final Torque Reference (04.003)** is converted to a current reference and the current limits are applied giving the **Final Current Reference (04.004)**. This is used as the reference input to the PI controller that regulates the torque producing current in the motor. The output of the PI controller is the **Post Ramp Reference (02.001)**, and so the torque is controlled by increasing or decreasing the motor frequency. This system gives only moderate dynamic performance. For better torque control in a system without position feedback, closed loop current control should be used.

It is possible to disable the flux compensation by setting **Flux Control Compensation Disable (05.028)** to 1. This is only normally required to prevent motor instability when an inaccurate value for **Motor Rated Speed (05.008)** is being used in RFC-A mode.

**Current Controller Kp Gain (04.013)** and **Current Controller Ki Gain (04.014)** are the proportional and integral gains of the current controller. As already mentioned the current controller either provides current limits or closed-loop torque control by modifying the **Post Ramp Reference (02.001)**. The control loop is also used in its torque mode during supply 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 flag (*Current Limit Active* (10.009)) could become active up to 12.5% below the current limit depending on the ramp rate used.

#### 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 rated frequency, and can be reduced by increasing the proportional gain. The controller can be less stable in torque control mode compared to 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.

#### Supply loss and standard ramp

The d.c. link voltage controller becomes active if supply loss detection is enabled and the drive supply is lost or standard ramp is being used (*Ramp Mode Select* (02.004) > 0) and the motor is regenerating. The d.c. link controller attempts to hold the d.c. link voltage at a fixed level by controlling the flow of current from the drive inverter into its d.c. link capacitors. The system is forced into current control mode and the output of the d.c. voltage controller is fed into the current controller as shown below.

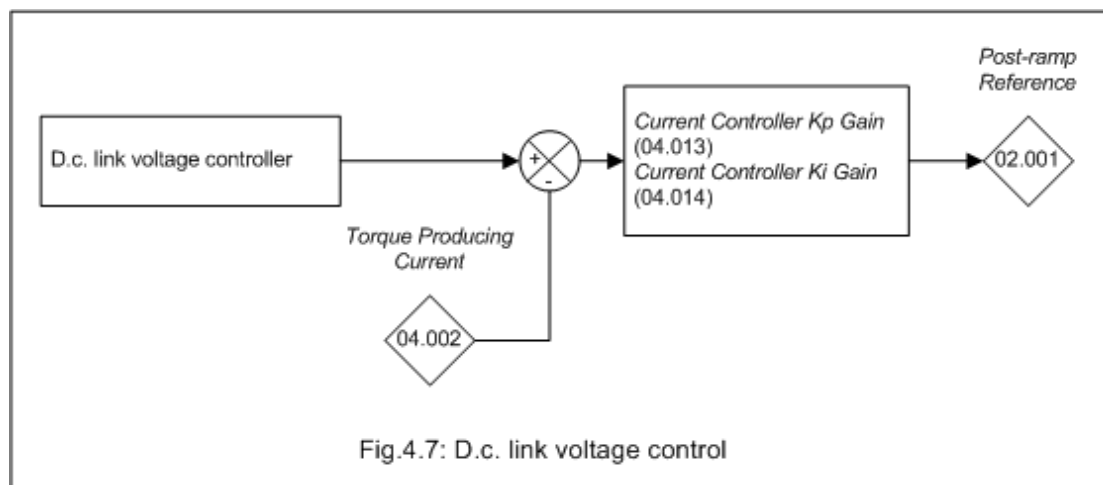
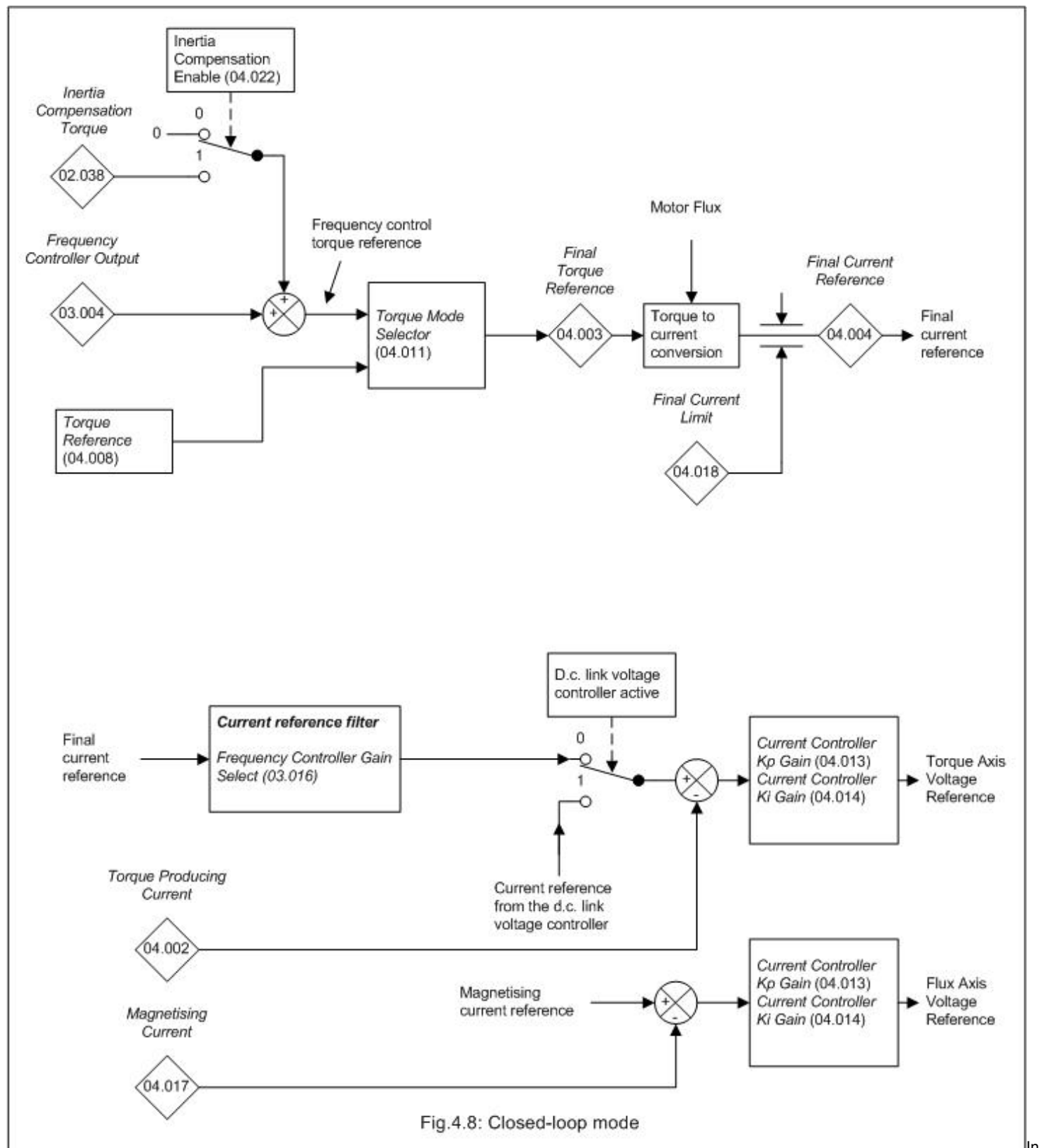


Fig.4.7: D.c. link voltage control

Although it is not usually necessary, the d.c. link voltage controller gain can be adjusted with the *Voltage Controller Gain* (05.031). However, 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 frequency 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. link voltage controller has a stabilising effect, provided that the drive is not required to operate in torque control mode.





RFC modes, closed-loop current control is provided for the torque and flux producing currents. The torque reference is normally provided by the frequency controller, or from the torque reference, or as a combination of both depending on the value of the *Torque Mode Selector* (04.011). During supply loss or when standard ramp mode is selected and the motor is regenerating it is possible that the torque producing current reference may be provided by the d.c. link voltage controller as shown above.

*Current Controller Kp Gain* (04.013) and *Current Controller Ki Gain* (04.014) are the proportional and integral gains of the current controllers. It should be noted that when an auto-tune is performed that measures the *Transient Inductance* (05.024) and *Stator Resistance* (05.017) the *Current Controller Kp Gain* (04.013) and *Current Controller Ki Gain* (04.014) are automatically set to the levels defined in the description. These represent the maximum levels that are likely to be used with this mode in most applications.

The current controller gains can either be set using auto-tuning (see *Auto-tune* (05.012)) or the values can be set up manually by the user. The calculations given below are those used by the auto-tuning system and should give good performance without excessive overshoot.

The proportional gain, *Current Controller Kp Gain* (04.013), is the most critical value in controlling the performance of the current controllers. The required value can be calculated as

**Current Controller Kp Gain (04.013)** =  $(L / T) \times (I_{fs} / V_{fs}) \times (256 / 37.5)$

where

T is the sample time of the current controllers. The drive compensates for any change of sample time, and so it should be assumed that the sample time is equivalent to the base value of 167µs.

L is the motor inductance. For a permanent magnet 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 transient inductance (sLs). The inductance for either of these motors can be taken from the manufacturer's data or it can be obtained from the value stored in the *Transient Inductance* (05.024) after auto-tuning.

$I_{fs}$  is the peak full scale current feedback, i.e. full scale current  $\times \sqrt{2}$ . The r.m.s. full scale current is given by *Full Scale Current Kc* (11.061), and so  $I_{fs} = \text{Full Scale Current Kc (11.061)} \times \sqrt{2}$ .

$V_{fs}$  is the maximum d.c. link voltage.

Therefore

**Current Controller Kp Gain (04.013)** =  $(L / 167\mu s) \times (Kc \times \sqrt{2} / V_{fs}) \times (256 / 37.5)$

=  $K \times L \times Kc$

where

$K = [\sqrt{2} / (V_{fs} \times 167\mu s)] \times (256 / 37.5)$

There is one value of the scaling factor K for each drive voltage rating as shown in the table below.

| <b>Drive Rated Voltage (11.033)</b> | <b><math>V_{fs}</math></b> | <b>K</b> |
|-------------------------------------|----------------------------|----------|
| 200V                                | 415V                       | 1045     |
| 400V                                | 830V                       | 522      |
| 575V                                | 990V                       | 438      |

The integral gain, **Current Controller Ki Gain (04.014)**, is less critical. A suggested value which matches the zero with the pole caused by the electrical time constant of the motor and ensures that the integral term does not contribute to current overshoot is given by

**Current Controller Ki Gain (04.014)** = **Current Controller Kp Gain (04.013)**  $\times 5 \times T / t_m$

Where  $t_m$  is the motor time constant ( $L / R$ ). R is the per phase stator resistance of the motor (i.e. half the resistance measured between two phases).

Therefore

**Current Controller Ki Gain (04.014)** =  $(K \times L \times Kc) \times 5 \times 167\mu s \times R / L$

=  $0.0427 \times K \times R \times Kc$

The above equations give the gain values that should give a good response with minimal overshoot. If required the gains can be adjusted to modify the performance as follows:

1. **Current Controller Ki Gain (04.014)** can be increased to improve the performance of the current controllers by reducing the effects of inverter non-linearity. These effects become more significant with higher switching frequency. These effects will be more significant for drives with higher current ratings and higher voltage ratings. If **Current Controller Ki Gain (04.014)** is increased by a factor of 4 it is possible to get up to 10% overshoot in response to a step change of current reference. For high performance applications, it is recommended that **Current Controller Ki Gain (04.014)** is increased by a factor of 4 from the auto-tuned values. As the inverter non-linearity is worse with higher switching frequencies it may be necessary to increase **Current Controller Ki Gain (04.014)** by a factor of 8 for operation with 16kHz switching frequency.
2. It is possible to increase **Current Controller Ki Gain (04.014)** to reduce the response time of the current controllers. If **Current Controller Kp Gain (04.013)** is increased by a factor of 1.5 then the response to a step change of reference will give 12.5% overshoot. It is recommended that **Current Controller Ki Gain (04.014)** is increased in preference to **Current Controller Kp Gain (04.013)**.

As already stated, the drive compensates for changes of switching frequency and the sampling method used by the controller. The table below shows the adjustment applied to the proportional and integral gains.

| <b>Switching Frequency (05.037)</b> | <b>Current controller sample time</b> | <b>Current Controller Kp Gain (04.013) adjustment</b> | <b>Current Controller Ki Gain (04.014) adjustment</b> |
|-------------------------------------|---------------------------------------|---|---|
| 0.667kHz                            | 750µs                                 | $\times 167 / 750 = 0.2$                              | $\times 1.0$  |
| 1kHz                                | 500µs                                 | $\times 167 / 500 = 0.3$                              | $\times 1.0$  |
| 2kHz                                | 500µs                                 | $\times 167 / 500 = 0.3$                              | $\times 1.0$  |
| 3kHz                                | 333µs                                 | $\times 167 / 333 = 0.5$                              | $\times 1.0$  |
| 4kHz                                | 250µs                                 | $\times 167 / 250 = 0.7$                              | $\times 1.0$  |
| 6kHz                                | 167µs                                 | $\times 167 / 167 = 1.0$                              | $\times 1.0$  |
| 8kHz                                | 125µs                                 | $\times 167 / 125 = 1.3$                              | $\times 1.0$  |
| 12kHz                               | 167µs                                 | $\times 167 / 167 = 1.0$                              | $\times 1.0$  |
| 16kHz                               | 125µs                                 | $\times 167 / 125 = 1.3$                              | $\times 1.0$  |

Note: 0.667kHz and 1kHz switching frequencies are not supported on standard drives or by large drive pods.

| Parameter         | 04.001 <i>Current Magnitude</i>              |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Shows the instantaneous drive output current |                |                  |
| Mode              | Open-Loop                                    |                |                  |
| Minimum           | -VM_DRIVE_CURRENT                            | Maximum        | VM_DRIVE_CURRENT |
| Default           |  | Units          | A                |
| Type              | 32 Bit Volatile                              | Update Rate    | 16ms             |
| Display Format    | Standard                                     | Decimal Places | 2                |
| Coding            | RO, FI, VM, ND, NC, PT                       |                |                  |

*Current Magnitude* (04.001) is the instantaneous drive output current scaled so that it represents the r.m.s. phase current in Amps under steady state conditions.

| Parameter         | 04.002 <i>Torque Producing Current</i>                    |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Shows the instantaneous level of torque producing current |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | -VM_DRIVE_CURRENT   | Maximum        | VM_DRIVE_CURRENT |
| Default           |   | Units          | A                |
| Type              | 32 Bit Volatile   | Update Rate    | 1ms              |
| Display Format    | Standard  | Decimal Places | 2                |
| Coding            | RO, FI, VM, ND, NC, PT                                    |                |                  |

*Torque Producing Current* (04.002) is the instantaneous level of torque producing current scaled so that it represents the r.m.s. level of torque producing current under steady state conditions. *Torque Producing Current* (04.002) is proportional to the torque produced by the motor provided field weakening is not active. For field weakening operation the *Torque Producing Current* (04.002) is boosted for a given level of torque to compensate for the reduction in the motor flux. The sign of *Torque Producing Current* (04.002) is defined in the table below.

| Sign of <i>Torque Producing Current</i> (04.002) | Sign of frequency | Direction of motor torque |
|--|-------------------|---------------------------|
| +  | +                 | Accelerating              |
| -  | +                 | Decelerating              |
| +  | -                 | Decelerating              |
| -  | -                 | Accelerating              |

| Parameter         | 04.003 <i>Final Torque Reference</i> |                |                   |
|-------------------|--------------------------------------|----------------|-------------------|
| Short description | Shows the final torque reference     |                |                   |
| Mode              | Open-Loop                            |                |                   |
| Minimum           | -VM_TORQUE_CURRENT                   | Maximum        | VM_TORQUE_CURRENT |
| Default           |                                      | Units          | %                 |
| Type              | 16 Bit Volatile                      | Update Rate    | 1ms               |
| Display Format    | Standard                             | Decimal Places | 1                 |
| Coding            | RO, FI, VM, ND, NC, PT               |                |                   |

The *Final Torque Reference* (04.003) will display the same as *Torque Reference* (04.008) as a percentage.

| Parameter         | 04.004 <i>Final Current Reference</i>                      |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Shows the final current reference after the current limits |                |                   |
| Mode              | Open-Loop  |                |                   |
| Minimum           | -VM_TORQUE_CURRENT   | Maximum        | VM_TORQUE_CURRENT |
| Default           |  | Units          | %                 |
| Type              | 16 Bit Volatile  | Update Rate    | 1ms               |
| Display Format    | Standard   | Decimal Places | 1                 |
| Coding            | RO, FI, VM, ND, NC, PT                                     |                |                   |

The *Final Torque Reference* (04.003) is converted into the *Final Current Reference* (04.004) by applying a torque to current conversion and by applying the *Final Current Limit* (04.018). The torque to current conversion is applied as follows:

$|Output\ Frequency\ (05.001)| \leq Motor\ Rated\ Frequency\ (05.006)$   
Current reference = *Final Torque Reference* (04.003)

$|Output\ Frequency\ (05.001)| > Motor\ Rated\ Frequency\ (05.006)$   
Current reference = *Final Torque Reference* (04.003) x *Motor Rated Frequency* (05.006) / *Output Frequency* (05.001)

It is possible to disable the flux compensation by setting *Flux Control Compensation Disable* (05.028) to 1. This is only normally required to prevent motor instability when an inaccurate value for *Motor Rated Speed* (05.008) is being used in RFC-A mode.

| Parameter         | 04.005 <i>Motoring Current Limit</i>  |                |                         |
|-------------------|---|----------------|-------------------------|
| Short description | Defines the current limit used when the motor is being accelerated away from standstill |                |                         |
| Mode              | Open-Loop   |                |                         |
| Minimum           | -VM_MOTOR1_CURRENT_LIMIT  | Maximum        | VM_MOTOR1_CURRENT_LIMIT |
| Default           | 165.0   | Units          | %                       |
| Type              | 16 Bit User Save  | Update Rate    | 16ms                    |
| Display Format    | Standard  | Decimal Places | 1                       |
| Coding            | RW, VM, RA  |                |                         |

The *Motoring Current Limit* (04.005) limits the current when the motor is being accelerated away from standstill. The *Regenerating Current Limit* (04.006) limits the current when the motor is being decelerated towards standstill. If the *Symmetrical Current Limit* (04.007) is below the *Motoring Current Limit* (04.005) then it is used instead of the *Motoring Current Limit* (04.005). If the *Symmetrical Current Limit* (04.007) is below the *Regenerating Current Limit* (04.006) then it is used instead of the *Regenerating Current Limit* (04.006).

The maximum possible current limit (VM\_MOTOR1\_CURRENT\_LIMIT [MAX]) varies between drive sizes with default parameters loaded. For some drive sizes the default value may be reduced below the value given by the parameter range limiting.

| Parameter         | 04.006 <i>Regenerating Current Limit</i>  |                |                         |
|-------------------|---|----------------|-------------------------|
| Short description | Defines the current limit used when the motor is being decelerated towards standstill |                |                         |
| Mode              | Open-Loop   |                |                         |
| Minimum           | -VM_MOTOR1_CURRENT_LIMIT  | Maximum        | VM_MOTOR1_CURRENT_LIMIT |
| Default           | 165.0   | Units          | %                       |
| Type              | 16 Bit User Save  | Update Rate    | 16ms                    |
| Display Format    | Standard  | Decimal Places | 1                       |
| Coding            | RW, VM, RA  |                |                         |

See *Motoring Current Limit* (04.005).

| Parameter         | 04.007 <i>Symmetrical Current Limit</i> |                |                         |
|-------------------|---|----------------|-------------------------|
| Short description | Defines the symmetrical current limit   |                |                         |
| Mode              | Open-Loop                               |                |                         |
| Minimum           | -VM_MOTOR1_CURRENT_LIMIT                | Maximum        | VM_MOTOR1_CURRENT_LIMIT |
| Default           | 165.0                                   | Units          | %                       |
| Type              | 16 Bit User Save                        | Update Rate    | 16ms                    |
| Display Format    | Standard                                | Decimal Places | 1                       |
| Coding            | RW, VM, RA                              |                |                         |

See *Motoring Current Limit* (04.005).

| Parameter         | 04.008 <i>Torque Reference</i> |                |                 |
|-------------------|--------------------------------|----------------|-----------------|
| Short description | Defines the torque reference   |                |                 |
| Mode              | Open-Loop                      |                |                 |
| Minimum           | -VM_USER_CURRENT               | Maximum        | VM_USER_CURRENT |
| Default           | 0.0                            | Units          | %               |
| Type              | 32 Bit User Save               | Update Rate    | 1ms             |
| Display Format    | Standard                       | Decimal Places | 1               |
| Coding            | RW, VM                         |                |                 |

See *Final Torque Reference* (04.003).

| Parameter         | 04.011 <i>Torque Mode Selector</i>        |                |      |
|-------------------|---|----------------|------|
| Short description | Defines the torque mode used by the drive |                |      |
| Mode              | Open-Loop                                 |                |      |
| Minimum           | 0   | Maximum        | 1    |
| Default           | 0   | Units          |      |
| Type              | 8 Bit User Save                           | Update Rate    | 16ms |
| Display Format    | Standard                                  | Decimal Places | 0    |
| Coding            | RW  |                |      |

If *Torque Mode Selector* (04.011) = 0 the ramp system defines the *Post Ramp Reference* (02.001) unless the current limits are active, and so the motor is frequency controlled. If *Torque Mode Selector* (04.011) = 1 the torque controller defines the *Post Ramp Reference* (02.001), and so the motor is torque controlled.

| Parameter         | 04.013 Current Controller Kp Gain                     |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the current loop controller proportional gain |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0.00  | Maximum        | 4000.00         |
| Default           | 20.00   | Units          |                 |
| Type              | 32 Bit User Save                                      | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 2               |
| Coding            | RW  |                |                 |

*Current Controller Kp Gain* (04.013) and *Current Controller Ki Gain* (04.014) are the proportional and integral gains of the current controller.

Refer to *Torque and Current control*.

| Parameter         | 04.014 Current Controller Ki Gain                 |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the current loop controller integral gain |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0.000   | Maximum        | 600.000         |
| Default           | 40.000  | Units          |                 |
| Type              | 32 Bit User Save                                  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 3               |
| Coding            | RW  |                |                 |

See *Current Controller Kp Gain* (04.013).

| Parameter         | 04.015 Motor Thermal Time Constant 1           |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to the thermal time constant for the motor |                |                 |
| Mode              | Open-Loop                                      |                |                 |
| Minimum           | 1  | Maximum        | 3000            |
| Default           | 179  | Units          | s               |
| Type              | 16 Bit User Save                               | Update Rate    | Background read |
| Display Format    | Standard                                       | Decimal Places | 0               |
| Coding            | RW   |                |                 |

A single time constant thermal model is provided that can be used to estimate the motor temperature as a percentage of its maximum allowed temperature. The input to the model is the *Current Magnitude* (04.001). Throughout the following discussion *Motor Rated Current* (05.007) is used in the model assuming *Select Motor 2 Parameters* (11.045) = 0. If *Select Motor 2 Parameters* (11.045) = 1 then *M2 Motor Rated Current* (21.007) is used instead.

#### Percentage Losses

The losses in the motor are calculated as a percentage value, so that under these conditions the *Motor Protection Accumulator* (04.019) would eventually reach 100%.

$$\text{Percentage Losses} = 100\% \times [\text{Load Related Losses}]$$

where

$$\text{Load Related Losses} = I / (K_1 \times I_{\text{Rated}})^2$$

where

$I$  = *Current Magnitude* (04.001)

$I_{\text{Rated}}$  = *Motor Rated Current* (05.007)

The value of  $K_1$  defines the continuous allowable motor overload as a proportion of the *Motor Rated Current* (05.007) before the *Motor Protection Accumulator* (04.019) reaches 100%. The value of  $K_1$  can be used to model reduced cooling at low frequencies and to allow the motor to operate under rated conditions with a small margin to prevent spurious trips.  $K_1$  is defined in more detail later.

#### Motor Protection Accumulator

So far the steady state motor losses have been defined, but the motor model must estimate the temperature within the motor under dynamically changing conditions, and so the *Motor Protection Accumulator* (04.019) is given by the following equation.

$$T = \text{Percentage Losses} \times (1 - e^{-t/\tau_1})$$

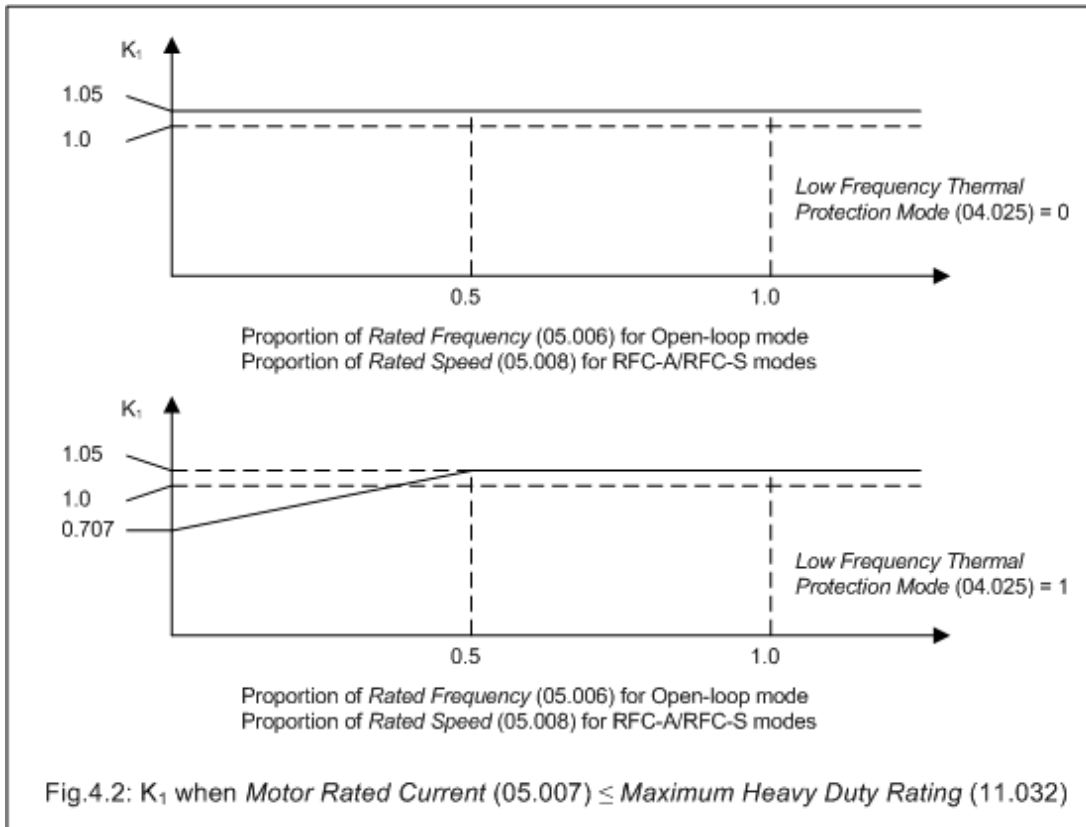
where

$T$  = *Motor Protection Accumulator* (04.019)

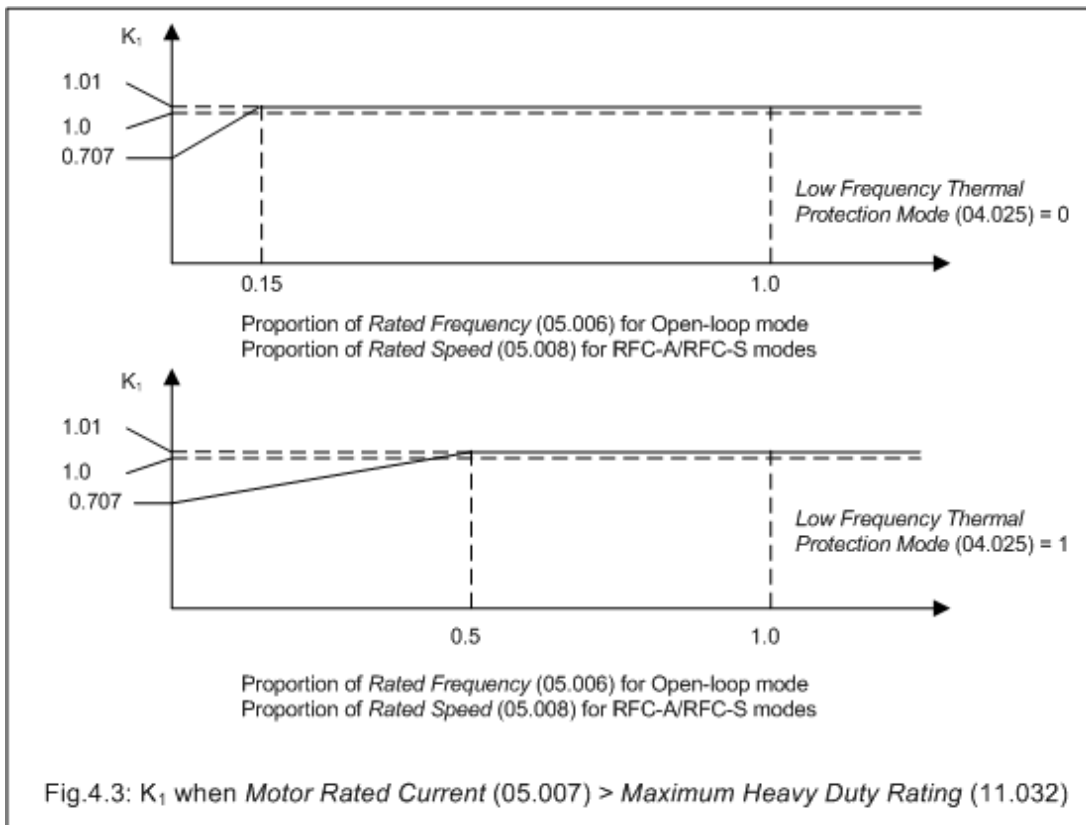
$\tau_1$  = *Motor Thermal Time Constant 1* (04.015)

Reduced cooling with lower frequency

If *Low Frequency Thermal Protection Mode* (04.025) = 0 the characteristic is intended for a motor which can operate at rated current over the whole frequency range. Induction motors with this type of characteristic normally have forced cooling. If *Low Frequency Thermal Protection Mode* (04.025) = 1 the characteristic is intended for motors where the cooling effect of motor fan reduces with reduced motor frequency below half of rated frequency. The maximum value for  $K_1$  is 1.05, so that above the knee of the characteristics the motor can operate continuously up to 105% of rated current.



If Motor Rated Current (05.007)  $>$  Maximum Heavy Duty Rating (11.032) then  $K_1$  is defined as shown below. Two different characteristics are provided, but in both cases the motor performance is limited at lower frequencies and the permissible overload is reduced from 105% to 101%.



#### Time for Motor Protection Accumulator to reach 100%

The time for the Motor Protection Accumulator (04.019) to change from its initial value to 100% is given by the following equation:

$$\text{Time to reach 100.0\%} = -\tau_1 \times \ln[(1 - C_1) / (C_0 - C_1)]$$

$C_0$  represents the conditions that have persisted for long enough for the Motor Protection Accumulator (04.019) to reach a steady state value. If the motor current and frequency are  $I_0$  and  $w_0$  then

$$C_0 = [(1 - K_{fe}) \times (I_0 / (K_1 \times I_{\text{Rated}}))^2] + [K_{fe} \times (w_0 / w_{\text{Rated}})^{1.6}]$$

$C_1$  represents the conditions that begin at the start of the time being calculated. If the motor current and frequency are by  $I_1$  and  $w_1$  then

$$C_1 = [(1 - K_{fe}) \times (I_1 / (K_1 \times I_{Rated}))^2] + [K_{fe} \times (w_1 / w_{Rated})^{1.6}]$$

Example 1: *Motor Thermal Time Constant 1* (04.015) = 89s, the initial current is zero, *Motor Rated Current* (05.007)  $\leq$  *Maximum Heavy Duty Rating* (11.032) and the new level of current is 1.5 x *Motor Rated Current* (05.007).

$$C_0 = 0$$

$$C_1 = [1.5 / (1.05 \times 1.0)]^2 = 2.041$$

$$\text{Time to reach 100.0\%} = -179 \times \ln(1 - 1/C_1) = -179 \times \ln(1 - (1 / 2.041)) = 120s$$

This is the default setting for Open loop and Closed Loop modes allowing an induction motor to run at 150% rated current for 120s from cold.

#### Motor Protection Accumulator Reset

The initial value in the *Motor Protection Accumulator* (04.019) at power-up is defined by *Motor Protection Accumulator Power-up Value* (04.036) as given in the table below.

| <i>Motor Protection Accumulator Power-up Value</i> (04.036) | <i>Motor Protection Accumulator</i> (04.019) at power-up   |
|---|--|
| Power Down  | The value is saved at power-down and is used as the initial value at power-up  |
| Zero  | The value is set to zero   |
| Real Time   | <p>If a real-time clock is present and if <i>Date/Time Selector</i> (06.019) is set up to select the real-time clock then the value saved at power-down is modified to include the effect of the motor thermal protection time constants over the time between power-down and power-up. This modified value is then used as the initial value at power-up.</p> <p>If no real time clock is present then and this option is selected then the value saved at power-down is used as the initial value.</p> |

The *Motor Protection Accumulator* (04.019) is reset under the following conditions:

1. *Motor Thermal Time Constant 1* (04.015) is set to 0.0. Note that this is not possible in the standard product as the minimum parameter value is 1.0.
2. *Select Motor 2 Parameters* (11.045) is modified.
3. *Motor Rated Current* (05.007) is modified when *Select Motor 2 Parameters* (11.045) = 0, or *M2 Motor Rated Current* (21.007) is modified when *Select Motor 2 Parameters* (11.045) = 1.

#### Motor Protection Accumulator Warning

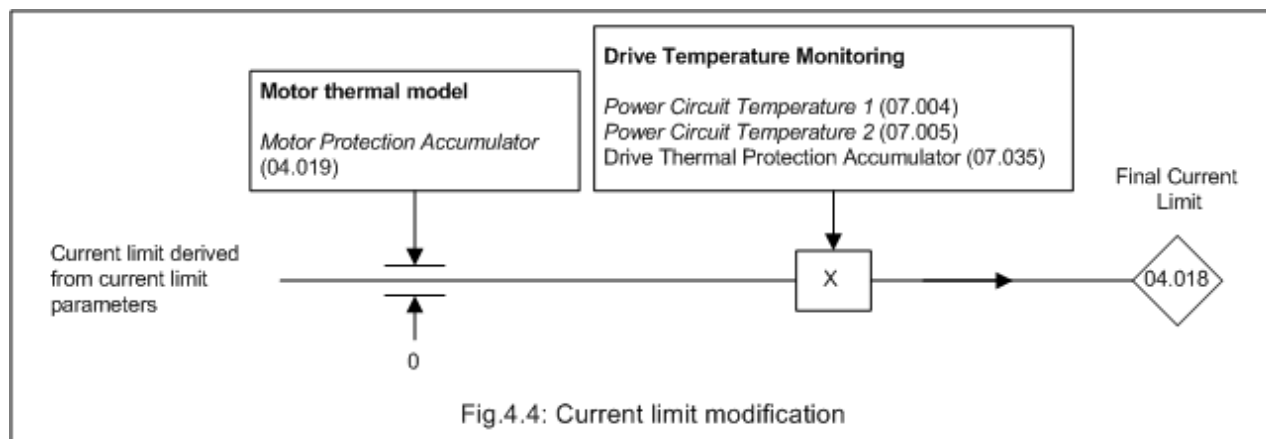
If Percentage Losses > 100% then eventually the *Motor Protection Accumulator* (04.019) will reach 100% causing the drive to trip or the current limits to be reduced. If this is the case and *Motor Protection Accumulator* (04.019) > 75.00% then a Motor Overload alarm indication is given and *Motor Overload Alarm* (10.017) is set to one.

| Parameter         | 04.016 Thermal Protection Mode             |                |                    |
|-------------------|--|----------------|--------------------|
| Short description | Set to the require thermal protection mode |                |                    |
| Mode              | Open-Loop                                  |                |                    |
| Minimum           | 0<br>(Display: 00)                         | Maximum        | 3<br>(Display: 11) |
| Default           | 0<br>(Display: 00)                         | Units          |                    |
| Type              | 8 Bit User Save                            | Update Rate    | Background read    |
| Display Format    | Binary                                     | Decimal Places | 0                  |
| Coding            | RW   |                |                    |

*Thermal Protection Mode* (04.016) defines the action taken by the drive when *Motor Protection Accumulator* (04.019) reaches 100% and/or the drive thermal monitoring parameters approach their trip levels. The bits in *Thermal Thermal Protection Mode* (04.016) are defined as follows:

| Bit | Function  |
|-----|---|
| 0   | <p>0 = <i>Motor Too Hot</i> trip is initiated when <i>Motor Protection Accumulator</i> (04.019) reaches 100%</p> <p>1 = <i>Motor Too Hot</i> trip is disabled and current limiting on motor overload is active as described below</p> |
| 1   | <p>0 = Drive thermal monitoring current limiting is disabled</p> <p>1 = Drive thermal monitoring current limiting is described is active</p>  |

The required current limit is derived from the current limit parameters (*Motoring Current Limit* (04.005) to *Symmetrical Current Limit* (04.007) or 21.027 to 21.029) depending on the set-up and conditions. The current limit can be further limited by current limit on motor overload and/or drive temperature monitoring as shown below to give the *Final Current Limit* (04.018).



#### Current limiting on motor overload

When the *Motor Protection Accumulator* (04.019) reaches 100.0% the current limit is limited to  $(K - 0.05) \times 100.0\%$ . This limitation is removed when the *Motor Protection Accumulator* (04.019) falls below 95.0%.

#### Drive thermal monitoring current limiting

If any of the drive temperature monitoring parameters (*Stack Temperature* (07.004) and *Auxiliary Temperature* (07.005)) are above their trip threshold minus 10°C the one that is closest to its trip threshold is used to modify the current limits as follows:

*Final Current Limit* (04.018) = Current limit x (Trip threshold - T) / (Trip threshold - 10°C)

where T is the drive temperature monitoring parameter value.

If the *Percentage Of Drive Thermal Trip Level* (07.036) is above 90% then the final current limit is modified as follows:

*Final Current Limit* (04.018) = Current limit x (100% - *Percentage Of Drive Thermal Trip Level* (07.036)) / 10%

If both of the above attempt to reduce the final current limit the lowest calculated value of current limit is used. This system has the effect of reducing the current limit to zero at the point where the drive should be tripped because its thermal monitoring has reached a trip threshold. This is intended to limit the load on the drive to prevent it from tripping when supplying a load that increases with frequency and does not include rapid transients (i.e. a fan).

| Parameter         | 04.017 <i>Magnetising Current</i>                    |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Shows the instantaneous level of magnetising current |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | -VM_DRIVE_CURRENT                                    | Maximum        | VM_DRIVE_CURRENT |
| Default           |  | Units          | A                |
| Type              | 32 Bit Volatile                                      | Update Rate    | 1ms              |
| Display Format    | Standard   | Decimal Places | 2                |
| Coding            | RO, FI, VM, ND, NC, PT                               |                |                  |

*Magnetising Current* (04.017) is the instantaneous level of magnetising current scaled so that it represents the r.m.s. level of magnetising current under steady state conditions.

| Parameter         | 04.018 <i>Final Current Limit</i>   |                |                   |
|-------------------|---|----------------|-------------------|
| Short description | Shows the final current limit that is applied to the torque producing current |                |                   |
| Mode              | Open-Loop   |                |                   |
| Minimum           | -VM_TORQUE_CURRENT  | Maximum        | VM_TORQUE_CURRENT |
| Default           |   | Units          | %                 |
| Type              | 16 Bit Volatile   | Update Rate    | 16ms              |
| Display Format    | Standard  | Decimal Places | 1                 |
| Coding            | RO, VM, ND, NC, PT  |                |                   |

*Final Current Limit* (04.018) is the current limit level that is applied to the torque producing current. See *Thermal Protection Mode* (04.016).

| Parameter         | 04.019 <i>Motor Protection Accumulator</i>          |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Shows the level of the motor protection accumulator |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0.0   | Maximum        | 100.0            |
| Default           |   | Units          | %                |
| Type              | 16 Bit Power Down Save                              | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 1                |
| Coding            | RO, ND, NC, PT                                      |                |                  |

See *Motor Thermal Time Constant 1* (04.015).



| Parameter         | 04.020 <i>Percentage Load</i>   |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Shows the level of torque producing current as a percentage of rated torque producing current for the motor |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | -VM_USER_CURRENT  | Maximum        | VM_USER_CURRENT  |
| Default           |   | Units          | %                |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 1                |
| Coding            | RO, FI, VM, ND, NC, PT  |                |                  |

*Percentage Load* (04.020) gives the *Torque Producing Current* (04.002) as a percentage of the rated torque producing current for the motor. Positive values indicate motoring and negative values represent regenerating.

| Parameter         | 04.024 <i>User Current Maximum Scaling</i>                                  |                |                            |
|-------------------|---|----------------|----------------------------|
| Short description | Defines the maximum for the torque reference and percentage load parameters |                |                            |
| Mode              | Open-Loop   |                |                            |
| Minimum           | -VM_TORQUE_CURRENT_UNIPOLAR   | Maximum        | VM_TORQUE_CURRENT_UNIPOLAR |
| Default           | 165.0   | Units          | %                          |
| Type              | 16 Bit User Save  | Update Rate    | Background read            |
| Display Format    | Standard  | Decimal Places | 1                          |
| Coding            | RW, VM, RA  |                |                            |

*User Current Maximum Scaling* (04.024) defines the variable maximum/minimums VM\_USER\_CURRENT which is applied to *Percentage Load* (04.020). This is useful when routing these parameters to an analogue output as it allows the full scale output value to be defined by the user.

The maximum value (VM\_TORQUE\_CURRENT\_UNIPOLAR [MAX]) varies between drive sizes with default parameters loaded. For some drive sizes the default value may be reduced below the value given by the parameter range limiting.

| Parameter         | 04.025 <i>Low Frequency Thermal Protection Mode</i> |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to enable low frequency thermal protection mode |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save                                     | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See *Motor Thermal Time Constant 1* (04.015).

| Parameter         | 04.026 <i>Percentage Torque</i>  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Displays the torque producing current as a percentage of motor rated current |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | -VM_USER_CURRENT   | Maximum        | VM_USER_CURRENT |
| Default           |  | Units          | %               |
| Type              | 16 Bit Volatile  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 1               |
| Coding            | RO, FI, VM, ND, NC, PT   |                |                 |

*Percentage Torque* (04.026) gives the *Torque Producing Current* (04.002) as a percentage of the rated torque producing current for the motor, but with an additional adjustment above rated frequency so that it gives percentage torque. Below rated frequency, *Percentage Torque* (04.026) = *Percentage Load* (04.020). Above rated frequency, the *Percentage Torque* (04.026) is adjusted as follows:

*Percentage Torque* (04.026) = *Percentage Load* (04.020) x *Motor Rated Frequency* (05.006) / *Output Frequency* (05.001)

| Parameter         | 04.036 <i>Motor Protection Accumulator Power-up Value</i>              |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the initial power-up value of the motor protection accumulator |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0  | Maximum        | 2                |
| Default           | 0  | Units          |                  |
| Type              | 8 Bit User Save  | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RW, TE   |                |                  |

| Value | Text   |
|-------|--------|
| 0     | Pr.dn  |
| 1     | 0      |
| 2     | Real t |

See *Motor Thermal Time Constant 1* (04.015).

| Parameter         | 04.041 User Over Current Trip Level   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the trip level for the user over-current trip as a percentage of the drive over current trip level. |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0   | Maximum        | 100             |
| Default           | 100   | Units          | %               |
| Type              | 8 Bit User Save   | Update Rate    | Background Read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, RA  |                |                 |

The User Over-Current Trip protection level in % of *Full Scale Current Kc* (11.061) which is the full scale current in r.m.s. Amps. The User Over-Current Trip may be used to limit the output current of the drive when supplying a motor with a lower current rating than the drive. If the value of *User Over Current Trip Level* (04.041) is set at 100%, the user over-current trip is disabled.

## Menu 5 Single Line Descriptions – Motor Control

Mode: Open-Loop

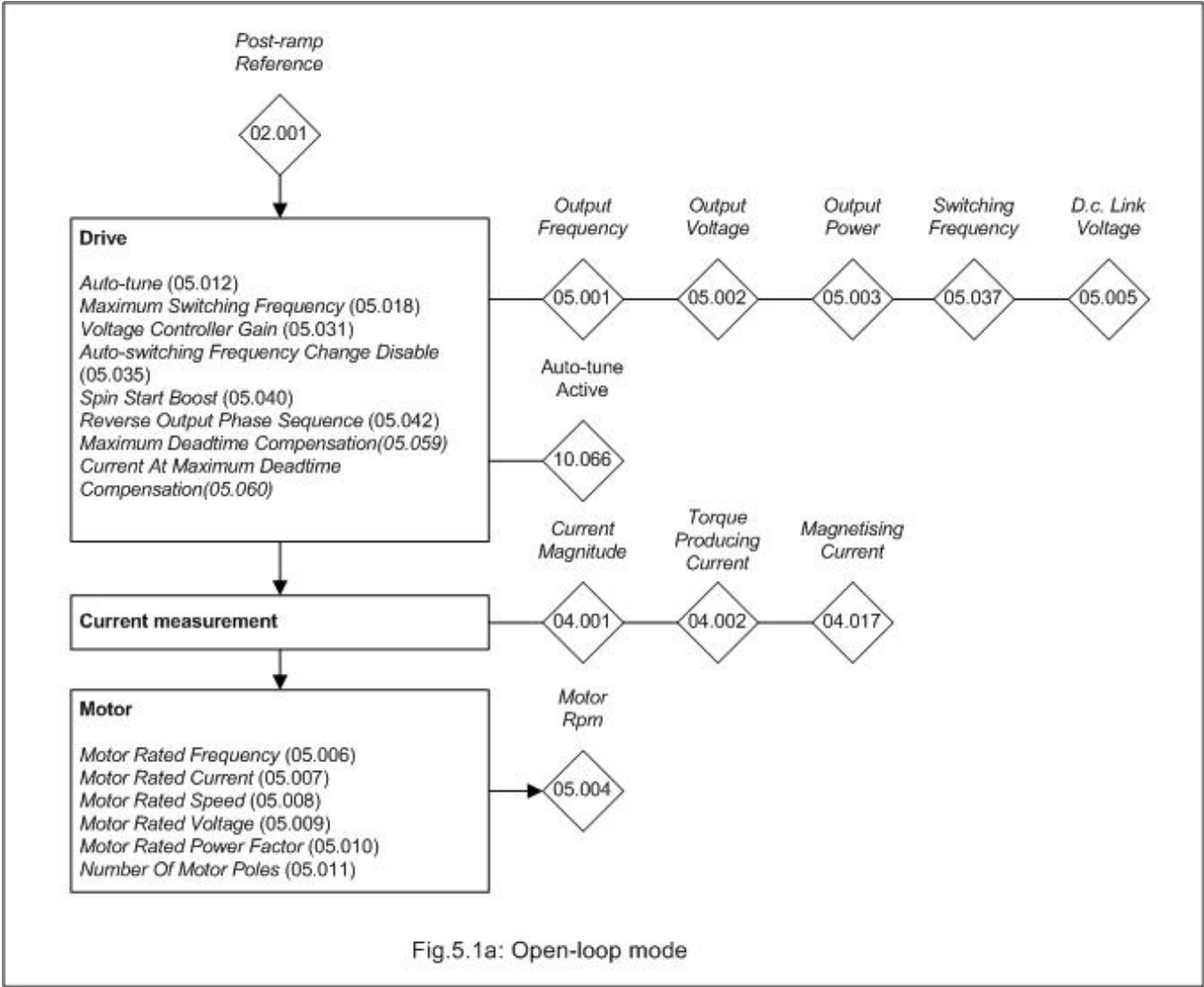
| Parameter |   | Range   | Default  | Type |     |    |    |    |    |
|-----------|---|---|--|------|-----|----|----|----|----|
| 05.001    | Output Frequency  | ±VM_SPEED_FREQ_REF Hz   |  | RO   | Num | ND | NC | PT | FI |
| 05.002    | Output Voltage  | ±VM_AC_VOLTAGE V  |  | RO   | Num | ND | NC | PT | FI |
| 05.003    | Output Power  | ±VM_POWER kW  |  | RO   | Num | ND | NC | PT | FI |
| 05.004    | Motor Rpm   | ±80000 rpm  |  | RO   | Num | ND | NC | PT | FI |
| 05.005    | D.c. Link Voltage   | ±VM_DC_VOLTAGE V  |  | RO   | Num | ND | NC | PT | FI |
| 05.006    | Motor Rated Frequency   | 0.00 to 550.00 Hz   | 50Hz: 50.00 Hz<br>60Hz: 60.00 Hz   | RW   | Num |    |    |    | US |
| 05.007    | Motor Rated Current   | ±VM_RATED_CURRENT A   | 0.00 A   | RW   | Num |    | RA |    | US |
| 05.008    | Motor Rated Speed   | 0.0 to 80000.0 rpm  | 50Hz: 1500.0 rpm<br>60Hz: 1800.0 rpm   | RW   | Num |    |    |    | US |
| 05.009    | Motor Rated Voltage   | ±VM_AC_VOLTAGE_SET V  | 110V drive: 230 V<br>200V drive: 230 V<br>400V drive 50Hz: 400 V<br>400V drive 60Hz: 460 V<br>575V drive: 575 V<br>690V drive: 690 V | RW   | Num |    | RA |    | US |
| 05.010    | Motor Rated Power Factor  | 0.00 to 1.00  | 0.85   | RW   | Num |    | RA |    | US |
| 05.011    | Number Of Motor Poles   | Automatic (0) to 32 (16) Poles  | Automatic (0) Poles  | RW   | Txt |    |    |    | US |
| 05.012    | Auto-tune   | 0 to 2  | 0  | RW   | Num |    | NC |    | US |
| 05.013    | Dynamic V To F Select   | 0 to 1  | 0  | RW   | Num |    |    |    | US |
| 05.014    | Control Mode  | Ur.S (0), Ur (1), Fd (2), Ur.Auto (3), Ur.I (4),<br>SrE (5), Fd.tap (6) | Ur.I (4)   | RW   | Txt |    |    |    | US |
| 05.015    | Low Frequency Voltage Boost                                       | 0.0 to 25.0 %   | 3.0 %  | RW   | Num |    |    |    | US |
| 05.017    | Stator Resistance   | 0.0000 to 99.9999 Ω   | 0.0000 Ω   | RW   | Num |    | RA |    | US |
| 05.018    | Maximum Switching Frequency                                       | 0 to VM_MAX_SWITCHING_FREQUENCY kHz                                     | 3 (3) kHz  | RW   | Txt |    | RA |    | US |
| 05.019    | High Stability Space Vector Modulation                            | Off (0) or On (1)   | Off (0)  | RW   | Bit |    |    |    | US |
| 05.020    | Over Modulation Enable  | Off (0) or On (1)   | Off (0)  | RW   | Bit |    |    |    | US |
| 05.024    | Transient Inductance  | 0.000 to 500.000 mH   | 0.000 mH   | RW   | Num |    | RA |    | US |
| 05.025    | Stator Inductance   | 0.00 to 5000.00 mH  | 0.00 mH  | RW   | Num |    | RA |    | US |
| 05.027    | Slip Compensation Level   | ±150.0 %  | 100.0 %  | RW   | Num |    |    |    | US |
| 05.028    | Flux Control Compensation Disable                                 | Off (0) or On (1)   | Off (0)  | RW   | Bit |    |    |    | US |
| 05.031    | Voltage Controller Gain   | 1 to 30   | 1  | RW   | Num |    |    |    | US |
| 05.032    | Torque Per Amp  | 0.00 to 500.00 Nm/A   |  | RO   | Num | ND | NC | PT |    |
| 05.033    | Slip Compensation Limit   | 0.00 to 10.00 Hz  | 10.00 Hz   | RW   | Num |    |    |    | US |
| 05.035    | Auto-switching Frequency Change Disable                           | 0 to 2  | 0  | RW   | Num |    |    |    | US |
| 05.036    | Slip Compensation Filter  | 64 (0), 128 (1), 256 (2), 512 (3) ms                                    | 128 (1) ms   | RW   | Txt |    |    |    | US |
| 05.037    | Switching Frequency   | 0 to VM_MAX_SWITCHING_FREQUENCY kHz                                     |  | RO   | Txt | ND | NC | PT |    |
| 05.038    | Minimum Switching Frequency                                       | 0 to VM_MAX_SWITCHING_FREQUENCY kHz                                     | 0.667 (0) kHz  | RW   | Txt |    | RA |    | US |
| 05.040    | Spin Start Boost  | 0.0 to 10.0   | 1.0  | RW   | Num |    |    |    | US |
| 05.042    | Reverse Output Phase Sequence                                     | Off (0) or On (1)   | Off (0)  | RW   | Bit |    |    |    | US |
| 05.059    | Maximum Deadtime Compensation                                     | 0.000 to 10.000 μs  | 0.000 μs   | RO   | Num |    | NC | PT | US |
| 05.060    | Current At Maximum Deadtime Compensation                          | 0.00 to 100.00 %  | 0.00 %   | RO   | Num |    | NC | PT | US |
| 05.061    | Disable Deadtime Compensation                                     | Off (0) or On (1)   | Off (0)  | RW   | Bit |    |    |    | US |
| 05.074    | Boost End Voltage   | 0.0 to 100.0 %  | 50.0 %   | RW   | Num |    |    |    | US |
| 05.075    | Boost End Frequency   | 0.0 to 100.0 %  | 50.0 %   | RW   | Num |    |    |    | US |
| 05.076    | Second Point Voltage  | 0.0 to 100.0 %  | 55.0 %   | RW   | Num |    |    |    | US |
| 05.077    | Second Point Frequency  | 0.0 to 100.0 %  | 55.0 %   | RW   | Num |    |    |    | US |
| 05.078    | Third point voltage   | 0.0 to 100.0 %  | 75.0 %   | RW   | Num |    |    |    | US |
| 05.079    | Third point frequency   | 0.0 to 100.0 %  | 75.0 %   | RW   | Num |    |    |    | US |
| 05.080    | Low acoustic noise enable   | Off (0) or On (1)   | Off (0)  | RW   | Bit |    |    |    | US |
| 05.081    | Change to maximum drive switching frequency at low output current | Off (0) or On (1)   | Off (0)  | RW   | Bit |    |    |    | US |
| 05.083    | Voltage Shelving Disable  | Off (0) or On (1)   | Off (0)  | RW   | Bit |    |    |    | US |
| 05.084    | Low Frequency Slip Boost  | 0.0 to 100.0 %  | 0.0 %  | RW   | Num |    |    |    | US |
| 05.088    | Ur Mode Pre-Flux delay  | 0.0 to 0.7 s  | 0.5 s  | RW   | Num |    |    |    | US |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

# Menu 5 – Motor Control

Mode: Open-Loop

The drive can operate under Open Loop and RFC modes with respect to frequency and current control and can drive asynchronous machines. The open loop asynchronous control is further broken down into vector and fixed boost modes.



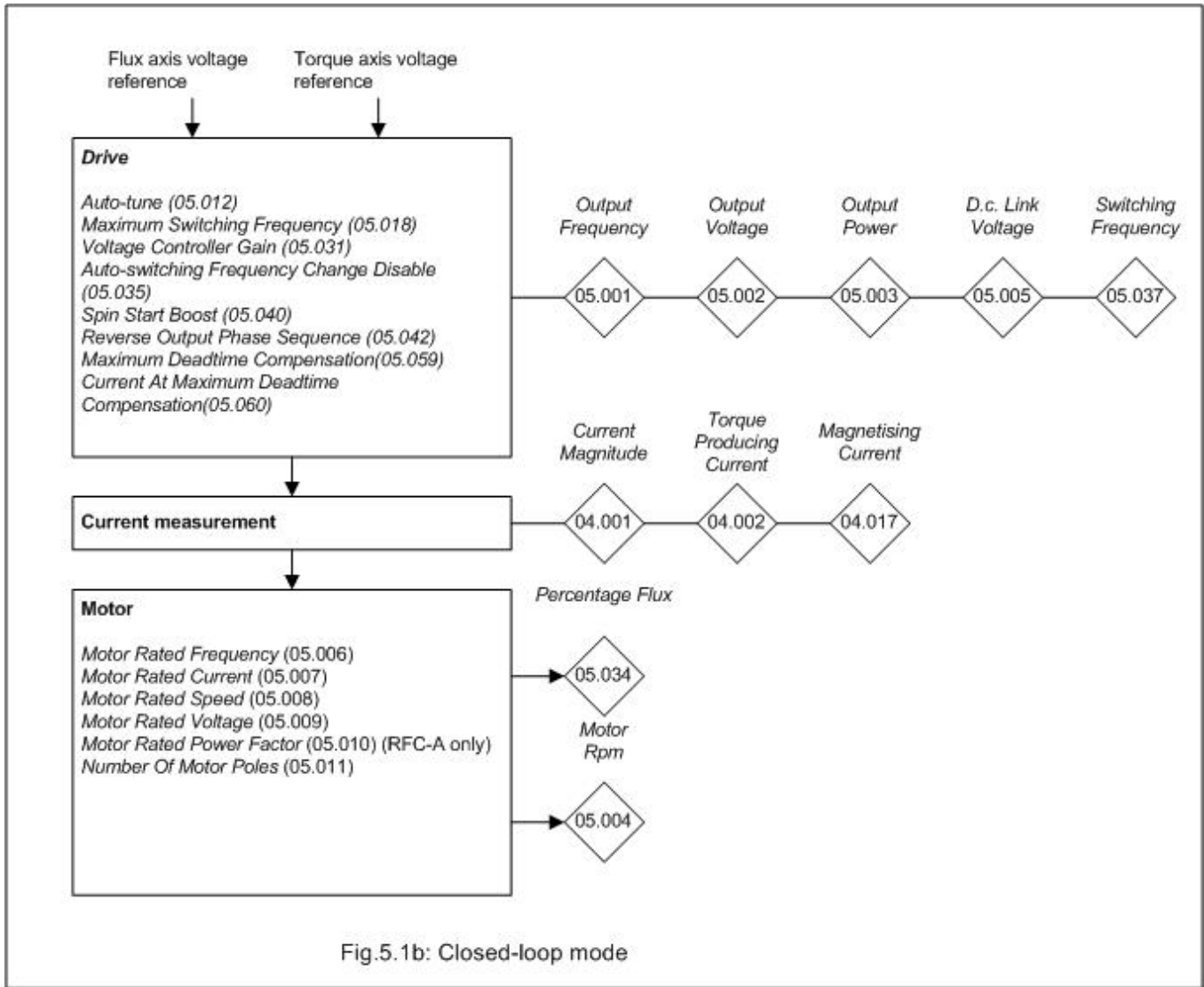


Fig.5.1b: Closed-loop mode

Open-loop mode

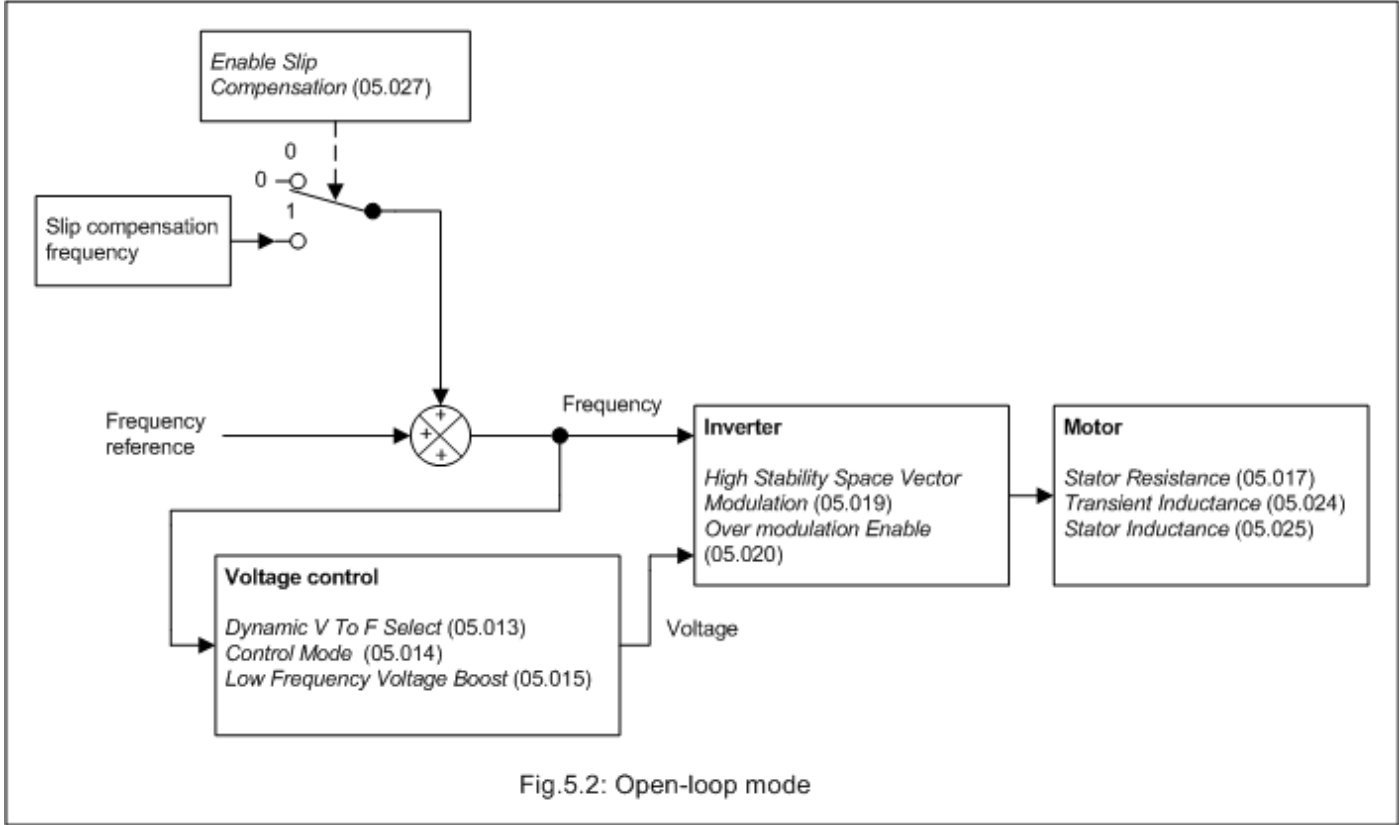
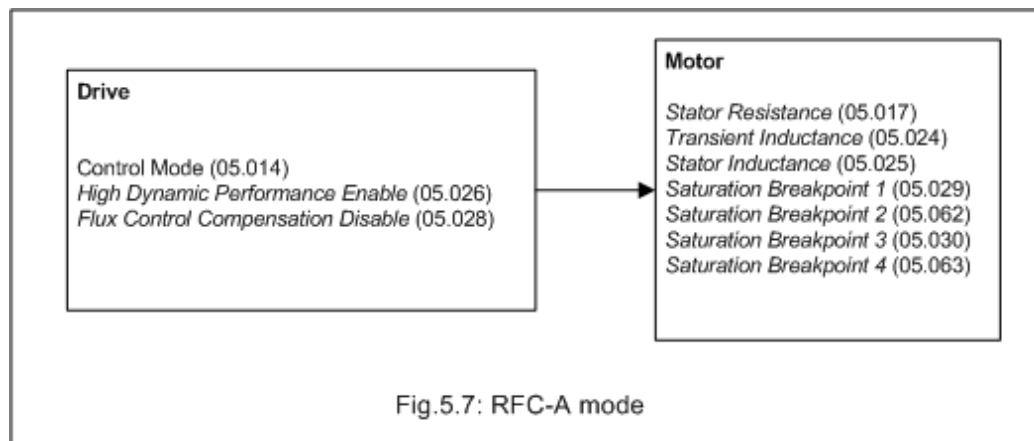


Fig.5.2: Open-loop mode

## RFC operation



| Parameter         | 05.001 Output Frequency                    |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Displays the output frequency of the drive |                |                   |
| Mode              | Open-Loop                                  |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                         | Maximum        | VM_SPEED_FREQ_REF |
| Default           |  | Units          | Hz                |
| Type              | 32 Bit Volatile                            | Update Rate    | 16ms              |
| Display Format    | Standard                                   | Decimal Places | 2                 |
| Coding            | RO, FI, VM, ND, NC, PT                     |                |                   |

### Open loop mode

The *Output Frequency* (05.001) is the sum of the *Post Ramp Reference* (02.001) and the motor slip compensation frequency.

| Parameter         | 05.002 Output Voltage   |                |               |
|-------------------|---|----------------|---------------|
| Short description | Displays the r.m.s. line to line voltage at the a.c. terminals of the drive |                |               |
| Mode              | Open-Loop   |                |               |
| Minimum           | -VM_AC_VOLTAGE  | Maximum        | VM_AC_VOLTAGE |
| Default           |   | Units          | V             |
| Type              | 16 Bit Volatile   | Update Rate    | 16ms          |
| Display Format    | Standard  | Decimal Places | 0             |
| Coding            | RO, FI, VM, ND, NC, PT  |                |               |

The *Output Voltage* (05.002) is the r.m.s line to line voltage at the a.c. terminals of the drive.

| Parameter         | 05.003 Output Power  |                |          |
|-------------------|--|----------------|----------|
| Short description | Displays the power flowing via the a.c. terminals of the drive |                |          |
| Mode              | Open-Loop  |                |          |
| Minimum           | -VM_POWER  | Maximum        | VM_POWER |
| Default           |  | Units          | kW       |
| Type              | 32 Bit Volatile  | Update Rate    | 16ms     |
| Display Format    | Standard   | Decimal Places | 2        |
| Coding            | RO, FI, VM, ND, NC, PT   |                |          |

The *Output Power* (05.003) is the power flowing via the a.c. terminals of the drive. The power is derived as the dot product of the output voltage and current vectors, and so this is correct even if the motor parameters are incorrect and the motor model does not align the reference frame with the flux axis of a motor. A positive value of power indicates power flowing from the drive to the motor.

The maximum power is  $VM\_POWER[MAX] = \sqrt{3} \times VM\_AC\_VOLTAGE[MAX] \times Full\ Scale\ Current\ Kc (11.061) / 1000$

| Parameter         | 05.004 Motor Rpm                                    |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the Final Demand Reference in units of rpm |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | -80000  | Maximum        | 80000            |
| Default           |   | Units          | rpm              |
| Type              | 32 Bit Volatile                                     | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, FI, ND, NC, PT                                  |                |                  |

*Motor Rpm* (05.004) =  $60 \times \text{Frequency} / \text{Pole pairs}$

where

Pole pairs = the numeric value of *Number Of Motor Poles* (i.e. 3 for a 6 pole motor)

The frequency used to derive the *Motor Rpm* (05.004) is the *Final Demand Reference* (03.001). The maximum and minimum values allow for a 10%

over-shoot of the speed.

| Parameter         | 05.005 D.c. Link Voltage                               |                |               |
|-------------------|--|----------------|---------------|
| Short description | Displays the voltage across the d.c. link of the drive |                |               |
| Mode              | Open-Loop  |                |               |
| Minimum           | -VM_DC_VOLTAGE   | Maximum        | VM_DC_VOLTAGE |
| Default           |  | Units          | V             |
| Type              | 16 Bit Volatile  | Update Rate    | 16ms          |
| Display Format    | Standard   | Decimal Places | 0             |
| Coding            | RO, FI, VM, ND, NC, PT                                 |                |               |

D.c. Link Voltage (05.005) gives the voltage across the d.c. link of the drive.

| Parameter         | 05.006 Motor Rated Frequency            |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to the rated frequency of the motor |                |                 |
| Mode              | Open-Loop                               |                |                 |
| Minimum           | 0.00                                    | Maximum        | 550.00          |
| Default           | See exceptions below                    | Units          | Hz              |
| Type              | 32 Bit User Save                        | Update Rate    | Background read |
| Display Format    | Standard                                | Decimal Places | 2               |
| Coding            | RW                                      |                |                 |

| Region | Default Value |
|--------|---------------|
| 50Hz   | 50.00         |
| 60Hz   | 60.00         |

Motor Rated Frequency (05.006) and Motor Rated Voltage (05.009) define the frequency to voltage characteristic applied to the motor. See Control Mode (05.014) for more details. Motor Rated Frequency (05.006), Motor Rated Speed (05.008) and Number Of Motor Poles (05.011) are used to calculate the rated slip of the motor for slip compensation.

Rated slip (Hz) = Motor Rated Frequency (05.006) - (Pole pairs x Motor Rated Speed (05.008) / 60)

where

Pole pairs = the numeric value of Number Of Motor Poles (05.011) (i.e. 3 for a 6 pole motor)

If slip compensation is required Motor Rated Speed (05.008) should be set to the motor nameplate value, which should give the correct compensation for a hot motor provide the nameplate value is correct. Slip compensation can be used throughout the speed range of the motor, i.e. below base speed and in the flux weakening region, to correct the motor speed to minimise the change of speed with load. Motor Rated Speed (05.008) can be set to a value that is higher than synchronous speed to deliberately introduce speed droop, which can be used to aid load sharing with mechanically coupled motors.

Slip compensation is disabled under the following conditions:

1. Motor Rated Speed (05.008) = 0
2. Motor Rated Speed (05.008) = Motor Rated Frequency (05.006) x 60 / Pole pairs, i.e. synchronous speed.
3. Slip Compensation Level (05.027) = 0.0%

It should be noted that Motor Rated Speed (05.008) is used to calculate the rotor time constant of the motor which is then used to determine the flux build-up time at the start of the catch a spinning motor algorithm. If spinning start is required (i.e. Catch A Spinning Motor (06.009) ≥ 1) then Motor Rated Speed (05.008) should be set up correctly for the motor. If slip compensation is not required, it can be disabled by setting Slip Compensation Level (05.027) to 0.0%.

| Parameter         | 05.007 Motor Rated Current                  |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Set to the rated current rated of the motor |                |                  |
| Mode              | Open-Loop                                   |                |                  |
| Minimum           | -VM_RATED_CURRENT                           | Maximum        | VM_RATED_CURRENT |
| Default           | 0.00  | Units          | A                |
| Type              | 32 Bit User Save                            | Update Rate    | Background read  |
| Display Format    | Standard                                    | Decimal Places | 2                |
| Coding            | RW, VM, RA                                  |                |                  |

Motor Rated Current is used as follows:

1. To define the rated operating conditions for motor thermal protection. See Thermal Protection Mode (04.016).
2. To define the range of the current limits.
3. In the motor control algorithm for Open-loop and Closed Loop asynchronous modes.



| Parameter         | 05.008 Motor Rated Speed            |                |                 |
|-------------------|-------------------------------------|----------------|-----------------|
| Short description | Set to the rated speed of the motor |                |                 |
| Mode              | Open-Loop                           |                |                 |
| Minimum           | 0.0                                 | Maximum        | 80000.0         |
| Default           | See exceptions below                | Units          | rpm             |
| Type              | 32 Bit User Save                    | Update Rate    | Background read |
| Display Format    | Standard                            | Decimal Places | 1               |
| Coding            | RW                                  |                |                 |

| Region | Default Value |
|--------|---------------|
| 50Hz   | 1500.0        |
| 60Hz   | 1800.0        |

See *Motor Rated Frequency* (05.006).

| Parameter         | 05.009 Motor Rated Voltage            |                |                   |
|-------------------|---------------------------------------|----------------|-------------------|
| Short description | Set to the rated voltage of the motor |                |                   |
| Mode              | Open-Loop                             |                |                   |
| Minimum           | -VM_AC_VOLTAGE_SET                    | Maximum        | VM_AC_VOLTAGE_SET |
| Default           | See exceptions below                  | Units          | V                 |
| Type              | 16 Bit User Save                      | Update Rate    | 16ms              |
| Display Format    | Standard                              | Decimal Places | 0                 |
| Coding            | RW, VM, RA                            |                |                   |

| Voltage | Region | Default Value |
|---------|--------|---------------|
| 110V    | All    | 230           |
| 200V    | All    | 230           |
| 400V    | 50Hz   | 400           |
| 400V    | 60Hz   | 460           |
| 575V    | All    | 575           |
| 690V    | All    | 690           |

*Motor Rated Frequency* (05.006) and *Motor Rated Voltage* (05.009) define the frequency to voltage characteristic applied to the motor. See *Control Mode* (05.014) for more details.

| Parameter         | 05.010 Motor Rated Power Factor  |                |                       |
|-------------------|--|----------------|-----------------------|
| Short description | Set to the rated power factor of the motor. This value can be measured by the drive during a rotating autotune |                |                       |
| Mode              | Open-Loop  |                |                       |
| Minimum           | 0.00   | Maximum        | 1.00                  |
| Default           | 0.85   | Units          |                       |
| Type              | 16 Bit User Save   | Update Rate    | Background read/write |
| Display Format    | Standard   | Decimal Places | 2                     |
| Coding            | RW, RA   |                |                       |

*Motor Rated Power Factor* (05.010) is the true power factor of the motor under rated conditions, i.e. the cosine of the angle between the motor voltage and current. If *Stator Inductance* (05.025) is set to a non-zero value then the stator inductance is used to calculate the rated magnetising current for the motor and the rated power factor can be calculated by the drive. Therefore if *Stator Inductance* (05.025) is non-zero *Motor Rated Power Factor* (05.010) is continuously set to the calculated value of rated power factor by the drive. If *Stator Inductance* (05.025) is set to zero then *Motor Rated Power Factor* (05.010) is used to estimate the rated magnetising current which is an approximation and not as accurate. *Stator Inductance* (05.025) can be measured by the drive during auto-tuning and this is the preferred option, however, if it is not possible to obtain the value for *Stator Inductance* (05.025) then *Motor Rated Power Factor* (05.010) should be set to the motor nameplate value.

| Parameter         | 05.011 Number Of Motor Poles            |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to the number of poles of the motor |                |                 |
| Mode              | Open-Loop                               |                |                 |
| Minimum           | 0                                       | Maximum        | 16              |
| Default           | 0                                       | Units          | PolePairs       |
| Type              | 8 Bit User Save                         | Update Rate    | Background read |
| Display Format    | Standard                                | Decimal Places | 0               |
| Coding            | RW, BU                                  |                |                 |

If *Number Of Motor Poles* (05.011) = 0 the number of motor poles are calculated automatically as given below.

Pole pairs =  $60 \times \text{Motor Rated Frequency (05.006)} / \text{Motor Rated Speed (05.008)}$  rounded down to the nearest integer

| Parameter         | 05.012 Auto-tune                           |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the auto-tune test to be performed |                |                 |
| Mode              | Open-Loop                                  |                |                 |
| Minimum           | 0  | Maximum        | 2               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit Volatile                             | Update Rate    | Background read |
| Display Format    | Standard                                   | Decimal Places | 0               |
| Coding            | RW, NC                                     |                |                 |

The following describes how an auto-tune test can be initiated and normal operation can be resumed after the test for Open loop, Closed loop mode:

1. An auto-tune test cannot be initiated if the drive is tripped or the drive inverter is active, i.e. *Drive Healthy* (10.001) = 0 or *Drive Active* (10.002) = 1. The inverter can be made inactive by ensuring that the Final drive enable is inactive (see Menu 06), or the Final drive run (see Menu 06) is inactive and *Hold Zero Frequency* (06.008) = 0.
2. An auto-tune test is initiated by setting *Auto-tune* (05.012) to a non-zero value and making the Final drive enable and the Final drive run active.
3. All tests that move the motor will move the motor in the forward direction if *Reverse Select* (01.012) = 0 or the reverse direction if *Reverse Select* (01.012) = 1. It should be noted that the motor may jump by up to half an electrical revolution in either direction at the start of auto-tuning test 1 in Synchronous mode whatever the value of *Reverse Select* (01.012), but after the initial jump the remainder of the test will be carried out in the correct direction.
4. If the auto-tune sequence is completed successfully the Final drive enable is set to the inactive state and *Auto-tune* (05.012) is set to zero. The Final drive enable can only be set to the active state again by removing the enable and reapplying it. The enable can be removed by setting *Drive Enable* (06.015) = 0, or by setting bit 0 of the *Control Word* (06.042) to 0 provided *Control Word Enable* (06.043) = 1, or by making *Hardware Enable* = 0.
5. If a trip occurs during the auto-tune sequence the drive will go into the trip state and *Auto-tune* (05.012) is set to zero. As in 4. above, the enable must be removed and re-applied before the drive can be restarted after the trip has been reset. However, care should be taken because if the auto-tune was not completed the drive parameters that should have been measured and set up will still have their original values.
6. If the Final drive enable is made active, the Final drive run is inactive and *Hold Zero Frequency* (06.008) = 1 the drive would normally be in the Stop state (i.e. the inverter is active, but the frequency or speed reference is 0). However, the transition from the Disable state to the Stop state cannot be made in closed loop mode if *Auto-tune* (05.012) is non-zero. This is intended to prevent the drive entering the Stop state when an auto-tune test is required, but the enable is applied before the run as the control of the motor may rely on position estimation.

The following describes the effects of the auto-tune test on the drive :

1. All auto-tune tests rely on the motor being stationary when the test is initiated to give accurate results.
2. If *Select Motor 2 Parameters* (11.045) = 0 then the parameters associated with motor map 1 are updated as a result of the test, and if *Select Motor 2 Parameters* (11.045) = 1 the parameters associated with motor map 2 are updated.
3. Only when the whole test is completed, are the results written to the appropriate parameters and these parameters saved in the drive non-volatile memory. If *Parameter Cloning* (11.042) is set to 3 or 4 the parameters are also written to a non-volatile media card fitted on the drive.

#### Open-loop mode

The table below shows the parameters required for motor control indicating which should be set by the user and which can be measured with an auto-tune test.

| Parameter  | Required for   | Measured in test |
|--|--|------------------|
| <i>Motor Rated Frequency</i> (05.006)                    | Basic control  |                  |
| <i>Motor Rated Current</i> (05.007)                      | Basic control  |                  |
| <i>Motor Rated Speed</i> (05.008)                        | Slip compensation<br>Catch a spinning motor                |                  |
| <i>Motor Rated Voltage</i> (05.009)                      | Basic control  |                  |
| <i>Motor Rated Power Factor</i> (05.010)                 | Basic control  | 2                |
| <i>Number Of Motor Poles</i> (05.011)                    | Not used   |                  |
| <i>Stator Resistance</i> (05.017)                        | Ur, Ur I, Ur S and Ur Auto modes<br>Catch a spinning motor | 1, 2             |
| <i>Transient Inductance</i> (05.024)                     | Improved performance                                       | 1, 2             |
| <i>Stator Inductance</i> (05.025)                        | Improved performance                                       | 2                |
| <i>Maximum Deadtime Compensation</i> (05.059)            | Basic control  | 1, 2             |
| <i>Current At Maximum Deadtime Compensation</i> (05.060) | Basic control  | 1, 2             |

#### Auto-tune test 1: Basic control parameters

This test measures the basic control parameters without moving the motor.

1. A stationary test is performed to measure *Stator Resistance* (05.017), *Transient Inductance* (05.024), *Maximum Deadtime Compensation* (05.059) and *Current At Maximum Deadtime Compensation* (05.060).

#### Auto-tune test 2: Basic control and improved performance parameters

This test measures the parameters for improved performance by rotating the motor.

1. Auto-tune test 1 is performed.
2. A rotating test is performed in which the motor is accelerated with the currently selected ramps up to a frequency of *Motor Rated Frequency* (05.006) x 2/3, and the frequency is maintained at that level for 4 seconds. *Stator Inductance* (05.025) is measured and this value is used in conjunction with other motor parameters to calculate *Motor Rated Power Factor* (05.010). The motor should be unloaded for this test.

The table below shows the trips that can occur during an auto-tune test:

| Trip                    | Reason   | Trip can occur in test |
|-------------------------|--|------------------------|
| <i>Autotune Stopped</i> | The final drive enable or the final drive run were removed before the test was completed.    | All                    |
| <i>Resistance</i>       | The measured value of <i>Stator Resistance</i> (05.017) exceeded the range of the parameter. | All                    |

| Parameter         | 05.013 <i>Dynamic V To F Select</i>    |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to 1 to enable Dynamic V to F mode |                |                 |
| Mode              | Open-Loop                              |                |                 |
| Minimum           | 0                                      | Maximum        | 1               |
| Default           | 0                                      | Units          |                 |
| Type              | 8 Bit User Save                        | Update Rate    | Background read |
| Display Format    | Standard                               | Decimal Places | 0               |
| Coding            | RW                                     |                |                 |

Dynamic V to F mode is intended for applications where power loss should be kept to a minimum under low load conditions, but dynamic performance is not important. The reduction in power loss under low load conditions is achieved by increasing the rated frequency used to derive the frequency to voltage characteristic of the drive with reduced load. If *Flux Optimisation Select, Dynamic V To F Select* (05.013) = 0 then *Motor Rated Frequency* (05.006) is used directly to define the output voltage characteristic. If *Flux Optimisation Select, Dynamic V To F Select* (05.013) = 1 then a modified value of motor rated frequency is used:

Motor rated frequency = *Motor Rated Frequency* (05.006) x [2 - |*Percentage Load* (04.020)| / 70.0%]

For higher load levels *Motor Rated Frequency* (05.006) is used directly.

| Parameter         | 05.014 <i>Control Mode</i>  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the drive output mode, which can either be a voltage mode or a current mode |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0   | Maximum        | 6               |
| Default           | 4   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text    | Description   |
|-------|---------|---|
| 0     | Ur.S    | Stator resistance and voltage offset measured at each start         |
| 1     | Ur      | No measurements   |
| 2     | Fd      | Fixed boost mode.   |
| 3     | Ur.Auto | Stator resistance and voltage offset measured at first drive enable |
| 4     | Ur.I    | Stator resistance and voltage offset measured at each power-up      |
| 5     | SrE     | Square law characteristic   |
| 6     | Fd.tap  | Fixed boost with zero slip at zero reference                        |

| Value | Text          |
|-------|---------------|
| 0     | Ur S          |
| 1     | Ur            |
| 2     | Fixed         |
| 3     | Ur Auto       |
| 4     | Ur I          |
| 5     | Square        |
| 6     | Fixed Tapered |

The *Control Mode* (05.014) defines the drive output mode, which can either be a voltage mode or a current mode as given below. It should be noted that the maximum output voltage of the drive is limited to a level just below *D.c. Link Voltage* (05.005) /  $\sqrt{2}$ . Therefore, if the drive is being supplied via its own rectifier input stage the output voltage is limited to a level just below that of the supply voltage. If the drive is operating in voltage mode the output voltage is limited to *Motor Rated Voltage* (05.009) or the maximum possible output voltage whichever is the lowest (also refer to *Over Modulation Enable* (05.020)).

#### 0: Ur S (Resistance compensation, stator resistance measured at each start)

Resistance compensation is a form of stator flux oriented sensorless motor control. A linear frequency to voltage characteristic is used where the drive output voltage is increased from 0V to *Motor Rated Voltage* (05.009). as the |*Output Frequency* (05.001)| increases from 0Hz to *Motor Rated Frequency* (05.006). When the |*Output Frequency* (05.001)| is above *Motor Rated Frequency* (05.006) the output voltage is limited to *Motor Rated Voltage* (05.009). Vector based stator resistance compensation is applied below *Motor Rated Frequency* (05.006) / 4 and then this is tapered off from *Motor Rated Frequency* (05.006) / 4 to *Motor Rated Frequency* (05.006) / 2. This method controls the flux level correctly in the motor in the steady state provided the correct value of *Stator Resistance* (05.017) is used.

The *Stator Resistance* (05.017) is measured each time the drive is started. This test can only be done with a stationary motor where the flux has decayed to zero. Therefore this mode should only be used if the motor is guaranteed to be stationary each time the drive is enabled. To ensure that the measurement is not carried out before the flux has decayed, there is a period of one second after the inverter has been disabled during which the test is not carried out if the drive is re-started. The *Stator Resistance* (05.017) is not automatically saved in non-volatile memory after each test.

#### 1: Ur (Resistance compensation with no stator resistance measurement)

Resistance compensation is used as in Ur S mode, but the *Stator Resistance* (05.017) is not measured.

## 2: Fixed (Fixed boost with linear characteristic)

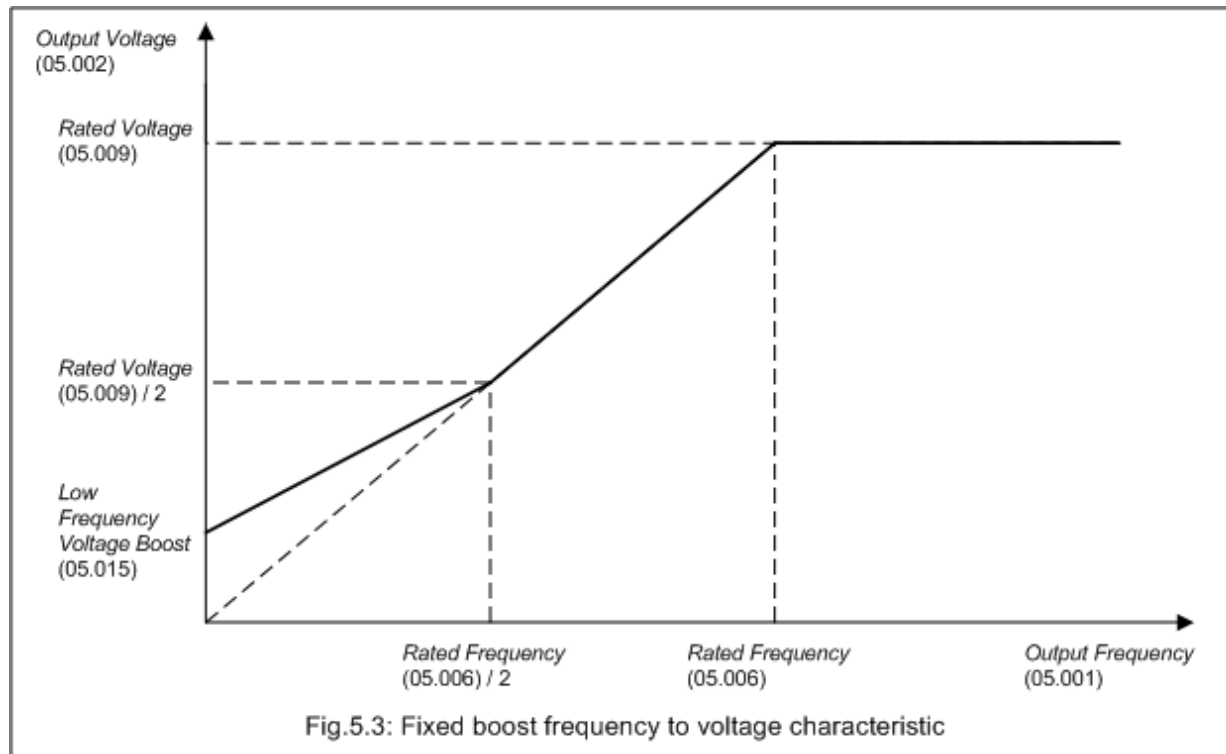


Fig.5.3: Fixed boost frequency to voltage characteristic

A fixed frequency to voltage characteristic is used as shown above where the voltage at 0Hz is defined by *Low Frequency Voltage Boost* (05.015). The voltage characteristic moves linearly with output frequency passing through three points determined by [*Boost End Voltage* (05.074) and *Boost End Frequency* (05.075)], [*Second Point Voltage* (05.076) and *Second Point Frequency* (05.077)] and [*Motor Rated Voltage* (05.009) and *Motor Rated Frequency* (05.006)].

By default *Boost End Frequency* (05.075) is set to half the *Motor Rated Frequency* (05.006) and *Second Point Frequency* (05.077) is set to three quarters. By default *Boost End Voltage* (05.074) is set at half the *Motor Rated Voltage* (05.009) and *Second Point Voltage* (05.076) is set to three quarters. This is to produce the SK curve by default.

## 3: Ur Auto (Resistance compensation, stator resistance measured on first start)

Resistance compensation is used as in Ur S mode, but the *Stator Resistance* (05.017) is only measured once when the drive is first enabled. After the test has been completed successfully the mode is changed to Ur mode and *Stator Resistance* (05.017) is saved to non-volatile memory. If *Parameter Cloning* (11.042) is set to 3 or 4 the *Stator Resistance* (05.017) is also written to a non-volatile media card fitted in the drive. If the test fails the mode is changed to Ur mode, but *Stator Resistance* (05.017) is not updated.

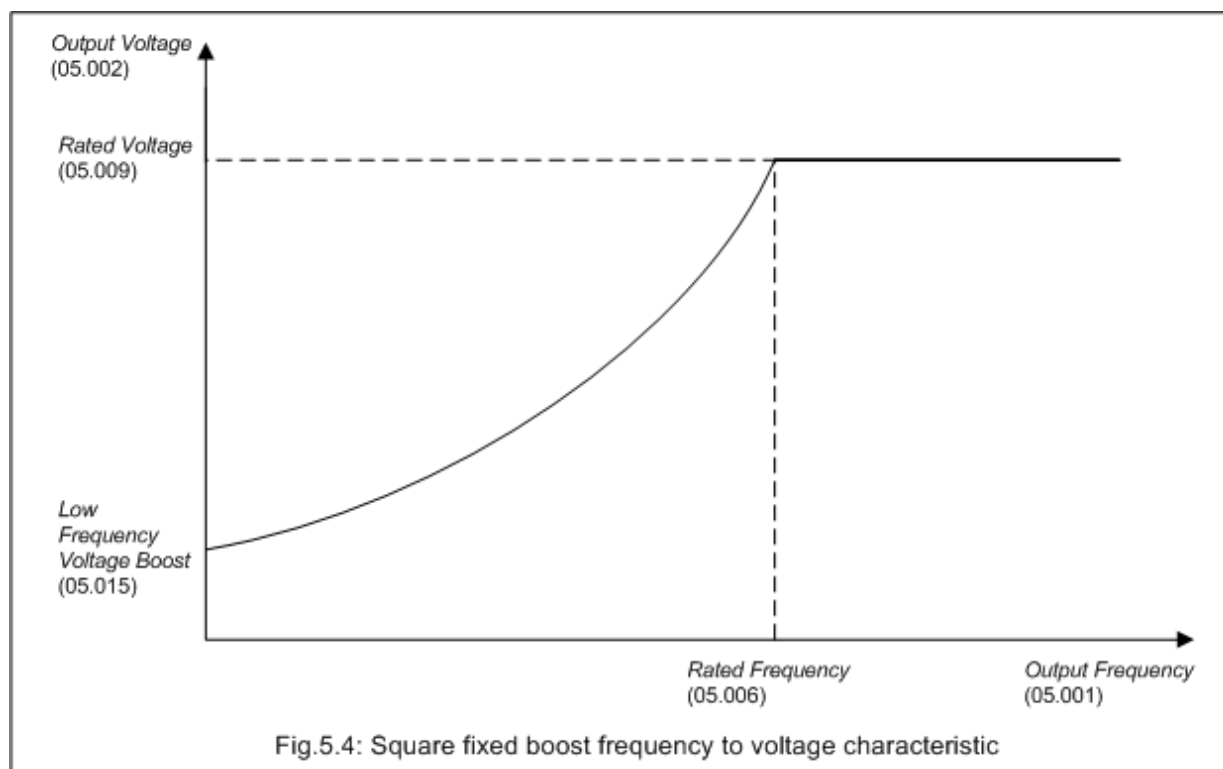
## 4: Ur I (Resistance compensation, stator resistance measured at power-up)

Resistance compensation is used as in Ur S mode, but the *Stator Resistance* (05.017) is only measured when the drive is enabled for the first time after each power-up.

## 5: Square (Fixed boost with square characteristic)

A fixed square frequency to voltage characteristic is used as shown below. When the [*Output Frequency* (05.001)] is below *Motor Rated Frequency* (05.006) the *Output Voltage* (05.002) is given by:

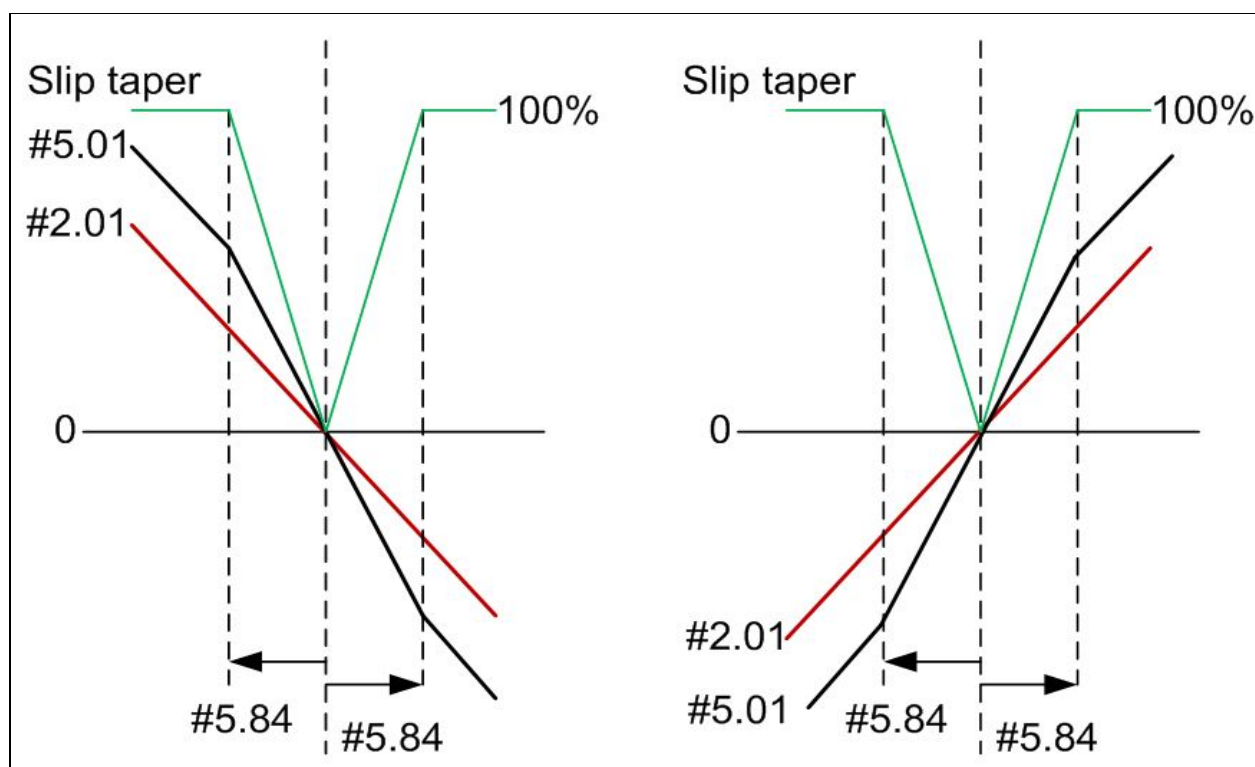
$$\text{Output Voltage (05.002)} = \text{Low Frequency Voltage Boost (05.015)} + [(\text{Motor Rated Voltage (05.009)} - \text{Low Frequency Voltage Boost (05.015)}) \times (\text{Output Frequency (05.001)} / \text{Motor Rated Frequency (05.006)})^2]$$



#### 6: Fixed boost with tapered slip limit

A fixed boost frequency to voltage characteristic is used with:

- the (Post Ramp Reference (02.001) + Slip) direction clamp removed, and
- the slip limit tapering to zero at zero Post Ramp Reference (02.001) starting from a frequency determined by Low Frequency Estimator Threshold, Low Frequency Slip Boost (05.084) (as a 0.1% of the rated frequency.)



| Parameter         | 05.015 Low Frequency Voltage Boost   |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the level of voltage boost at 0Hz when using a fixed V to F relationship |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0.0  | Maximum        | 25.0            |
| Default           | 3.0  | Units          | %               |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 1               |
| Coding            | RW, BU   |                |                 |

\* 3.0% up to Size D, 2.0% for Size 7 and 8, and 1.0% for larger sizes

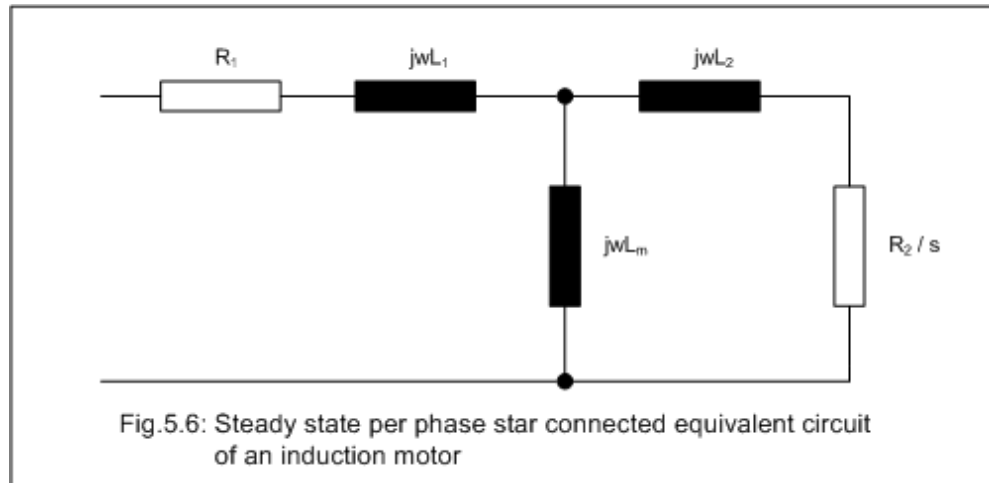
See *Control Mode* (05.014).

During auto-tune test 2 the drive uses the Open-loop mode control strategy with fixed voltage boost. *Low Frequency Voltage Boost* (05.015) is used to define the level of low voltage boost used during the test. See *Control Mode* (05.014) in Open-loop mode for more details.

| Parameter         | 05.017 Stator Resistance                   |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the resistance of the motor stator |                |                 |
| Mode              | Open-Loop                                  |                |                 |
| Minimum           | 0.0000                                     | Maximum        | 99.9999         |
| Default           | 0.0000                                     | Units          | Ω               |
| Type              | 32 Bit User Save                           | Update Rate    | Background read |
| Display Format    | Standard                                   | Decimal Places | 4               |
| Coding            | RW, RA                                     |                |                 |

#### Asynchronous machines:

The *Stator Resistance* (05.017), *Transient Inductance* (05.024) and *Stator Inductance* (05.025) are derived from the star connected per phase equivalent circuit of an induction motor shown below.



The steady state parameters are converted to equivalent transient model parameters:

$$R_s = R_1$$

$$L_m = L_m$$

$$L_s = L_1 + L_m$$

$$L_r = L_2 + L_m$$

$$\sigma L_s = L_s - (L_m^2 / L_r)$$

The equivalent drive parameters are:

$$\text{Stator Resistance (05.017)} = R_s$$

$$\text{Transient Inductance (05.024)} = \sigma L_s$$

$$\text{Stator Inductance (05.025)} = L_s$$

| Parameter         | 05.018 Maximum Switching Frequency                                    |                |                            |
|-------------------|---|----------------|----------------------------|
| Short description | Defines the maximum switching frequency that can be used by the drive |                |                            |
| Mode              | Open-Loop   |                |                            |
| Minimum           | 0   | Maximum        | VM_MAX_SWITCHING_FREQUENCY |
| Default           | 3   | Units          | kHz                        |
| Type              | 8 Bit User Save   | Update Rate    | Background read            |
| Display Format    | Standard  | Decimal Places | 0                          |
| Coding            | RW, TE, VM, RA  |                |                            |

| Value | Text  | Description               |
|-------|-------|---------------------------|
| 0     | 0.667 | 667Hz switching frequency |
| 1     | 1     | 1kHz switching frequency  |
| 2     | 2     | 2kHz switching frequency  |
| 3     | 3     | 3kHz switching frequency  |
| 4     | 4     | 4kHz switching frequency  |
| 5     | 6     | 6kHz switching frequency  |
| 6     | 8     | 8kHz switching frequency  |
| 7     | 12    | 12kHz switching frequency |
| 8     | 16    | 16kHz switching frequency |

*Maximum Switching Frequency* (05.018) should be set to the required PWM switching frequency. The drive inverter will operate at this frequency unless *Auto-switching Frequency Change Disable* (05.035) = 0 and the inverter temperature exceeds the threshold for automatic switching frequency reduction (see *Inverter Temperature* (07.034)). The actual switching frequency is shown in *Switching Frequency* (05.037). The switching frequency has a direct effect on the sample rate for the current controllers (see *Current Controller Kp Gain* (04.013)). All other control tasks are at a fixed rate of 1ms.

Note: 0.667kHz and 1kHz switching frequencies are not supported in RFC-A mode.

As default *Auto-switching Frequency Change Disable* (05.035) = 0 and the system described above is always active. If *Auto-switching Frequency Change Disable* (05.035) = 1 then the automatic switching frequency changing system is disabled. If *Auto-switching Frequency Change Disable* (05.035) = 2 the system is active, but does not take into account the device temperature at low output frequencies.

We recommend that a minimum ratio of 12:1 for the switching frequency compared to the output frequency is used.

| Parameter         | 05.019 High Stability Space Vector Modulation             |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to enable High Stability Space Vector Modulation |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

If *High Stability Space Vector Modulation* (05.019) = 0 standard space vector modulation is used to derive the inverter control signals. If *High Stability Space Vector Modulation* (05.019) = 1 a modified form of space vector modulation is selected which can give the following advantages:

1. With some motors instability can occur when operating below *Motor Rated Frequency* (05.006) / 2 especially with light loads and high switching frequency. The preferred method to solve this problem is to use RFC-A mode. However, if Open-loop mode is required, the instability can sometimes be reduced by selecting high stability space vector modulation.
2. 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 motor. High stability space vector modulation will reduce this effect.

The disadvantages of using high stability space vector modulation are:

1. Increased acoustic noise from the motor.
2. A reduction in the thermal capability of the drive at low output frequencies.

| Parameter         | 05.020 Over Modulation Enable      |                |                 |
|-------------------|------------------------------------|----------------|-----------------|
| Short description | Set to 1 to enable over modulation |                |                 |
| Mode              | Open-Loop                          |                |                 |
| Minimum           | 0                                  | Maximum        | 1               |
| Default           | 0                                  | Units          |                 |
| Type              | 1 Bit User Save                    | Update Rate    | Background read |
| Display Format    | Standard                           | Decimal Places | 0               |
| Coding            | RW                                 |                |                 |

The maximum modulation level of the drive is normally limited to unity giving an output voltage equivalent to the drive input voltage minus voltage drops within the drive. 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 motor rated voltage level. If *Over Modulation Enable* (05.020) is set to 1 the modulator will allow over modulation, so that as the output frequency increases beyond the motor rated frequency the voltage continues to increase above the motor rated voltage. The modulation depth will increase beyond unity producing trapezoidal waveforms. This can be used for example to get slightly better performance above motor rated frequency. 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 odd harmonics of the fundamental output frequency.

| Parameter         | 05.024 <i>Transient Inductance</i>                                     |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the inductance of the transient components in the motor stator |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0.000  | Maximum        | 500.000         |
| Default           | 0.000  | Units          | mH              |
| Type              | 32 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 3               |
| Coding            | RW, RA   |                |                 |

See *Stator Resistance* (05.017).

| Parameter         | 05.025 <i>Stator Inductance</i>            |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the inductance of the motor stator |                |                 |
| Mode              | Open-Loop                                  |                |                 |
| Minimum           | 0.00                                       | Maximum        | 5000.00         |
| Default           | 0.00                                       | Units          | mH              |
| Type              | 32 Bit User Save                           | Update Rate    | Background read |
| Display Format    | Standard                                   | Decimal Places | 2               |
| Coding            | RW, RA                                     |                |                 |

See *Stator Resistance* (05.017).

| Parameter         | 05.027 <i>Slip Compensation Level</i> |                |                 |
|-------------------|---------------------------------------|----------------|-----------------|
| Short description | Defines the gain of slip compensation |                |                 |
| Mode              | Open-Loop                             |                |                 |
| Minimum           | -150.0                                | Maximum        | 150.0           |
| Default           | 100.0                                 | Units          | %               |
| Type              | 16 Bit User Save                      | Update Rate    | Background read |
| Display Format    | Standard                              | Decimal Places | 1               |
| Coding            | RW                                    |                |                 |

See *Motor Rated Frequency* (05.006).

Used in open loop mode to set the level of slip compensation or droop control.

A value of 100.0% gives standard slip compensation.

A value of 0.0% disable slip compensation.

| Parameter         | 05.028 <i>Flux Control Compensation Disable</i> |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to disable Flux Control Compensation   |                |                 |
| Mode              | Open-Loop                                       |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit User Save                                 | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

If *Flux Control Compensation Disable* (05.028) = 0 the conversion from the *Final Torque Reference* (04.003) to *Final Current Reference* (04.004) uses the estimated level of motor flux. This is the preferred method of control as it ensures that the gain of the system remains constant in speed control mode and it gives the correct relationship between torque and current in torque control modes. However, it is possible to get instability in speed control mode when flux weakening is active at high speed if the *Motor Rated Speed* (05.008) is set to an incorrect value. If *Flux Control Compensation Disable* (05.028) = 1 the compensation for flux level is disabled which can sometimes prevent instability under these conditions.

| Parameter         | 05.031 <i>Voltage Controller Gain</i>                             |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the proportional gain of the d.c. link voltage controller |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 1   | Maximum        | 30              |
| Default           | 1   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

*Voltage Controller Gain* (05.031) can be used to modify the proportional gain of the d.c. link voltage controller used for standard ramp and supply loss control.



| Parameter         | 05.032 Torque Per Amp                                      |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the calculated value of kt for the attached motor |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0.00   | Maximum        | 500.00           |
| Default           |  | Units          | Nm/A             |
| Type              | 16 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 2                |
| Coding            | RO, ND, NC, PT, BU   |                |                  |

*Torque Per Amp* (05.032) is automatically calculated from the motor parameters assuming a motor efficiency of 90%.

*Torque Per Amp* (05.032) = Estimated rated shaft power /  $[(\text{Motor Rated Speed} \times 2\pi) / 60] \times I_{\text{Trated}}$

where

$I_{\text{Trated}}$  is the rated torque producing current and

Estimated rated shaft power =  $\sqrt{3} \times \text{Motor Rated Voltage}$  (05.009)  $\times \text{Motor Rated Current}$  (05.007)  $\times \text{Motor Rated Power Factor}$  (05.010)  $\times 0.9$

*Torque Per Amp* (05.032) is used in the automatic calculation of the speed controller gains.

| Parameter         | 05.033 Slip Compensation Limit          |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the limit for slip compensation |                |                 |
| Mode              | Open-Loop                               |                |                 |
| Minimum           | 0.00                                    | Maximum        | 10.00           |
| Default           | 10.00                                   | Units          | Hz              |
| Type              | 16 Bit User Save                        | Update Rate    | Background read |
| Display Format    | Standard                                | Decimal Places | 2               |
| Coding            | RW                                      |                |                 |

See *Slip Compensation Level* (05.027).

Symmetrical maximum of the slip compensation frequency.

| Parameter         | 05.035 Auto-switching Frequency Change Disable                            |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to prevent the drive from changing between switching frequencies |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0   | Maximum        | 2               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See *Maximum Switching Frequency* (05.018).

| Parameter         | 05.036 Slip Compensation Filter                                    |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the time constant of the filter used for slip compensation |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0  | Maximum        | 3               |
| Default           | 1  | Units          | ms              |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, TE   |                |                 |

| Value | Text |
|-------|------|
| 0     | 64   |
| 1     | 128  |
| 2     | 256  |
| 3     | 512  |

See *Slip Compensation Level* (05.027).

Time constant for the slip compensation filter.

| Parameter         | 05.037 Switching Frequency                                 |                |                            |
|-------------------|--|----------------|----------------------------|
| Short description | Displays the current switching frequency used by the drive |                |                            |
| Mode              | Open-Loop  |                |                            |
| Minimum           | 0  | Maximum        | VM_MAX_SWITCHING_FREQUENCY |
| Default           |  | Units          | kHz                        |
| Type              | 8 Bit Volatile   | Update Rate    | Background write           |
| Display Format    | Standard   | Decimal Places | 0                          |
| Coding            | RO, TE, VM, ND, NC, PT                                     |                |                            |

| Value | Text  | Description               |
|-------|-------|---------------------------|
| 0     | 0.667 | 667Hz switching frequency |
| 1     | 1     | 1kHz switching frequency  |
| 2     | 2     | 2kHz switching frequency  |
| 3     | 3     | 3kHz switching frequency  |
| 4     | 4     | 4kHz switching frequency  |
| 5     | 6     | 6kHz switching frequency  |
| 6     | 8     | 8kHz switching frequency  |
| 7     | 12    | 12kHz switching frequency |
| 8     | 16    | 16kHz switching frequency |

See *Maximum Switching Frequency* (05.018).

| Parameter         | 05.038 Minimum Switching Frequency                                    |                |                            |
|-------------------|---|----------------|----------------------------|
| Short description | Defines the minimum switching frequency that can be used by the drive |                |                            |
| Mode              | Open-Loop   |                |                            |
| Minimum           | 0   | Maximum        | VM_MAX_SWITCHING_FREQUENCY |
| Default           | 0   | Units          | kHz                        |
| Type              | 8 Bit User Save   | Update Rate    | Background read            |
| Display Format    | Standard  | Decimal Places | 0                          |
| Coding            | RW, TE, VM, RA  |                |                            |

| Value | Text  | Description               |
|-------|-------|---------------------------|
| 0     | 0.667 | 667Hz switching frequency |
| 1     | 1     | 1kHz switching frequency  |
| 2     | 2     | 2kHz switching frequency  |
| 3     | 3     | 3kHz switching frequency  |
| 4     | 4     | 4kHz switching frequency  |
| 5     | 6     | 6kHz switching frequency  |
| 6     | 8     | 8kHz switching frequency  |
| 7     | 12    | 12kHz switching frequency |
| 8     | 16    | 16kHz switching frequency |

*Minimum Switching Frequency* (05.038) defines the minimum frequency limit used if the inverter thermal model is actively reducing the switching frequency due to temperature.

Note that parameter *Maximum Switching Frequency* (05.018) takes priority over parameter *Minimum Switching Frequency* (05.038) so is not limited by parameter *Minimum Switching Frequency* (05.038). The actual minimum switching frequency limit used is the lower of *Maximum Switching Frequency* (05.018) and *Minimum Switching Frequency* (05.038).

| Parameter         | 05.040 Spin Start Boost  |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the level of spin start boost used by the algorithm that detects the speed of a spinning motor |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0.0  | Maximum        | 10.0             |
| Default           | 1.0  | Units          |                  |
| Type              | 8 Bit User Save  | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 1                |
| Coding            | RW   |                |                  |

*Spin Start Boost* (05.040) is used by the algorithm that detects the frequency of a spinning motor when the drive is enabled and *Catch A Spinning Motor* (06.009)  $\geq 1$ . For smaller motors the default value of 1.0 is suitable, but for larger motors *Spin Start Boost* (05.040) may need to be increased. If *Spin Start Boost* (05.040) is too small the drive will detect zero speed whatever the frequency of the motor, and if *Spin Start Boost* (05.040) is too large the motor may accelerate away from standstill when the drive is enabled.

| Parameter         | 05.042 Reverse Output Phase Sequence                  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to reverse the sequence on the output phases |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit User Save                                       | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

If *Reverse Output Phase Sequence* (05.042) = 0 the output phase sequence is U-V-W when *Output Frequency* (05.001) is positive and W-V-U when *Output Frequency* (05.001) is negative. If *Reverse Output Phase Sequence* (05.042) = 1 the output phase sequence is reversed so that the phase sequence in W-V-U for positive frequencies and U-V-W for negative frequencies.

| Parameter         | 05.059 Maximum Deadtime Compensation |                |                 |
|-------------------|--------------------------------------|----------------|-----------------|
| Short description | Maximum Deadtime Compensation        |                |                 |
| Mode              | Open-Loop                            |                |                 |
| Minimum           | 0.000                                | Maximum        | 10.000          |
| Default           | 0.000                                | Units          | μs              |
| Type              | 16 Bit User Save                     | Update Rate    | Background Read |
| Display Format    | Standard                             | Decimal Places | 3               |
| Coding            | RO, NC, PT                           |                |                 |

*Maximum Deadtime Compensation* (05.059) is the deadtime compensation used to compensate for dead-time effects in the inverter. This level of compensation is used when the drive output current is above *Current At Maximum Deadtime Compensation* (05.060) Both of these values related to dead-time compensation are measured during auto-tuning and cannot be set by the user. It should be noted that if the auto-tuning test is not performed and *Maximum Deadtime Compensation* (05.059) = 0 then dead-time compensation is disabled. Although it is not recommended, it is possible to disable dead-time compensation by setting *Disable Deadtime Compensation* (05.061) = 1.

| Parameter         | 05.060 Current At Maximum Deadtime Compensation           |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Current at which maximum deadtime compensation is applied |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0.00  | Maximum        | 100.00          |
| Default           | 0.00  | Units          | %               |
| Type              | 16 Bit User Save  | Update Rate    | Background Read |
| Display Format    | Standard  | Decimal Places | 2               |
| Coding            | RO, NC, PT  |                |                 |

See *Maximum Deadtime Compensation* (05.059).

| Parameter         | 05.061 Disable Deadtime Compensation |                |                 |
|-------------------|--------------------------------------|----------------|-----------------|
| Short description | Disable Deadtime Compensation        |                |                 |
| Mode              | Open-Loop                            |                |                 |
| Minimum           | 0                                    | Maximum        | 1               |
| Default           | 0                                    | Units          |                 |
| Type              | 1 Bit User Save                      | Update Rate    | Background Read |
| Display Format    | Standard                             | Decimal Places | 0               |
| Coding            | RW                                   |                |                 |

See *Maximum Deadtime Compensation* (05.059).

| Parameter         | 05.074 Boost End Voltage      |                |       |
|-------------------|-------------------------------|----------------|-------|
| Short description | Defines the boost end voltage |                |       |
| Mode              | Open-Loop                     |                |       |
| Minimum           | 0.0                           | Maximum        | 100.0 |
| Default           | 50.0                          | Units          | %     |
| Type              | 16 Bit User Save              | Update Rate    | 16ms  |
| Display Format    | Standard                      | Decimal Places | 1     |
| Coding            | RW                            |                |       |

See *Control Mode* (05.014).

Multiple point V to F characteristic.

A fixed frequency to voltage characteristic is used as shown above where the voltage at 0Hz is defined by *Low Frequency Voltage Boost* (05.015). The voltage characteristic moves linearly with output frequency passing through three points determined by [*Boost End Voltage* (05.074) and *Boost End Frequency* (05.075)], [*Second Point Voltage* (05.076) and *Second Point Frequency* (05.077)] and [*Motor Rated Voltage* (05.009) and *Motor Rated Frequency* (05.006)].

By default *Boost End Frequency* (05.075) is set to 50.0% of the *Motor Rated Frequency* (05.006), *Second Point Frequency* (05.077) is set to 55.0% and *Third point frequency* (05.079) is set to 75.0%.

By default *Boost End Voltage* (05.074) is set to 50.0% of the *Motor Rated Voltage* (05.009), *Second Point Voltage* (05.076) is set to 55.0% and *Third point voltage* (05.078) is set to 75.0%.

This is to produce the SK curve by default and the percentage method results in the curve naturally.

| Parameter         | <b>05.075 Boost End Frequency</b> |                |                 |
|-------------------|-----------------------------------|----------------|-----------------|
| Short description | Defines the boost end frequency   |                |                 |
| Mode              | Open-Loop                         |                |                 |
| Minimum           | 0.0                               | Maximum        | 100.0           |
| Default           | 50.0                              | Units          | %               |
| Type              | 16 Bit User Save                  | Update Rate    | Background read |
| Display Format    | Standard                          | Decimal Places | 1               |
| Coding            | RW                                |                |                 |

See *Control Mode* (05.014).

| Parameter         | <b>05.076 Second Point Voltage</b> |                |       |
|-------------------|------------------------------------|----------------|-------|
| Short description | Defines the second point voltage   |                |       |
| Mode              | Open-Loop                          |                |       |
| Minimum           | 0.0                                | Maximum        | 100.0 |
| Default           | 55.0                               | Units          | %     |
| Type              | 16 Bit User Save                   | Update Rate    | 16ms  |
| Display Format    | Standard                           | Decimal Places | 1     |
| Coding            | RW                                 |                |       |

See *Control Mode* (05.014).

| Parameter         | <b>05.077 Second Point Frequency</b> |                |                 |
|-------------------|--------------------------------------|----------------|-----------------|
| Short description | Defines the second point frequency   |                |                 |
| Mode              | Open-Loop                            |                |                 |
| Minimum           | 0.0                                  | Maximum        | 100.0           |
| Default           | 55.0                                 | Units          | %               |
| Type              | 16 Bit User Save                     | Update Rate    | Background read |
| Display Format    | Standard                             | Decimal Places | 1               |
| Coding            | RW                                   |                |                 |

See *Control Mode* (05.014).

| Parameter         | <b>05.078 Third point voltage</b> |                |       |
|-------------------|-----------------------------------|----------------|-------|
| Short description | Defines the third point voltage   |                |       |
| Mode              | Open-Loop                         |                |       |
| Minimum           | 0.0                               | Maximum        | 100.0 |
| Default           | 75.0                              | Units          | %     |
| Type              | 16 Bit User Save                  | Update Rate    | 16ms  |
| Display Format    | Standard                          | Decimal Places | 1     |
| Coding            | RW                                |                |       |

See *Control Mode* (05.014).

| Parameter         | <b>05.079 Third point frequency</b> |                |                 |
|-------------------|-------------------------------------|----------------|-----------------|
| Short description | Defines the third point frequency   |                |                 |
| Mode              | Open-Loop                           |                |                 |
| Minimum           | 0.0                                 | Maximum        | 100.0           |
| Default           | 75.0                                | Units          | %               |
| Type              | 16 Bit User Save                    | Update Rate    | Background read |
| Display Format    | Standard                            | Decimal Places | 1               |
| Coding            | RW                                  |                |                 |

See *Control Mode* (05.014).

| Parameter         | <b>05.080 Low acoustic noise enable</b>                                   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to change the modulation to reduce the switching frequency noise |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

Open loop modes only. User set maximum switching frequencies 2kHz to 6kHz only.

When this parameter is one, the modulation scheme is modified to reduce the fundamental switching frequency acoustic noise.

When this mode is enabled, the effect of the switching frequency fundamental in the output voltage is reduced by moving the switching points of the output phases in each PWM switching period by the same randomly weighted offset. This reduces the level of noise from the switching frequency but will introduce noise at lower and higher frequencies at a lower level. The maximum offset reduces as the output voltage increases if the dc bus voltage level remains constant.

| Parameter         | 05.081 <i>Change to maximum drive switching frequency at low output current</i> |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Change to maximum drive switching frequency at low output current               |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

Open-loop and RFC modes. User set maximum switching frequencies 2kHz to 6kHz only.

Swaps to 16kHz if the output current magnitude is less than 30% (Frame sizes 1-4) and 20% (Frame sizes 5 and above) drive OI.AC limit for longer than 100ms.

Swaps back immediately if the output current magnitude is greater than 15% drive OI.AC limit.

The original switching frequency may still be under the control of the inverter thermal model. This feature is disabled if the thermal model or user have changed the switching frequency within the last 10 seconds.

| Parameter         | 05.083 <i>Voltage Shelving Disable</i>                                     |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to 1 to only measure the d.c. link voltage when the inverter is active |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

When this parameter is one, the DC link voltage will only be measured when the inverter is inactive.

Open loop mode only.

A 128ms filtered version of the Vdc measurement is sampled only when the inverter stack is inactive.

The sampled filtered version of the vdc measurement is limited to between +/-10% of the actual measured vdc while the drive inverter is inactive. This sampled level for the Vdc is used instead of the actual measurement when the demand voltage is converted to a modulation index to be used by the inverter.

This removes the dc bus voltage forward compensation. It will also removed the effects of "oscillation" experienced when the drive is supplied by an extremely soft supply of through a high inductance filter.

| Parameter         | 05.084 <i>Low Frequency Slip Boost</i>  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Controls the boost level of the slip frequency when the output frequency is below one third of the rated frequency. |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0.0   | Maximum        | 100.0           |
| Default           | 0.0   | Units          | %               |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 1               |
| Coding            | RW  |                |                 |

#### Open-Loop mode:

In resistor compensation open loop modes (*Control Mode* (05.014) set to 0, 1, 3, and 4):

If the rated slip frequency is non-zero, the rated slip frequency (see *Motor Rated Frequency* (05.006) can be modified when the output frequency is below one third of the motor rate frequency to provide a torque boost.

The modification consists of an addition to the calculated slip frequency controlled by the user parameter *Low Frequency Estimator Threshold*, *Low Frequency Slip Boost* (05.084). The addition is equal to *Low Frequency Estimator Threshold*, *Low Frequency Slip Boost* (05.084) at zero Hz falling linearly to 0.0% at one third of the motor rated frequency.

If the rated slip frequency is zero, the amount of stator resistor compensation can be modified when the output frequency is below one tenth of the motor rate frequency to provide a torque boost. The modification consists of an addition to the calculated stator resistor compensation controlled by the user parameter *Low Frequency Estimator Threshold*, *Low Frequency Slip Boost* (05.084). The addition is equal to *Low Frequency Estimator Threshold*, *Low Frequency Slip Boost* (05.084). at zero Hz falling linearly to 0.0% at one tenth of the motor rated frequency.

In fixed boost tapered open loop control (*Control Mode* (05.014) set to 6):

*Low Frequency Estimator Threshold*, *Low Frequency Slip Boost* (05.084) sets the frequency at which the taper of the slip begins. This is expressed in *Low Frequency Estimator Threshold*, *Low Frequency Slip Boost* (05.084) as a percentage of the motor rated frequency, *Motor Rated Frequency* (05.006) . See #5.014 = 6.

#### RFC-A mode:

If *Low Frequency Estimator Threshold, Low Frequency Slip Boost* (05.084) = 0.0% (default) the RFC-A speed estimator is used when the ramp output is greater than the rated motor frequency divided by 64.

If *Low Frequency Estimator Threshold, Low Frequency Slip Boost* (05.084) > 0.0% , the RFC-A speed estimator is used when the ramp output is greater than the rated motor frequency divided by 128.

| Parameter         | 05.088 <i>Ur Mode Pre-Flux delay</i>  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | The delay begins as the motor starts to run and during the pre-flux delay the torque axis voltage compensation is held at zero. |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0.0   | Maximum        | 0.7             |
| Default           | 0.5   | Units          | s               |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 1               |
| Coding            | RW  |                |                 |

Setting *Ur Mode Pre-Flux delay* to a value from 0.0s to 0.7s will configure the Ur mode pre-flux delay. The delay begins as the motor starts to run and during the pre-flux delay the torque axis voltage compensation is held at zero. The delay provides time for the flux to build up to reduce the risk of unstable behaviour during motor starting. The user configurable delay function has been added for use with the brake macro, where the mechanical brake is holding the shaft while the motor is started. The delay can be set depending on the motor and the system.

## Menu 6 Single Line Descriptions – *Sequencer and Clock*

Mode: Open-Loop

| Parameter |                                      | Range   | Default   | Type |      |    |    |    |    |
|-----------|--------------------------------------|---|---|------|------|----|----|----|----|
| 06.001    | Stop Mode                            | Coast (0), rp (1), rP.dcl (2), dc l (3), td.dcl (4), Dis (5)    | rp (1)  | RW   | Txt  |    |    |    | US |
| 06.002    | Limit Switch Stop Mode               | Stop (0), rp (1)  | rp (1)  | RW   | Txt  |    |    |    | US |
| 06.003    | Supply Loss Mode                     | Dis (0), rP.Stop (1), ridE.th (2), Lt.Stop (3)                  | Dis (0)   | RW   | Txt  |    |    |    | US |
| 06.004    | Start/Stop Logic Select              | 0 to 6  | 50Hz: 0<br>60Hz: 4  | RW   | Num  |    |    |    | US |
| 06.006    | Injection Braking Level              | 0.0 to 150.0 %  | 100.0 %   | RW   | Num  |    | RA |    | US |
| 06.007    | Injection Braking Time               | 0.0 to 100.0 s  | 1.0 s   | RW   | Num  |    |    |    | US |
| 06.008    | Hold Zero Frequency                  | Off (0) or On (1)   | Off (0)   | RW   | Bit  |    |    |    | US |
| 06.009    | Catch A Spinning Motor               | Dis (0), Enable (1), Fr.Only (2), Rv.Only (3)                   | Dis (0)   | RW   | Txt  |    |    |    | US |
| 06.010    | Enable Conditions                    | 000000000000 to 111111110111                                    |   | RO   | Bin  | ND | NC | PT |    |
| 06.011    | Sequencer State Machine Inputs       | 0000000 to 1111111  |   | RO   | Bin  | ND | NC | PT |    |
| 06.012    | Enable Stop Key                      | Off (0) or On (1)   | Off (0)   | RW   | Bit  |    |    |    | US |
| 06.013    | Enable Auxiliary Key                 | Dis (0), Fd.Rv (1), Rev (2)                                     | Dis (0)   | RW   | Txt  |    |    |    | US |
| 06.014    | Disable Auto Reset On Enable         | Off (0) or On (1)   | Off (0)   | RW   | Bit  |    |    |    | US |
| 06.015    | Drive Enable                         | Off (0) or On (1)   | On (1)  | RW   | Bit  |    |    |    | US |
| 06.016    | Date                                 | 00-00-00 to 31-12-99  |   | RW   | Date | ND | NC | PT |    |
| 06.017    | Time                                 | 00:00:00 to 23:59:59  |   | RW   | Time | ND | NC | PT |    |
| 06.018    | Day Of Week                          | Sun (0), Non (1), Tue (2), Ued (3), Thu (4), Fri (5), Sat (6)   |   | RO   | Txt  | ND | NC | PT |    |
| 06.019    | Date/Time Selector                   | Set (0), Po.up (1), Run (2), Acc.Po (3), Re.Pad (5), Slot.1 (6) | Po.up (1)   | RW   | Txt  |    |    |    | US |
| 06.020    | Date Format                          | Std (0), US (1)   | Std (0)   | RW   | Txt  |    |    |    | US |
| 06.021    | Time Between Filter Changes          | 0 to 30000 Hours  | 0 Hours   | RW   | Num  |    |    |    | US |
| 06.022    | Filter Change Required / Change Done | Off (0) or On (1)   |   | RW   | Bit  | ND | NC |    |    |
| 06.023    | Time Before Filter Change Due        | 0 to 30000 Hours  |   | RO   | Num  | ND | NC | PT | PS |
| 06.024    | Reset Energy Meter                   | Off (0) or On (1)   | Off (0)   | RW   | Bit  |    |    |    |    |
| 06.025    | Energy Meter: MWh                    | ±999.9 MWh  |   | RO   | Num  | ND | NC | PT | PS |
| 06.026    | Energy Meter: kWh                    | ±99.99 kWh  |   | RO   | Num  | ND | NC | PT | PS |
| 06.027    | Energy Cost Per kWh                  | 0.0 to 600.0  | 0.0   | RW   | Num  |    |    |    | US |
| 06.028    | Running Cost                         | ±32000  |   | RO   | Num  | ND | NC | PT |    |
| 06.029    | Hardware Enable                      | Off (0) or On (1)   | On (1)  | RO   | Bit  |    | NC |    |    |
| 06.030    | Run Forward                          | Off (0) or On (1)   | Off (0)   | RW   | Bit  |    | NC |    |    |
| 06.031    | Jog Forward                          | Off (0) or On (1)   | Off (0)   | RW   | Bit  |    | NC |    |    |
| 06.032    | Run Reverse                          | Off (0) or On (1)   | Off (0)   | RW   | Bit  |    | NC |    |    |
| 06.033    | Forward/Reverse                      | Off (0) or On (1)   | Off (0)   | RW   | Bit  |    | NC |    |    |
| 06.034    | Run                                  | Off (0) or On (1)   | Off (0)   | RW   | Bit  |    | NC |    |    |
| 06.035    | Forward Limit Switch                 | Off (0) or On (1)   | Off (0)   | RW   | Bit  |    | NC |    |    |
| 06.036    | Reverse Limit Switch                 | Off (0) or On (1)   | Off (0)   | RW   | Bit  |    | NC |    |    |
| 06.037    | Jog Reverse                          | Off (0) or On (1)   | Off (0)   | RW   | Bit  |    | NC |    |    |
| 06.038    | User Enable                          | Off (0) or On (1)   | Off (0)   | RW   | Bit  |    | NC |    |    |
| 06.039    | Not Stop                             | Off (0) or On (1)   | Off (0)   | RW   | Bit  |    | NC |    |    |
| 06.040    | Enable Sequencer Latching            | Off (0) or On (1)   | Off (0)   | RW   | Bit  |    |    |    | US |
| 06.041    | Drive Event Flags                    | 00 to 11  | 00  | RW   | Bin  |    | NC |    |    |
| 06.042    | Control Word                         | 00000000000000 to 11111111111111                                | 00000000000000  | RW   | Bin  |    | NC |    |    |
| 06.043    | Control Word Enable                  | 0 to 1  | 0   | RW   | Num  |    | NC |    | US |
| 06.045    | Cooling Fan control                  | 0 to 5  | 2   | RW   | Num  |    |    |    | US |
| 06.046    | Supply Loss Hold Disable             | Off (0) or On (1)   | Off (0)   | RW   | Bit  |    |    |    | US |
| 06.047    | Input Phase Loss Detection Mode      | Full (0), RIPPLE (1), Dis (2)                                   | Full (0)  | RW   | Txt  |    |    |    | US |
| 06.048    | Supply Loss Detection Level          | 0 to VM_SUPPLY_LOSS_LEVEL V                                     | 110V drive: 205 V<br>200V drive: 205 V<br>400V drive: 410 V<br>575V drive: 540 V<br>690V drive: 540 V | RW   | Num  |    | RA |    | US |
| 06.051    | Hold Supply Loss Active              | Off (0) or On (1)   | Off (0)   | RW   | Bit  |    | NC |    |    |
| 06.052    | Motor Pre-heat Current Magnitude     | 0 to 100 %  | 0 %   | RW   | Num  |    |    |    | US |
| 06.058    | Output Phase Loss Detection Time     | 0.5 (0), 1.0 (1), 2.0 (2), 4.0 (3)                              | 0.5 (0)   | RW   | Txt  |    |    |    | US |
| 06.059    | Output Phase Loss Detection Enable   | Off (0) or On (1)   | Off (0)   | RW   | Bit  |    |    |    | US |
| 06.060    | Standby Mode Enable                  | Off (0) or On (1)   | Off (0)   | RW   | Bit  |    |    |    | US |
| 06.061    | Standby Mode Mask                    | 0000 to 1111  | 0000  | RW   | Bin  |    |    |    | US |
| 06.071    | Slow Rectifier Charge Rate Enable    | Off (0) or On (1)   | Off (0)   | RW   | Bit  |    |    |    | US |
| 06.073    | Braking IGBT Lower Threshold         | ±VM_DC_VOLTAGE_SET V  | 110V drive: 390 V<br>200V drive: 390 V<br>400V drive: 780 V<br>575V drive: 930 V                      | RW   | Num  |    | RA |    | US |



|        |   |                      |  |    |     |  |    |    |    |
|--------|---|----------------------|--|----|-----|--|----|----|----|
|        |   |                      | 690V drive: 1120 V   |    |     |  |    |    |    |
| 06.074 | Braking IGBT Upper Threshold              | ±VM_DC_VOLTAGE_SET V | 110V drive: 390 V<br>200V drive: 390 V<br>400V drive: 780 V<br>575V drive: 930 V<br>690V drive: 1120 V | RW | Num |  | RA |    | US |
| 06.075 | Low Voltage Braking IGBT Threshold        | ±VM_DC_VOLTAGE_SET V | 0 V  | RW | Num |  | RA |    | US |
| 06.076 | Low Voltage Braking IGBT Threshold Select | Off (0) or On (1)    | Off (0)  | RW | Bit |  |    |    |    |
| 06.077 | Low DC Link Operation                     | Off (0) or On (1)    | Off (0)  | RW | Bit |  |    |    | US |
| 06.084 | UTC Offset                                | ±24.00 Hours         | 0.00 Hours   | RW | Num |  |    |    | US |
| 06.089 | DC Injection Active                       | Off (0) or On (1)    | Off (0)  | RO | Bit |  | NC | PT | US |

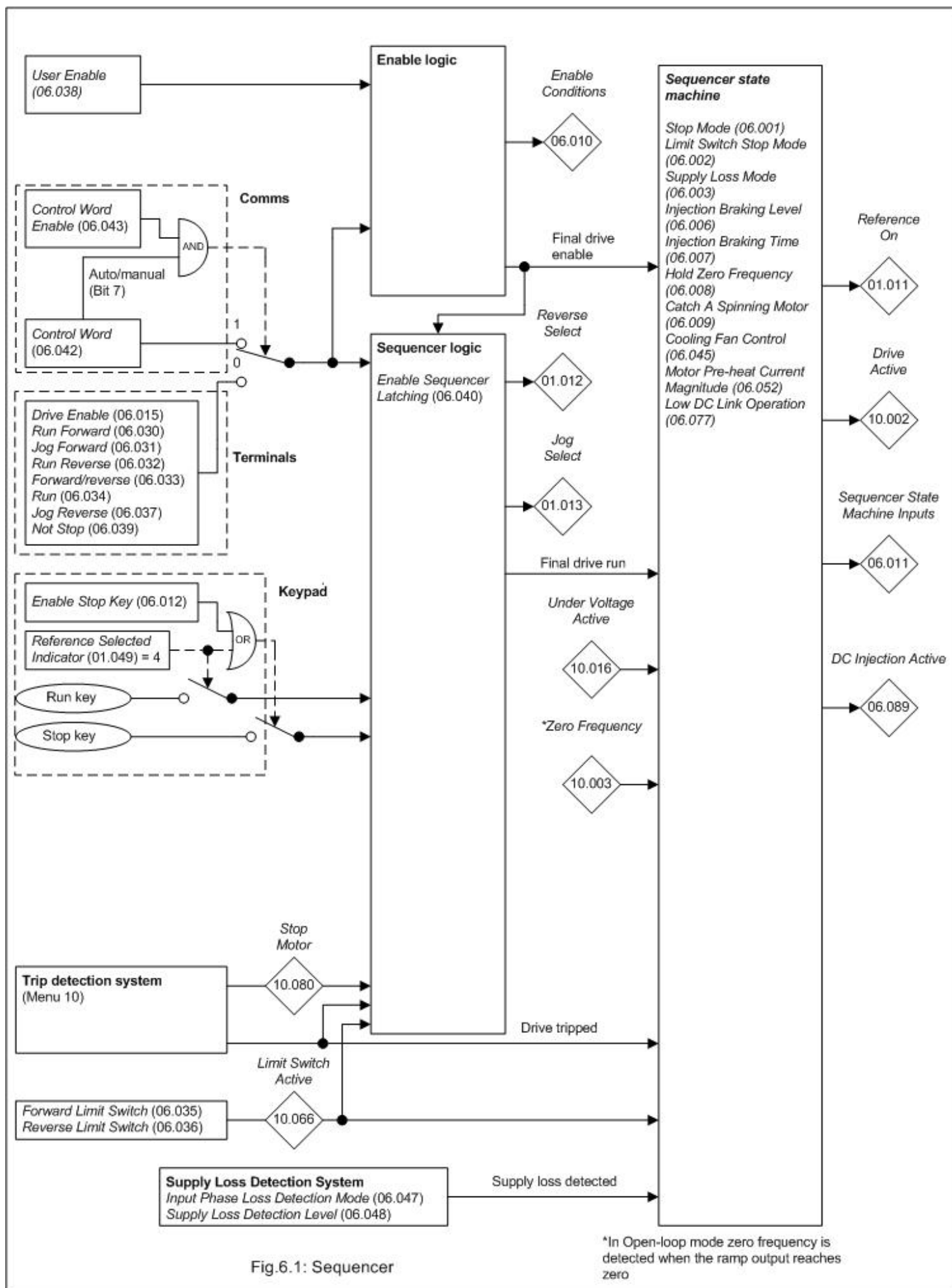
| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

## Menu 6 – *Sequencer and Clock*

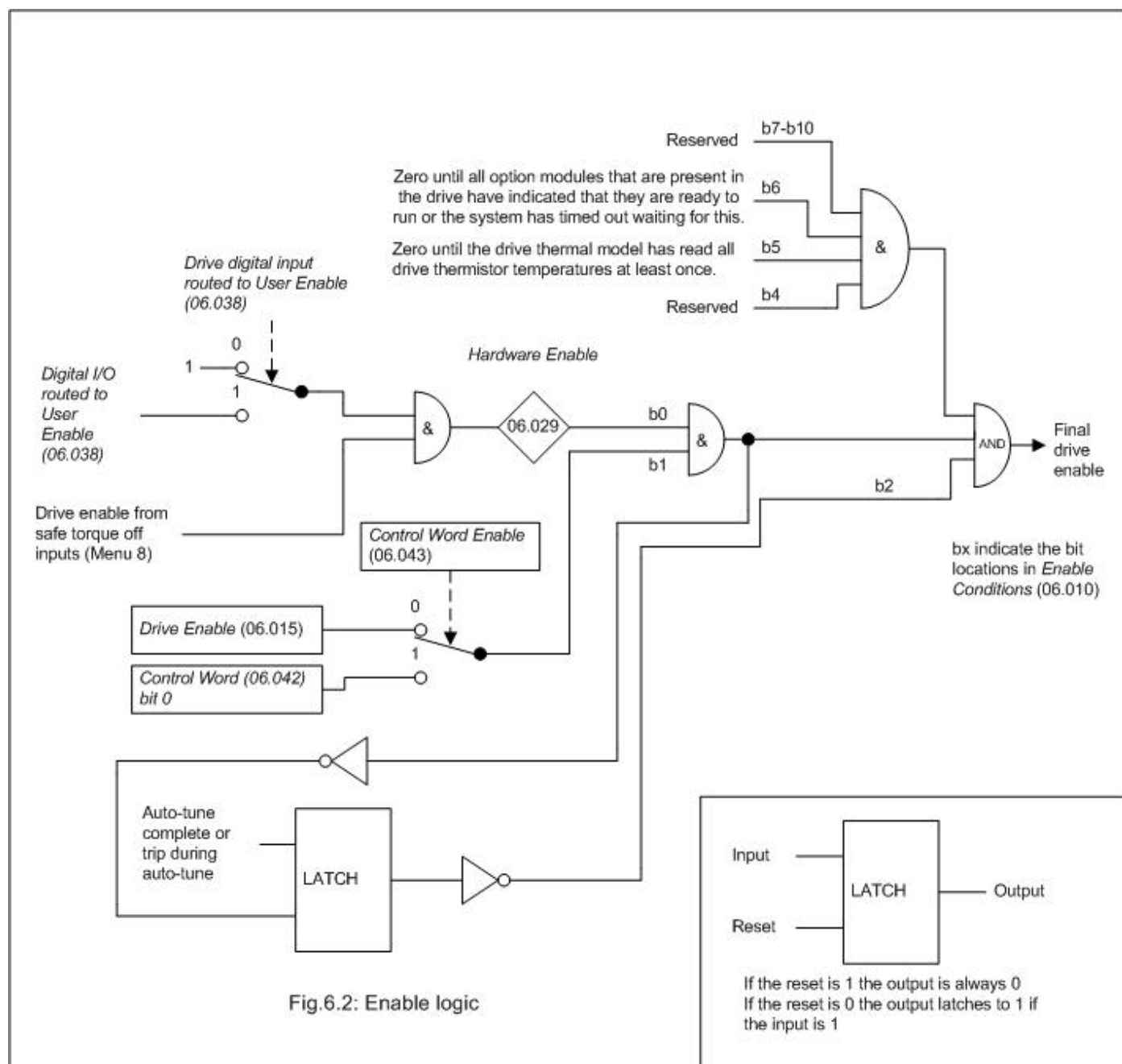
Mode: Open-Loop

### **Sequencer**

The diagram below shows the sequencer all modes.



The sequencer, which provides overall control of the drive, is implemented in two stages. The first stage includes the enable logic and sequencer logic and consists of static logic elements. The second stage is a state machine with internal states.



**Hardware Enable (06.029)** follows the safe torque off enable signal provided none of the digital inputs that are integral to the drive are routed to the **User Enable (06.038)**. The safe torque off hardware includes a delay in detecting a change from the enable to disable state of up to 20ms, but for most applications this is not a problem.

If the safety function of the safe torque off input is required then there must not be a direct connection between the safe torque off input and any other digital I/O on the drive. If the safety function of the safe torque off input and a disable function are required together, then the drive should be given two separate independent enable input signals. A signal from a safe source should be connected to the safe torque off input on the drive. A second enable should be connected to the digital I/O selected for the disable function. The circuit must be arranged so that a fault which causes the digital input to be forced high cannot cause the safe torque off input to be forced high as well, including the case where a component such as a blocking diode has failed.

## Sequencer logic

The diagram below shows the sequencer logic when *Reference Selected Indicator* (01.049) is not equal to 4 (i.e. keypad control mode is not selected). The definition of the logic symbols are given in Fig.6.5

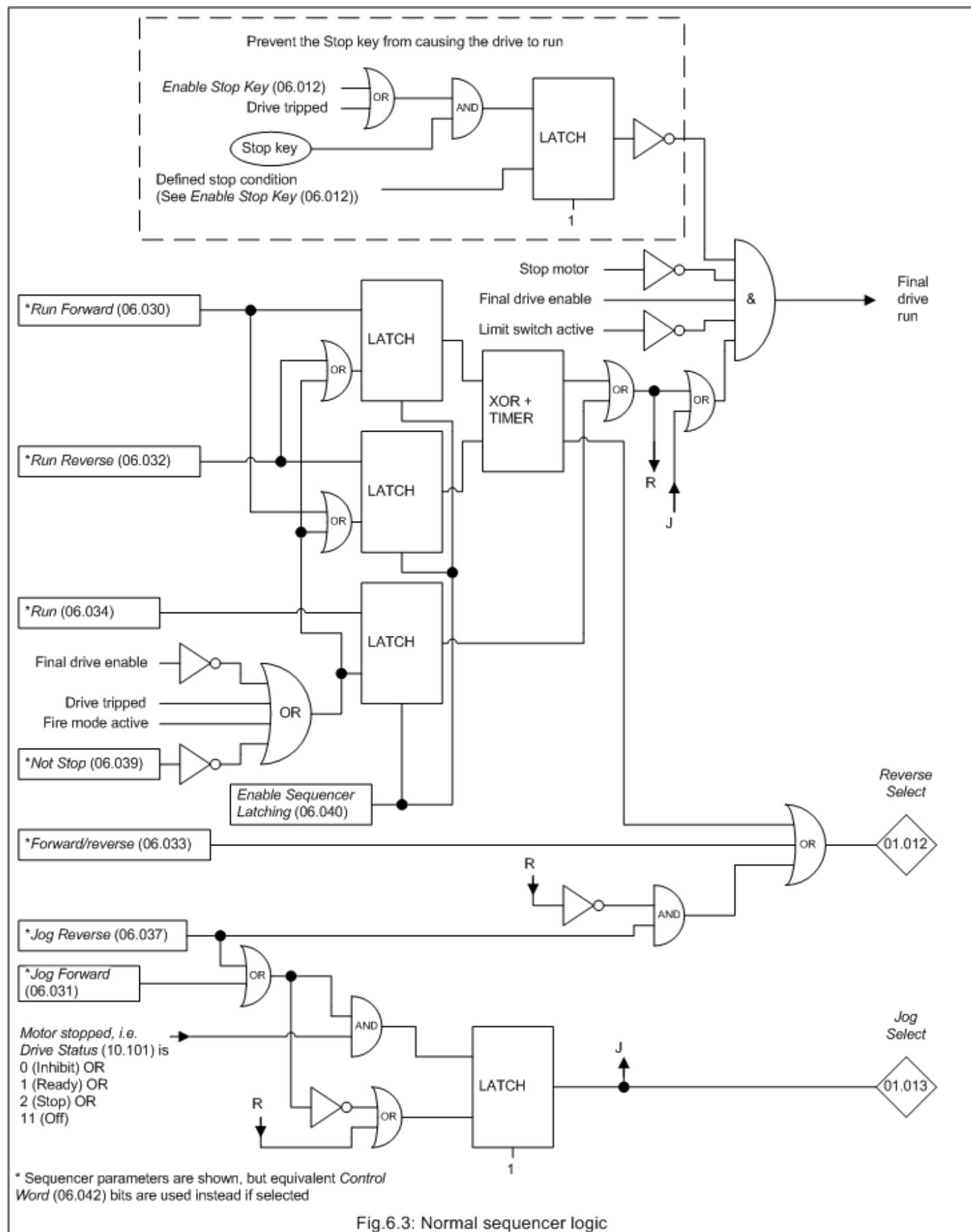
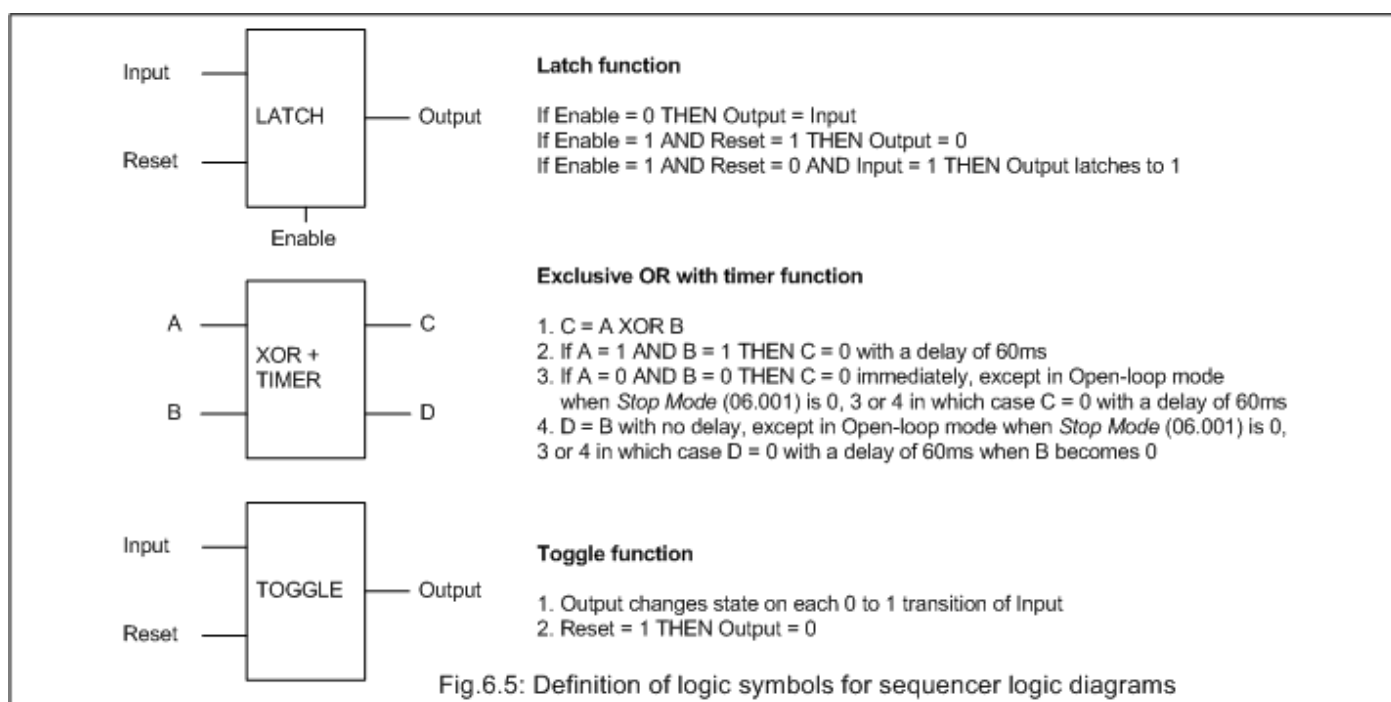
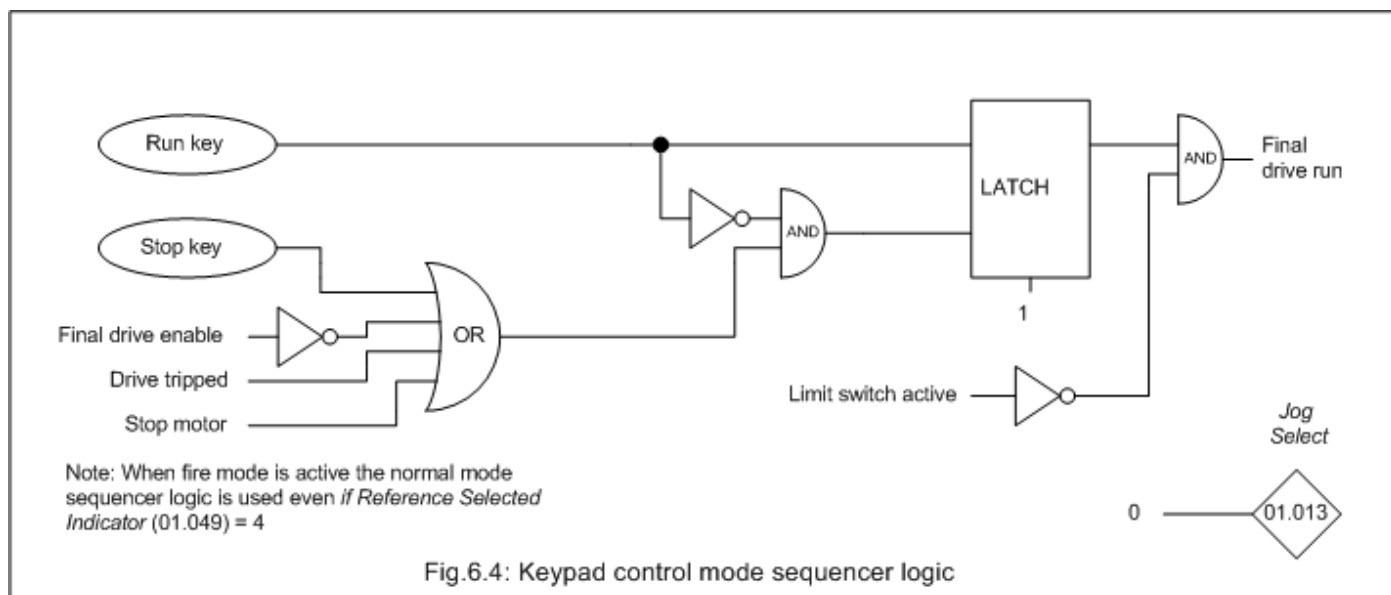


Fig.6.3: Normal sequencer logic

The diagram below shows the sequencer logic when *Reference Selected Indicator* (01.049) = 4 (i.e. keypad control mode is selected). The definition of the logic symbols are given in Fig.6.7



Throughout this section reference is made to the sequencer bit parameters *Drive Enable* (06.015), *Run Forward* (06.030), *Jog Forward* (06.031), *Run Reverse* (06.032), *Forward/Reverse* (06.033), *Run* (06.034), *Jog Reverse* (06.037) and *Not Stop* (06.039). If *Control Word Enable* (06.043) = 1 and bit 7 (Auto/manual) in the *Control Word* (06.042) is 1 then the appropriate bits in the control word are used instead.

| Parameter         | 06.001 Stop Mode  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines how the motor is controlled when the run signal is removed from the drive |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0   | Maximum        | 5               |
| Default           | 1   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text   | Description   |
|-------|--------|---|
| 0     | Coast  | Coast stop  |
| 1     | rp     | Ramp stop   |
| 2     | rP.dcl | Ramp stop + 1 second dc injection                   |
| 3     | dc I   | Injection braking stop with detection of zero speed |
| 4     | td.dcl | Timed injection braking stop                        |
| 5     | Dis    | Disable   |

Stopping is in two distinct phases as shown in the table below for each of the possible values of *Stop Mode* (06.001).

| Stop Mode (06.001)                              | Phase 1  | Phase 2  | Comments  |
|---|--|--|---|
| 0: Coast  | Inverter disabled  | Drive cannot be re-enabled for 1s  | Delay in phase 2 allows rotor flux to decay   |
| 1: Ramp   | Ramp down to zero frequency  | Wait for 1s with inverter enabled  |   |
| 2: Ramp followed by d.c. injection              | Ramp down to zero frequency  | Inject d.c. at level defined by <i>Injection Braking Level</i> (06.006) for time defined by <i>Injection Braking Time</i> (06.007) |   |
| 3: D.c. injection with zero frequency detection | Low frequency current injection with detection of low speed before next phase  | Inject d.c. at level defined by <i>Injection Braking Level</i> (06.006) for time defined by <i>Injection Braking Time</i> (06.007) | The drive automatically senses low speed and adjusts the injection time to suit the application |
| 4: Timed d.c. injection stop                    | Inject d.c. at level defined by <i>Injection Braking Level</i> (06.006) for time defined by <i>Injection Braking Time</i> (06.007) | Inject d.c. at level defined by <i>Injection Braking Level</i> (06.006) for 1s.  | The minimum total injection time is 1s for phase 1 and 1s for phase 2, i.e. 2s in total.        |
| 5: Disable                                      | Inverter disabled  | No phase 2   | Allows drive to be disabled then re-enabled immediately   |

The following should be noted:

- Once phase 1 has begun with *Stop Mode* (06.001) = 3 or 4 the stopping sequence must be completed or terminated by de-activating the Final drive enable or because the drive has tripped.
- If *Stop Mode* (06.001) = 5 the drive can be disabled and re-enabled immediately if the Final drive run is de-activated to stop the drive. If the Final drive enable is used to stop the drive then there is a 1s delay before the drive can be re-enabled.

| Parameter         | 06.002 Limit Switch Stop Mode                                  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the behaviour of the drive when limit switch is active |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 1  | Units          |                 |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, TE   |                |                 |

| Value | Text |
|-------|------|
| 0     | Stop |
| 1     | rp   |

If *Limit Switch Stop Mode* (06.002) = 0 then when *Limit Switch Active* (10.066) is activated the motor is stopped without ramps (under current limit for closed loop or dc injection for open loop).

If *Limit Switch Stop Mode* (06.002) = 1 then the motor is stopped with the currently selected ramp rate.

| Parameter         | 06.003 Supply Loss Mode   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the behaviour of the drive when the supply voltage is reduced |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0   | Maximum        | 3               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text    | Description  |
|-------|---------|--------------|
| 0     | Dis     | Disabled     |
| 1     | rP.Stop | Ramp stop    |
| 2     | ridE.th | Ride through |
| 3     | Lt.Stop | Limit stop   |

If *Supply Loss Mode* (06.003) > 0 and the *D.c. Link Voltage* (05.005) falls below *Supply Loss Detection Level* (06.048) then the supply loss condition is detected. If *Supply Loss Mode* (06.003) = 2 (ride through) the supply loss system will attempt to control the *D.c. Link Voltage* (05.005) to a level just below the *Supply Loss Detection Level* (06.048) using a d.c. link voltage controller which provides a torque producing current reference to the current controllers to regulate the power flow into the d.c. link. Therefore *Current Controller Kp Gain* (04.013) and *Current Controller Ki Gain* (04.014) must be set up correctly for the application. When the supply is reapplied it must be at a level that is high enough for the *D.c. Link Voltage* (05.005) to rise above *Supply Loss Detection Level* (06.048) plus a hysteresis margin. This will disable the supply loss controller and the drive will return to normal operation. The table below gives the d.c. link voltage levels used by the supply loss detection system for different drive voltage ratings.

| Voltage level   | 200V  | 400V  | 575V  | 690V  |
|---|---|---|---|---|
| Supply loss d.c. link voltage control level                               | <i>Supply Loss Detection Level</i> (06.048) - 10V | <i>Supply Loss Detection Level</i> (06.048) - 20V | <i>Supply Loss Detection Level</i> (06.048) - 25V | <i>Supply Loss Detection Level</i> (06.048) - 25V |
| Voltage above which supply loss detection changes from active to inactive | <i>Supply Loss Detection Level</i> (06.048) + 10V | <i>Supply Loss Detection Level</i> (06.048) + 15V | <i>Supply Loss Detection Level</i> (06.048) + 50V | <i>Supply Loss Detection Level</i> (06.048) + 50V |

#### 0: Disable

No supply loss detection is provided by monitoring the *D.c. Link Voltage* (05.005). The drive will continue to operate normally unless the under voltage

condition is detected.

### 1: Ramp Stop

The action taken by the drive is the same as for ride through mode, except that the ramp down rate is at least as fast as the currently selected deceleration ramp and the drive will continue to decelerate and stop even if the supply is re-applied. If *Stop Mode* (06.001) = 3 or 4 (i.e. d.c. injection) the drive will use ramp mode to stop on loss of the supply. If *Stop Mode* (06.001) = 2 (i.e. ramp stop followed by injection) the drive will ramp to a stop and then attempt to apply d.c. injection. The ramp down rate is at least as fast as the currently selected deceleration ramp and the drive will continue to decelerate and stop even if the supply is re-applied. Once the sequencer state machine has reached the DISABLE state the drive can restart provided the necessary controls are still active to initiate a start.

### 2: Ride through

The drive attempts to control the d.c. link voltage to take energy from the motor and load inertia to ride through the Supply loss condition for as long as possible.

### 3: Limit Stop - Closed loop

The frequency 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 supply is re-applied while the motor is stopping any run signal is ignored until the motor has stopped. If the current limit value is set at a very low level the drive may trip UU before the motor has stopped. Once the sequencer state machine has reached the DISABLE state the drive can restart provided the necessary controls are still active to initiate a start.

| Parameter         | 06.004 Start/Stop Logic Select |                |  |
|-------------------|--------------------------------|----------------|--|
| Short description |                                |                |  |
| Mode              | Open-Loop                      |                |  |
| Minimum           | 0                              | Maximum        | 6  |
| Default           | See exceptions below           | Units          |  |
| Type              | 8 Bit User Save                | Update Rate    | Actioned on exit of edit mode and on drive reset |
| Display Format    | Standard                       | Decimal Places | 0  |
| Coding            | RW                             |                |  |

| Region | Default Value |
|--------|---------------|
| 50Hz   | 0             |
| 60Hz   | 4             |

This parameter changes the functions of the input terminals which are normally associated with the enabling, starting and stopping the drive. This also writes to *Enable Sequencer Latching* (06.040) to enable and disable the input latches.

| Start/Stop Logic Select (06.004) | Digital I/O 2     | Digital Input 3   | Digital Input 4   |   |
|----------------------------------|-------------------|-------------------|-------------------|---|
| Base and Standard                | Terminal 8        | Terminal 9        | Terminal 10       | <i>Enable Sequencer Latching</i> (06.040) |
| Premium                          | Terminal 11       | Terminal 12       | Terminal 13       | <i>Enable Sequencer Latching</i> (06.040) |
| 0 (default)                      | User Enable       | Run Forward       | Run Reverse       | 0 (non-latching)                          |
| 1                                | Not Stop          | Run Forward       | Run Reverse       | 1 (latching)                              |
| 2                                | User Enable       | Run               | Reverse           | 0 (non-latching)                          |
| 3                                | Not Stop          | Run               | Reverse           | 1 (latching)                              |
| 4                                | Not Stop          | Run               | Jog Forward       | 1 (latching)                              |
| 5                                | User programmable | Run Forward       | Run Reverse       | 0 (non-latching)                          |
| 6                                | User programmable | User programmable | User programmable | User programmable                         |

*Start/Stop Logic Select* (06.004), *Enable Sequencer Latching* (06.040), *Digital IO2 Source/Destination A* (08.022), *Digital Input 03 Destination A* (08.023) and *Digital Input 04 Destination A* (08.024) are also saved when this parameter is modified. Action will only occur if the drive is inactive. If the drive is active the parameter will return to its pre altered value on exit from edit mode. In mode 6 the user is free to assign the terminals as appropriate to their application.

| Parameter         | 06.006 Injection Braking Level                          |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the level of current used for injection braking |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0.0   | Maximum        | 150.0           |
| Default           | 100.0   | Units          | %               |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 1               |
| Coding            | RW, RA  |                |                 |

### Open loop control mode

*Injection Braking Level* (06.006) defines the level of current used for injection braking as a percentage of *Motor Rated Current* (05.007).



| Parameter         | 06.007 Injection Braking Time   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the time during which d.c. current is injected into the motor during stopping with injection stopping modes |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0.0   | Maximum        | 100.0           |
| Default           | 1.0   | Units          | s               |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 1               |
| Coding            | RW  |                |                 |

#### Open loop control mode

*Injection Braking Time* (06.007) defines the time during which d.c. current is injected into the motor during stopping with injection stopping modes. See *Stop Mode* (06.001).

| Parameter         | 06.008 Hold Zero Frequency                   |                |      |
|-------------------|--|----------------|------|
| Short description | Set to 1 to hold the motor at zero frequency |                |      |
| Mode              | Open-Loop                                    |                |      |
| Minimum           | 0  | Maximum        | 1    |
| Default           | 0  | Units          |      |
| Type              | 1 Bit User Save                              | Update Rate    | 16ms |
| Display Format    | Standard                                     | Decimal Places | 0    |
| Coding            | RW   |                |      |

If *Hold Zero Frequency* (06.008) = 0 the sequencer state machine goes to the DISABLE state and the inverter is disabled when the Final drive run is de-activated and the motor reaches standstill.

If *Hold Zero Frequency* (06.008) = 1 and *Motor Pre-heat Current Magnitude* (06.052) = 0% the sequencer state machine goes to the STOP state when the Final drive run is de-activated and the motor reaches standstill. The drive remains enabled with a frequency reference of zero. If *Motor Pre-heat Current Magnitude* (06.052) is set to a non-zero value it defines the current in the motor when the sequencer state machine is in the STOP state. This is intended for applications where there is no motor load at standstill, but motor current is required to prevent condensation in the motor when it is stopped. If the motor is not force cooled the motor cooling is less effective at standstill than when the motor is rotating, and so care should be taken not to damage the motor by leaving it at standstill for prolonged periods with a high level of current.

When in HEAT mode i.e. *Motor Pre-heat Current Magnitude* (06.052) is non-zero value, the current used is a percentage of the motor rated current.

| Parameter         | 06.009 Catch A Spinning Motor  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the behaviour of the drive when the drive is enabled whilst the motor is not at zero frequency |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0  | Maximum        | 3               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, TE   |                |                 |

| Value | Text    |
|-------|---------|
| 0     | Dis     |
| 1     | Enable  |
| 2     | Fr.Only |
| 3     | Rv.Only |

If *Catch A Spinning Motor* (06.009) = 0 the *Post Ramp Reference* (02.001) is set to zero when the drive is started. This is suitable for applications where the motor is at standstill or rotating at a low speed when the drive is enabled. However, if *Catch A Spinning Motor* (06.009) > 0 the sensorless control algorithm will pre-load the *Post Ramp Reference* (02.001) in a similar way to the Open loop mode test and give a smooth start even if the motor is already spinning. The direction of frequency detection can be restricted in the same way as for Open loop mode if *Catch A Spinning Motor* (06.009) is set to a value of 2 or 3.

If *Catch A Spinning Motor* (06.009) > 0 a test is carried out to measure the frequency of the motor when the sequencer state machine enters the RUN state. The minimum time for the test is approximately 250ms, but this may be extended as time is allowed for the motor flux to build up based on the setting of the motor parameters including *Motor Rated Speed* (05.008) which should be set to approximately the correct value. The measured frequency is used to preset the *Post Ramp Reference* (02.001) and give a smooth start even if the motor is already spinning. The test is not carried out if the Final drive run is activated when the sequencer state machine is in the STOP state or if a stator resistance measurement is carried out when the drive is enabled (see *Control Mode* (05.014)). For the test to be successful it is important that the motor parameters, and especially the *Stator Resistance* (05.017), are set up correctly even if fixed boost mode is selected with *Control Mode* (05.014). For larger motors it may also be necessary for *Spin Start Boost* (05.040) to be increased from its default value of 1.0.

Restrictions can be placed on the direction of movement and the possible direction of the detected frequency as given in the table below.

| Catch A Spinning Motor (06.009) | Function                         |
|---------------------------------|----------------------------------|
| 0                               | Catch a spinning motor disabled  |
| 1                               | Detect all possible frequencies  |
| 2                               | Detect positive frequencies only |
| 3                               | Detect negative frequencies only |

| Parameter         | 06.010 <i>Enable Conditions</i>  |                |                                |
|-------------------|--|----------------|--------------------------------|
| Short description | Displays all the conditions needed to change the state of the final drive enable |                |                                |
| Mode              | Open-Loop  |                |                                |
| Minimum           | 0<br>(Display: 000000000000)   | Maximum        | 4087<br>(Display: 11111110111) |
| Default           |  | Units          |                                |
| Type              | 16 Bit Volatile  | Update Rate    | 4ms                            |
| Display Format    | Binary   | Decimal Places | 0                              |
| Coding            | RO, ND, NC, PT   |                |                                |

The Final drive enable is a combination of the *Hardware Enable* (06.029), *Drive Enable* (06.015) and other conditions that can prevent the drive from being enabled. All of these conditions are shown as bits in *Enable Conditions* (06.010) as given in the table below.

| <i>Enable Conditions</i> (06.010) bits | Enable condition  |
|--|---|
| 0                                      | <i>Hardware Enable</i> (06.029)   |
| 1                                      | <i>Drive Enable</i> (06.015)  |
| 2                                      | 0 if auto tune completed or trip during auto-tune, but drive needs to be disabled and re-enabled  |
| 3                                      | 1 if fire mode is active  |
| 4                                      | Reserved  |
| 5                                      | Zero until the drive thermal model has obtained temperatures from all drive thermistors at least once   |
| 6                                      | Zero until all option modules that are present in the drive have indicated that they are ready to run or the system has timed out waiting for this. |
| 7                                      | If an option module has forced the drive to be disabled if for example it is updating its user program.   |
| 8-10                                   | Reserved  |
| 11                                     | Zero if the drive is in standby mode. See <i>Standby Mode Enable</i> (06.060)   |

| Parameter         | 06.011 <i>Sequencer State Machine Inputs</i>                   |                |                           |
|-------------------|--|----------------|---------------------------|
| Short description | Displays the states of inputs into the sequencer state machine |                |                           |
| Mode              | Open-Loop  |                |                           |
| Minimum           | 0<br>(Display: 0000000)  | Maximum        | 127<br>(Display: 1111111) |
| Default           |  | Units          |                           |
| Type              | 8 Bit Volatile   | Update Rate    | 4ms                       |
| Display Format    | Binary   | Decimal Places | 0                         |
| Coding            | RO, ND, NC, PT, BU   |                |                           |

The bits in *Sequencer State Machine Inputs* (06.011) show the state of the inputs to the sequencer state machine as given in the tables below.

| <i>Sequencer State Machine Inputs</i> (06.011) | Signal                               | Indicates                                      |
|--|--------------------------------------|--|
| 0  | Final drive enable                   | The drive inverter is allowed to be enabled.   |
| 1  | Final drive run                      | The motor can move away from standstill.       |
| 2  | <i>Under Voltage Active</i> (10.016) | The under voltage condition has been detected. |
| 3  | <i>Zero Frequency</i> (10.003)       | Indicated when the motor has stopped.          |
| 4  | Drive tripped                        | The drive is tripped.                          |
| 5  | <i>Limit Switch Active</i> (10.066)  | Limit switch is active                         |
| 6  | <i>Supply Loss</i> (10.015)          | Supply loss condition has been detected.       |

| Parameter         | 06.012 <i>Enable Stop Key</i>              |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to 1 to enable the use of the stop key |                |                 |
| Mode              | Open-Loop                                  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

The Stop key can be used to stop the drive if *Enable Stop Key* (06.012) = 1 or Keypad command is selected (see *Reference Selector* (01.014)).

If *Enable Stop Key* (06.012) = 0 and Keypad command is not selected. The Stop key is not active and can be used to initiate a drive reset and without stopping the drive from running.

If *Enable Stop Key* (06.012) = 1 or Keypad command is selected, the drive reset can be initiated without stopping the drive by holding the Run key and then pressing the Stop key.

The Stop key is also used to reset the drive from the keypad.

It should be noted that if the drive is tripped and is then reset from any source other than the keypad Stop key then the drive may start immediately under

the following conditions:

1. *Enable Sequencer Latching* (06.040) = 0, the Final drive enable is active and one of the sequencer bits (*Run Forward* (06.030), *Run Reverse* (06.032) or *Run* (06.034) is active.
2. *Enable Sequencer Latching* (06.040) = 1, the Final drive enable is active, *Not Stop* (06.039) is active and one of the sequencer bits (*Run Forward* (06.030), *Run Reverse* (06.032) or *Run* (06.034) is active.

The drive sequencer has been designed so that pressing the Stop key, whatever the value of *Enable Stop Key* (06.012) or the Command Selection, does not make the drive state change from stopped to running. As pressing the Stop key could reset a drive trip which could then restart the drive, the run output from the sequencer is held off until the following conditions are met when the drive is tripped and the Stop key is pressed.

1. *Run Forward* (06.030) = 0 and *Run Reverse* (06.032) = 0 and *Run* (06.034) = 0\*
2. OR *Run Forward* (06.030) = 1 and *Run Reverse* (06.032) = 1 for at least 60ms\*
3. OR The Final drive enable = 0
4. OR The sequencer is in the UNDER\_VOLTAGE state
5. OR If *Enable Sequencer Latching* (06.040) = 1, *Not Stop* (06.039) = 0

\* If *Enable Sequencer Latching* (06.040) = 1 then the state of these sequencer bits must be 0 at the output of their latches.

Once the necessary conditions have been met the drive can then be restarted by activating the necessary bits for a normal start.

| Parameter         | 06.013 <i>Enable Auxiliary Key</i>                                       |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the behaviour of the drive when the auxilliary button is pressed |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0  | Maximum        | 2               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, TE   |                |                 |

| Value | Text  |
|-------|-------|
| 0     | Dis   |
| 1     | Fd.Rv |
| 2     | Rev   |

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If *Reference Selected Indicator* (01.049) = 4 then *Enable Auxiliary Key* (06.013) can be used to enable the Auxiliary key as a reverse key. If *Enable Auxiliary Key* (06.013) = 1 then each time the Auxiliary key is pressed *Reverse Select* (01.012) is toggled. If *Enable Auxiliary Key* (06.013) = 2 then the Auxiliary key behaves in a similar way to the Run key except that the drive runs in the reverse direction when it is pressed.

| Parameter         | 06.014 <i>Disable Auto Reset On Enable</i> |                |     |
|-------------------|--|----------------|-----|
| Short description | Set to 1 to disable auto reset on enable   |                |     |
| Mode              | Open-Loop                                  |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                            | Update Rate    | 4ms |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RW   |                |     |

*Disable Auto Reset On Enable* (06.014) will automatically reset trips on the application of an enable signal. This feature can be disabled using this parameter if *Disable Auto Reset On Enable* (06.014) = 1.

| Parameter         | 06.015 <i>Drive Enable</i>   |                |     |
|-------------------|------------------------------|----------------|-----|
| Short description | Set to 1 to enable the drive |                |     |
| Mode              | Open-Loop                    |                |     |
| Minimum           | 0                            | Maximum        | 1   |
| Default           | 1                            | Units          |     |
| Type              | 1 Bit User Save              | Update Rate    | 4ms |
| Display Format    | Standard                     | Decimal Places | 0   |
| Coding            | RW, BU                       |                |     |

*Drive Enable* (06.015) must be active for the drive to be enabled. See Menu 06.

| Parameter         | 06.016 <i>Date</i>        |                |                               |
|-------------------|---------------------------|----------------|-------------------------------|
| Short description | Displays the current date |                |                               |
| Mode              | Open-Loop                 |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)  | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           |                           | Units          |                               |
| Type              | 32 Bit Volatile           | Update Rate    | Background read/write         |
| Display Format    | Date                      | Decimal Places | 0                             |
| Coding            | RW, ND, NC, PT            |                |                               |

*Date* (06.016), *Time* (06.017) and *Day Of Week* (06.018) show the date and time as selected by *Date/Time Selector* (06.019). *Date* (06.016) stores the date in dd.mm.yy format regardless of the setting made in *Date Format* (06.020) however if the parameter is viewed using a keypad the date will be displayed in the format selected in *Date Format* (06.020). If a real time clock is selected from an option module then the days, months and years are from the real time clock and the day of the week is displayed in *Day Of Week* (06.018). Otherwise the days have a minimum value of 0 and roll over after 30, the months have a minimum value of 0 and roll over after 11, and *Day Of Week* (06.018) is always 0 (Sunday).

If when setting the date/time this parameter is being written via comms then the value should be written in standard dd/mm/yy format as described below.

The value of this parameter as seen over comms is as follows.

Value = (day[1..31] x 10000) + (month[1..12] x 100) + year[0..99]

| Parameter         | 06.017 Time              |                |                               |
|-------------------|--------------------------|----------------|-------------------------------|
| Short description | Dispals the current time |                |                               |
| Mode              | Open-Loop                |                |                               |
| Minimum           | 0<br>(Display: 00:00:00) | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           |                          | Units          |                               |
| Type              | 32 Bit Volatile          | Update Rate    | Background read/write         |
| Display Format    | Time                     | Decimal Places | 0                             |
| Coding            | RW, ND, NC, PT           |                |                               |

See *Date* (06.016).

The value of this parameter as seen over comms is as follows.

Value = (hour[0..23] x 10000) + (minute[0..59] x 100) + seconds[0..59]

| Parameter         | 06.018 Day Of Week                   |                |                  |
|-------------------|--------------------------------------|----------------|------------------|
| Short description | Displays the current day of the week |                |                  |
| Mode              | Open-Loop                            |                |                  |
| Minimum           | 0                                    | Maximum        | 6                |
| Default           |                                      | Units          |                  |
| Type              | 8 Bit Volatile                       | Update Rate    | Background write |
| Display Format    | Standard                             | Decimal Places | 0                |
| Coding            | RO, TE, ND, NC, PT                   |                |                  |

| Value | Text |
|-------|------|
| 0     | Sun  |
| 1     | Non  |
| 2     | Tue  |
| 3     | Wed  |
| 4     | Thu  |
| 5     | Fri  |
| 6     | Sat  |

See *Date* (06.016).

| Parameter         | 06.019 Date/Time Selector   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines which clock is used to display the current time, date and day of the week |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0   | Maximum        | 6               |
| Default           | 1   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text   |
|-------|--------|
| 0     | Set    |
| 1     | Po.up  |
| 2     | Run    |
| 3     | Acc.Po |
| 5     | Re.Pad |
| 6     | Slot.1 |

*Date/Time Selector* (06.019) is used to select the drive date and time as shown in the table below.

| <b>Date/Time Selector (06.019)</b> | <b>Date/Time source</b>   |
|------------------------------------|---|
| 0: Set                             | Date and time parameters can be written by the user   |
| 1: Power                           | Time since the drive was powered up   |
| 2: Running                         | Accumulated drive running time since the drive was manufactured   |
| 3: Acc Power                       | Accumulated powered-up time since the drive was manufactured  |
| 4: Reserved                        | Reserved  |
| 5: Remote Keypad                   | If a keypad connected to the user comms port (AI-485) of a drive with a 485 port includes a real-time clock then the date/time from this clock is displayed, otherwise the date/time is set to zero |
| 6: Slot 1                          | As 4 above, but for option slot 1   |

When *Date/Time Selector* (06.019) = 0 the *Date* (06.016) and *Time* (06.017) can be written by the user and the values in these parameters are transferred to the real time clocks in the keypad or any option modules that support this feature that are fitted to the drive. When *Date/Time Selector* (06.019) is changed to any other value, the real time clocks are allowed to run normally again. When *Date/Time Selector* (06.019) is changed from any value to 0 the date and time from a real time clock, if present, is automatically loaded into *Date* (06.016) and *Time* (06.017), so that this date and time is used as the initial value for editing. If more than one real time clock is present the date/time from the remote keypad is used, if present, and if not then the date/time from the option module slot.

*Date* (06.016) and *Time* (06.017) are used by the timers in Menu 09 and for time stamping trips. These features will continue to use the originally selected clock even if *Date/Time Selector* (06.019) is changed until a drive reset is initiated. If *Date/Time Selector* (06.019) has been changed and a reset is initiated *Timer 1 Repeat Function* (09.039) and *Timer 2 Repeat Function* (09.049) are set to zero to disable the timers, and the trip dates and times (10.041 to 10.060) are reset to zero.

| <b>Parameter</b>  | <b>06.020 Date Format</b>                    |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines if the US date format is used or not |                |                 |
| Mode              | Open-Loop                                    |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save                              | Update Rate    | Background read |
| Display Format    | Standard                                     | Decimal Places | 0               |
| Coding            | RW, TE                                       |                |                 |

| <b>Value</b> | <b>Text</b> | <b>Description</b>            |
|--------------|-------------|-------------------------------|
| 0            | Std         | Standard date format dd.mm.yy |
| 1            | US          | US date format mm.dd.yy       |

*Date Format* (06.020) selects the display style for *Date* (06.016), *Timer 1 Start Date* (09.035), *Timer 1 Stop Date* (09.037), *Timer 2 Start Date* (09.045), *Timer 2 Stop Date* (09.047) and for the trip time stamping date parameters ( *Trip 0 Date* (10.041), *Trip 1 Date* (10.043), *Trip 2 Date* (10.045), *Trip 3 Date* (10.047), *Trip 4 Date* (10.049), *Trip 5 Date* (10.051), *Trip 5 Date* (10.051), *Trip 6 Date* (10.053), *Trip 7 Date* (10.055), *Trip 8 Date* (10.057), *Trip 9 Date* (10.059)) when displayed on a keypad connected to the drive. The format selection made in this parameter does not affect the value of these parameters if they are read using comms or by a user program.

If *Date Format* (06.020) is 0 then standard format is used and the date is displayed on the keypad as dd.mm.yy and if *Date Format* (06.020) is 1 then US format is used and the date is displayed on the keypad as mm.dd.yy.

| <b>Parameter</b>  | <b>06.021 Time Between Filter Changes</b> |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the time between filter changes   |                |                 |
| Mode              | Open-Loop                                 |                |                 |
| Minimum           | 0   | Maximum        | 30000           |
| Default           | 0   | Units          | Hours           |
| Type              | 16 Bit User Save                          | Update Rate    | Background read |
| Display Format    | Standard                                  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

*Time Between Filter Changes* (06.021) should be set to a non-zero value to enable the filter change timer system. Each time *Filter Change Required / Change Done* (06.022) is changed by the user from 1 to 0 the value of *Time Between Filter Changes* (06.021) is copied to *Time Before Filter Change Due* (06.023). For each hour while *Drive Active* (10.002) = 1 the *Time Before Filter Change Due* (06.023) is reduced by 1 until it reaches zero. When *Time Before Filter Change Due* (06.023) changes from 1 to 0 *Filter Change Required / Change Done* (06.022) is set to 1 to indicate that a filter change is required. The filter should be changed and the system reset again by resetting *Filter Change Required / Change Done* (06.022) to 0.

| <b>Parameter</b>  | <b>06.022 Filter Change Required / Change Done</b> |                |                       |
|-------------------|--|----------------|-----------------------|
| Short description | Set to 0 when a filter change has taken place      |                |                       |
| Mode              | Open-Loop  |                |                       |
| Minimum           | 0  | Maximum        | 1                     |
| Default           |  | Units          |                       |
| Type              | 1 Bit Volatile                                     | Update Rate    | Background read/write |
| Display Format    | Standard   | Decimal Places | 0                     |
| Coding            | RW, ND, NC   |                |                       |

See *Time Between Filter Changes* (06.021).

| Parameter         | 06.023 Time Before Filter Change Due                 |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the time before a filter change is required |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0  | Maximum        | 30000            |
| Default           |  | Units          | Hours            |
| Type              | 16 Bit Power Down Save                               | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                                       |                |                  |

See *Time Between Filter Changes* (06.021).

| Parameter         | 06.024 Reset Energy Meter          |                |                 |
|-------------------|------------------------------------|----------------|-----------------|
| Short description | Set to 1 to reset the energy meter |                |                 |
| Mode              | Open-Loop                          |                |                 |
| Minimum           | 0                                  | Maximum        | 1               |
| Default           | 0                                  | Units          |                 |
| Type              | 1 Bit Volatile                     | Update Rate    | Background read |
| Display Format    | Standard                           | Decimal Places | 0               |
| Coding            | RW                                 |                |                 |

*Energy Meter: MWh* (06.025) and *Energy Meter: kWh* (06.026) accumulate the energy transferred through the drive. A positive energy value indicates net transfer of energy from the drive to the motor. If *Reset Energy Meter* (06.024) = 1 then *Energy Meter: MWh* (06.025) and *Energy Meter: kWh* (06.026) are held at zero. If *Reset Energy Meter* (06.024) = 0 then the energy meter is enabled and will accumulate the energy flow. If the maximum or minimum of *Energy Meter: MWh* (06.025) is reached the parameter does not rollover and is instead clamped at the maximum or minimum value.

| Parameter         | 06.025 Energy Meter: MWh                                    |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the energy accumulated by through the drive in MWh |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | -999.9  | Maximum        | 999.9            |
| Default           |   | Units          | MWh              |
| Type              | 16 Bit Power Down Save                                      | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 1                |
| Coding            | RO, ND, NC, PT  |                |                  |

See *Reset Energy Meter* (06.024).

| Parameter         | 06.026 Energy Meter: kWh                                    |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the energy accumulated by through the drive in kWh |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | -99.99  | Maximum        | 99.99            |
| Default           |   | Units          | kWh              |
| Type              | 16 Bit Power Down Save                                      | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 2                |
| Coding            | RO, ND, NC, PT  |                |                  |

See *Reset Energy Meter* (06.024).

| Parameter         | 06.027 Energy Cost Per kWh         |                |                 |
|-------------------|------------------------------------|----------------|-----------------|
| Short description | Defines the cost of energy per kWh |                |                 |
| Mode              | Open-Loop                          |                |                 |
| Minimum           | 0.0                                | Maximum        | 600.0           |
| Default           | 0.0                                | Units          |                 |
| Type              | 16 Bit User Save                   | Update Rate    | Background read |
| Display Format    | Standard                           | Decimal Places | 1               |
| Coding            | RW                                 |                |                 |

*Running Cost* (06.028) is derived from the *Output Power* (05.003) and the *Energy Cost Per kWh* (06.027) in cost per hour. The sign of *Running Cost* (06.028) is the same as the sign of *Output Power* (05.003).

| Parameter         | 06.028 Running Cost                    |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the running cost of the drive |                |                  |
| Mode              | Open-Loop                              |                |                  |
| Minimum           | -32000                                 | Maximum        | 32000            |
| Default           |  | Units          |                  |
| Type              | 16 Bit Volatile                        | Update Rate    | Background write |
| Display Format    | Standard                               | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                         |                |                  |

See *Energy Cost Per kWh* (06.027).

| Parameter         | 06.029 Hardware Enable                       |                |     |
|-------------------|--|----------------|-----|
| Short description | Set to 1 to enable the hardware of the drive |                |     |
| Mode              | Open-Loop                                    |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 1  | Units          |     |
| Type              | 1 Bit Volatile                               | Update Rate    | 4ms |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RO, NC, BU                                   |                |     |

*Hardware Enable* (06.029) normally shows the hardware enable state based on the state of the safe torque off system. However, drive I/O can be routed to *Hardware Enable* (06.029) to reduce the disable time. See description of the enable logic for more details.

| Parameter         | 06.030 Run Forward                            |                |     |
|-------------------|---|----------------|-----|
| Short description | Set to to give the drive a run forward signal |                |     |
| Mode              | Open-Loop                                     |                |     |
| Minimum           | 0   | Maximum        | 1   |
| Default           | 0   | Units          |     |
| Type              | 1 Bit Volatile                                | Update Rate    | 4ms |
| Display Format    | Standard                                      | Decimal Places | 0   |
| Coding            | RW, NC  |                |     |

If the command source is not the keypad, then *Run Forward* (06.030) can be used to make the Final drive run active and *Reverse Select* (01.012) = 0, i.e. to make the drive run in the forward direction. See description of sequencer logic for more details.

| Parameter         | 06.031 Jog Forward                              |                |     |
|-------------------|---|----------------|-----|
| Short description | Set to 1 to give the drive a jog forward signal |                |     |
| Mode              | Open-Loop                                       |                |     |
| Minimum           | 0   | Maximum        | 1   |
| Default           | 0   | Units          |     |
| Type              | 1 Bit Volatile                                  | Update Rate    | 4ms |
| Display Format    | Standard  | Decimal Places | 0   |
| Coding            | RW, NC  |                |     |

If the command source is not the keypad, then *Jog Forward* (06.031) can be used to make the Final drive run active and *Jog Select* (01.013) = 1, i.e. to make the drive run using the jog reference and jog ramps rates. The jog function is disabled if the run is made active through the normal running sequencing bits. See description of sequencer logic for more details.

| Parameter         | 06.032 Run Reverse                              |                |     |
|-------------------|---|----------------|-----|
| Short description | Set to 1 to give the drive a run reverse signal |                |     |
| Mode              | Open-Loop                                       |                |     |
| Minimum           | 0   | Maximum        | 1   |
| Default           | 0   | Units          |     |
| Type              | 1 Bit Volatile                                  | Update Rate    | 4ms |
| Display Format    | Standard  | Decimal Places | 0   |
| Coding            | RW, NC  |                |     |

If the command source is not the keypad, then *Run Reverse* (06.032) can be used to make the Final drive run active and *Reverse Select* (01.012) = 1, i.e. to make the drive run in the reverse direction. See description of sequencer logic for more details.

| Parameter         | 06.033 Forward/Reverse                         |                |     |
|-------------------|--|----------------|-----|
| Short description | Set to 1 to reverse the direction of the motor |                |     |
| Mode              | Open-Loop                                      |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit Volatile                                 | Update Rate    | 4ms |
| Display Format    | Standard                                       | Decimal Places | 0   |
| Coding            | RW, NC   |                |     |

If the command source is not the keypad, then *Forward/Reverse* (06.033) can be used to force the state of *Reverse Select* (01.012). If *Forward/Reverse* (06.033) = 1 then *Reverse Select* (01.012) = 1. If *Forward/Reverse* (06.033) = 0 then *Reverse Select* (01.012) = 0 unless it is set to 1 by the rest of the normal run or jog logic. See description of sequencer logic for more details.

| Parameter         | 06.034 Run                              |                |     |
|-------------------|---|----------------|-----|
| Short description | Set to 1 to give the drive a run signal |                |     |
| Mode              | Open-Loop                               |                |     |
| Minimum           | 0                                       | Maximum        | 1   |
| Default           | 0                                       | Units          |     |
| Type              | 1 Bit Volatile                          | Update Rate    | 4ms |
| Display Format    | Standard                                | Decimal Places | 0   |
| Coding            | RW, NC                                  |                |     |

If the command source is not the keypad, then *Run* (06.034) can be used to make the Final drive run active, but not to affect the state of *Reverse Select* (01.012). Normally *Run* (06.034) would be used in conjunction with *Forward/Reverse* (06.033) if control of the direction is required. See description of sequencer logic for more details.

| Parameter         | 06.035 Forward Limit Switch   |                |          |
|-------------------|---|----------------|----------|
| Short description | Set to 1 to activate the forward limit switch active signal and remove the Final drive run signal |                |          |
| Mode              | Open-Loop   |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit Volatile  | Update Rate    | 1ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW, NC  |                |          |

*Forward Limit Switch* (06.035) and *Reverse Limit Switch* (06.036) can be used to activate the Limit switch active signal and remove the Final drive run signal. See description of sequencer logic for more details.

| Condition  | Forward Limit Switch (06.035) | Reverse Limit Switch (06.036) |
|--|-------------------------------|-------------------------------|
| <i>Pre-ramp Reference</i> (01.003) + * <i>Hard Frequency Reference</i> (03.022) > 0.00 | Active                        | Not active                    |
| <i>Pre-ramp Reference</i> (01.003) + * <i>Hard Frequency Reference</i> (03.022)        | Not active                    | Active                        |
| <i>Pre-ramp Reference</i> (01.003) + * <i>Hard Frequency Reference</i> (03.022) = 0.00 | Active                        | Active                        |

\* If *Hard Frequency Reference Select* (03.023) = 0 then the *Hard Frequency Reference* (03.022) is taken as 0

#### Open loop mode

Normally digital input destinations are routed to *Forward Limit Switch* (06.035) and *Reverse Limit Switch* (06.036) to activate the limit switch system. If a digital input that is integral to the drive is used then Limit switch active will follow the state of the input with a maximum delay of approximately 2.5ms. If Limit switch active becomes active the motor is stopped using the currently selected ramp rate. The limit switches are direction dependant, so that the motor can rotate in a direction that allows the system to move away from the limit switch.

#### RFC modes

*Forward Limit Switch* (06.035) and *Reverse Limit Switch* (06.036) operate in a similar way to RFC-A mode when Limit switch active becomes active. If *Limit Switch Stop Mode* (06.002) = 0 the motor is stopped without ramps, otherwise it is stopped with the currently selected ramp rate. If a digital input that is integral to the drive is used the maximum delay is approximately TBA. The limit switches are direction dependant, so that the motor can rotate in a direction that allows the system to move away from the limit switch.

| Parameter         | 06.036 Reverse Limit Switch   |                |          |
|-------------------|---|----------------|----------|
| Short description | Set to 1 to activate the reverse limit switch active signal and remove the Final drive run signal |                |          |
| Mode              | Open-Loop   |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit Volatile  | Update Rate    | 1ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW, NC  |                |          |

See *Forward Limit Switch* (06.035).

| Parameter         | 06.037 Jog Reverse                              |                |     |
|-------------------|---|----------------|-----|
| Short description | Set to 1 to give the drive a jog reverse signal |                |     |
| Mode              | Open-Loop                                       |                |     |
| Minimum           | 0   | Maximum        | 1   |
| Default           | 0   | Units          |     |
| Type              | 1 Bit Volatile                                  | Update Rate    | 4ms |
| Display Format    | Standard  | Decimal Places | 0   |
| Coding            | RW, NC  |                |     |

If the command source is not the keypad, then *Jog Reverse* (06.037) can be used to make the Final drive run active, *Jog Select* (01.013) = 1 and *Reverse Select* (01.012) = 1, i.e. to make the drive run using the jog reference and jog ramps rates in the reverse direction. The jog function is disabled if the run is made active through the normal running sequencing bits. See description of sequencer logic for more details.

| Parameter         | 06.038 User Enable  |                |     |
|-------------------|---|----------------|-----|
| Short description | Set to 1 to reset the latched sequencer bits if sequencer latching is enabled |                |     |
| Mode              | Open-Loop   |                |     |
| Minimum           | 0   | Maximum        | 1   |
| Default           | 0   | Units          |     |
| Type              | 1 Bit Volatile  | Update Rate    | 4ms |
| Display Format    | Standard  | Decimal Places | 0   |
| Coding            | RW, NC  |                |     |

This parameter controls *Hardware Enable* (06.029). A user must set this parameter as a destination from a digital input. The logic value of this parameter will be set to 1 if it has not been used as a destination.



| Parameter         | 06.039 <i>Not Stop</i>  |                |     |
|-------------------|---|----------------|-----|
| Short description | Set to 1 to reset the latched sequencer bits if sequencer latching is enabled |                |     |
| Mode              | Open-Loop   |                |     |
| Minimum           | 0   | Maximum        | 1   |
| Default           | 0   | Units          |     |
| Type              | 1 Bit Volatile  | Update Rate    | 4ms |
| Display Format    | Standard  | Decimal Places | 0   |
| Coding            | RW, NC  |                |     |

If *Enable Sequencer Latching* (06.040) = 1 then the sequencer bits can be latched. *Not Stop* (06.039) should be used to reset the latched sequencer bits. If *Not Stop* (06.039) = 1 then the sequencer bits can be latched. If *Not Stop* (06.039) = 0 then the latches are cleared and their outputs are forced to zero which will de-activate the Final drive run. See description of sequencer logic for more details.

| Parameter         | 06.040 <i>Enable Sequencer Latching</i> |                |     |
|-------------------|---|----------------|-----|
| Short description | Set to 1 to enable sequencer latching   |                |     |
| Mode              | Open-Loop                               |                |     |
| Minimum           | 0                                       | Maximum        | 1   |
| Default           | 0                                       | Units          |     |
| Type              | 1 Bit User Save                         | Update Rate    | 4ms |
| Display Format    | Standard                                | Decimal Places | 0   |
| Coding            | RW                                      |                |     |

See *Not Stop* (06.039).

| Parameter         | 06.041 <i>Drive Event Flags</i>                            |                |                    |
|-------------------|--|----------------|--------------------|
| Short description | Displays if certain actions have occurred within the drive |                |                    |
| Mode              | Open-Loop  |                |                    |
| Minimum           | 0<br>(Display: 00)   | Maximum        | 3<br>(Display: 11) |
| Default           | 0<br>(Display: 00)   | Units          |                    |
| Type              | 8 Bit Volatile   | Update Rate    | Background write   |
| Display Format    | Binary   | Decimal Places | 0                  |
| Coding            | RW, NC   |                |                    |

*Drive Event Flags* (06.041) indicates that certain actions have occurred within the drive as described below.

| Bit | Corresponding event |
|-----|---------------------|
| 0   | Defaults loaded     |
| 1   | Drive mode changed  |

#### Bit 0: Defaults loaded

The drive sets bit 0 when defaults have been loaded and the associated parameter save has been completed. The drive does not reset this flag except at power-up.

#### Bit 1: Drive mode changed

The drive sets bit 1 when the drive mode has changed and the associated parameter save has been completed. The drive does not reset this flag except at power-up.

| Parameter         | 06.042 <i>Control Word</i>   |                |  |
|-------------------|--|----------------|--|
| Short description | Controls the sequencer state machine inputs if the control word is enabled |                |  |
| Mode              | Open-Loop  |                |  |
| Minimum           | 0<br>(Display: 0000000000000000)   | Maximum        | 32767<br>(Display: 1111111111111111)             |
| Default           | 0<br>(Display: 0000000000000000)   | Units          |  |
| Type              | 16 Bit Volatile  | Update Rate    | Bits 9,7-0: 16ms, Other bits:<br>Background read |
| Display Format    | Binary   | Decimal Places | 0  |
| Coding            | RW, NC   |                |  |

If *Control Word Enable* (06.043) = 0 then *Control Word* (06.042) has no effect. If *Control Word Enable* (06.043) = 1 the bits in *Control Word* (06.042) are used instead of their corresponding parameters or to initiate drive functions as shown in the table below.

| Bit | Corresponding paramter or function |
|-----|------------------------------------|
| 0   | <i>Drive Enable</i> (06.015)       |
| 1   | <i>Run Forward</i> (06.030)        |
| 2   | <i>Jog Forward</i> (06.031)        |
| 3   | <i>Run Reverse</i> (06.032)        |
| 4   | <i>Forward/Reverse</i> (06.033)    |
| 5   | <i>Run</i> (06.034)                |
| 6   | <i>Not Stop</i> (06.039)           |
| 7   | Auto / manual                      |
| 8   | Analog / Preset reference          |
| 9   | <i>Jog Reverse</i> (06.037)        |
| 10  | Not used                           |
| 11  | Not used                           |
| 12  | Trip drive                         |
| 13  | Reset drive                        |
| 14  | Watchdog                           |

#### Bits 0-7 and bit 9: Sequencer control

When Auto/manual bit (bit7) = 1 then bits 0 to 6 and bit 9 of the *Control Word* (06.042) become active. The equivalent parameters are not modified by these bits, but become inactive when the equivalent bits in the *Control Word* (06.042) are active. When the bits are active they replace the functions of the equivalent parameters.

#### Bit 8: Analogue/preset reference

The state of Analogue/Preset Reference (bit 8) is written continuously to *Reference Select Flag 2* (01.042). With default drive settings (i.e. *Reference Selector* (01.014) = 0) this selects *Analog Reference 1* (01.036) when bit 8 = 0 or *Preset Reference 1* (01.021) when bit8 = 1. If any other drive parameters are routed to *Reference Select Flag 2* (01.042) the value of this parameter is undefined.

#### Bit 10 and bit 11: Not used

The values of these bits have no effect on the drive.

#### Bit 12: Trip drive

If bit 12 = 1 then a *Control Word* trip is repeatedly initiated. The trip cannot be cleared until bit 12 = 0.

#### Bit 13: Reset drive

If bit 13 is changed from 0 to 1 a drive reset is initiated. Bit 13 does not modify *Drive Reset* (10.033).

#### Bit 14: Watchdog

A watchdog system can be enabled or serviced each time bit 14 is changed from 0 to 1. Once bit 14 has been changed from 0 to 1 to enable the watchdog, this must be repeated every 1s or else a *Watchdog* trip will be initiated. The watchdog is disabled when the trip occurs and must be re-enabled if required when the trip is reset.

| Parameter         | 06.043 Control Word Enable          |                |     |
|-------------------|-------------------------------------|----------------|-----|
| Short description | Set to 1 to enable the control word |                |     |
| Mode              | Open-Loop                           |                |     |
| Minimum           | 0                                   | Maximum        | 1   |
| Default           | 0                                   | Units          |     |
| Type              | 8 Bit User Save                     | Update Rate    | 4ms |
| Display Format    | Standard                            | Decimal Places | 0   |
| Coding            | RW, NC                              |                |     |

See *Control Word* (06.042).

| Parameter         | 06.045 Cooling Fan control                         |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the maximum speed of the drive cooling fan |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0  | Maximum        | 5               |
| Default           | 2  | Units          |                 |
| Type              | 8 Bit User Save                                    | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

If *Cooling Fan control* (06.045) = 0 the cooling fan in the drive are off.

- If an option module is fitted, the drive might trip *Oht Control* if *Stack Temperature* (07.004) is above a set threshold and the option module will be forced to go to standby.
- If an option module is fitted, the cooling fan might go to low speed in certain conditions.

If *Cooling Fan control* (06.045) = 1 the cooling fan in the drive are all forced to run at full speed.

If *Cooling Fan control* (06.045) = 2 the cooling fan in the drive is controlled by the value of *Stack Temperature* (07.004). The fan run at full speed. for at least 20 seconds if *Stack Temperature* (07.004) is greater than a frame dependent threshold (60 °C for size 1 & 2 or 50 °C for size 3 & 4) or *Current Magnitude* (04.001) is greater than 75% of *Drive current rating* (11.068) otherwise the cooling fan is off. If the cooling fan is off, it might go to low speed if the control board temperature is too high.

If *Cooling Fan control* (06.045) = 3 is the same as *Cooling Fan control* (06.045) = 2 but the cooling fan never turns off but runs at low speed continuously.

If *Cooling Fan control* (06.045) = 4 the cooling fan in the drive is at low speed continuously.

If *Cooling Fan control* (06.045) = 5 is the same as *Cooling Fan control* (06.045) = 2 but with lower threshold using minimum speed - "theatre mode".

Note: Size 1 drives only have single fan speed

| Parameter         | 06.046 <i>Supply Loss Hold Disable</i> |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to 1 to disable supply loss hold   |                |                 |
| Mode              | Open-Loop                              |                |                 |
| Minimum           | 0                                      | Maximum        | 1               |
| Default           | 0                                      | Units          |                 |
| Type              | 1 Bit User Save                        | Update Rate    | Background read |
| Display Format    | Standard                               | Decimal Places | 0               |
| Coding            | RW                                     |                |                 |

#### Frame sizes 06 and below

*Supply Loss Hold Disable* (06.046) has no effect.

#### Frame sizes 07 and above

When leaving the supply loss ride through condition the control system does not apply any motoring load until the d.c. link change system is fully inactive. This prevents a dip in the d.c. link voltage that would occur if the load is applied before the thyristor rectifier in the charge system is fully phased forwards. If the d.c. link is not supplied via its own input rectifier then it is necessary to set *Supply Loss Hold Disable* (06.046) = 1 to disable this feature.

| Parameter         | 06.047 <i>Input Phase Loss Detection Mode</i> |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines how the input phase loss is detected  |                |                 |
| Mode              | Open-Loop                                     |                |                 |
| Minimum           | 0   | Maximum        | 2               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save                               | Update Rate    | Background read |
| Display Format    | Standard                                      | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text   |
|-------|--------|
| 0     | Full   |
| 1     | RIPPLE |
| 2     | Dis    |

Input phase loss is detected by monitoring the d.c. link voltage ripple which increases with load. When compared to normal operation, if an input phase is missing or there is excessive input phase imbalance the d.c. link ripple level is higher. The high ripple level is detected to initiate a *PH.Lo* trip. For drive sizes 8 and above and above additional input phase loss detection is provided by direct monitoring of the supply voltages (*PH.Lo* trip). Unlike the d.c. voltage ripple based detection which can only operate when the drive is enabled and on load, the additional input phase loss detection can operate whether the drive is enabled or not. *Input Phase Loss Detection Mode* (06.047) defines the methods used for input phase loss detection provided by the drive.

| <i>Input Phase Loss Detection Mode</i> (06.047) | <i>Drive Active</i> (10.002) = 0   | <i>Drive Active</i> (10.002) = 1   |
|---|------------------------------------|--|
| 0   | *Direct input phase loss detection | *Direct input phase loss detection<br>D.c. link voltage ripple detection |
| 1   | *Direct input phase loss detection | D.c. link voltage ripple detection                                       |
| 2   | No input phase loss detection      | No input phase loss detection  |

\*Frame sizes 8 and above

Input phase loss detection can be disabled when the drive is required to operate from a d.c. supply connected to the d.c. link or from a single phase supply. If the drive operates from a single phase supply or a supply with high levels of phase imbalanced under load the input stage and d.c. link thermal protection system may produce a *OHT dc bus* trip.

| Parameter         | 06.048 <i>Supply Loss Detection Level</i>                                       |                |                      |
|-------------------|---|----------------|----------------------|
| Short description | Defines the threshold for indicating when the supply loss condition is detected |                |                      |
| Mode              | Open-Loop   |                |                      |
| Minimum           | 0   | Maximum        | VM_SUPPLY_LOSS_LEVEL |
| Default           | See exceptions below  | Units          | V                    |
| Type              | 16 Bit User Save  | Update Rate    | Background read      |
| Display Format    | Standard  | Decimal Places | 0                    |
| Coding            | RW, VM, RA  |                |                      |

| Voltage | Default Value |
|---------|---------------|
| 110V    | 205           |
| 200V    | 205           |
| 400V    | 410           |
| 575V    | 540           |
| 690V    | 540           |

Defines the threshold for indicating when the supply loss condition is detected.

The threshold can be adjusted using this parameter. If the value is reduced below the default value the default value is used by the drive. If the level is set too high so that supply loss detection becomes active under normal operating conditions, the motor will coast to a stop.

| Parameter         | 06.051 <i>Hold Supply Loss Active</i> |                |          |
|-------------------|---------------------------------------|----------------|----------|
| Short description | Hold Supply Loss Active               |                |          |
| Mode              | Open-Loop                             |                |          |
| Minimum           | 0                                     | Maximum        | 1        |
| Default           | 0                                     | Units          |          |
| Type              | 1 Bit Volatile                        | Update Rate    | 1ms read |
| Display Format    | Standard                              | Decimal Places | 0        |
| Coding            | RW, NC                                |                |          |

If supply loss is detected (i.e. *Supply Loss* (10.015) = 1) or *Hold Supply Loss Active* (06.051) = 1 the supply loss indication and the action taken on supply loss will be active. For example, *Hold Supply Loss Active* (06.051) can be controlled by an external rectifier or a Regen system (via a digital input) to prevent power from being taken from the supply if supply loss ride-through mode is being used until the input system is ready to provide power. This can allow for the charge system in an external rectifier to complete the charging, or it can allow a Regen system to become synchronised.

| Parameter         | 06.052 <i>Motor Pre-heat Current Magnitude</i>                               |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the current in the motor when the state machine is in the stop state |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0  | Maximum        | 100             |
| Default           | 0  | Units          | %               |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

See *Hold Zero Frequency* (06.008).

| Parameter         | 06.058 <i>Output Phase Loss Detection Time</i> |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Output Phase Loss Detection Time               |                |                 |
| Mode              | Open-Loop                                      |                |                 |
| Minimum           | 0  | Maximum        | 3               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save                                | Update Rate    | Background Read |
| Display Format    | Standard                                       | Decimal Places | 0               |
| Coding            | RW, TE   |                |                 |

| Value | Text |
|-------|------|
| 0     | 0.5  |
| 1     | 1.0  |
| 2     | 2.0  |
| 3     | 4.0  |

See *Output Phase Loss Detection Enable* (06.059).

| Parameter         | 06.059 <i>Output Phase Loss Detection Enable</i> |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to 1 to enable output phase loss detection   |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save                                  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

Output phase loss detection can be used to detect a disconnected motor phase if *Output Phase Loss Detection Enable* (06.059) is set to a non-zero value.

#### 0: Disabled

Output phase loss detection is not active.

#### 1: Enabled

A test is carried out each time the drive is enabled to run to check if all three phases are connected. If the test fails a *Out Phase Loss.X* trip is initiated where X indicates which phase is not connected (1 = U, 2 = V, 3 = W). It should be noted that this test is not carried out in Open-loop mode if "catch a spinning motor" is enabled (i.e. *Catch A Spinning Motor* (06.009) > 0).

For Open-loop and RFC-A modes a test is also carried out while the drive is running. If the drive output frequency is above 4Hz and a phase is disconnected for the time specified by *Output Phase Loss Detection Time* (06.058) then a *Out Phase Loss.4* trip is initiated. It should be noted that if the motor is operating at high speed and flux weakening is active so that the magnetising current is below half the rated level then output phase loss will not be detected. If the motor is heavily loaded when a phase is disconnected it is likely that the motor will stall and the drive output frequency may fall below 4Hz before output phase loss is detected.

| Parameter         | 06.060 Standby Mode Enable   |                |                 |
|-------------------|------------------------------|----------------|-----------------|
| Short description | Set to 1 enable standby mode |                |                 |
| Mode              | Open-Loop                    |                |                 |
| Minimum           | 0                            | Maximum        | 1               |
| Default           | 0                            | Units          |                 |
| Type              | 1 Bit User Save              | Update Rate    | Background read |
| Display Format    | Standard                     | Decimal Places | 0               |
| Coding            | RW                           |                |                 |

If *Standby Mode Enable* (06.060) = 1 then the drive will go into the standby power state 20 seconds after the last key press and whenever *Drive Active* (10.002) = 0. In this state the LED on the front of the drive flashes 0.25s on and 2s off. And the following actions are taken as defined by the *Standby Mode Mask* (06.061). Actions are enabled by setting the appropriate bit to 1.

| Standby Mode Mask (06.061) bits | Action   |
|---------------------------------|--|
| 0                               | NA   |
| 1                               | Instruct all keypads to go into their standby state                            |
| 2                               | NA   |
| 3                               | Instruct the option module in option slot 1 to go into the standby power state |

| Parameter         | 06.061 Standby Mode Mask              |                |                       |
|-------------------|---------------------------------------|----------------|-----------------------|
| Short description | Defines the behaviour of standby mode |                |                       |
| Mode              | Open-Loop                             |                |                       |
| Minimum           | 0<br>(Display: 0000)                  | Maximum        | 15<br>(Display: 1111) |
| Default           | 0<br>(Display: 0000)                  | Units          |                       |
| Type              | 8 Bit User Save                       | Update Rate    | Background read       |
| Display Format    | Binary                                | Decimal Places | 0                     |
| Coding            | RW                                    |                |                       |

See *Standby Mode Enable* (06.060).

| Parameter         | 06.071 Slow Rectifier Charge Rate Enable           |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to 1 to reduce the charge rate of the d.c. bus |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save                                    | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

For Frame size 07 and larger, which use a d.c. link charge system based on a half controlled thyristor input bridge, the rate at which the d.c. link is charged can be reduced by setting *Slow Rectifier Charge Rate Enable* (06.071) to one. This will reduce the charging current which may be required if significant additional capacitance is added to the d.c. link to prevent rupturing of input fuses.

| Parameter         | 06.073 Braking IGBT Lower Threshold  |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Defines the lowest level of the d.c. bus voltage where the braking IGBT becomes active |                |                   |
| Mode              | Open-Loop  |                |                   |
| Minimum           | -VM_DC_VOLTAGE_SET   | Maximum        | VM_DC_VOLTAGE_SET |
| Default           | See exceptions below   | Units          | V                 |
| Type              | 16 Bit User Save   | Update Rate    | Background        |
| Display Format    | Standard   | Decimal Places | 0                 |
| Coding            | RW, VM, RA   |                |                   |

| Voltage | Default Value |
|---------|---------------|
| 110V    | 390           |
| 200V    | 390           |
| 400V    | 780           |
| 575V    | 930           |
| 690V    | 1120          |

*Braking IGBT Lower Threshold* (06.073) defines the lowest level of *D.c. Link Voltage* (05.005) where the braking IGBT will become active and *Braking IGBT Upper Threshold* (06.074) defines the level of *D.c. Link Voltage* (05.005) where the braking IGBT will be on continuously. When the braking IGBT is turned on it will remain on for at least 1ms. The braking IGBT on-time is defined by the thresholds and the d.c. link voltage as given in the table below where L = *Braking IGBT Lower Threshold* (06.073) and U = *Braking IGBT Upper Threshold* (06.074).

| D.c. link voltage level                       | On-time   |
|---|---|
| <i>D.c. Link Voltage</i> (05.005)             | 0%  |
| $L \leq D.c. \text{ Link Voltage}$ (05.005)   | $[(D.c. \text{ Link Voltage} (05.005) - L) / (U - L)] \times 100\%$ |
| $D.c. \text{ Link Voltage}$ (05.005) $\geq U$ | 100%  |

As the *D.c. Link Voltage* (05.005) rises above the lower threshold the braking IGBT is active with an on/off ratio of 1/100. As the voltage rises further, the on/off ratio increases until at the upper threshold the braking IGBT is on continuously. The upper and lower voltage threshold can be set up so that braking resistors in drives with parallel connected d.c. links will share the braking load.

If *Braking IGBT Lower Threshold* (06.073)  $\geq$  *Braking IGBT Upper Threshold* (06.074) then the braking IGBT is off when *D.c. Link Voltage* (05.005) *Braking IGBT Upper Threshold* (06.074) and on if *D.c. Link Voltage* (05.005)  $\geq$  *Braking IGBT Upper Threshold* (06.074). This method of control is the same as that used in Commander SK and the default values for the braking thresholds are equal to the braking thresholds in Commander SK.

Unless sharing between braking resistors is required the braking thresholds do not normally need to be adjusted. Care should be taken when reducing the thresholds because if either threshold is below the maximum value of the peak rectified supply voltage the braking resistor could take power from the supply.

The list below gives conditions that will disable the braking IGBT:

1. *Braking IGBT Upper Threshold* (06.074) = 0, or *Low Voltage Braking IGBT Threshold Select* (06.076) = 1 and *Low Voltage Braking IGBT Threshold* (06.075) = 0.
2. The drive is in the under-voltage state.
3. A priority 1, 2 or 3 trip is active.
4. There is a fault in the control system power supply.
5. The hardware or software over-temperature systems indicate that the braking resistor is too hot.
6. A braking IGBT over-current trip is active *OI Brake*.

| Parameter         | 06.074 <i>Braking IGBT Upper Threshold</i>   |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Defines the level of the d.c. bus voltage where the braking IGBT will be on continuously |                |                   |
| Mode              | Open-Loop  |                |                   |
| Minimum           | -VM_DC_VOLTAGE_SET   | Maximum        | VM_DC_VOLTAGE_SET |
| Default           | See exceptions below   | Units          | V                 |
| Type              | 16 Bit User Save   | Update Rate    | Background        |
| Display Format    | Standard   | Decimal Places | 0                 |
| Coding            | RW, VM, RA   |                |                   |

| Voltage | Default Value |
|---------|---------------|
| 110V    | 390           |
| 200V    | 390           |
| 400V    | 780           |
| 575V    | 930           |
| 690V    | 1120          |

See *Braking IGBT Lower Threshold* (06.073).

| Parameter         | 06.075 <i>Low Voltage Braking IGBT Threshold</i>   |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Defines the threshold used for low voltage braking |                |                   |
| Mode              | Open-Loop  |                |                   |
| Minimum           | -VM_DC_VOLTAGE_SET                                 | Maximum        | VM_DC_VOLTAGE_SET |
| Default           | 0  | Units          | V                 |
| Type              | 16 Bit User Save                                   | Update Rate    | Background        |
| Display Format    | Standard   | Decimal Places | 0                 |
| Coding            | RW, VM, RA   |                |                   |

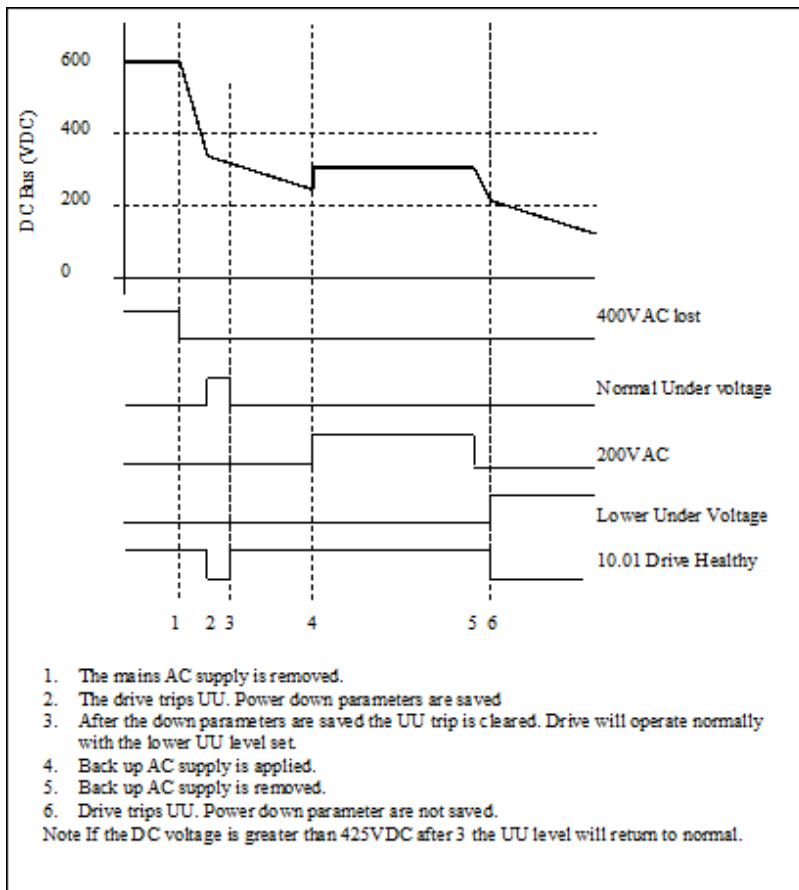
If *Low Voltage Braking IGBT Threshold Select* (06.076) = 0 the normal thresholds are used. If *Low Voltage Braking IGBT Threshold Select* (06.076) = 1 then *Low Voltage Braking IGBT Threshold* (06.075) is used, so that the braking IGBT is on with a minimum on time of 1ms if the d.c. link voltage is above this level, or off if the d.c. link voltage is below this level.

| Parameter         | 06.076 <i>Low Voltage Braking IGBT Threshold Select</i> |                |            |
|-------------------|---|----------------|------------|
| Short description | Set to 1 enable low voltage IGBT braking                |                |            |
| Mode              | Open-Loop   |                |            |
| Minimum           | 0   | Maximum        | 1          |
| Default           | 0   | Units          |            |
| Type              | 1 Bit Volatile  | Update Rate    | Background |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

See *Low Voltage Braking IGBT Threshold* (06.075)

| Parameter         | 06.077 Low DC Link Operation                                |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to allow a 400V drive to be ran from a 240V supply |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

On the 400V product setting this bit will enable the drive to run from a 240VAC input. Low DC Link Operation is enabled when *Low DC Link Operation* (06.077) is set to one. See figure below.



*Low AC Alarm* (10.107) is displayed from step 2 on the graph above.

The functionality described for *Low DC Link Operation* (06.077) is supported across Frames 02-09. For Frames 05 and above, the minimum supply voltage supported is 330V DC (233VAC RMS)

| Parameter         | 06.084 UTC Offset |                |                 |
|-------------------|-------------------|----------------|-----------------|
| Short description | UTC Offset        |                |                 |
| Mode              | Open-Loop         |                |                 |
| Minimum           | -24.00            | Maximum        | 24.00           |
| Default           | 0.00              | Units          | Hours           |
| Type              | 16 Bit User Save  | Update Rate    | Background Read |
| Display Format    | Standard          | Decimal Places | 2               |
| Coding            | RW                |                |                 |

*UTC Offset* (06.084) is an offset, specified in hours, applied to the selected clock source (see *Date/Time Selector* (06.019)). This could be used for time zone offsets etc. The offset will be applied to the time obtained from the selected clock source, in addition to any offset already applied to the time from that source.

| Parameter         | 06.089 DC Injection Active               |                |     |
|-------------------|--|----------------|-----|
| Short description | Indicates when d.c. injection is active. |                |     |
| Mode              | Open-Loop                                |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                          | Update Rate    | 4ms |
| Display Format    | Standard                                 | Decimal Places | 0   |
| Coding            | RO, NC, PT                               |                |     |

This flag is high when the sequencer is in the dc injection state and low for all other conditions.



## Menu 7 Single Line Descriptions – Analog I/O

Mode: Open-Loop

| Parameter |  | Range   | Default    | Type |     |    |    |    |    |
|-----------|--|---|------------|------|-----|----|----|----|----|
| 07.001    | Analogue Input 1                           | ±100.00 %   |            | RO   | Num | ND | NC | PT | FI |
| 07.002    | Analogue Input 2                           | 0.00 to 100.00 %  |            | RO   | Num | ND | NC | PT | FI |
| 07.004    | Stack Temperature                          | ±250 °C   |            | RO   | Num | ND | NC | PT |    |
| 07.005    | Auxiliary Temperature                      | ±250 °C   |            | RO   | Num | ND | NC | PT |    |
| 07.007    | Analogue Input 1 Mode                      | 4-20.S (-6), 20-4.S (-5),<br>4-20.L (-4), 20-4.L (-3),<br>4-20.H (-2), 20-4.H (-1),<br>0-20 (0), 20-0 (1), 4-20.tr (2),<br>20-4.tr (3), 4-20 (4), 20-4 (5),<br>Volt (6) | Volt (6)   | RW   | Txt |    |    |    | US |
| 07.008    | Analogue Input 1 Scaling                   | 0.000 to 10.000   | 1.000      | RW   | Num |    |    |    | US |
| 07.009    | Analogue Input 1 Invert                    | Off (0) or On (1)   | Off (0)    | RW   | Bit |    |    |    | US |
| 07.010    | Analogue Input 1 Destination A             | 0.000 to 30.999   | 1.036      | RW   | Num | DE |    | PT | US |
| 07.011    | Analogue Input 2 Mode                      | Volt (6), dig (7)   | Volt (6)   | RW   | Txt |    |    |    | US |
| 07.012    | Analogue Input 2 Scaling                   | 0.000 to 10.000   | 1.000      | RW   | Num |    |    |    | US |
| 07.013    | Analogue Input 2 Invert                    | Off (0) or On (1)   | Off (0)    | RW   | Bit |    |    |    | US |
| 07.014    | Analogue Input 2 Destination A             | 0.000 to 30.999   | 1.037      | RW   | Num | DE |    | PT | US |
| 07.019    | Analogue Output 1 Source A                 | 0.000 to 30.999   | 2.001      | RW   | Num |    |    | PT | US |
| 07.020    | Analogue Output 1 Scaling                  | 0.000 to 40.000   | 1.000      | RW   | Num |    |    |    | US |
| 07.026    | Analog Input 1 Preset on Current Loss      | 4.00 to 20.00 mA  | 4.00 mA    | RW   | Num |    |    |    | US |
| 07.028    | Analogue Input 1 Current Loop Loss         | Off (0) or On (1)   |            | RO   | Bit | ND | NC | PT |    |
| 07.030    | Analogue Input 1 Offset                    | ±100.00 %   | 0.00 %     | RW   | Num |    |    |    | US |
| 07.031    | Analogue Input 2 Offset                    | ±100.00 %   | 0.00 %     | RW   | Num |    |    |    | US |
| 07.034    | Inverter Temperature                       | ±250 °C   |            | RO   | Num | ND | NC | PT |    |
| 07.035    | Percentage Of d.c. Link Thermal Trip Level | 0 to 100 %  |            | RO   | Num | ND | NC | PT |    |
| 07.036    | Percentage Of Drive Thermal Trip Level     | 0 to 100 %  |            | RO   | Num | ND | NC | PT |    |
| 07.037    | Temperature Nearest To Trip Level          | 0 to 29999  |            | RO   | Num | ND | NC | PT |    |
| 07.046    | Thermistor Type                            | D44081 (0), 84 (1),<br>PT1000 (2), PT2000 (3),<br>other (4)   | D44081 (0) | RW   | Txt |    |    |    | US |
| 07.047    | Thermistor Feedback                        | 0 to 4000 Ω   |            | RO   | Num | ND | NC | PT | FI |
| 07.048    | Thermistor Trip Threshold                  | 0 to 4000 Ω   | 3300 Ω     | RW   | Num |    |    |    | US |
| 07.049    | Thermistor Reset Threshold                 | 0 to 4000 Ω   | 1800 Ω     | RW   | Num |    |    |    | US |
| 07.050    | Thermistor Temperature                     | -50 to 300 °C   |            | RO   | Num | ND | NC | PT | FI |
| 07.051    | Analogue Input 1 Control                   | 0 to 5  | 0          | RW   | Num |    |    |    | US |
| 07.052    | Analogue Input 2 Control                   | 0 to 5  | 0          | RW   | Num |    |    |    | US |
| 07.055    | Analogue Output 1 Control                  | 0 to 15   | 0          | RW   | Num |    |    |    | US |
| 07.061    | Analogue Input 1 Minimum Reference         | 0.00 to 100.00 %  | 0.00 %     | RW   | Num |    |    |    | US |
| 07.062    | Analogue Input 1 At Minimum Reference      | ±100.00 %   | 0.00 %     | RW   | Num |    |    |    | US |
| 07.063    | Analogue Input 1 Maximum Reference         | 0.00 to 100.00 %  | 100.00 %   | RW   | Num |    |    |    | US |
| 07.064    | Analogue Input 1 At Maximum Reference      | ±100.00 %   | 100.00 %   | RW   | Num |    |    |    | US |
| 07.065    | Analogue Input 2 Minimum Reference         | 0.00 to 100.00 %  | 0.00 %     | RW   | Num |    |    |    | US |
| 07.066    | Analogue Input 2 At Minimum Reference      | ±100.00 %   | 0.00 %     | RW   | Num |    |    |    | US |
| 07.067    | Analogue Input 2 Maximum Reference         | 0.00 to 100.00 %  | 100.00 %   | RW   | Num |    |    |    | US |
| 07.068    | Analogue Input 2 At Maximum Reference      | ±100.00 %   | 100.00 %   | RW   | Num |    |    |    | US |
| 07.090    | Analogue Input 1 Destination B             | 0.000 to 30.999   | 0.000      | RO   | Num | DE |    | PT | US |
| 07.094    | Analogue Input 2 Destination B             | 0.000 to 30.999   | 0.000      | RO   | Num | DE |    | PT | US |
| 07.099    | Analogue Output 1 Source B                 | 0.000 to 30.999   | 0.000      | RO   | Num |    |    | PT | US |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

# Menu 7 – Analog I/O

Mode: Open-Loop

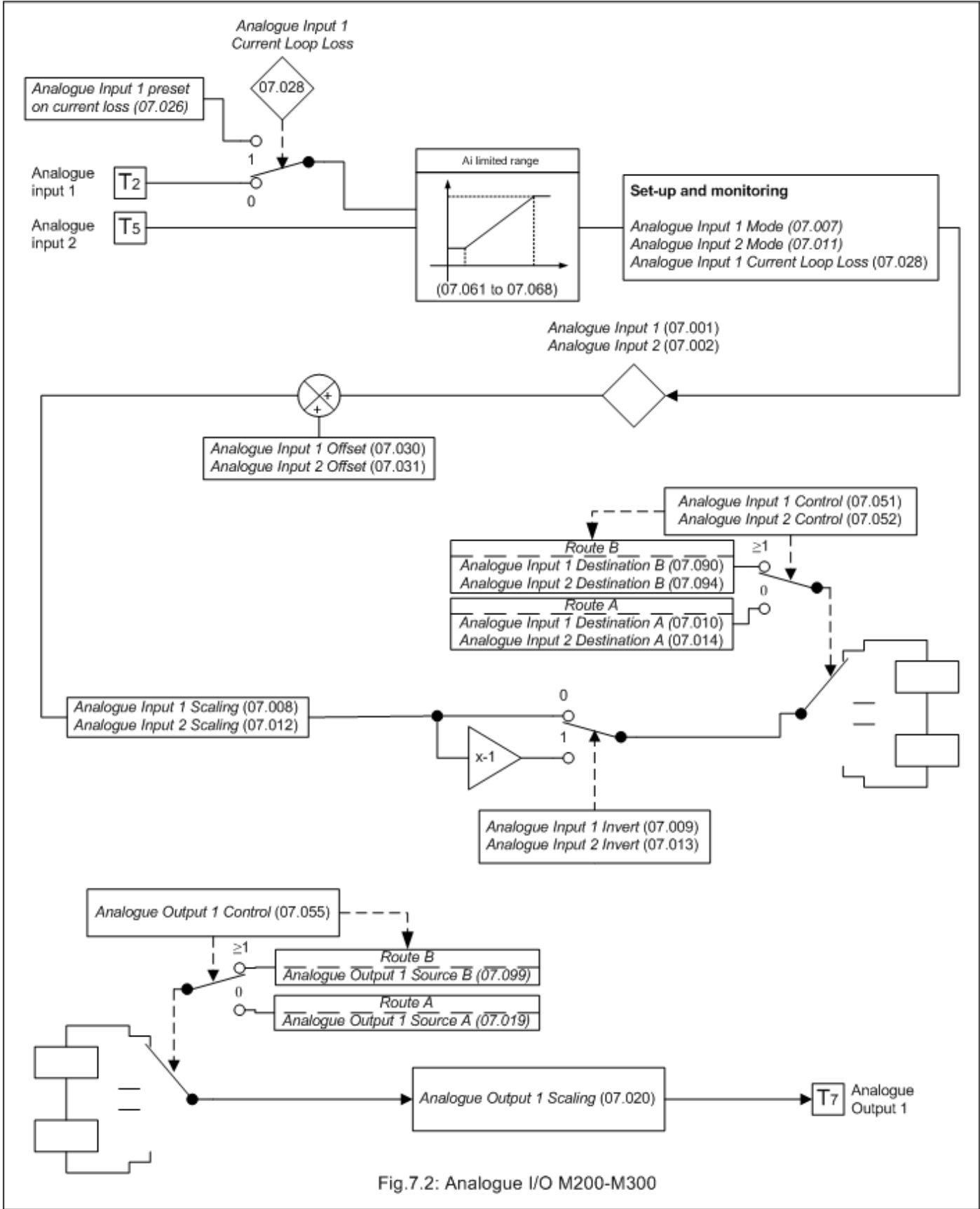
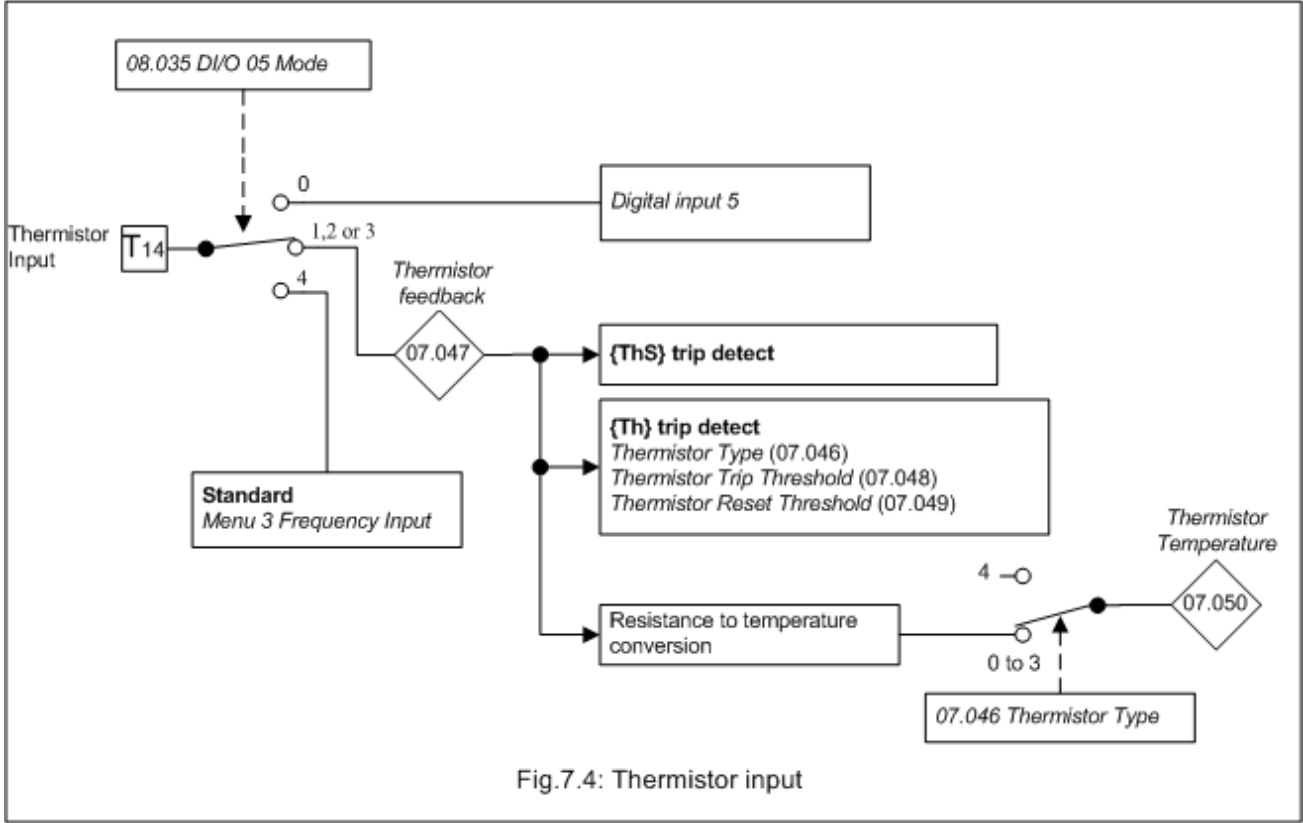
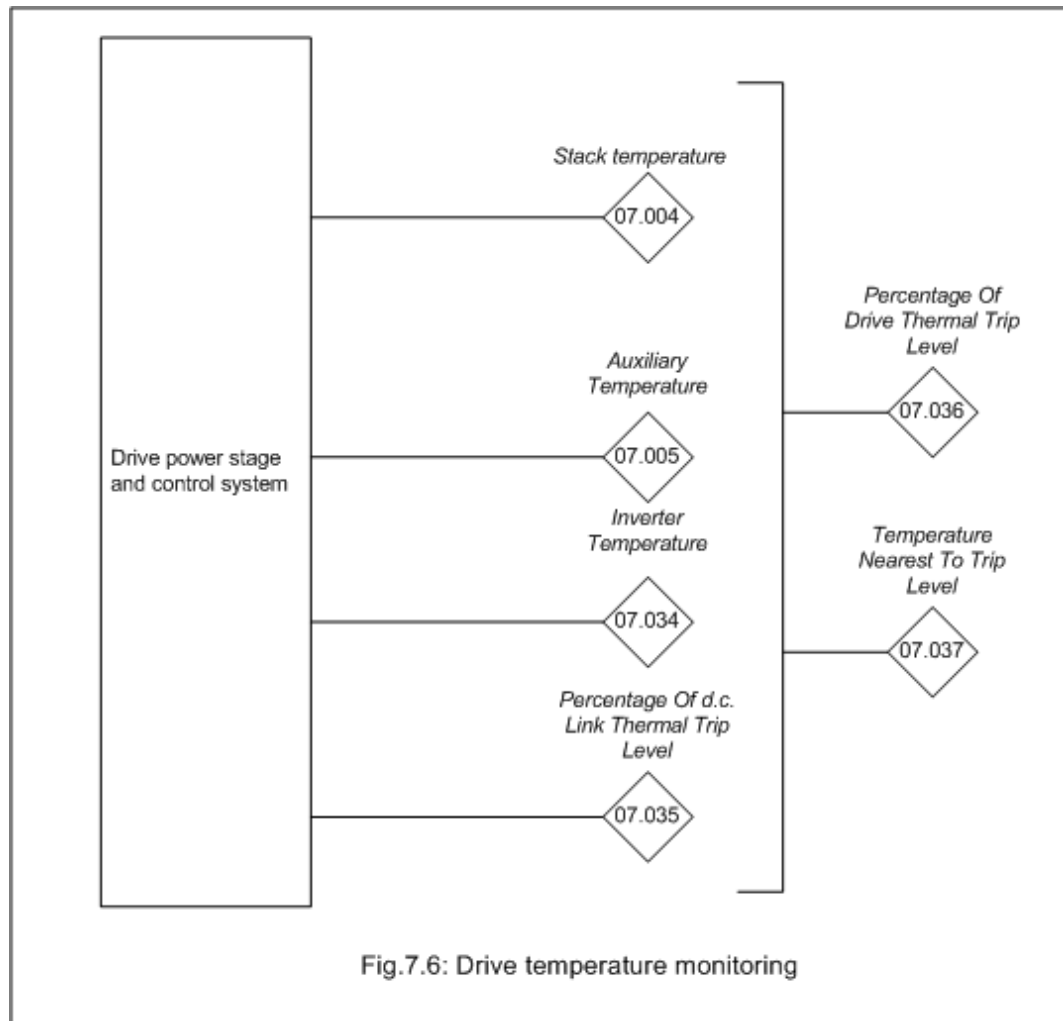


Fig.7.2: Analogue I/O M200-M300

Thermistor Input



## Drive thermal monitoring



| Parameter         | 07.001 Analogue Input 1              |                |        |
|-------------------|--------------------------------------|----------------|--------|
| Short description | Displays the value of analog input 1 |                |        |
| Mode              | Open-Loop                            |                |        |
| Minimum           | -100.00                              | Maximum        | 100.00 |
| Default           |                                      | Units          | %      |
| Type              | 16 Bit Volatile                      | Update Rate    | 4ms    |
| Display Format    | Standard                             | Decimal Places | 2      |
| Coding            | RO, FI, ND, NC, PT                   |                |        |

The Analog input 1 can operate in different modes as defined by *Analogue Input 1 Mode* (07.007) including current modes. See *Analog I/O*.

**Voltage mode:** Resolution of 11 bits. It is a single ended unipolar voltage input 0V-10V

**Current mode:** Resolution of 11 bits. It is a single ended unipolar 0-20mA

The "Input Level" is defined for the different modes in the table below.

| Mode    | Input Level  |
|---------|--|
| Voltage | $(\text{Input Voltage} / 10\text{V}) \times 100.00\%$                |
| 0-20mA  | $(\text{Input Current} / 20\text{mA}) \times 100.00\%$               |
| 20-0mA  | $(20\text{mA} - \text{Input Current}) / 20\text{mA} \times 100.00\%$ |
| 4-20mA  | $(\text{Input Current} - 4\text{mA}) / 16\text{mA} \times 100.00\%$  |
| 20-4mA  | $(20\text{mA} - \text{Input Current}) / 16\text{mA} \times 100.00\%$ |

| Parameter         | 07.002 Analogue Input 2              |                |        |
|-------------------|--------------------------------------|----------------|--------|
| Short description | Displays the value of analog input 2 |                |        |
| Mode              | Open-Loop                            |                |        |
| Minimum           | 0.00                                 | Maximum        | 100.00 |
| Default           |                                      | Units          | %      |
| Type              | 16 Bit Volatile                      | Update Rate    | 4ms    |
| Display Format    | Standard                             | Decimal Places | 2      |
| Coding            | RO, FI, ND, NC, PT                   |                |        |

See *Analog I/O*.

**Voltage mode:** This input is a unipolar voltage 0-10V.

**Digital mode:** This input can also be configured as a digital input in which case this parameter will indicate 0.00% or 100.00% depending on the state of the input.

The "Input Level" is defined for the different modes in the table below.

| Mode    | Input Level  |
|---------|--|
| Voltage | (Input Voltage/ 10V) x 100.00%   |
| Digital | 0.00% (corresponds to logical 0 if less than 9V) or 100.0% (corresponds to logical 1 if more than 11V) |

| Parameter         | 07.004 Stack Temperature   |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the temperature currently being measured on the heat sink |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | -250   | Maximum        | 250              |
| Default           |  | Units          | °C               |
| Type              | 16 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT   |                |                  |

This parameter displays the temperature currently being measured on the heat sink. This is used as part of the drive thermal model, see *Drive Over-temperature Alarm* (10.018) for further details.

| Parameter         | 07.005 Auxiliary Temperature  |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the temperature currently being measured on the power system |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | -250  | Maximum        | 250              |
| Default           |   | Units          | °C               |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

This parameter displays the temperature currently being measured on the power system on large frame. This is used as part of the drive thermal model.

| Parameter         | 07.007 Analogue Input 1 Mode       |                |                 |
|-------------------|------------------------------------|----------------|-----------------|
| Short description | Defines the mode of analog input 1 |                |                 |
| Mode              | Open-Loop                          |                |                 |
| Minimum           | -6                                 | Maximum        | 6               |
| Default           | 6                                  | Units          |                 |
| Type              | 8 Bit User Save                    | Update Rate    | Background read |
| Display Format    | Standard                           | Decimal Places | 0               |
| Coding            | RW, TE                             |                |                 |

| Value | Text    |
|-------|---------|
| -6    | 4-20.S  |
| -5    | 20-4.S  |
| -4    | 4-20.L  |
| -3    | 20-4.L  |
| -2    | 4-20.H  |
| -1    | 20-4.H  |
| 0     | 0-20    |
| 1     | 20-0    |
| 2     | 4-20.tr |
| 3     | 20-4.tr |
| 4     | 4-20    |
| 5     | 20-4    |
| 6     | Volt    |

See *Analogue Input 1* (07.001).

The table below gives all the possible analogue input modes.

| Value | Mode        | Function   |
|-------|-------------|--|
| -6    | 4-20mA Stop | Stop on loss   |
| -5    | 20-4mA Stop | Stop on loss   |
| -4    | 4-20mA Low  | 4-20mA switching to equivalent of 4mA input current on loss(1). See <i>Analog Input 1 Preset on Current Loss</i> (07.026). |
| -3    | 20-4mA Low  | 20-4mA switching to equivalent of 4mA input current on loss(1). See <i>Analog Input 1 Preset on Current Loss</i> (07.026)  |
| -2    | 4-20mA Hold | 4-20mA hold at level before loss on current loss (2)   |
| -1    | 20-4mA Hold | 20-4mA hold at level before loss on current loss (2)   |
| 0     | 0-20mA      | 0-20mA   |
| 1     | 20-0mA      | 20-0mA   |
| 2     | 4-20mA Trip | 4-20mA trip on current loss (1), (3)   |
| 3     | 20-4mA Trip | 20-4mA trip on current loss (1), (3)   |
| 4     | 4-20mA      | 4-20mA no action on loss (1)   |
| 5     | 20-4mA      | 20-4mA no action on loss (1)   |
| 6     | Voltage     | Voltage  |

(1) Analogue input level is 0.00% if the current is below 3mA.

(2) Analogue input level remains at the value it had in the previous sample before the current fell below 3mA.

(3) A *An Input 1 Loss* is initiated if the current falls below 3mA.

| Parameter         | 07.008 Analogue Input 1 Scaling              |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the scaling factor of analog input 1 |                |                 |
| Mode              | Open-Loop                                    |                |                 |
| Minimum           | 0.000  | Maximum        | 10.000          |
| Default           | 1.000  | Units          |                 |
| Type              | 16 Bit User Save                             | Update Rate    | Background read |
| Display Format    | Standard                                     | Decimal Places | 3               |
| Coding            | RW   |                |                 |

See *Analog I/O*.

*Analogue Input 1* (07.001) is modified by *Analogue Input 1 Scaling* (07.008), *Analogue Input 1 Offset* (07.030) and *Analogue Input 1 Invert* (07.009) before it is routed to its destination as follows:

$A_{1O} = \text{Analogue Input 1 (07.001)} + \text{Analogue Input 1 Offset (07.030)}$

$A_{1O}$  is the value after the offset has been applied and is limited between -100.00% and 100.00%

$A_{1S} = A_{1O} \times \text{Analogue Input 1 Scaling (07.008)}$

$A_{1S}$  is the value after the scaling and the offset have been applied and is limited between -100.00% and 100.00%

If *Analogue Input 1 Invert* (07.009) = 0 then  $A_{1I} = A_{1S}$  otherwise  $A_{1I} = -A_{1S}$

$A_{1I}$  is the value after the invert, scaling and offset have been applied and is the final value that is routed to the destination defined by

- *Analogue Input 1 Destination A* (07.010) if *Analogue Input 1 Control* (07.051) = 0
- *Analogue Input 1 Destination B* (07.090) if *Analogue Input 1 Control* (07.051) > 0

| Parameter         | 07.009 Analogue Input 1 Invert        |                |                 |
|-------------------|---------------------------------------|----------------|-----------------|
| Short description | Inverts the signal for analog input 1 |                |                 |
| Mode              | Open-Loop                             |                |                 |
| Minimum           | 0                                     | Maximum        | 1               |
| Default           | 0                                     | Units          |                 |
| Type              | 1 Bit User Save                       | Update Rate    | Background read |
| Display Format    | Standard                              | Decimal Places | 0               |
| Coding            | RW                                    |                |                 |

See *Analogue Input 1 Scaling* (07.008).

| Parameter         | 07.010 Analogue Input 1 Destination A           |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the output parameter for analog input 1 |                |                  |
| Mode              | Open-Loop                                       |                |                  |
| Minimum           | 0.000   | Maximum        | 30.999           |
| Default           | 1.036   | Units          |                  |
| Type              | 16 Bit User Save                                | Update Rate    | Drive reset read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, DE, PT                                      |                |                  |

See *Analogue Input 1 Scaling* (07.008).

| Parameter         | 07.011 Analogue Input 2 Mode        |                |                 |
|-------------------|-------------------------------------|----------------|-----------------|
| Short description | Defines the mode for analog input 2 |                |                 |
| Mode              | Open-Loop                           |                |                 |
| Minimum           | 6                                   | Maximum        | 7               |
| Default           | 6                                   | Units          |                 |
| Type              | 8 Bit User Save                     | Update Rate    | Background read |
| Display Format    | Standard                            | Decimal Places | 0               |
| Coding            | RW, TE                              |                |                 |

| Value | Text |
|-------|------|
| 6     | Volt |
| 7     | dig  |

See *Analogue Input 2* (07.002).

The table below gives all the possible analogue input modes.

| Value | Mode    | Function |
|-------|---------|----------|
| 6     | Voltage | Voltage  |
| 7     | Digital | Digital  |

| Parameter         | 07.012 Analogue Input 2 Scaling               |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the scaling factor for analog input 2 |                |                 |
| Mode              | Open-Loop                                     |                |                 |
| Minimum           | 0.000   | Maximum        | 10.000          |
| Default           | 1.000   | Units          |                 |
| Type              | 16 Bit User Save                              | Update Rate    | Background read |
| Display Format    | Standard                                      | Decimal Places | 3               |
| Coding            | RW  |                |                 |

See *Analog I/O*.

*Analogue Input 2* (07.002) is modified by *Analogue Input 2 Scaling* (07.012), *Analogue Input 2 Offset* (07.031) and *Analogue Input 2 Invert* (07.013) before it is routed to its destination as follows:

$A_{20} = \text{Analogue Input 2 (07.002)} + \text{Analogue Input 2 Offset (07.031)}$

$A_{20}$  is the value after the offset has been applied and is limited between 0.00% and 100.00%

$A_{2S} = A_{20} \times \text{Analogue Input 2 Scaling (07.012)}$

$A_{2S}$  is the value after the scaling and the offset have been applied and is limited between 0.00% and 100.00%

If *Analogue Input 2 Invert* (07.013) = 0 then  $A_{2I} = A_{2S}$  otherwise  $A_{2I} = -A_{2S}$

$A_{2I}$  is the value after the invert, scaling and offset have been applied and is the final value that is routed to the destination defined by

- *Analogue Input 2 Destination A* (07.014) if *Analogue Input 2 Control* (07.052) = 0
- *Analogue Input 2 Destination B* (07.094) if *Analogue Input 2 Control* (07.052) > 0

| Parameter         | 07.013 Analogue Input 2 Invert        |                |                 |
|-------------------|---------------------------------------|----------------|-----------------|
| Short description | Inverts the signal for analog input 2 |                |                 |
| Mode              | Open-Loop                             |                |                 |
| Minimum           | 0                                     | Maximum        | 1               |
| Default           | 0                                     | Units          |                 |
| Type              | 1 Bit User Save                       | Update Rate    | Background read |
| Display Format    | Standard                              | Decimal Places | 0               |
| Coding            | RW                                    |                |                 |

See *Analogue Input 2 Scaling* (07.012).

| Parameter         | 07.014 Analogue Input 2 Destination A           |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the output parameter for analog input 2 |                |                  |
| Mode              | Open-Loop                                       |                |                  |
| Minimum           | 0.000   | Maximum        | 30.999           |
| Default           | 1.037   | Units          |                  |
| Type              | 16 Bit User Save                                | Update Rate    | Drive reset read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, DE, PT                                      |                |                  |

See *Analogue Input 2 Scaling* (07.012).

| Parameter         | 07.019 Analogue Output 1 Source A               |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the input parameter for analog output 1 |                |                  |
| Mode              | Open-Loop                                       |                |                  |
| Minimum           | 0.000   | Maximum        | 30.999           |
| Default           | 2.001   | Units          |                  |
| Type              | 16 Bit User Save                                | Update Rate    | Drive reset read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, PT  |                |                  |

*Analogue Output 1 Source A* (07.019) defines the source parameter for Analogue Output 1. The value is then scaled with *Analogue Output 1 Scaling* (07.020) and if the scaling is greater than 1.000 the value is clamped between -100.0% and +100.0% which corresponds to:

M200, M201, M300:

- In voltage mode: 0V to +10V

M400:

- In voltage mode: 0V to +10V
- In current mode: 4-20mA or 0-20mA depending on the mode selected
- In digital mode: 0V to +24V. Scaling parameter has no effect.
  - If source is a bit parameter then "Off" gives 0V and "On" gives +24V
  - If source is not a bit parameter then source parameter must be more than half its positive range to be +24V.

| Parameter         | 07.020 Analogue Output 1 Scaling               |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the scaling factor for analog output 1 |                |                 |
| Mode              | Open-Loop                                      |                |                 |
| Minimum           | 0.000  | Maximum        | 40.000          |
| Default           | 1.000  | Units          |                 |
| Type              | 16 Bit User Save                               | Update Rate    | Background read |
| Display Format    | Standard                                       | Decimal Places | 3               |
| Coding            | RW, BU   |                |                 |

See *Analogue Output 1 Source A* (07.019).

| Parameter         | 07.026 Analog Input 1 Preset on Current Loss                    |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the current level held on analogue input 1 current loss |                |          |
| Mode              | Open-Loop   |                |          |
| Minimum           | 4.00  | Maximum        | 20.00    |
| Default           | 4.00  | Units          | mA       |
| Type              | 16 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 2        |
| Coding            | RW  |                |          |

If *Analogue Input 1 Mode* (07.007) is set to any of the 4-20mA Low or 20-4mA Low modes and the current falls below 3mA (*Analogue Input 1 Current Loop Loss* (07.028) = 1) then the analogue input 1 is held to *Analog Input 1 Preset on Current Loss* (07.026).

If the current rise above 4mA (*Analogue Input 1 Current Loop Loss* (07.028) = 0) then the analogue input 1 current is used as normal.

| Parameter         | 07.028 Analogue Input 1 Current Loop Loss    |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays when analog input 1 falls below 3mA |                |                  |
| Mode              | Open-Loop                                    |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile                               | Update Rate    | Background write |
| Display Format    | Standard                                     | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                               |                |                  |

See *Analog Input 1 Preset on Current Loss* (07.026).



| Parameter         | 07.030 Analogue Input 1 Offset       |                |                 |
|-------------------|--------------------------------------|----------------|-----------------|
| Short description | Defines the offset of analog input 1 |                |                 |
| Mode              | Open-Loop                            |                |                 |
| Minimum           | -100.00                              | Maximum        | 100.00          |
| Default           | 0.00                                 | Units          | %               |
| Type              | 16 Bit User Save                     | Update Rate    | Background read |
| Display Format    | Standard                             | Decimal Places | 2               |
| Coding            | RW                                   |                |                 |

See *Analogue Input 1 Scaling* (07.008).

| Parameter         | 07.031 Analogue Input 2 Offset       |                |                 |
|-------------------|--------------------------------------|----------------|-----------------|
| Short description | Defines the offset of analog input 2 |                |                 |
| Mode              | Open-Loop                            |                |                 |
| Minimum           | -100.00                              | Maximum        | 100.00          |
| Default           | 0.00                                 | Units          | %               |
| Type              | 16 Bit User Save                     | Update Rate    | Background read |
| Display Format    | Standard                             | Decimal Places | 2               |
| Coding            | RW                                   |                |                 |

See *Analogue Input 2 Scaling* (07.012).

| Parameter         | 07.034 Inverter Temperature   |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the estimated junction temperature of the hottest power device within the drive inverter |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | -250  | Maximum        | 250              |
| Default           |   | Units          | °C               |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

*Inverter Temperature* (07.034) shows the estimated junction temperature of the hottest power device within the drive inverter. If this temperature exceeds the switch down threshold defined for the power stage the switching frequency is reduced provided this feature has not been disabled (i.e. *Auto-switching Frequency Change Disable* (05.035) = 0) or the minimum switching frequency has not been reached. The switching frequency can be reduced from 12kHz to 6kHz to 3kHz, or from 16kHz to 8kHz to 4kHz to 2kHz. If the switching frequency has been reduced the drive will attempt to restore it to the required level when the *Inverter Temperature* (07.034) reduces.

| Parameter         | 07.035 Percentage Of d.c. Link Thermal Trip Level  |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the percentage of the maximum allowed temperature as estimated by the thermal model of the d.c. link components |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0  | Maximum        | 100              |
| Default           |  | Units          | %                |
| Type              | 8 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT   |                |                  |

*Percentage Of d.c. Link Thermal Trip Level* (07.035) gives the percentage of the maximum allowed temperature as estimated by the thermal model of the d.c. link components.

| Parameter         | 07.036 Percentage Of Drive Thermal Trip Level   |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the percentage of the thermal trip level of the temperature monitoring point or thermal model in the drive that is highest |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0   | Maximum        | 100              |
| Default           |   | Units          | %                |
| Type              | 8 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

*Percentage Of Drive Thermal Trip Level* (07.036) gives the percentage of the thermal trip level of the temperature monitoring point or thermal model in the drive that is highest. This includes all thermal monitoring points *Stack Temperature* (07.004), *Auxiliary Temperature* (07.005), *Inverter Temperature* (07.034) and *Percentage Of d.c. Link Thermal Trip Level* (07.035).

*Percentage Of d.c. Link Thermal Trip Level* (07.035) is used directly to give *Percentage Of Drive Thermal Trip Level* (07.036), but for all other monitored values which are temperatures this is given by

$$\text{Percentage of thermal trip level} = (\text{Temperature} - 40^{\circ}\text{C}) / (\text{Trip temperature} - 40^{\circ}\text{C}) \times 100\%$$

The location of the measurement or the thermal model that is related to this temperature is given in *Temperature Nearest To Trip Level* (07.037). If *Percentage Of Drive Thermal Trip Level* (07.036) exceeds 90% *Drive Over-temperature Alarm* (10.018) is set to one. If *Percentage Of Drive Thermal Trip Level* (07.036) reaches 100% one of the trips given in the table below is initiated. The trip can be reset when the percentage of thermal trip level fall below 95%.

| Temperature  | Trip                |
|--|---------------------|
| <i>Inverter Temperature</i> (07.034)                       | <i>OHT Inverter</i> |
| <i>Auxiliary Temperature</i> (07.005)                      | <i>OHT Power</i>    |
| <i>Percentage Of d.c. Link Thermal Trip Level</i> (07.035) | <i>OHT dc bus</i>   |

| Parameter         | 07.037 Temperature Nearest To Trip Level   |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the location or the model that corresponds to the value shown in Percentage Of Drive Thermal Trip Level |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0  | Maximum        | 29999            |
| Default           |  | Units          |                  |
| Type              | 32 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT   |                |                  |

*Temperature Nearest To Trip Level* (07.037) shows the location or the model that corresponds to the value shown in *Percentage Of Drive Thermal Trip Level* (07.036) in the form xxyz as shown in the table below.

| Source                          | xx | y | zz  |
|---------------------------------|----|---|---|
| Control system                  | 00 | 1 | 00: Inverter thermal model                                |
| Control system                  | 00 | 2 | 00: D.c. link thermal model                               |
| Power system                    | 01 | 0 | zz: Thermistor location defined by zz in the power system |
| Power system (Large frame only) | 01 | 1 | zz: Thermistor location defined by zz in the rectifier    |

| Parameter         | 07.046 Thermistor Type                |                |                  |
|-------------------|---------------------------------------|----------------|------------------|
| Short description | Defines the thermistor type when used |                |                  |
| Mode              | Open-Loop                             |                |                  |
| Minimum           | 0                                     | Maximum        | 4                |
| Default           | 0                                     | Units          |                  |
| Type              | 8 Bit User Save                       | Update Rate    | Background write |
| Display Format    | Standard                              | Decimal Places | 0                |
| Coding            | RW, TE                                |                |                  |

| Value | Text   |
|-------|--------|
| 0     | D44081 |
| 1     | 84     |
| 2     | PT1000 |
| 3     | PT2000 |
| 4     | other  |

*Thermistor Type* (07.046) defines the operation of the temperature feedback interface for DI/O 05 when *Digital input 5 mode* (08.035) is 1, 2 or 3.

If *Thermistor Type* (07.046) = 0, the thermistor DIN44081 is designed to react like a temperature switch and therefore *Thermistor Temperature* (07.050) always reads 0.0°C.

If *Thermistor Type* (07.046) = 1 to 3 is selected, the digital input operation of the terminal is disabled.

If *Thermistor Type* (07.046) = 4, any thermistor can be used but *Thermistor Temperature* (07.050) always reads 0.0°C.

| Parameter         | 07.047 Thermistor Feedback                                   |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the measured resistance of the thermistor when used |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0  | Maximum        | 4000             |
| Default           |  | Units          | Ω                |
| Type              | 16 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, FI, ND, NC, PT   |                |                  |

*Thermistor Feedback* (07.047) shows the measured resistance. If *Digital input 5 mode* (08.035) is 2 then {Th} trip is initiated if the feedback value is higher than *Thermistor Trip Threshold* (07.048). The trip cannot be reset unless the feedback is below *Thermistor Reset Threshold* (07.049). The default values for *Thermistor Trip Threshold* (07.048) and *Thermistor Reset Threshold* (07.049) are the levels specified in the DIN 44082 standard.

| Parameter         | 07.048 Thermistor Trip Threshold                |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the thermistor trip threshold when used |                |                 |
| Mode              | Open-Loop                                       |                |                 |
| Minimum           | 0   | Maximum        | 4000            |
| Default           | 3300  | Units          | Ω               |
| Type              | 16 Bit User Save                                | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See *Thermistor Feedback* (07.047).

| Parameter         | 07.049 Thermistor Reset Threshold                |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the thermistor reset threshold when used |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0  | Maximum        | 4000            |
| Default           | 1800   | Units          | Ω               |
| Type              | 16 Bit User Save                                 | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

See *Thermistor Feedback* (07.047).

| Parameter         | 07.050 Thermistor Temperature   |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the temperature of the device based on the resistance to temperature characteristic for the specified device |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | -50   | Maximum        | 300              |
| Default           |   | Units          | °C               |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, FI, ND, NC, PT  |                |                  |

If a KTY84, PT1000 or PT2000 type device is selected for temperature feedback (i.e. *Thermistor Type* (07.046) = 1 to 3) then *Thermistor Temperature* (07.050) shows the temperature of the device based on the resistance to temperature characteristic specified for this device. Otherwise *Thermistor Temperature* (07.050) = 0.0.

| Parameter         | 07.051 Analogue Input 1 Control             |                |  |
|-------------------|---|----------------|--|
| Short description | Defines the functionality of analog input 1 |                |  |
| Mode              | Open-Loop                                   |                |  |
| Minimum           | 0   | Maximum        | 5  |
| Default           | 0   | Units          |  |
| Type              | 8 Bit User Save                             | Update Rate    | Actioned on exit of edit mode and on drive reset |
| Display Format    | Standard                                    | Decimal Places | 0  |
| Coding            | RW  |                |  |

| Value | Description  | Analogue Input 1 Destination B (07.090) |
|-------|--|---|
| 0     | User defined by <i>Analogue Input 1 Destination A</i> (07.010) | 00.000                                  |
| 1     | Frequency reference 1  | 01.036                                  |
| 2     | Frequency reference 2  | 01.037                                  |
| 3     | Maximum reference clamp  | 01.006                                  |
| 4     | Current limit  | 04.007                                  |
| 5     | Torque reference   | 04.008                                  |

This offers a simple control of parameter to change the analogue input 1 functionality.

If *Analogue Input 1 Control* (07.051) is more than 0 then the destination is defined by *Analogue Input 1 Destination B* (07.090). The destination *Analogue Input 1 Destination B* (07.090) is written by *Analogue Input 1 Control* (07.051) selection. (i.e. If *Analogue Input 1 Control* (07.051) = 3 then *Analogue Input 1 Destination B* (07.090) = 01.006)

If *Analogue Input 1 Control* (07.051) is 0 then the destination is defined by *Analogue Input 1 Destination A* (07.010).

| Parameter         | 07.052 Analogue Input 2 Control             |                |  |
|-------------------|---|----------------|--|
| Short description | Defines the functionality of analog input 2 |                |  |
| Mode              | Open-Loop                                   |                |  |
| Minimum           | 0   | Maximum        | 5  |
| Default           | 0   | Units          |  |
| Type              | 8 Bit User Save                             | Update Rate    | Actioned on exit of edit mode and on drive reset |
| Display Format    | Standard                                    | Decimal Places | 0  |
| Coding            | RW  |                |  |

| Value | Description  | Analogue Input 2 Destination B (07.094) |
|-------|--|---|
| 0     | User defined by <i>Analogue Input 2 Destination A</i> (07.014) | 00.000                                  |
| 1     | Frequency reference 1  | 01.036                                  |
| 2     | Frequency reference 2  | 01.037                                  |
| 3     | Maximum reference clamp  | 01.006                                  |
| 4     | Current limit  | 04.007                                  |
| 5     | Torque reference   | 04.008                                  |

This offers a simple control of parameter to change the analogue input 2 functionality.

If *Analogue Input 2 Control* (07.052) is more than 0 then the destination is defined by *Analogue Input 2 Destination B* (07.094). The destination *Analogue Input 2 Destination B* (07.094) is written by *Analogue Input 2 Control* (07.052) selection. (i.e. If *Analogue Input 2 Control* (07.052)= 3 then *Analogue Input 2 Destination B* (07.094) = 01.006)

If *Analogue Input 2 Control* (07.052) is 0 then then the destination is defined by *Analogue Input 2 Destination A* (07.014).

| Parameter         | 07.055 <i>Analogue Output 1 Control</i>      |                |  |
|-------------------|--|----------------|--|
| Short description | Defines the functionality of analog output 1 |                |  |
| Mode              | Open-Loop                                    |                |  |
| Minimum           | 0  | Maximum        | 15   |
| Default           | 0  | Units          |  |
| Type              | 8 Bit User Save                              | Update Rate    | Actioned on exit of edit mode and on drive reset |
| Display Format    | Standard                                     | Decimal Places | 0  |
| Coding            | RW, BU                                       |                |  |

| Value | Description  | Analogue Output 1 Source B (07.099) |
|-------|--|-------------------------------------|
| 0     | User defined by <i>Analogue Output 1 Source A</i> (07.019) | 00.000                              |
| 1     | Frequency output   | 02.001                              |
| 2     | Frequency reference  | 01.003                              |
| 3     | Motor speed  | 05.004                              |
| 4     | Current output vs drive                                    | 04.001                              |
| 5     | Current output vs motor                                    | TBD: 0 ~ double motor rated current |
| 6     | Torque output  | 04.020                              |
| 7     | Torque current output                                      | 04.002                              |
| 8     | Voltage output   | 05.002                              |
| 9     | DC bus voltage (0~800V)                                    | 05.005                              |
| 10    | Analogue Input 1   | 07.001                              |
| 11    | Analogue Input 2   | 07.002                              |
| 12    | Power output (0~2*Pe)                                      | 05.003                              |
| 13    | Torque limitation  | 04.018                              |
| 14    | Torque reference (0~300%Tem)                               | 04.008                              |
| 15    | External function of host (0~4095)                         | TBD (from comms)                    |

This offers a simple control of parameter *Analogue Output 1 Source B* (07.099) to change the analogue output 1 source.

If *Analogue Output 1 Control* (07.055) is more than 0 then the source is defined by *Analogue Output 1 Source B* (07.099). The source *Analogue Output 1 Source B* (07.099) is written by *Analogue Output 1 Control* (07.055) selection. (i.e. If *Analogue Output 1 Control* (07.055) = 13 then *Analogue Output 1 Source B* (07.099) = 04.018)

If 07.055 is 0 then then the source is defined by 07.019.

| Parameter         | 07.061 <i>Analogue Input 1 Minimum Reference</i> |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the minimum reference for analog input 1 |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0.00   | Maximum        | 100.00          |
| Default           | 0.00   | Units          | %               |
| Type              | 16 Bit User Save                                 | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 2               |
| Coding            | RW   |                |                 |

*Analogue Input 1* (07.001) can be scaled and limited using the following parameters:

- *Analogue Input 1 Minimum Reference* (07.061)
- *Analogue Input 1 At Minimum Reference* (07.062)
- *Analogue Input 1 Maximum Reference* (07.063)
- *Analogue Input 1 At Maximum Reference* (07.064)

Parameters above can be selected to limit the range of *Analogue Input 1* (07.001) and also scale it between the minimum and maximum reference.

If *Analogue Input 1 Minimum Reference* (07.061) ≥ *Analogue Input 1 Maximum Reference* (07.063) then  $A_{i1} = 0.00\%$  whatever the input level.

Input Level is limited between *Analogue Input 1 At Minimum Reference* (07.062) and *Analogue Input 1 At Maximum Reference* (07.064)

$$\text{Analogue Input 1 (07.001)} = \frac{(\text{Analogue Input 1 At Maximum Reference (07.064)} - \text{Analogue Input 1 At Minimum Reference (07.062)})}{(\text{Analogue Input 1 Maximum Reference (07.063)} - \text{Analogue Input 1 Minimum Reference (07.061)})} \times (\text{Input level} - \text{Analogue Input 1 Minimum Reference (07.061)}) + \text{Analogue Input 1 At Minimum Reference (07.062)}.$$

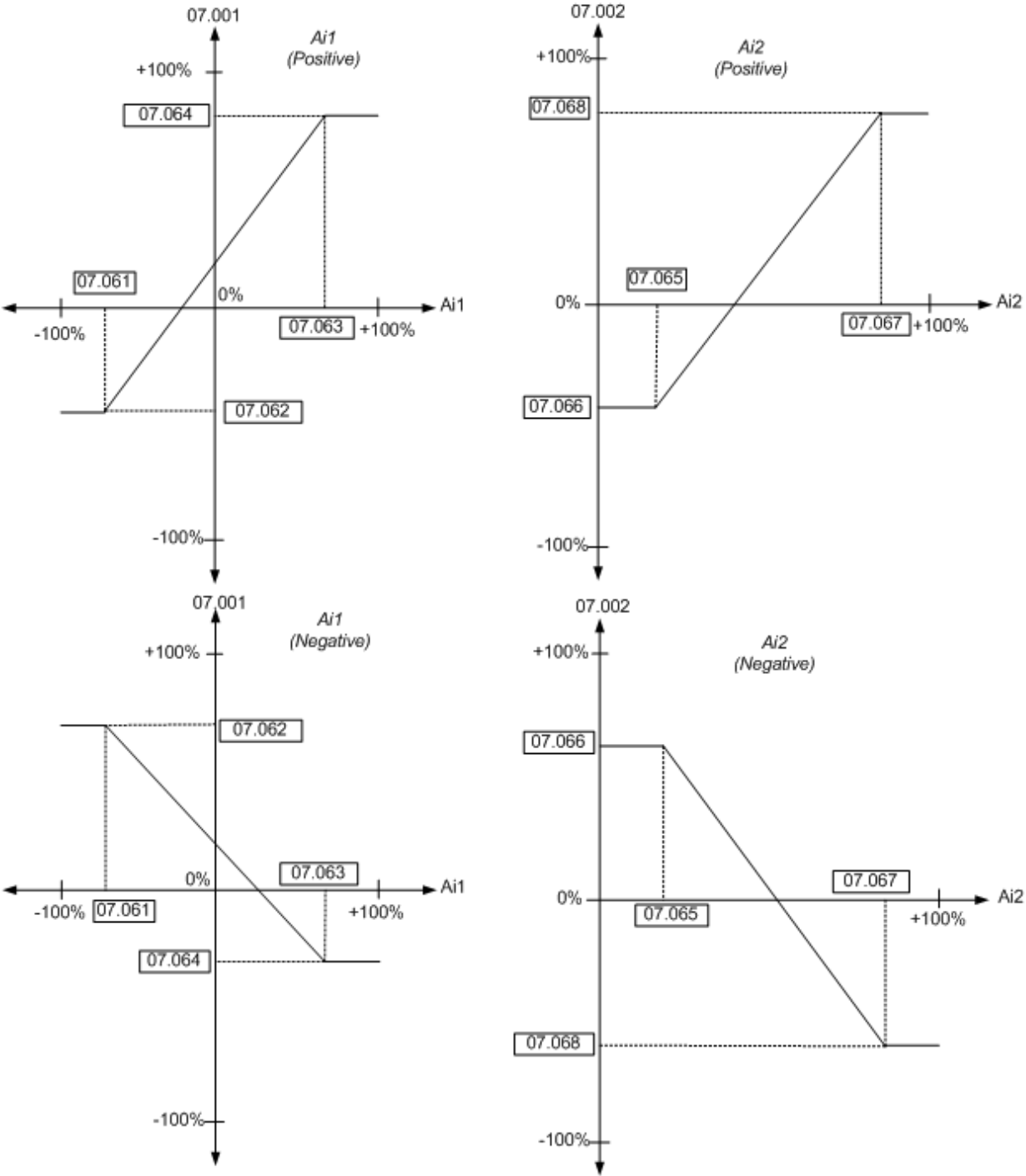


Fig.7.5c: Analogue Input scaling & limit

| Parameter         | <b>07.062 Analogue Input 1 At Minimum Reference</b>      |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the value of analog input 1 at minimum reference |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | -100.00  | Maximum        | 100.00          |
| Default           | 0.00   | Units          | %               |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 2               |
| Coding            | RW   |                |                 |

See *Analogue Input 1 Minimum Reference* (07.061).

| Parameter         | <b>07.063 Analogue Input 1 Maximum Reference</b> |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the maximum reference for analog input 1 |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0.00   | Maximum        | 100.00          |
| Default           | 100.00   | Units          | %               |
| Type              | 16 Bit User Save                                 | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 2               |
| Coding            | RW   |                |                 |

See *Analogue Input 1 Minimum Reference* (07.061).

| Parameter         | <b>07.064 Analogue Input 1 At Maximum Reference</b>      |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the value of analog input 1 at maximum reference |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | -100.00  | Maximum        | 100.00          |
| Default           | 100.00   | Units          | %               |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 2               |
| Coding            | RW   |                |                 |

See *Analogue Input 1 Minimum Reference* (07.061).

| Parameter         | <b>07.065 Analogue Input 2 Minimum Reference</b> |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the minimum reference for analog input 2 |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0.00   | Maximum        | 100.00          |
| Default           | 0.00   | Units          | %               |
| Type              | 16 Bit User Save                                 | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 2               |
| Coding            | RW   |                |                 |

See graph in *Analogue Input 1 Minimum Reference* (07.061).

*Analogue Input 2* (07.002) can be scaled and limited using the following parameters:

- *Analogue Input 2 Minimum Reference* (07.065)
- *Analogue Input 2 At Minimum Reference* (07.066)
- *Analogue Input 2 Maximum Reference* (07.067)
- *Analogue Input 2 At Maximum Reference* (07.068)

Parameters above can be selected to limit the range of *Analogue Input 2* (07.002) and also scale it between the minimum and maximum reference.

If *Analogue Input 2 Minimum Reference* (07.065)  $\geq$  *Analogue Input 2 Maximum Reference* (07.067) then  $A_{i2} = 0.00\%$  whatever the input level.

Input Level is limited between *Analogue Input 2 At Minimum Reference* (07.066) and *Analogue Input 2 At Maximum Reference* (07.068)

$$\text{Analogue Input 2 (07.002)} = [(\text{Analogue Input 2 At Maximum Reference (07.068)} - \text{Analogue Input 2 At Minimum Reference (07.066)}) / (\text{Analogue Input 2 Maximum Reference (07.067)} - \text{Analogue Input 2 Minimum Reference (07.065)})] \times (\text{Input level} - \text{Analogue Input 2 Minimum Reference (07.065)}) + \text{Analogue Input 2 At Minimum Reference (07.066)}$$

| Parameter         | <b>07.066 Analogue Input 2 At Minimum Reference</b>      |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the value of analog input 2 at minimum reference |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | -100.00  | Maximum        | 100.00          |
| Default           | 0.00   | Units          | %               |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 2               |
| Coding            | RW   |                |                 |

See *Analogue Input 2 Minimum Reference* (07.065).

| Parameter         | <b>07.067 Analogue Input 2 Maximum Reference</b> |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the maximum reference for analog input 2 |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0.00   | Maximum        | 100.00          |
| Default           | 100.00   | Units          | %               |
| Type              | 16 Bit User Save                                 | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 2               |
| Coding            | RW   |                |                 |

See *Analogue Input 2 Minimum Reference* (07.065).

| Parameter         | <b>07.068 Analogue Input 2 At Maximum Reference</b>      |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the value of analog input 2 at maximum reference |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | -100.00  | Maximum        | 100.00          |
| Default           | 100.00   | Units          | %               |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 2               |
| Coding            | RW   |                |                 |

See *Analogue Input 2 Minimum Reference* (07.065).

| Parameter         | <b>07.090 Analogue Input 1 Destination B</b>         |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the secondary destination for analog input 1 |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0.000  | Maximum        | 30.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save                                     | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RO, DE, PT   |                |                  |

See *Analogue Input 1 Destination A* (07.010).

| Parameter         | <b>07.094 Analogue Input 2 Destination B</b>         |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the secondary destination for analog input 2 |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0.000  | Maximum        | 30.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save                                     | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RO, DE, PT   |                |                  |

See *Analogue Input 2 Destination A* (07.014).

| Parameter         | <b>07.099 Analogue Output 1 Source B</b>         |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the secondary source for analog output 1 |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0.000  | Maximum        | 30.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save                                 | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RO, PT   |                |                  |

See *Analogue Output 1 Source A* (07.019).

## Menu 8 Single Line Descriptions – Digital I/O

Mode: Open-Loop

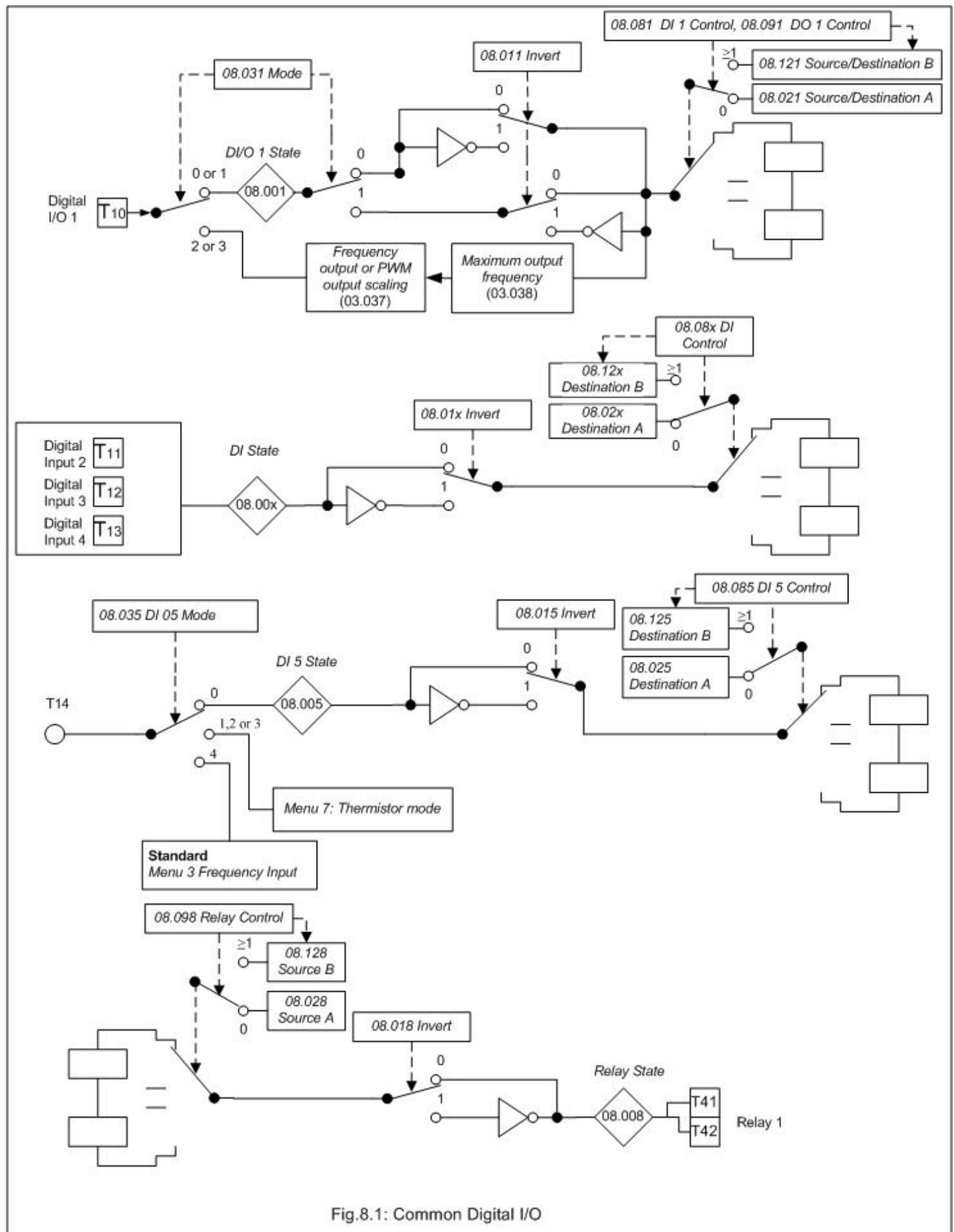
| Parameter |                                       | Range   | Default                    | Type |     |    |    |    |    |
|-----------|---------------------------------------|---|----------------------------|------|-----|----|----|----|----|
| 08.001    | Digital I/O 1 State                   | Off (0) or On (1)                                     |                            | RO   | Bit | ND | NC | PT |    |
| 08.002    | Digital I/O 2 State                   | Off (0) or On (1)                                     |                            | RO   | Bit | ND | NC | PT |    |
| 08.003    | Digital Input 3 State                 | Off (0) or On (1)                                     |                            | RO   | Bit | ND | NC | PT |    |
| 08.004    | Digital Input 4 State                 | Off (0) or On (1)                                     |                            | RO   | Bit | ND | NC | PT |    |
| 08.005    | Digital Input 5 State                 | Off (0) or On (1)                                     |                            | RO   | Bit | ND | NC | PT |    |
| 08.008    | Relay 1 Output State                  | Off (0) or On (1)                                     |                            | RO   | Bit | ND | NC | PT |    |
| 08.011    | Digital I/O 1 Invert                  | Not.Inv (0), Invert (1)                               | Not.Inv (0)                | RW   | Txt |    |    |    | US |
| 08.012    | Digital I/O 2 Invert                  | Not.Inv (0), Invert (1)                               | Not.Inv (0)                | RW   | Txt |    |    |    | US |
| 08.013    | Digital Input 3 Invert                | Not.Inv (0), Invert (1)                               | Not.Inv (0)                | RW   | Txt |    |    |    | US |
| 08.014    | Digital Input 4 Invert                | Not.Inv (0), Invert (1)                               | Not.Inv (0)                | RW   | Txt |    |    |    | US |
| 08.015    | Digital Input 5 Invert                | Not.Inv (0), Invert (1)                               | Not.Inv (0)                | RW   | Txt |    |    |    | US |
| 08.018    | Relay 1 Invert                        | Not.Inv (0), Invert (1)                               | Not.Inv (0)                | RW   | Txt |    |    |    | US |
| 08.020    | Digital I/O Read Word                 | 000000000000 to 100000000000                          |                            | RO   | Bin | ND | NC | PT |    |
| 08.021    | Digital IO1 Source/Destination A      | 0.000 to 30.999                                       | 10.003                     | RW   | Num | DE |    | PT | US |
| 08.022    | Digital IO2 Source/Destination A      | 0.000 to 30.999                                       | 50Hz: 6.038<br>60Hz: 6.039 | RW   | Num | DE |    | PT | US |
| 08.023    | Digital Input 03 Destination A        | 0.000 to 30.999                                       | 6.030                      | RW   | Num | DE |    | PT | US |
| 08.024    | Digital Input 04 Destination A        | 0.000 to 30.999                                       | 6.032                      | RW   | Num | DE |    | PT | US |
| 08.025    | Digital Input 05 Destination A        | 0.000 to 30.999                                       | 1.041                      | RW   | Num | DE |    | PT | US |
| 08.028    | Relay 1 Output Source A               | 0.000 to 30.999                                       | 10.001                     | RW   | Num |    |    | PT | US |
| 08.031    | Digital I/O 01 mode                   | Input (0), Output (1), Fr (2), Pulse (3)              | Output (1)                 | RW   | Txt |    |    |    | US |
| 08.035    | Digital input 5 mode                  | Input (0), Th.Sct (1), th (2),<br>Th.NoTr (3), Fr (4) | Input (0)                  | RW   | Txt |    |    |    | US |
| 08.041    | Keypad Run Button State               | Off (0) or On (1)                                     |                            | RO   | Bit | ND | NC | PT |    |
| 08.042    | Keypad Auxiliary Button State         | Off (0) or On (1)                                     |                            | RO   | Bit | ND | NC | PT |    |
| 08.043    | 24V Supply Input State                | Off (0) or On (1)                                     |                            | RO   | Bit | ND | NC | PT |    |
| 08.044    | Keypad Stop Button State              | Off (0) or On (1)                                     |                            | RO   | Bit | ND | NC | PT |    |
| 08.051    | Keypad Run Button Invert/Toggle       | Not.Inv (0), Invert (1), Toggle (2)                   | Not.Inv (0)                | RW   | Txt |    |    |    | US |
| 08.052    | Keypad Auxiliary Button Invert/Toggle | Not.Inv (0), Invert (1), Toggle (2)                   | Not.Inv (0)                | RW   | Txt |    |    |    | US |
| 08.053    | 24V Supply Input Invert               | Not.Inv (0), Invert (1)                               | Not.Inv (0)                | RW   | Txt |    |    |    | US |
| 08.061    | Keypad Run Button Destination         | 0.000 to 30.999                                       | 0.000                      | RW   | Num | DE |    | PT | US |
| 08.062    | Keypad Auxiliary Button Destination   | 0.000 to 30.999                                       | 0.000                      | RW   | Num | DE |    | PT | US |
| 08.063    | 24V Supply Input Destination          | 0.000 to 30.999                                       | 0.000                      | RW   | Num | DE |    | PT | US |
| 08.081    | DI1 Control                           | 0 to 26   | 0                          | RW   | Num |    |    |    | US |
| 08.082    | DI2 Control                           | 0 to 26   | 0                          | RW   | Num |    |    |    | US |
| 08.083    | DI3 Control                           | 0 to 26   | 0                          | RW   | Num |    |    |    | US |
| 08.084    | DI4 Control                           | 0 to 26   | 0                          | RW   | Num |    |    |    | US |
| 08.085    | DI5 Control                           | 0 to 26   | 0                          | RW   | Num |    |    |    | US |
| 08.091    | DO1 Control                           | 0 to 21   | 0                          | RW   | Num |    |    |    | US |
| 08.098    | Relay 1 Control                       | 0 to 21   | 0                          | RW   | Num |    |    |    | US |
| 08.121    | DI/O 01 Source/Destination B          | 0.000 to 30.999                                       | 0.000                      | RO   | Num | DE |    | PT | US |
| 08.122    | DI/O 02 Source/Destination B          | 0.000 to 30.999                                       | 0.000                      | RO   | Num | DE |    | PT | US |
| 08.123    | DI 03 Destination B                   | 0.000 to 30.999                                       | 0.000                      | RO   | Num | DE |    | PT | US |
| 08.124    | DI 04 Destination B                   | 0.000 to 30.999                                       | 0.000                      | RO   | Num | DE |    | PT | US |
| 08.125    | DI 05 Destination B                   | 0.000 to 30.999                                       | 0.000                      | RO   | Num | DE |    | PT | US |
| 08.128    | Relay 01 Source B                     | 0.000 to 30.999                                       | 0.000                      | RW   | Num |    |    | PT | US |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |



## Menu 8 – *Digital I/O*

Mode: Open-Loop



| Parameter         | 08.001 Digital I/O 1 State                    |                |     |
|-------------------|---|----------------|-----|
| Short description | Displays the state for digital input/output 1 |                |     |
| Mode              | Open-Loop                                     |                |     |
| Minimum           | 0   | Maximum        | 1   |
| Default           |   | Units          |     |
| Type              | 1 Bit Volatile                                | Update Rate    | 1ms |
| Display Format    | Standard                                      | Decimal Places | 0   |
| Coding            | RO, ND, NC, PT                                |                |     |

*Digital I/O 1 State* (08.001) represents the digital input/output 1 state whether it is a digital input or an output.

If *Digital I/O 01 mode* (08.031) = 0 then it is a digital input:

- Comply with IEC 61131-2. Positive logic only.
- *Digital I/O 1 State* (08.001) = 0 if the digital I/O is low (<9V).
- *Digital I/O 1 State* (08.001) = 1 if the digital I/O is high (>11V).

If *Digital I/O 01 mode* (08.031) = 1 then it is a digital output:

- 200mA total current including +24Vout; (50mA max per output).
- Positive logic only (with 6-7kΩ pull down).
- *Digital I/O 1 State* (08.001) = 0 if the source parameter value less than 50% of its range.
- *Digital I/O 1 State* (08.001) = 1 if the source parameter value more than 50% of its range.

If *Digital I/O 01 mode* (08.031) = 2 then it is a frequency output.

If *Digital I/O 01 mode* (08.031) = 3 then it is a PWM output.

| Parameter         | 08.002 Digital I/O 2 State                    |                |     |
|-------------------|---|----------------|-----|
| Short description | Displays the state for digital input/output 2 |                |     |
| Mode              | Open-Loop                                     |                |     |
| Minimum           | 0   | Maximum        | 1   |
| Default           |   | Units          |     |
| Type              | 1 Bit Volatile                                | Update Rate    | 1ms |
| Display Format    | Standard                                      | Decimal Places | 0   |
| Coding            | RO, ND, NC, PT                                |                |     |

*Digital I/O 2 State* (08.002) represents the digital input 2 state.

- Comply with IEC 61131-2. Positive logic only.
- *Digital I/O 2 State* (08.002) = 0 if the digital input is low (<9V).
- *Digital I/O 2 State* (08.002) = 1 if the digital input is high (>11V).

| Parameter         | 08.003 Digital Input 3 State           |                |     |
|-------------------|--|----------------|-----|
| Short description | Displays the state for digital input 3 |                |     |
| Mode              | Open-Loop                              |                |     |
| Minimum           | 0                                      | Maximum        | 1   |
| Default           |  | Units          |     |
| Type              | 1 Bit Volatile                         | Update Rate    | 1ms |
| Display Format    | Standard                               | Decimal Places | 0   |
| Coding            | RO, ND, NC, PT                         |                |     |

*Digital Input 3 State* (08.003) represents the digital input 3 state.

- Comply with IEC 61131-2. Positive logic only.
- *Digital Input 3 State* (08.003) = 0 if the digital input is low (<9V).
- *Digital Input 3 State* (08.003) = 1 if the digital input is high (>11V).

| Parameter         | 08.004 Digital Input 4 State           |                |     |
|-------------------|--|----------------|-----|
| Short description | Displays the state for digital input 4 |                |     |
| Mode              | Open-Loop                              |                |     |
| Minimum           | 0                                      | Maximum        | 1   |
| Default           |  | Units          |     |
| Type              | 1 Bit Volatile                         | Update Rate    | 1ms |
| Display Format    | Standard                               | Decimal Places | 0   |
| Coding            | RO, ND, NC, PT                         |                |     |

*Digital Input 4 State* (08.004) represents the digital input 4 state.

- Comply with IEC 61131-2. Positive logic only.
- *Digital Input 4 State* (08.004) = 0 if the digital input is low (<9V)
- *Digital Input 4 State* (08.004) = 1 if the digital input is high (>11V).

| Parameter         | 08.005 <i>Digital Input 5 State</i>    |                |     |
|-------------------|--|----------------|-----|
| Short description | Displays the state for digital input 5 |                |     |
| Mode              | Open-Loop                              |                |     |
| Minimum           | 0                                      | Maximum        | 1   |
| Default           |  | Units          |     |
| Type              | 1 Bit Volatile                         | Update Rate    | 1ms |
| Display Format    | Standard                               | Decimal Places | 0   |
| Coding            | RO, ND, NC, PT                         |                |     |

*Digital Input 5 State* (08.005) represents the digital input 5 state if *Digital input 5 mode* (08.035) = 0.

- Comply with IEC 61131-2. Positive logic only.
- *Digital Input 5 State* (08.005) = 0 if the digital input is low (<9V)
- *Digital Input 5 State* (08.005) = 1 if the digital input is high (>11V).

| Parameter         | 08.008 <i>Relay 1 Output State</i> |                |     |
|-------------------|------------------------------------|----------------|-----|
| Short description | Displays the state for relay 1     |                |     |
| Mode              | Open-Loop                          |                |     |
| Minimum           | 0                                  | Maximum        | 1   |
| Default           |                                    | Units          |     |
| Type              | 1 Bit Volatile                     | Update Rate    | 1ms |
| Display Format    | Standard                           | Decimal Places | 0   |
| Coding            | RO, ND, NC, PT                     |                |     |

*Relay 1 Output State* (08.008) shows the state of Relay 1.

| Parameter         | 08.011 <i>Digital I/O 1 Invert</i>        |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to invert digital input/output 1 |                |                 |
| Mode              | Open-Loop                                 |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save                           | Update Rate    | Background read |
| Display Format    | Standard                                  | Decimal Places | 0               |
| Coding            | RW, TE                                    |                |                 |

| Value | Text    |
|-------|---------|
| 0     | Not.Inv |
| 1     | Invert  |

A value of 0 or 1 in *Digital I/O 1 Invert* (08.011) allows the I/O state to be non-inverted(0) or inverted(1) respectively.

If *Digital I/O 01 mode* (08.031) = 0 (Input) then *Digital I/O 1 Invert* (08.011) inverts the destination parameter *Digital IO1 Source/Destination A* (08.021) or *DI/O 01 Source/Destination B* (08.121).

If *Digital I/O 01 mode* (08.031) = 1 (Output) then *Digital I/O 1 Invert* (08.011) inverts *Digital I/O 1 State* (08.001) and the voltage on the output terminal.

If *Digital I/O 01 mode* (08.031) = 2 or 3 (Frequency or PWM output) then *Digital I/O 1 Invert* (08.011) has no effect.

| Parameter         | 08.012 <i>Digital I/O 2 Invert</i>        |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to invert digital input/output 2 |                |                 |
| Mode              | Open-Loop                                 |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save                           | Update Rate    | Background read |
| Display Format    | Standard                                  | Decimal Places | 0               |
| Coding            | RW, TE                                    |                |                 |

| Value | Text    |
|-------|---------|
| 0     | Not.Inv |
| 1     | Invert  |

A value of 0 or 1 in *Digital I/O 2 Invert* (08.012) allows the input state to be non-inverted(0) or inverted(1) respectively.

*Digital I/O 2 Invert* (08.012) inverts the destination parameter *Digital IO2 Source/Destination A* (08.022) or *DI/O 02 Source/Destination B* (08.122).

| Parameter         | 08.013 Digital Input 3 Invert      |                |                 |
|-------------------|------------------------------------|----------------|-----------------|
| Short description | Set to 1 to invert digital input 3 |                |                 |
| Mode              | Open-Loop                          |                |                 |
| Minimum           | 0                                  | Maximum        | 1               |
| Default           | 0                                  | Units          |                 |
| Type              | 8 Bit User Save                    | Update Rate    | Background read |
| Display Format    | Standard                           | Decimal Places | 0               |
| Coding            | RW, TE                             |                |                 |

| Value | Text    |
|-------|---------|
| 0     | Not.Inv |
| 1     | Invert  |

A value of 0 or 1 in *Digital Input 3 Invert* (08.013) allows the input state to be non-inverted(0) or inverted(1) respectively.

*Digital Input 3 Invert* (08.013) inverts the destination parameter *Digital Input 03 Destination A* (08.023) or *DI 03 Destination B* (08.123).

| Parameter         | 08.014 Digital Input 4 Invert      |                |                 |
|-------------------|------------------------------------|----------------|-----------------|
| Short description | Set to 1 to invert digital input 4 |                |                 |
| Mode              | Open-Loop                          |                |                 |
| Minimum           | 0                                  | Maximum        | 1               |
| Default           | 0                                  | Units          |                 |
| Type              | 8 Bit User Save                    | Update Rate    | Background read |
| Display Format    | Standard                           | Decimal Places | 0               |
| Coding            | RW, TE                             |                |                 |

| Value | Text    |
|-------|---------|
| 0     | Not.Inv |
| 1     | Invert  |

A value of 0 or 1 in *Digital Input 4 Invert* (08.014) allows the input state to be non-inverted(0) or inverted(1) respectively.

*Digital Input 4 Invert* (08.014) inverts the destination parameter *Digital Input 04 Destination A* (08.024) or *DI 04 Destination B* (08.124).

| Parameter         | 08.015 Digital Input 5 Invert      |                |                 |
|-------------------|------------------------------------|----------------|-----------------|
| Short description | Set to 1 to invert digital input 5 |                |                 |
| Mode              | Open-Loop                          |                |                 |
| Minimum           | 0                                  | Maximum        | 1               |
| Default           | 0                                  | Units          |                 |
| Type              | 8 Bit User Save                    | Update Rate    | Background read |
| Display Format    | Standard                           | Decimal Places | 0               |
| Coding            | RW, TE                             |                |                 |

| Value | Text    |
|-------|---------|
| 0     | Not.Inv |
| 1     | Invert  |

A value of 0 or 1 in *Digital Input 5 Invert* (08.015) allows the input state to be non-inverted(0) or inverted(1) respectively.

If *Digital input 5 mode* (08.035) = 0 then *Digital Input 5 Invert* (08.015) inverts the destination parameter *Digital Input 05 Destination A* (08.025) or *DI 05 Destination B* (08.125).

If *Digital input 5 mode* (08.035) > 0 then *Digital Input 5 Invert* (08.015) has no effect.

| Parameter         | 08.018 Relay 1 Invert      |                |                 |
|-------------------|----------------------------|----------------|-----------------|
| Short description | Set to 1 to invert relay 1 |                |                 |
| Mode              | Open-Loop                  |                |                 |
| Minimum           | 0                          | Maximum        | 1               |
| Default           | 0                          | Units          |                 |
| Type              | 8 Bit User Save            | Update Rate    | Background read |
| Display Format    | Standard                   | Decimal Places | 0               |
| Coding            | RW, TE                     |                |                 |

| Value | Text    |
|-------|---------|
| 0     | Not.Inv |
| 1     | Invert  |

A value of 0 or 1 in *Relay 1 Invert* (08.018) allows the input state to be non-inverted(0) or inverted(1) respectively.

| Parameter         | 08.020 Digital I/O Read Word            |                |                                 |
|-------------------|---|----------------|---------------------------------|
| Short description | Displays the states for the digital I/O |                |                                 |
| Mode              | Open-Loop                               |                |                                 |
| Minimum           | 0<br>(Display: 000000000000)            | Maximum        | 2048<br>(Display: 100000000000) |
| Default           |   | Units          |                                 |
| Type              | 16 Bit Volatile                         | Update Rate    | Background write                |
| Display Format    | Binary                                  | Decimal Places | 0                               |
| Coding            | RO, ND, NC, PT                          |                |                                 |

*Digital I/O Read Word* (08.020) reflects the state of DI/O 01 to DI 05 and the relay as given below. Each bit matches the value of the state parameter for the respective digital input or output so the bit value for digital inputs will be the state of the actual input before any inversion or toggle selections are applied. The bit value for digital outputs will include the state inversion if selected in the invert/toggle parameter for the output.

| Name     | Digital I/O Read Word (08.020) bit |
|----------|------------------------------------|
| DI/O 01  | 0                                  |
| DI 02    | 1                                  |
| DI 03    | 2                                  |
| DI 04    | 3                                  |
| DI 05    | 4                                  |
| Reserved | 5                                  |
| Reserved | 6                                  |
| Reserved | 7                                  |
| Reserved | 8                                  |
| RLY 01   | 9                                  |
| Reserved | 10                                 |

| Parameter         | 08.021 Digital IO1 Source/Destination A                       |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the source or destination parameter for digital I/O 1 |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0.000   | Maximum        | 30.999           |
| Default           | 10.003  | Units          |                  |
| Type              | 16 Bit User Save  | Update Rate    | Drive Reset Read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, DE, PT  |                |                  |

*Digital IO1 Source/Destination A* (08.021) provides the destination parameter if DI/O 1 is an input and *DI1 Control* (08.081) = 0.

*Digital IO1 Source/Destination A* (08.021) provides the source parameter if DI/O 1 is an output and *DO1 Control* (08.091) = 0.

| Parameter         | 08.022 Digital IO2 Source/Destination A                       |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the source or destination parameter for digital I/O 2 |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0.000   | Maximum        | 30.999           |
| Default           | See exceptions below  | Units          |                  |
| Type              | 16 Bit User Save  | Update Rate    | Drive Reset Read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, DE, PT  |                |                  |

| Region | Default Value |
|--------|---------------|
| 50Hz   | 6.038         |
| 60Hz   | 6.039         |

*Digital IO2 Source/Destination A* (08.022) provides the destination parameter if *DI2 Control* (08.082) = 0.

| Parameter         | 08.023 Digital Input 03 Destination A                 |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the destination parameter for digital Input 3 |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0.000   | Maximum        | 30.999           |
| Default           | 6.030   | Units          |                  |
| Type              | 16 Bit User Save                                      | Update Rate    | Drive Reset Read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, DE, PT  |                |                  |

*Digital Input 03 Destination A* (08.023) provides the destination parameter if *DI3 Control* (08.083) = 0.

| Parameter         | 08.024 <i>Digital Input 04 Destination A</i>          |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the destination parameter for digital input 4 |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0.000   | Maximum        | 30.999           |
| Default           | 6.032   | Units          |                  |
| Type              | 16 Bit User Save                                      | Update Rate    | Drive Reset Read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, DE, PT  |                |                  |

*Digital Input 04 Destination A* (08.024) provides the destination parameter if *DI4 Control* (08.084) = 0.

| Parameter         | 08.025 <i>Digital Input 05 Destination A</i>          |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the destination parameter for digital input 5 |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0.000   | Maximum        | 30.999           |
| Default           | 1.041   | Units          |                  |
| Type              | 16 Bit User Save                                      | Update Rate    | Drive Reset Read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, DE, PT  |                |                  |

*Digital Input 05 Destination A* (08.025) provides the destination parameter if *DI5 Control* (08.085) = 0.

| Parameter         | 08.028 <i>Relay 1 Output Source A</i>    |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the source parameter for relay 1 |                |                  |
| Mode              | Open-Loop                                |                |                  |
| Minimum           | 0.000                                    | Maximum        | 30.999           |
| Default           | 10.001                                   | Units          |                  |
| Type              | 16 Bit User Save                         | Update Rate    | Drive Reset Read |
| Display Format    | Standard                                 | Decimal Places | 3                |
| Coding            | RW, PT                                   |                |                  |

*Relay 1 Output Source A* (08.028) provides the source parameter if *Relay 1 Control* (08.098) = 0.

| Parameter         | 08.031 <i>Digital I/O 01 mode</i>                                |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the mode for the functionality of digital input/output 1 |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0  | Maximum        | 3               |
| Default           | 1  | Units          |                 |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, TE   |                |                 |

| Value | Text   | Description      |
|-------|--------|------------------|
| 0     | Input  | Digital input    |
| 1     | Output | Digital output   |
| 2     | Fr     | Frequency output |
| 3     | Pulse  | PWM output       |

This parameter selects the function of input/output DI/O 1.

See also *Digital I/O 1 State* (08.001).

| Parameter         | 08.035 <i>Digital input 5 mode</i>       |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the function for digital input 5 |                |                 |
| Mode              | Open-Loop                                |                |                 |
| Minimum           | 0  | Maximum        | 4               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save                          | Update Rate    | Background read |
| Display Format    | Standard                                 | Decimal Places | 0               |
| Coding            | RW, TE                                   |                |                 |

| Value | Text    | Description  |
|-------|---------|--|
| 0     | Input   | Input  |
| 1     | Th.Sct  | Temperature measurement input with short circuit detection (Resistance <50Ohm) |
| 2     | th      | Temperature measurement input without short circuit detection but with Th trip |
| 3     | Th.NoTr | Temperature measurement input with no trips                                    |
| 4     | Fr      | Frequency Input  |

This parameter selects the function of input DI 05.

See also *Digital Input 5 State* (08.005).

The motor thermistor should be connected between terminal 14 and terminal 1 (0 V).

| Parameter         | 08.041 Keypad Run Button State                       |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Displays the state for the Keypad Run Forward button |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           |  | Units          |                 |
| Type              | 1 Bit Volatile                                       | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RO, ND, NC, PT                                       |                |                 |

Digital Input 11 (Keypad Run Button), Digital Input 12 (Keypad Auxiliary Button) and Digital Input 14 (Keypad Stop Button) represent the state of the Run, Auxiliary and Stop buttons on any keypad fitted to the drive; the input state is determined by ORing the state of the button on each keypad connected to the drive, if the button is pressed the state parameter is one otherwise it is zero. If a keypad is not fitted the state parameters are zero.

Digital Input 13 (24V Supply Input) is an external 24V supply input that is monitored and can be used as a 24V digital input if an external 24V supply is not required. The state parameter is low for the voltage range from 0V to 17V and high for the voltage range above 18V. As the input is a power supply it will consume significant current if the level is taken above 24V when the drive is running from its internal power supply, or at any voltage level if this input is the only power supply to the drive. The 24V Input is available on the AI SD card adaptor. The 24V alarm is triggered if *24V Alarm Loss Enable* (11.098) = 1 and *24V Supply Input State* (08.043) = 0.

| Parameter         | 08.042 Keypad Auxiliary Button State               |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Displays the state for the Keypad Auxiliary button |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           |  | Units          |                 |
| Type              | 1 Bit Volatile                                     | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RO, ND, NC, PT                                     |                |                 |

See *Keypad Run Button State* (08.041).

| Parameter         | 08.043 24V Supply Input State               |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the state for the 24V Supply Input |                |                  |
| Mode              | Open-Loop                                   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile                              | Update Rate    | Background write |
| Display Format    | Standard                                    | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                              |                |                  |

See *Keypad Run Button State* (08.041).

| Parameter         | 08.044 Keypad Stop Button State               |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the state for the Keypad Stop button |                |                  |
| Mode              | Open-Loop                                     |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile                                | Update Rate    | Background write |
| Display Format    | Standard                                      | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                                |                |                  |

See *Keypad Run Button State* (08.041).

| Parameter         | 08.051 Keypad Run Button Invert/Toggle |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to invert/toggle Keypad Run Button |                |                 |
| Mode              | Open-Loop                              |                |                 |
| Minimum           | 0                                      | Maximum        | 2               |
| Default           | 0                                      | Units          |                 |
| Type              | 8 Bit User Save                        | Update Rate    | Background read |
| Display Format    | Standard                               | Decimal Places | 0               |
| Coding            | RW, TE                                 |                |                 |

| Value | Text    |
|-------|---------|
| 0     | Not.Inv |
| 1     | Invert  |
| 2     | Toggle  |

A value of 0 or 1 allows the input state to be non-inverted or inverted respectively.

An additional toggle function is provided for Keypad Run and Auxiliary button inputs. The toggle function output changes state on each rising edge (0 to 1 change) at its input.

| Parameter         | 08.052 Keypad Auxiliary Button Invert/Toggle |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to invert/toggle Keypad Auxiliary Button |                |                 |
| Mode              | Open-Loop                                    |                |                 |
| Minimum           | 0  | Maximum        | 2               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save                              | Update Rate    | Background read |
| Display Format    | Standard                                     | Decimal Places | 0               |
| Coding            | RW, TE                                       |                |                 |

| Value | Text    |
|-------|---------|
| 0     | Not.Inv |
| 1     | Invert  |
| 2     | Toggle  |

See Keypad Run Button Invert/Toggle (08.051).

| Parameter         | 08.053 24V Supply Input Invert |                |                  |
|-------------------|--------------------------------|----------------|------------------|
| Short description | Set to invert 24V Supply Input |                |                  |
| Mode              | Open-Loop                      |                |                  |
| Minimum           | 0                              | Maximum        | 1                |
| Default           | 0                              | Units          |                  |
| Type              | 8 Bit User Save                | Update Rate    | Drive Reset Read |
| Display Format    | Standard                       | Decimal Places | 0                |
| Coding            | RW, TE                         |                |                  |

| Value | Text    |
|-------|---------|
| 0     | Not.Inv |
| 1     | Invert  |

See Keypad Run Button Invert/Toggle (08.051).

| Parameter         | 08.061 Keypad Run Button Destination                   |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the destination parameter for digital input 11 |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0.000  | Maximum        | 30.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save                                       | Update Rate    | Drive Reset Read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, DE, PT   |                |                  |

These destination parameters provide the routing for the Run (DI 11), Auxiliary (DI 12) and 24V Input(DI 13) inputs.

The Auxiliary button is available on the remote KI-Keypad. The 24V Input is available on the AI SD card adaptor.



| Parameter         | 08.062 Keypad Auxiliary Button Destination             |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the destination parameter for digital input 12 |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0.000  | Maximum        | 30.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save                                       | Update Rate    | Drive Reset Read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, DE, PT   |                |                  |

See Keypad Run Button Destination (08.061).

| Parameter         | 08.063 24V Supply Input Destination         |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the destination parameter for DI 13 |                |                  |
| Mode              | Open-Loop                                   |                |                  |
| Minimum           | 0.000                                       | Maximum        | 30.999           |
| Default           | 0.000                                       | Units          |                  |
| Type              | 16 Bit User Save                            | Update Rate    | Drive Reset Read |
| Display Format    | Standard                                    | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU                              |                |                  |

See Keypad Run Button Destination (08.061).

| Parameter         | 08.081 DI1 Control                       |                |                                    |
|-------------------|--|----------------|------------------------------------|
| Short description | Defines the behaviour of digital input 1 |                |                                    |
| Mode              | Open-Loop                                |                |                                    |
| Minimum           | 0  | Maximum        | 26                                 |
| Default           | 0  | Units          |                                    |
| Type              | 8 Bit User Save                          | Update Rate    | Action on exit from edit and reset |
| Display Format    | Standard                                 | Decimal Places | 0                                  |
| Coding            | RW                                       |                |                                    |

| Value | Description  | DI/O xx Source/Destination B | Other setup |
|-------|--|------------------------------|-------------|
| 0     | User defined by <i>Digital IO1 Source/Destination A</i> (08.021) to <i>Digital Input 05 Destination A</i> (08.025) | 00.000                       |             |
| 1     | Multi preset ref selection 1   | 01.045                       |             |
| 2     | Multi preset ref selection 2   | 01.046                       |             |
| 3     | Multi preset ref selection 3   | 01.047                       |             |
| 4     | External stop command  | 06.039                       |             |
| 5     | Acc time selection 1   | 02.032                       |             |
| 6     | Acc time selection 2   | 02.033                       |             |
| 7     | Acc time selection 3   | 02.034                       |             |
| 8     | Speed control and torque control switcher  | 04.011                       |             |
| 9     | External fault N.C. contact input  | 10.032                       |             |
| 10    | External reset   | 10.033                       |             |
| 11    | External jog fwd   | 06.031                       |             |
| 12    | External jog rev   | 06.037                       |             |
| 13    | Drive enable   | 06.015                       |             |
| 14    | Ramp hold  | 02.003                       |             |
| 15    | RUN FWD  | 06.030                       |             |
| 16    | RUN REV  | 06.032                       |             |
| 17    | 3-line run control (Latching)  | 06.040                       |             |
| 18    | Forward limit switch   | 06.035                       |             |
| 19    | Reverse limit switch   | 06.036                       |             |
| 20    | Main ref channel selection 3   | 01.043                       |             |
| 21    | Main ref channel selection 2   | 01.042                       |             |
| 22    | Main ref channel selection 3   | 01.041                       |             |
| 23    | PID1 Enable  | 14.008                       |             |
| 24    | Motor 1/2 switcher   | 11.045                       |             |
| 25    | Motorised pot UP   | 09.026                       |             |
| 26    | Motorised pot DOWN   | 09.027                       |             |

This offers a simple control of *DI/O 01 Source/Destination B* (08.121) to *DI 05 Destination B* (08.125), to change the digital input destination. If *Dlx Control* (08.08x) is more than 0 then the destination is defined by *DI/O 0x Source/Destination* (08.12x). *DI/O 0x Source/Destination* (08.12x) is written by *Dlx Control* (08.08x) selection. (e.g. If *DI1 Control* (08.081) = 13 then *DI/O 01 Source/Destination B* (08.121) = 06.015)

If *Dlx Control* (08.08x) is 0 then the destination is defined by *DI/O 0x Source/Destination* (08.02x).

| Parameter         | 08.082 DI2 Control                       |                |                                    |
|-------------------|--|----------------|------------------------------------|
| Short description | Defines the behaviour of digital input 2 |                |                                    |
| Mode              | Open-Loop                                |                |                                    |
| Minimum           | 0  | Maximum        | 26                                 |
| Default           | 0  | Units          |                                    |
| Type              | 8 Bit User Save                          | Update Rate    | Action on exit from edit and reset |
| Display Format    | Standard                                 | Decimal Places | 0                                  |
| Coding            | RW                                       |                |                                    |

See DI1 Control (08.081).

| Parameter         | 08.083 DI3 Control                       |                |                                    |
|-------------------|--|----------------|------------------------------------|
| Short description | Defines the behaviour of digital input 3 |                |                                    |
| Mode              | Open-Loop                                |                |                                    |
| Minimum           | 0  | Maximum        | 26                                 |
| Default           | 0  | Units          |                                    |
| Type              | 8 Bit User Save                          | Update Rate    | Action on exit from edit and reset |
| Display Format    | Standard                                 | Decimal Places | 0                                  |
| Coding            | RW                                       |                |                                    |

See DI1 Control (08.081).

| Parameter         | 08.084 DI4 Control                       |                |                                    |
|-------------------|--|----------------|------------------------------------|
| Short description | Defines the behaviour of digital input 4 |                |                                    |
| Mode              | Open-Loop                                |                |                                    |
| Minimum           | 0  | Maximum        | 26                                 |
| Default           | 0  | Units          |                                    |
| Type              | 8 Bit User Save                          | Update Rate    | Action on exit from edit and reset |
| Display Format    | Standard                                 | Decimal Places | 0                                  |
| Coding            | RW                                       |                |                                    |

See DI1 Control (08.081).

| Parameter         | 08.085 DI5 Control                       |                |                                    |
|-------------------|--|----------------|------------------------------------|
| Short description | Defines the behaviour of digital input 5 |                |                                    |
| Mode              | Open-Loop                                |                |                                    |
| Minimum           | 0  | Maximum        | 26                                 |
| Default           | 0  | Units          |                                    |
| Type              | 8 Bit User Save                          | Update Rate    | Action on exit from edit and reset |
| Display Format    | Standard                                 | Decimal Places | 0                                  |
| Coding            | RW                                       |                |                                    |

See DI1 Control (08.081).

| Parameter         | 08.091 DO1 Control                        |                |                                    |
|-------------------|---|----------------|------------------------------------|
| Short description | Defines the behaviour of digital output 1 |                |                                    |
| Mode              | Open-Loop                                 |                |                                    |
| Minimum           | 0   | Maximum        | 21                                 |
| Default           | 0   | Units          |                                    |
| Type              | 8 Bit User Save                           | Update Rate    | Action on exit from edit and reset |
| Display Format    | Standard                                  | Decimal Places | 0                                  |
| Coding            | RW  |                |                                    |

| Value | Description   | DI/O 01 Source/Destination B (08.121) or Relay 01 Source B (08.128) |
|-------|---|---|
| 0     | User defined by <i>Digital IO1 Source/Destination A</i> (08.021) or <i>Relay 1 Output Source A</i> (08.028) | 00.000  |
| 1     | Drive running signal (RUN)  | 10.002  |
| 2     | Frequency arrived signal (FAR)  | 10.006 (at frequency)   |
| 3     | Reserved  | Reserved  |
| 4     | Reserved  | Reserved  |
| 5     | Overload detection signal (OL)  | 10.017  |
| 6     | Power off state (LU)  | 10.016  |
| 7     | External fault stop (EXT)   | 10.032  |
| 8     | Frequency upper limit (FHL)   | 10.007  |
| 9     | Frequency lower limit (FLL)   | 10.004  |
| 10    | Drive running at zero frequency   | 10.003  |
| 11    | Reserved  | Reserved  |
| 12    | Reserved  | Reserved  |
| 13    | Reserved  | Reserved  |
| 14    | Drive (RDY)   | 10.090  |
| 15    | Drive healthy   | 10.001  |
| 16    | Reserved  | Reserved  |
| 17    | Reserved  | Reserved  |
| 18    | Brake release   | 12.040  |
| 19    | Torque limiting<br>(Valid while the torque is limited by torque limiting value 1/2)                         | 10.009  |
| 20    | Forward or reverse  | 10.014  |
| 21    | Motor 1 or 2  | 11.045  |

This offers a simple control of parameter *DI/O 01 Source/Destination B* (08.121) or *Relay 01 Source B* (08.128) to change the source.

If the control parameter (08.09x) is more than 0 then the source is defined by the relevant source parameter B (08.12x). The source parameter is written by the control selection. (e.g. If *DO1 Control* (08.091) = 10 then *DI/O 01 Source/Destination B* (08.121) = 10.003)

If the control parameter is 0 then the source is defined by the relevant source parameter A (08.02x).

| Parameter         | 08.098 Relay 1 Control           |                |                                    |
|-------------------|----------------------------------|----------------|------------------------------------|
| Short description | Defines the behaviour of relay 1 |                |                                    |
| Mode              | Open-Loop                        |                |                                    |
| Minimum           | 0                                | Maximum        | 21                                 |
| Default           | 0                                | Units          |                                    |
| Type              | 8 Bit User Save                  | Update Rate    | Action on exit from edit and reset |
| Display Format    | Standard                         | Decimal Places | 0                                  |
| Coding            | RW                               |                |                                    |

See *DO1 Control* (08.091).

| Parameter         | 08.121 DI/O 01 Source/Destination B  |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the secondary source or destination parameter for digital input/output 1 |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0.000  | Maximum        | 30.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save   | Update Rate    | Drive Reset Read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RO, DE, PT   |                |                  |

Refer to control parameters ( *DI1 Control* (08.081) and *DO1 Control* (08.091)) for more information.

| Parameter         | 08.122 DI/O 02 Source/Destination B  |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the secondary source or destination parameter for digital input/output 2 |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0.000  | Maximum        | 30.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save   | Update Rate    | Drive Reset Read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RO, DE, PT   |                |                  |

See *DI/O 01 Source/Destination B* (08.121).

| Parameter         | 08.123 <i>DI 03 Destination B</i>                               |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the secondary destination parameter for digital input 3 |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0.000   | Maximum        | 30.999           |
| Default           | 0.000   | Units          |                  |
| Type              | 16 Bit User Save  | Update Rate    | Drive Reset Read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RO, DE, PT  |                |                  |

See *DI/O 01 Source/Destination B* (08.121).

| Parameter         | 08.124 <i>DI 04 Destination B</i>                               |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the secondary destination parameter for digital input 4 |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0.000   | Maximum        | 30.999           |
| Default           | 0.000   | Units          |                  |
| Type              | 16 Bit User Save  | Update Rate    | Drive Reset Read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RO, DE, PT  |                |                  |

See *DI/O 01 Source/Destination B* (08.121).

| Parameter         | 08.125 <i>DI 05 Destination B</i>                               |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the secondary destination parameter for digital input 5 |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0.000   | Maximum        | 30.999           |
| Default           | 0.000   | Units          |                  |
| Type              | 16 Bit User Save  | Update Rate    | Drive Reset Read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RO, DE, PT  |                |                  |

See *DI/O 01 Source/Destination B* (08.121).

| Parameter         | 08.128 <i>Relay 01 Source B</i>                    |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the secondary source parameter for relay 1 |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0.000  | Maximum        | 30.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save                                   | Update Rate    | Drive Reset Read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, PT   |                |                  |

See *DO1 Control* (08.091).

## Menu 9 Single Line Descriptions – User Functions 1

Mode: Open-Loop

| Parameter |                                  | Range  | Default  | Type |      |    |    |    |    |
|-----------|----------------------------------|--|----------|------|------|----|----|----|----|
| 09.001    | Logic Function 1 Output          | Off (0) or On (1)  |          | RO   | Bit  | ND | NC | PT |    |
| 09.002    | Logic Function 2 Output          | Off (0) or On (1)  |          | RO   | Bit  | ND | NC | PT |    |
| 09.003    | Motorised Pot Output             | ±100.00 %  |          | RO   | Num  | ND | NC | PT | PS |
| 09.004    | Logic Function 1 Source 1        | 0.000 to 30.999  | 0.000    | RW   | Num  |    |    | PT | US |
| 09.005    | Logic Function 1 Source 1 Invert | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    |    |    | US |
| 09.006    | Logic Function 1 Source 2        | 0.000 to 30.999  | 0.000    | RW   | Num  |    |    | PT | US |
| 09.007    | Logic Function 1 Source 2 Invert | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    |    |    | US |
| 09.008    | Logic Function 1 Output Invert   | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    |    |    | US |
| 09.009    | Logic Function 1 Delay           | ±25.0 s  | 0.0 s    | RW   | Num  |    |    |    | US |
| 09.010    | Logic Function 1 Destination     | 0.000 to 30.999  | 0.000    | RW   | Num  | DE |    | PT | US |
| 09.014    | Logic Function 2 Source 1        | 0.000 to 30.999  | 0.000    | RW   | Num  |    |    | PT | US |
| 09.015    | Logic Function 2 Source 1 Invert | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    |    |    | US |
| 09.016    | Logic Function 2 Source 2        | 0.000 to 30.999  | 0.000    | RW   | Num  |    |    | PT | US |
| 09.017    | Logic Function 2 Source 2 Invert | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    |    |    | US |
| 09.018    | Logic Function 2 Output Invert   | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    |    |    | US |
| 09.019    | Logic Function 2 Delay           | ±25.0 s  | 0.0 s    | RW   | Num  |    |    |    | US |
| 09.020    | Logic Function 2 Destination     | 0.000 to 30.999  | 0.000    | RW   | Num  | DE |    | PT | US |
| 09.021    | Motorised Pot Mode               | 0 to 4   | 0        | RW   | Num  |    |    |    | US |
| 09.022    | Motorised Pot Bipolar Select     | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    |    |    | US |
| 09.023    | Motorised Pot Rate               | 0 to 250 s   | 20 s     | RW   | Num  |    |    |    | US |
| 09.024    | Motorised Pot Scaling            | 0.000 to 4.000   | 1.000    | RW   | Num  |    |    |    | US |
| 09.025    | Motorised Pot Destination        | 0.000 to 30.999  | 0.000    | RW   | Num  | DE |    | PT | US |
| 09.026    | Motorised Pot Up                 | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    | NC |    |    |
| 09.027    | Motorised Pot Down               | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    | NC |    |    |
| 09.028    | Motorised Pot Reset              | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    | NC |    |    |
| 09.029    | Binary Sum Ones                  | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    |    |    |    |
| 09.030    | Binary Sum Twos                  | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    |    |    |    |
| 09.031    | Binary Sum Fours                 | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    |    |    |    |
| 09.032    | Binary Sum Output                | 0 to 255   |          | RO   | Num  | ND | NC | PT |    |
| 09.033    | Binary Sum Destination           | 0.000 to 30.999  | 0.000    | RW   | Num  | DE |    | PT | US |
| 09.034    | Binary Sum Offset                | 0 to 248   | 0        | RW   | Num  |    |    |    | US |
| 09.035    | Timer 1 Start Date               | 00-00-00 to 31-12-99   | 00-00-00 | RW   | Date |    |    |    | US |
| 09.036    | Timer 1 Start Time               | 00:00:00 to 23:59:59   | 00:00:00 | RW   | Time |    |    |    | US |
| 09.037    | Timer 1 Stop Date                | 00-00-00 to 31-12-99   | 00-00-00 | RW   | Date |    |    |    | US |
| 09.038    | Timer 1 Stop Time                | 00:00:00 to 23:59:59   | 00:00:00 | RW   | Time |    |    |    | US |
| 09.039    | Timer 1 Repeat Function          | None (0), 1 (1), 2 (2), 3 (3), 4 (4),<br>5 (5), 6 (6), 7 (7) | None (0) | RW   | Txt  |    |    |    | US |
| 09.040    | Timer 1 Enable                   | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    |    |    | US |
| 09.041    | Timer 1 Invert                   | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    |    |    | US |
| 09.042    | Timer 1 Output                   | Off (0) or On (1)  |          | RO   | Bit  | ND | NC | PT |    |
| 09.043    | Timer 1 Destination              | 0.000 to 30.999  | 0.000    | RW   | Num  | DE |    | PT | US |
| 09.045    | Timer 2 Start Date               | 00-00-00 to 31-12-99   | 00-00-00 | RW   | Date |    |    |    | US |
| 09.046    | Timer 2 Start Time               | 00:00:00 to 23:59:59   | 00:00:00 | RW   | Time |    |    |    | US |
| 09.047    | Timer 2 Stop Date                | 00-00-00 to 31-12-99   | 00-00-00 | RW   | Date |    |    |    | US |
| 09.048    | Timer 2 Stop Time                | 00:00:00 to 23:59:59   | 00:00:00 | RW   | Time |    |    |    | US |
| 09.049    | Timer 2 Repeat Function          | None (0), 1 (1), 2 (2), 3 (3), 4 (4),<br>5 (5), 6 (6), 7 (7) | None (0) | RW   | Txt  |    |    |    | US |
| 09.050    | Timer 2 Enable                   | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    |    |    | US |
| 09.051    | Timer 2 Invert                   | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    |    |    | US |
| 09.052    | Timer 2 Output                   | Off (0) or On (1)  |          | RO   | Bit  | ND | NC | PT |    |
| 09.053    | Timer 2 Destination              | 0.000 to 30.999  | 0.000    | RW   | Num  | DE |    | PT | US |
| 09.055    | Scope Trace 1 Source             | 0.000 to 30.999  | 0.000    | RW   | Num  |    |    | PT | US |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

## Menu 9 – *User Functions 1*

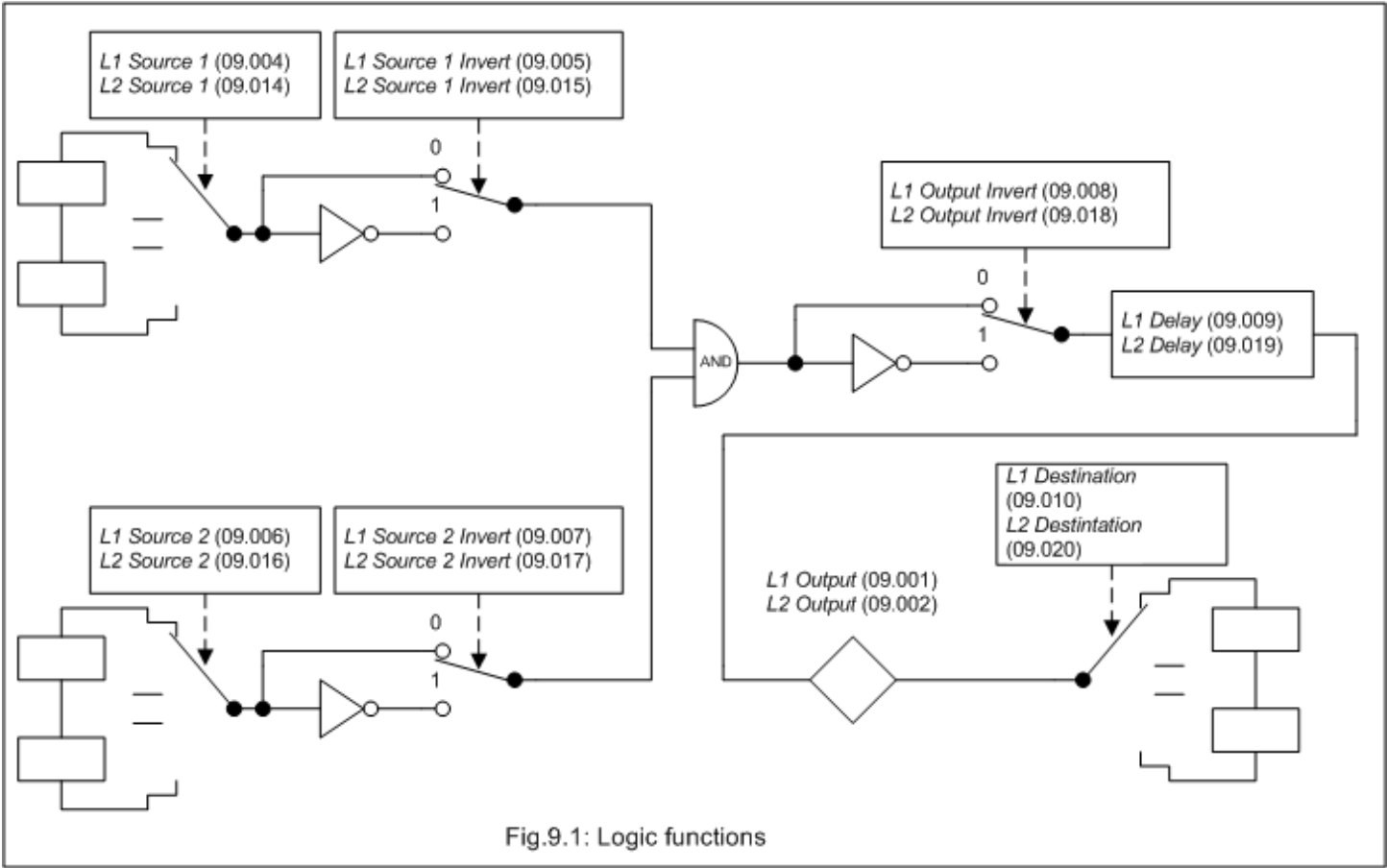
Mode: Open-Loop

Menu 9 provides the parameters for the following features:

1. Logic functions
2. Motorised Pot
3. Binary Sum
4. Timers

Logic functions

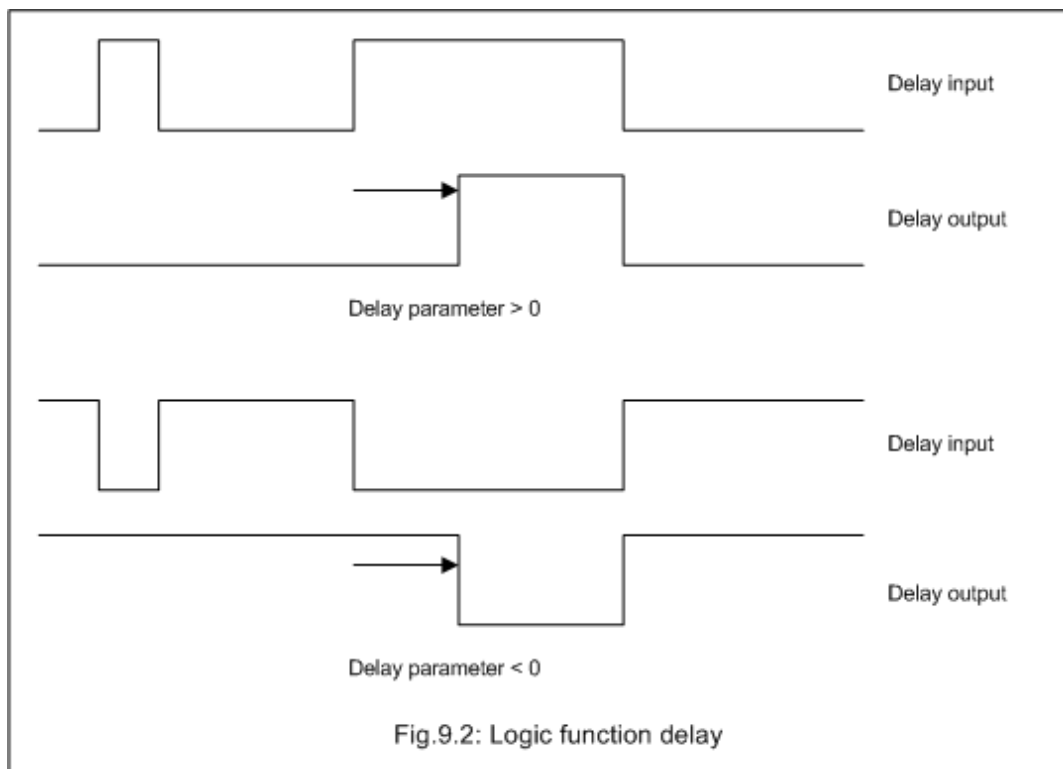
The logic functions are always active even if the sources and destinations are not routed to valid parameters. If the sources are not valid parameters then the source values are taken as 0. The update rate for each of the logic functions is always 4ms



The logic function consists of an AND gate with inverters on each input and an inverter on the output. Some of the other standard logic functions can be produced as shown in the table below.

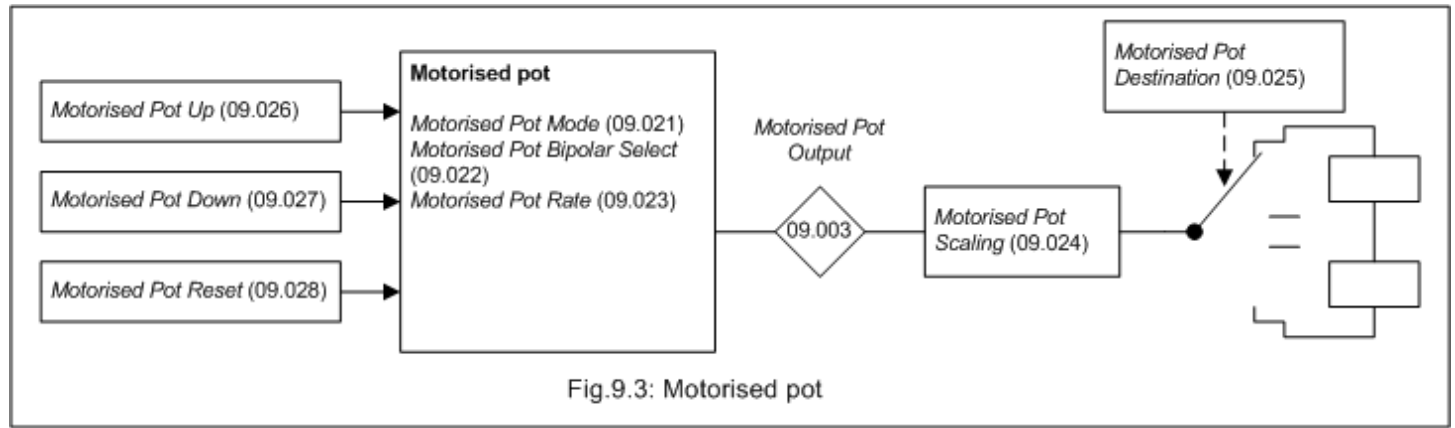
| Logic function | Source 1 Invert | Source 2 Invert | Output Invert |
|----------------|-----------------|-----------------|---------------|
| AND            | 0               | 0               | 0             |
| NAND           | 0               | 0               | 1             |
| OR             | 1               | 1               | 1             |
| NOR            | 1               | 1               | 0             |

A delay function is provided at the output of the logic functions. If *Logic Function 1 Delay* (09.009) or *Logic Function 2 Delay* (09.019) is positive then the output does not become 1 until the input to the delay has been at 1 for the delay time. If *Logic Function 1 Delay* (09.009) or *Logic Function 2 Delay* (09.019) is negative then the output remains at 1 until the input to the delay has been 0 for the delay time.





## Motorised pot



If *Motorised Pot Reset* (09.028) = 1 then the motorised pot is disabled and held in its reset state with *Motorised Pot Output* (09.003) = 0.0%. If *Motorised Pot Reset* (09.028) = 0 the motorised pot is enabled even if *Motorised Pot Destination* (09.025) is not routed to a valid parameter. The sample rate of the motorised pot is always 4ms.

When the motorised pot is active *Motorised Pot Output* (09.003) can be increased or decreased by setting *Motorised Pot Up* (09.026) or *Motorised Pot Down* (09.027) to 1 respectively. If both *Motorised Pot Up* (09.026) and *Motorised Pot Down* (09.027) are 1 then *Motorised Pot Output* (09.003) is increased. The rate of change of *Motorised Pot Output* (09.003) is defined by *Motorised Pot Rate* (09.023) which gives the time to change from 0 to 100%. The time to change from -100% to 100% is *Motorised Pot Rate* (09.023) x 2. If *Motorised Pot Bipolar Select* (09.022) = 0 then *Motorised Pot Output* (09.003) is limited in the range 0.00% to 100.00%, otherwise it is allowed to change in the range from -100.00% to 100.00%.

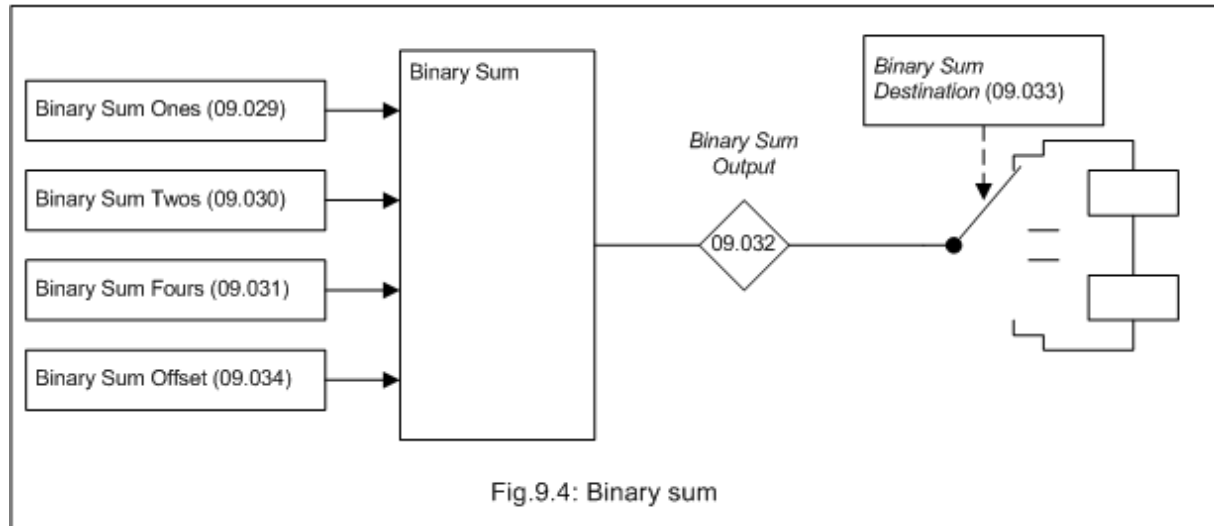
*Motorised Pot Mode* (09.021) defines the mode of operation as given in the table below.

| <b>Motorised Pot Mode (09.021)</b> | <b>Motorised Pot Output (09.003)</b>                                | <b>Motorised Pot Up (09.026) and Motorised Pot Down (09.027) active</b> |
|------------------------------------|---|---|
| 0                                  | Reset to zero at power-up   | Always  |
| 1                                  | Set to power-down value at power-up                                 | Always  |
| 2                                  | Reset to zero at power-up   | When <i>Drive Active</i> (10.002) = 1                                   |
| 3                                  | Set to power-down value at power-up                                 | When <i>Drive Active</i> (10.002) = 1                                   |
| 4                                  | Reset to zero at power-up and when <i>Drive Active</i> (10.002) = 0 | When <i>Drive Active</i> (10.002) = 1                                   |

*Motorised Pot Scaling* (09.024) introduces a scaling factor at the output of the motorised pot before the output is routed to the destination. If *Motorised Pot Scaling* (09.024) *Motorised Pot Scaling* (09.024) > 1.000 the output will exceed the range of the destination parameter, and so the destination parameter will be at its maximum or minimum before the output of the motorised pot reaches the limits of its range.

## Binary sum

The binary sum function is always active even if the destination is not routed to valid a parameter. The update rate for the binary sum is always 4ms.



The output of the binary sum block is given by

$Binary\ Sum\ Output\ (09.032) = Binary\ Sum\ Offset\ (09.034) + (Binary\ Sum\ Ones\ (09.029) \times 1) + (Binary\ Sum\ Twos\ (09.030) \times 2) + (Binary\ Sum\ Fours\ (09.031) \times 4)$

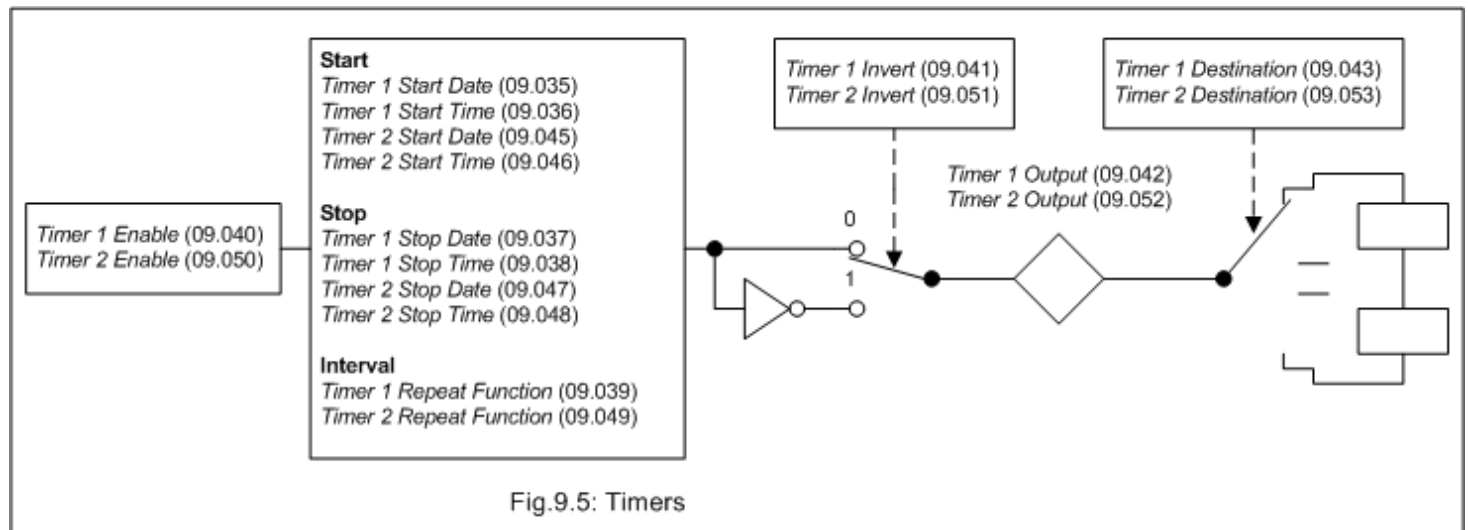
*Binary Sum Destination* (09.033) defines the destination for the binary sum output. The routing for this destination is special if the maximum of the destination parameter  $\leq 7 + [Binary\ Sum\ Offset\ (09.034)]$  as follows:

Destination parameter = *Binary Sum Output* (09.032), subject to the parameter minimum

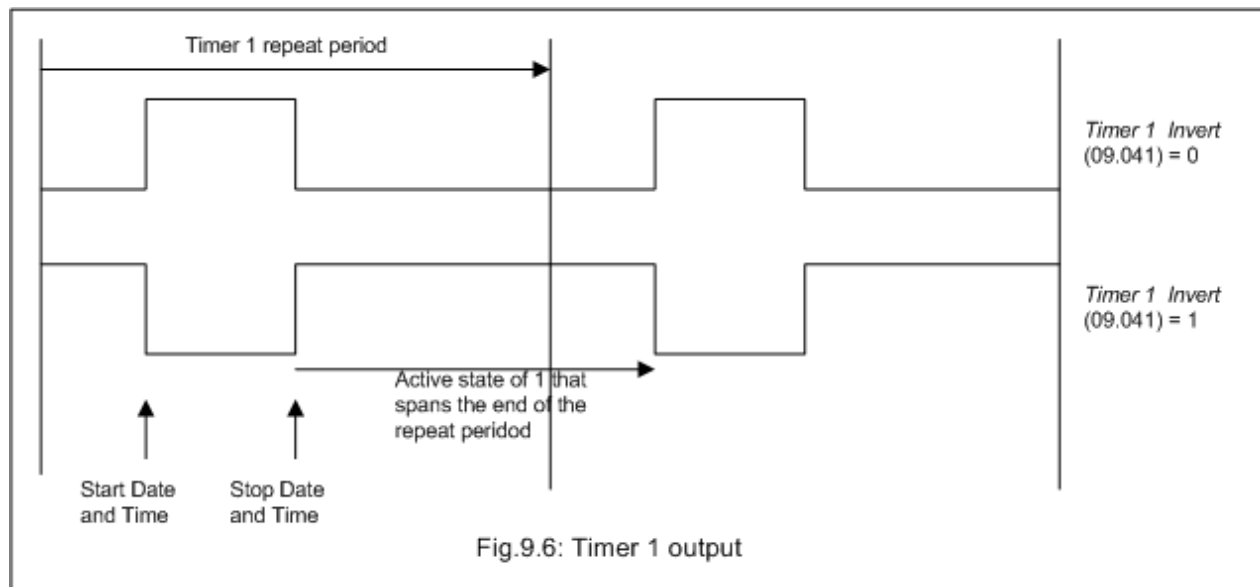
Otherwise *Binary Sum Output* (09.032) is routed in the same way as any other destination where the destination target is at its full scale value when the  $Binary\ Sum\ Output\ (09.032) = 7 + Offset$ .

## Timers

If the enable input to a timer is active and the repeat function is set to a non-zero value then the timer is active even if the destination is not routed to valid a parameter. The timers are updated in the background task and have a resolution of 1s.



The following is a description of Timer 1, but Timer 2 behaves in the same way. If *Timer 1 Invert* = 0 then *Timer 1 Output* (09.042) is inactive before the *Timer 1 Start Date* (09.035) / *Timer 1 Start Time* (09.036), active between this date/time and *Timer 1 Stop Date* (09.037) / *Timer 1 Stop Time* (09.038) and then inactive after the stop time/date within the timer 1 repeat period as shown in the diagram below.



*Timer 1 Repeat Function* (09.039) defines the length of the repeat period. For example if *Timer 1 Repeat Function* (09.039) = 2 then the repeat period is one day. The output is inactive until the time reaches the hour, minute and second defined in *Timer 1 Start Time* (09.036), and remains active until the time reaches the hour, minute and second defined in *Timer 1 Stop Time* (09.038). Different repeat periods may be selected as given in the table below. The table shows the constituent parts of the date and time that are used to determine the start and stop events. If the repeat period is set to every week then *Timer 1 Start Date* (09.035) and *Timer 1 Stop Date* (09.037) define the day of the week and not the date (i.e. 00.00.00 = Sunday, 00.00.01 = Monday, etc.). If the stop time event is set to occur at or before the start time event or the *Timer 1 Repeat Function* (09.039) = 0 or *Timer 1 Enable* (09.040) = 0 the output remains inactive at all times (i.e. *Timer 1 Output* (09.042) = 0 if *Timer 1 Invert* = 0).

| <b>Timer 1 Repeat Function (09.039)</b> | <b>Repeat period</b> | <b>Second</b> | <b>Minute</b> | <b>Hour</b> | <b>Day</b> | <b>Month</b> | <b>Year</b> | <b>Day of week</b> |
|---|----------------------|---------------|---------------|-------------|------------|--------------|-------------|--------------------|
| 0                                       | None                 |               |               |             |            |              |             |                    |
| 1                                       | Hour                 | .             | .             |             |            |              |             |                    |
| 2                                       | Day                  | .             | .             | .           |            |              |             |                    |
| 3                                       | Week                 | .             | .             | .           |            |              |             | .                  |
| 4                                       | Month                | .             | .             | .           | .          |              |             |                    |
| 5                                       | Year                 | .             | .             | .           | .          | .            |             |                    |
| 6                                       | One off              | .             | .             | .           | .          | .            | .           |                    |
| 7                                       | Minute               | .             |               |             |            |              |             |                    |

As *Timer 1 Invert* inverts the timer output it can be used to give an active state of 0 instead of 1. Alternatively it can be used to give an active state of 1, but for a time period that spans the ends of the repeat period as shown in the example above. It should be noted that if this method is used to allow the active period to span the ends of the repeat period then if the timer is disabled the output of the timer block before the invert becomes 0, and so the final output of the timer after the invert is 1.

If *Date/Time Selector* (06.019) is changed and the drive is reset then the source for the timers will change, therefore *Timer 1 Repeat Function* (09.039) and *Timer 2 Repeat Function* (09.049) are reset to 0 to disable the timers and the date and time entries in the trip log are cleared.

| <b>Parameter</b>  | <b>09.001 Logic Function 1 Output</b>      |                |           |
|-------------------|--|----------------|-----------|
| Short description | Shows the output state of logic function 1 |                |           |
| Mode              | Open-Loop                                  |                |           |
| Minimum           | 0  | Maximum        | 1         |
| Default           |  | Units          |           |
| Type              | 1 Bit Volatile                             | Update Rate    | 4ms write |
| Display Format    | Standard                                   | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                             |                |           |

*Logic Function 1 Output* (09.001) shows the output of logic function 1.

| <b>Parameter</b>  | <b>09.002 Logic Function 2 Output</b>      |                |           |
|-------------------|--|----------------|-----------|
| Short description | Shows the output state of logic function 2 |                |           |
| Mode              | Open-Loop                                  |                |           |
| Minimum           | 0  | Maximum        | 1         |
| Default           |  | Units          |           |
| Type              | 1 Bit Volatile                             | Update Rate    | 4ms write |
| Display Format    | Standard                                   | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                             |                |           |

*Logic Function 2 Output* (09.002) shows the output of logic function 2.

| <b>Parameter</b>  | <b>09.003 Motorised Pot Output</b>                   |                |           |
|-------------------|--|----------------|-----------|
| Short description | Shows the output level of the motorised pot function |                |           |
| Mode              | Open-Loop  |                |           |
| Minimum           | -100.00  | Maximum        | 100.00    |
| Default           |  | Units          | %         |
| Type              | 16 Bit Power Down Save                               | Update Rate    | 4ms write |
| Display Format    | Standard   | Decimal Places | 2         |
| Coding            | RO, ND, NC, PT                                       |                |           |

*Motorised Pot Output* (09.003) shows the output of the motorised pot function.

| <b>Parameter</b>  | <b>09.004 Logic Function 1 Source 1</b>    |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines input source 1 of logic function 1 |                |                  |
| Mode              | Open-Loop                                  |                |                  |
| Minimum           | 0.000                                      | Maximum        | 30.999           |
| Default           | 0.000                                      | Units          |                  |
| Type              | 16 Bit User Save                           | Update Rate    | Drive reset read |
| Display Format    | Standard                                   | Decimal Places | 3                |
| Coding            | RW, PT, BU                                 |                |                  |

*Logic Function 1 Source 1* (09.004) defines input source 1 of logic function 1.

| Parameter         | 09.005 <i>Logic Function 1 Source 1 Invert</i> |                |          |
|-------------------|--|----------------|----------|
| Short description | Set to invert input 1 of logic function 1      |                |          |
| Mode              | Open-Loop                                      |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit User Save                                | Update Rate    | 4ms read |
| Display Format    | Standard                                       | Decimal Places | 0        |
| Coding            | RW   |                |          |

Setting *Logic Function 1 Source 1 Invert* (09.005) inverts input 1 of logic function 1.

| Parameter         | 09.006 <i>Logic Function 1 Source 2</i>    |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines input source 2 of logic function 1 |                |                  |
| Mode              | Open-Loop                                  |                |                  |
| Minimum           | 0.000                                      | Maximum        | 30.999           |
| Default           | 0.000                                      | Units          |                  |
| Type              | 16 Bit User Save                           | Update Rate    | Drive reset read |
| Display Format    | Standard                                   | Decimal Places | 3                |
| Coding            | RW, PT, BU                                 |                |                  |

*Logic Function 1 Source 2* (09.006) defines input source 2 of logic function 1.

| Parameter         | 09.007 <i>Logic Function 1 Source 2 Invert</i> |                |          |
|-------------------|--|----------------|----------|
| Short description | Set to invert input 2 of logic function 1      |                |          |
| Mode              | Open-Loop                                      |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit User Save                                | Update Rate    | 4ms read |
| Display Format    | Standard                                       | Decimal Places | 0        |
| Coding            | RW   |                |          |

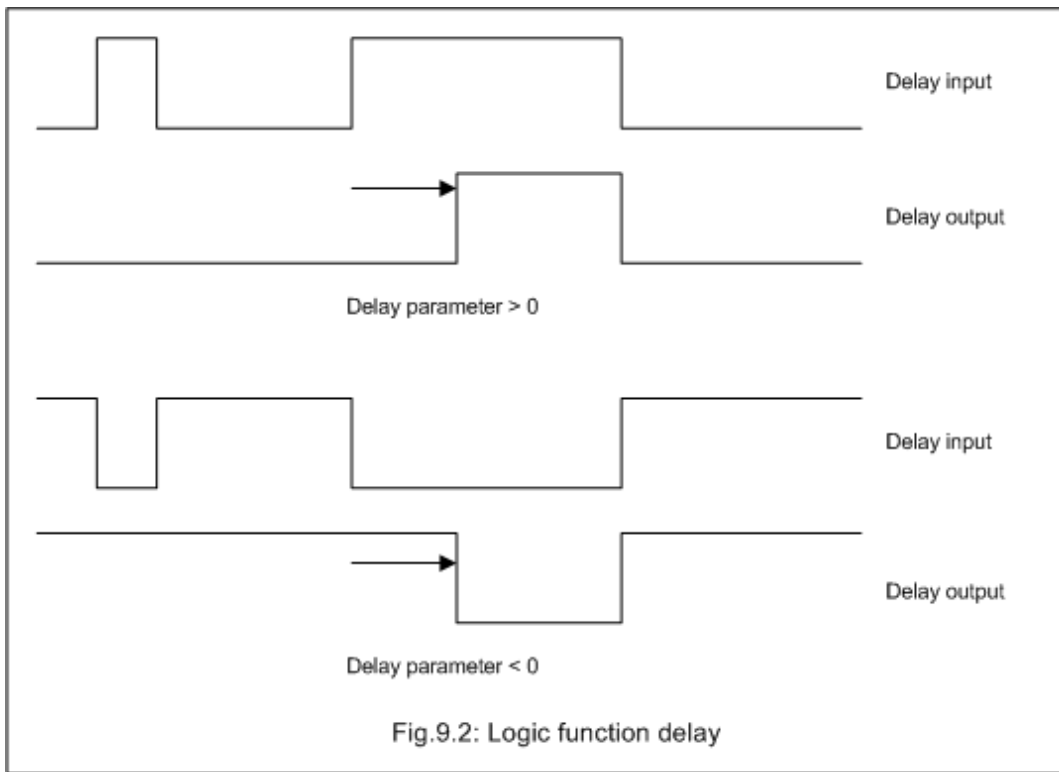
Setting *Logic Function 1 Source 2 Invert* (09.007) inverts input 2 of logic function 1.

| Parameter         | 09.008 <i>Logic Function 1 Output Invert</i> |                |          |
|-------------------|--|----------------|----------|
| Short description | Set to invert the output of logic function 1 |                |          |
| Mode              | Open-Loop                                    |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit User Save                              | Update Rate    | 4ms read |
| Display Format    | Standard                                     | Decimal Places | 0        |
| Coding            | RW   |                |          |

Setting *Logic Function 1 Output Invert* (09.008) inverts the output of logic function 1.

| Parameter         | 09.009 <i>Logic Function 1 Delay</i>         |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the output delay of logic function 1 |                |          |
| Mode              | Open-Loop                                    |                |          |
| Minimum           | -25.0  | Maximum        | 25.0     |
| Default           | 0.0  | Units          | s        |
| Type              | 16 Bit User Save                             | Update Rate    | 4ms read |
| Display Format    | Standard                                     | Decimal Places | 1        |
| Coding            | RW   |                |          |

*Logic Function 1 Delay* (09.009) defines the delay at the output of logic function 1. If *Logic Function 1 Delay* (09.009) is positive then the output does not become 1 until the input to the delay has been at 1 for the delay time. If *Logic Function 1 Delay* (09.009) is negative then the output remains at 1 until the input to the delay has been 0 for the delay time.



| Parameter         | 09.010 Logic Function 1 Destination                |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the output destination of logic function 1 |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0.000  | Maximum        | 30.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save                                   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU                                     |                |                  |

Logic Function 1 Destination (09.010) defines the output destination of logic function 1.

| Parameter         | 09.014 Logic Function 2 Source 1           |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines input source 1 of logic function 2 |                |                  |
| Mode              | Open-Loop                                  |                |                  |
| Minimum           | 0.000                                      | Maximum        | 30.999           |
| Default           | 0.000                                      | Units          |                  |
| Type              | 16 Bit User Save                           | Update Rate    | Drive reset read |
| Display Format    | Standard                                   | Decimal Places | 3                |
| Coding            | RW, PT, BU                                 |                |                  |

Logic Function 2 Source 1 (09.014) defines input source 1 of logic function 2.

| Parameter         | 09.015 Logic Function 2 Source 1 Invert   |                |          |
|-------------------|---|----------------|----------|
| Short description | Set to invert input 1 of logic function 2 |                |          |
| Mode              | Open-Loop                                 |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit User Save                           | Update Rate    | 4ms read |
| Display Format    | Standard                                  | Decimal Places | 0        |
| Coding            | RW  |                |          |

Setting Logic Function 2 Source 1 Invert (09.015) inverts input 1 of logic function 2.

| Parameter         | 09.016 Logic Function 2 Source 2           |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines input source 2 of logic function 2 |                |                  |
| Mode              | Open-Loop                                  |                |                  |
| Minimum           | 0.000                                      | Maximum        | 30.999           |
| Default           | 0.000                                      | Units          |                  |
| Type              | 16 Bit User Save                           | Update Rate    | Drive reset read |
| Display Format    | Standard                                   | Decimal Places | 3                |
| Coding            | RW, PT, BU                                 |                |                  |

*Logic Function 2 Source 2* (09.016) defines input source 2 of logic function 2.

| Parameter         | 09.017 <i>Logic Function 2 Source 2 Invert</i> |                |          |
|-------------------|--|----------------|----------|
| Short description | Set to invert input 2 of logic function 2      |                |          |
| Mode              | Open-Loop                                      |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit User Save                                | Update Rate    | 4ms read |
| Display Format    | Standard                                       | Decimal Places | 0        |
| Coding            | RW   |                |          |

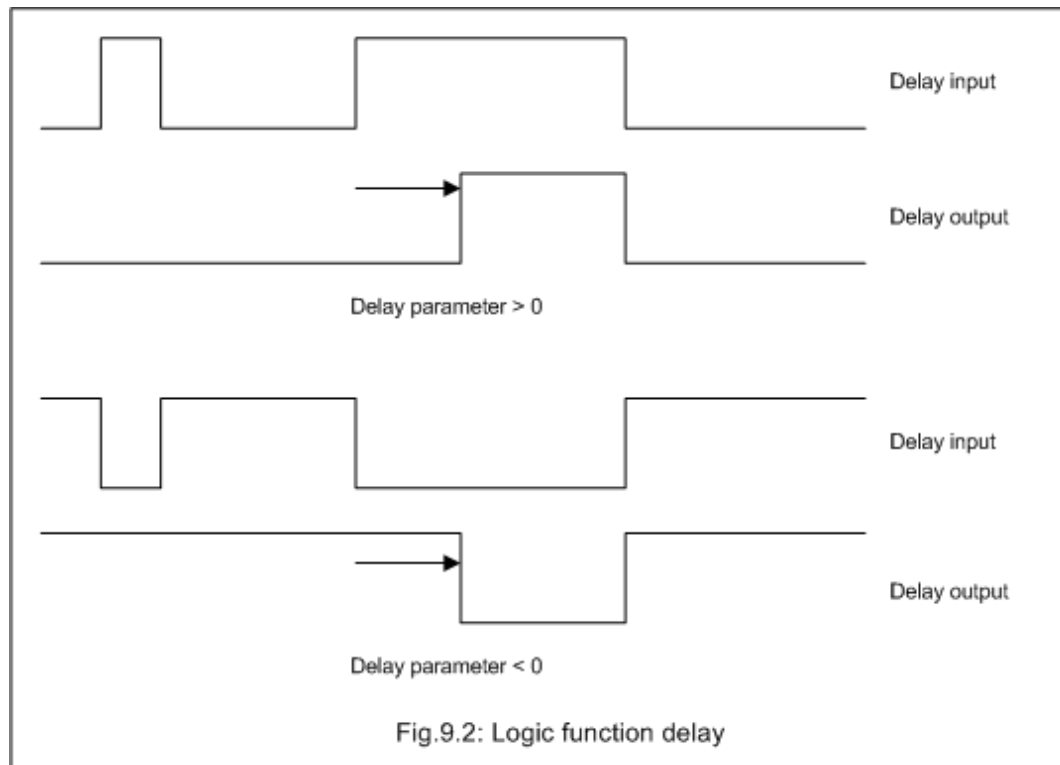
Setting *Logic Function 2 Source 2 Invert* (09.017) inverts input 2 of logic function 2.

| Parameter         | 09.018 <i>Logic Function 2 Output Invert</i> |                |          |
|-------------------|--|----------------|----------|
| Short description | Set to invert the ouptut of logic function 2 |                |          |
| Mode              | Open-Loop                                    |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit User Save                              | Update Rate    | 4ms read |
| Display Format    | Standard                                     | Decimal Places | 0        |
| Coding            | RW   |                |          |

Setting *Logic Function 2 Output Invert* (09.018) inverts the output of logic function 2.

| Parameter         | 09.019 <i>Logic Function 2 Delay</i>         |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the output delay of logic function 2 |                |          |
| Mode              | Open-Loop                                    |                |          |
| Minimum           | -25.0  | Maximum        | 25.0     |
| Default           | 0.0  | Units          | s        |
| Type              | 16 Bit User Save                             | Update Rate    | 4ms read |
| Display Format    | Standard                                     | Decimal Places | 1        |
| Coding            | RW   |                |          |

*Logic Function 2 Delay* (09.019) defines the delay at the output of logic function 1. If *Logic Function 2 Delay* (09.019) is positive then the output does not become 1 until the input to the delay has been at 1 for the delay time. If *Logic Function 2 Delay* (09.019) is negative then the output remains at 1 until the input to the delay has been 0 for the delay time.



| Parameter         | 09.020 <i>Logic Function 2 Destination</i>         |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the output destination of logic function 2 |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0.000  | Maximum        | 30.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save                                   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU                                     |                |                  |

*Logic Function 2 Destination* (09.020) defines the output destination of logic function 2.

| Parameter         | 09.021 <i>Motorised Pot Mode</i> |                |                 |
|-------------------|----------------------------------|----------------|-----------------|
| Short description | Defines the motorised pot mode   |                |                 |
| Mode              | Open-Loop                        |                |                 |
| Minimum           | 0                                | Maximum        | 4               |
| Default           | 0                                | Units          |                 |
| Type              | 8 Bit User Save                  | Update Rate    | Background read |
| Display Format    | Standard                         | Decimal Places | 0               |
| Coding            | RW                               |                |                 |

*Motorised Pot Mode* (09.021) defines the mode of operation as given in the table below.

| <i>Motorised Pot Mode</i> (09.021) | <i>Motorised Pot Output</i> (09.003)                                | <i>Motorised Pot Up</i> (09.026) and <i>Motorised Pot Down</i> (09.027) active |
|------------------------------------|---|--|
| 0                                  | Reset to zero at power-up   | Always   |
| 1                                  | Set to power-down value at power-up                                 | Always   |
| 2                                  | Reset to zero at power-up   | When <i>Drive Active</i> (10.002) = 1  |
| 3                                  | Set to power-down value at power-up                                 | When <i>Drive Active</i> (10.002) = 1  |
| 4                                  | Reset to zero at power-up and when <i>Drive Active</i> (10.002) = 0 | When <i>Drive Active</i> (10.002) = 1  |

| Parameter         | 09.022 <i>Motorised Pot Bipolar Select</i>           |                |          |
|-------------------|--|----------------|----------|
| Short description | Set to enable bipolar operation of the motorised pot |                |          |
| Mode              | Open-Loop  |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit User Save                                      | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW   |                |          |

If *Motorised Pot Bipolar Select* (09.022) = 0 then *Motorised Pot Output* (09.003) is limited in the range 0.00% to 100.00%, otherwise it is allowed to change in the range from -100.00% to 100.00%.

| Parameter         | 09.023 <i>Motorised Pot Rate</i>                       |                |            |
|-------------------|--|----------------|------------|
| Short description | Defines the rate of change of the motorised pot output |                |            |
| Mode              | Open-Loop  |                |            |
| Minimum           | 0  | Maximum        | 250        |
| Default           | 20   | Units          | s          |
| Type              | 8 Bit User Save  | Update Rate    | Background |
| Display Format    | Standard   | Decimal Places | 0          |
| Coding            | RW, BU   |                |            |

The rate of change of *Motorised Pot Output* (09.003) is defined by *Motorised Pot Rate* (09.023) which gives the time to change from 0 to 100%. The time to change from -100% to 100% is *Motorised Pot Rate* (09.023) x 2.

| Parameter         | 09.024 <i>Motorised Pot Scaling</i>                     |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the scaling applied to the motorised pot output |                |          |
| Mode              | Open-Loop   |                |          |
| Minimum           | 0.000   | Maximum        | 4.000    |
| Default           | 1.000   | Units          |          |
| Type              | 16 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 3        |
| Coding            | RW  |                |          |

*Motorised Pot Scaling* (09.024) introduces a scaling factor at the output of the motorised pot before the output is routed to the destination. If *Motorised Pot Scaling* (09.024) > 1.000 the output will exceed the range of the destination parameter, and so the destination parameter will be at its maximum or minimum before the output of the motorised pot reaches the limits of its range.



| Parameter         | 09.025 <i>Motorised Pot Destination</i>             |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the output destination of the motorised pot |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0.000   | Maximum        | 30.999           |
| Default           | 0.000   | Units          |                  |
| Type              | 16 Bit User Save                                    | Update Rate    | Drive reset read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU                                      |                |                  |

*Motorised Pot Destination* (09.025) defines the output destination of the motorised pot function.

| Parameter         | 09.026 <i>Motorised Pot Up</i>           |                |          |
|-------------------|--|----------------|----------|
| Short description | Set to increase the motorised pot output |                |          |
| Mode              | Open-Loop                                |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit Volatile                           | Update Rate    | 4ms read |
| Display Format    | Standard                                 | Decimal Places | 0        |
| Coding            | RW, NC                                   |                |          |

If *Motorised Pot Up* (09.026) = 1, then the *Motorised Pot Output* (09.003) will increase.

| Parameter         | 09.027 <i>Motorised Pot Down</i>         |                |          |
|-------------------|--|----------------|----------|
| Short description | Set to decrease the motorised pot output |                |          |
| Mode              | Open-Loop                                |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit Volatile                           | Update Rate    | 4ms read |
| Display Format    | Standard                                 | Decimal Places | 0        |
| Coding            | RW, NC                                   |                |          |

If *Motorised Pot Down* (09.027) = 1, then the *Motorised Pot Output* (09.003) will decrease.

| Parameter         | 09.028 <i>Motorised Pot Reset</i>             |                |          |
|-------------------|---|----------------|----------|
| Short description | Set to reset the motorised pot output to zero |                |          |
| Mode              | Open-Loop                                     |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit Volatile                                | Update Rate    | 4ms read |
| Display Format    | Standard                                      | Decimal Places | 0        |
| Coding            | RW, NC  |                |          |

If *Motorised Pot Reset* (09.028) = 1 then the motorised pot is disabled and held in its reset state with *Motorised Pot Output* (09.003) = 0.0%.  
If *Motorised Pot Reset* (09.028) the motorised pot is enabled even if *Motorised Pot Destination* (09.025) is not routed to a valid parameter.

| Parameter         | 09.029 <i>Binary Sum Ones</i>           |                |          |
|-------------------|---|----------------|----------|
| Short description | Set to add one to the binary sum output |                |          |
| Mode              | Open-Loop                               |                |          |
| Minimum           | 0                                       | Maximum        | 1        |
| Default           | 0                                       | Units          |          |
| Type              | 1 Bit Volatile                          | Update Rate    | 4ms read |
| Display Format    | Standard                                | Decimal Places | 0        |
| Coding            | RW                                      |                |          |

See *Binary Sum Output* (09.032).

| Parameter         | 09.030 <i>Binary Sum Twos</i>           |                |          |
|-------------------|---|----------------|----------|
| Short description | Set to add two to the binary sum output |                |          |
| Mode              | Open-Loop                               |                |          |
| Minimum           | 0                                       | Maximum        | 1        |
| Default           | 0                                       | Units          |          |
| Type              | 1 Bit Volatile                          | Update Rate    | 4ms read |
| Display Format    | Standard                                | Decimal Places | 0        |
| Coding            | RW                                      |                |          |

See *Binary Sum Output* (09.032).

| Parameter         | 09.031 Binary Sum Fours                   |                |          |
|-------------------|---|----------------|----------|
| Short description | Set to add three to the binary sum output |                |          |
| Mode              | Open-Loop                                 |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit Volatile                            | Update Rate    | 4ms read |
| Display Format    | Standard                                  | Decimal Places | 0        |
| Coding            | RW  |                |          |

See *Binary Sum Output* (09.032).

| Parameter         | 09.032 Binary Sum Output                 |                |           |
|-------------------|--|----------------|-----------|
| Short description | Shows the output level of the binary sum |                |           |
| Mode              | Open-Loop                                |                |           |
| Minimum           | 0  | Maximum        | 255       |
| Default           |  | Units          |           |
| Type              | 8 Bit Volatile                           | Update Rate    | 4ms write |
| Display Format    | Standard                                 | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT, BU                       |                |           |

The binary sum function is always active even if the destination is not routed to valid a parameter. The update rate for the binary sum is always 4ms.

The output of the binary sum block is given by

$$\text{Binary Sum Output (09.032)} = \text{Binary Sum Offset (09.034)} + (\text{Binary Sum Ones (09.029)} \times 1) + (\text{Binary Sum Twos (09.030)} \times 2) + (\text{Binary Sum Fours (09.031)} \times 4)$$

*Binary Sum Destination* (09.033) defines the destination for the binary sum output. The routing for this destination is special if the maximum of the destination parameter  $\leq 7 + [\text{Binary Sum Offset (09.034)}]$  as follows:

Destination parameter = *Binary Sum Output* (09.032), subject to the parameter minimum

Otherwise *Binary Sum Output* (09.032) is routed in the same way as any other destination where the destination target is at its full scale value when the *Binary Sum Output* (09.032) =  $7 + \text{Binary Sum Offset (09.034)}$

Example:

$$09.033 = 01.015$$

$$09.029 = 0$$

$$09.030 = 1$$

$$09.031 = 0$$

$$09.034 = 0$$

$$\text{So } 09.032 = 2$$

$$\text{And } 01.015 = (01.015[\text{MAX}] \times 09.032) / (7 + 09.034)$$

$$01.015 = (9 \times 2) / (7 + 0) = 2.57 = 3 \text{ (rounded to nearest integer)}$$

$$\text{If } 09.034 = 1 \text{ then } 01.015 = (9 \times 3) / (7 + 1) = 3.37 = 3 \text{ (rounded to nearest integer)}$$

$$\text{If } 09.034 = 2 \text{ then } 01.015 = (9 \times 4) / (7 + 2) = 4$$

| Parameter         | 09.033 Binary Sum Destination                    |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the output destination of the binary sum |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0.000  | Maximum        | 30.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save                                 | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU                                   |                |                  |

*Binary Sum Destination* (09.033) defines the destination for the binary sum output.

See *Binary Sum Output* (09.032) for more information.

| Parameter         | 09.034 <i>Binary Sum Offset</i>                          |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the offset added to the output of the binary sum |                |          |
| Mode              | Open-Loop  |                |          |
| Minimum           | 0  | Maximum        | 248      |
| Default           | 0  | Units          |          |
| Type              | 8 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW, BU   |                |          |

See *Binary Sum Output* (09.032).

| Parameter         | 09.035 <i>Timer 1 Start Date</i>   |                |                               |
|-------------------|------------------------------------|----------------|-------------------------------|
| Short description | Defines the start date for timer 1 |                |                               |
| Mode              | Open-Loop                          |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)           | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           | 0<br>(Display: 00-00-00)           | Units          |                               |
| Type              | 32 Bit User Save                   | Update Rate    | Background read               |
| Display Format    | Date                               | Decimal Places | 0                             |
| Coding            | RW                                 |                |                               |

*Timer 1 Start Date* (09.035) defines the start time within the repeat period of timer 1.

See *Timer 1 Repeat Function* (09.039) for more information.

| Parameter         | 09.036 <i>Timer 1 Start Time</i>   |                |                               |
|-------------------|------------------------------------|----------------|-------------------------------|
| Short description | Defines the start time for timer 1 |                |                               |
| Mode              | Open-Loop                          |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)           | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           | 0<br>(Display: 00:00:00)           | Units          |                               |
| Type              | 32 Bit User Save                   | Update Rate    | Background read               |
| Display Format    | Time                               | Decimal Places | 0                             |
| Coding            | RW                                 |                |                               |

*Timer 1 Start Time* (09.036) defines the start time within the repeat period of timer 1.

See *Timer 1 Repeat Function* (09.039) for more information.

| Parameter         | 09.037 <i>Timer 1 Stop Date</i>   |                |                               |
|-------------------|-----------------------------------|----------------|-------------------------------|
| Short description | Defines the stop date for timer 1 |                |                               |
| Mode              | Open-Loop                         |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)          | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           | 0<br>(Display: 00-00-00)          | Units          |                               |
| Type              | 32 Bit User Save                  | Update Rate    | Background read               |
| Display Format    | Date                              | Decimal Places | 0                             |
| Coding            | RW                                |                |                               |

*Timer 1 Stop Date* (09.037) defines the stop date within the repeat period of timer 1.

See *Timer 1 Repeat Function* (09.039) for more information.

| Parameter         | 09.038 <i>Timer 1 Stop Time</i>   |                |                               |
|-------------------|-----------------------------------|----------------|-------------------------------|
| Short description | Defines the stop time for timer 1 |                |                               |
| Mode              | Open-Loop                         |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)          | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           | 0<br>(Display: 00:00:00)          | Units          |                               |
| Type              | 32 Bit User Save                  | Update Rate    | Background read               |
| Display Format    | Time                              | Decimal Places | 0                             |
| Coding            | RW                                |                |                               |

*Timer 1 Stop Time* (09.038) defines the stop time within the repeat period of timer 1.

See *Timer 1 Repeat Function* (09.039) for more information.

| Parameter         | 09.039 <i>Timer 1 Repeat Function</i>   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the length of the repeat period |                |                 |
| Mode              | Open-Loop                               |                |                 |
| Minimum           | 0                                       | Maximum        | 7               |
| Default           | 0                                       | Units          |                 |
| Type              | 8 Bit User Save                         | Update Rate    | Background read |
| Display Format    | Standard                                | Decimal Places | 0               |
| Coding            | RW, TE                                  |                |                 |

| Value | Text |
|-------|------|
| 0     | None |
| 1     | 1    |
| 2     | 2    |
| 3     | 3    |
| 4     | 4    |
| 5     | 5    |
| 6     | 6    |
| 7     | 7    |

*Timer 1 Repeat Function* (09.039) defines the length of the repeat period. For example if *Timer 1 Repeat Function* (09.039) = 2 then the repeat period is one day. The output is inactive until the time reaches the hour, minute and second defined in *Timer 1 Start Time* (09.036), and remains active until the time reaches the hour, minute and second defined in *Timer 1 Stop Time* (09.038). Different repeat periods may be selected as given in the table below. The table shows the constituent parts of the date and time that are used to determine the start and stop events. If the repeat period is set to every week then *Timer 1 Start Date* (09.035) and *Timer 1 Stop Date* (09.037) define the day of the week and not the date (i.e. 00.00.00 = Sunday, 00.00.01 = Monday, etc.). If the stop time event is set to occur at or before the start time event or the *Timer 1 Repeat Function* (09.039) = 0 or *Timer 1 Enable* (09.040) = 0 the output remains inactive at all times (i.e. *Timer 1 Output* (09.042) = 0 if *Timer 1 Invert* = 0).

| <i>Timer 1 Repeat Function</i> (09.039) | Repeat period | Second | Minute | Hour | Day | Month | Year | Day of week |
|---|---------------|--------|--------|------|-----|-------|------|-------------|
| 0                                       | None          |        |        |      |     |       |      |             |
| 1                                       | Hour          | .      | .      |      |     |       |      |             |
| 2                                       | Day           | .      | .      | .    |     |       |      |             |
| 3                                       | Week          | .      | .      | .    |     |       |      | .           |
| 4                                       | Month         | .      | .      | .    | .   |       |      |             |
| 5                                       | Year          | .      | .      | .    | .   | .     |      |             |
| 6                                       | One off       | .      | .      | .    | .   | .     | .    |             |
| 7                                       | Minute        | .      |        |      |     |       |      |             |

| Parameter         | 09.040 <i>Timer 1 Enable</i>       |                |                 |
|-------------------|------------------------------------|----------------|-----------------|
| Short description | Set to enable the timer 1 function |                |                 |
| Mode              | Open-Loop                          |                |                 |
| Minimum           | 0                                  | Maximum        | 1               |
| Default           | 0                                  | Units          |                 |
| Type              | 1 Bit User Save                    | Update Rate    | Background read |
| Display Format    | Standard                           | Decimal Places | 0               |
| Coding            | RW                                 |                |                 |

*Timer 1 Enable* (09.040) enables the timer 1 function. If *Timer 1 Enable* (09.040) = 0, then the output of the timer is always inactive, i.e. *Timer 1 Output* (09.042) = 0.

| Parameter         | 09.041 <i>Timer 1 Invert</i>        |                |                 |
|-------------------|-------------------------------------|----------------|-----------------|
| Short description | Set to invert the output of timer 1 |                |                 |
| Mode              | Open-Loop                           |                |                 |
| Minimum           | 0                                   | Maximum        | 1               |
| Default           | 0                                   | Units          |                 |
| Type              | 1 Bit User Save                     | Update Rate    | Background read |
| Display Format    | Standard                            | Decimal Places | 0               |
| Coding            | RW                                  |                |                 |

*Timer 1 Invert* (09.041) inverts the timer output to give an active state of 0 instead of 1. Alternatively it can be used to give an active state of 1, but for a

time period that spans the ends of the repeat period as shown in the example above. It should be noted that if this method is used to allow the active period to span the ends of the repeat period then if the timer is disabled the output of the timer block before the invert becomes 0, and so the final output of the timer after the invert is 1.

See *Timer 1 Repeat Function* (09.039) for more information.

| Parameter         | 09.042 <i>Timer 1 Output</i>               |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Shows the output state of timer function 1 |                |                  |
| Mode              | Open-Loop                                  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile                             | Update Rate    | Background write |
| Display Format    | Standard                                   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                             |                |                  |

*Timer 1 Output* (09.042) shows the output of the timer function 1.

| Parameter         | 09.043 <i>Timer 1 Destination</i>                  |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the output destination of timer function 1 |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0.000  | Maximum        | 30.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save                                   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU                                     |                |                  |

*Timer 1 Destination* (09.043) defines the output destination of timer function 1.

| Parameter         | 09.045 <i>Timer 2 Start Date</i>   |                |                               |
|-------------------|------------------------------------|----------------|-------------------------------|
| Short description | Defines the start date for timer 2 |                |                               |
| Mode              | Open-Loop                          |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)           | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           | 0<br>(Display: 00-00-00)           | Units          |                               |
| Type              | 32 Bit User Save                   | Update Rate    | Background read               |
| Display Format    | Date                               | Decimal Places | 0                             |
| Coding            | RW                                 |                |                               |

*Timer 2 Start Date* (09.045) defines the start date within the repeat period of timer 2.

See *Timer 1 Repeat Function* (09.039) for more information.

| Parameter         | 09.046 <i>Timer 2 Start Time</i>   |                |                               |
|-------------------|------------------------------------|----------------|-------------------------------|
| Short description | Defines the start time for timer 2 |                |                               |
| Mode              | Open-Loop                          |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)           | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           | 0<br>(Display: 00:00:00)           | Units          |                               |
| Type              | 32 Bit User Save                   | Update Rate    | Background read               |
| Display Format    | Time                               | Decimal Places | 0                             |
| Coding            | RW                                 |                |                               |

*Timer 2 Start Time* (09.046) defines the start time within the repeat period of timer 2.

See *Timer 1 Repeat Function* (09.039) for more information.

| Parameter         | 09.047 <i>Timer 2 Stop Date</i> |                |                               |
|-------------------|---------------------------------|----------------|-------------------------------|
| Short description |                                 |                |                               |
| Mode              | Open-Loop                       |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)        | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           | 0<br>(Display: 00-00-00)        | Units          |                               |
| Type              | 32 Bit User Save                | Update Rate    | Background read               |
| Display Format    | Date                            | Decimal Places | 0                             |
| Coding            | RW                              |                |                               |

*Timer 2 Stop Date* (09.047) defines the stop date within the repeat period of timer 2.

See *Timer 1 Repeat Function* (09.039) for more information.

| Parameter         | 09.048 <i>Timer 2 Stop Time</i>   |                |                               |
|-------------------|-----------------------------------|----------------|-------------------------------|
| Short description | Defines the stop time for timer 2 |                |                               |
| Mode              | Open-Loop                         |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)          | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           | 0<br>(Display: 00:00:00)          | Units          |                               |
| Type              | 32 Bit User Save                  | Update Rate    | Background read               |
| Display Format    | Time                              | Decimal Places | 0                             |
| Coding            | RW                                |                |                               |

*Timer 2 Stop Time* (09.048) defines the stop time within the repeat period of timer 2.

See *Timer 1 Repeat Function* (09.039) for more information.

| Parameter         | 09.049 <i>Timer 2 Repeat Function</i>   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the length of the repeat period |                |                 |
| Mode              | Open-Loop                               |                |                 |
| Minimum           | 0                                       | Maximum        | 7               |
| Default           | 0                                       | Units          |                 |
| Type              | 8 Bit User Save                         | Update Rate    | Background read |
| Display Format    | Standard                                | Decimal Places | 0               |
| Coding            | RW, TE                                  |                |                 |

| Value | Text |
|-------|------|
| 0     | None |
| 1     | 1    |
| 2     | 2    |
| 3     | 3    |
| 4     | 4    |
| 5     | 5    |
| 6     | 6    |
| 7     | 7    |

See *Timer 1 Repeat Function* (09.039).

| Parameter         | 09.050 <i>Timer 2 Enable</i>       |                |                 |
|-------------------|------------------------------------|----------------|-----------------|
| Short description | Set to enable the timer 2 function |                |                 |
| Mode              | Open-Loop                          |                |                 |
| Minimum           | 0                                  | Maximum        | 1               |
| Default           | 0                                  | Units          |                 |
| Type              | 1 Bit User Save                    | Update Rate    | Background read |
| Display Format    | Standard                           | Decimal Places | 0               |
| Coding            | RW                                 |                |                 |

*Timer 2 Enable* (09.050) enables the timer 2 function. If *Timer 2 Enable* (09.050) = 0, then the output of the timer is always inactive, i.e. *Timer 2 Output* (09.052) = 0.

| Parameter         | 09.051 <i>Timer 2 Invert</i>        |                |                 |
|-------------------|-------------------------------------|----------------|-----------------|
| Short description | Set to invert the output of timer 2 |                |                 |
| Mode              | Open-Loop                           |                |                 |
| Minimum           | 0                                   | Maximum        | 1               |
| Default           | 0                                   | Units          |                 |
| Type              | 1 Bit User Save                     | Update Rate    | Background read |
| Display Format    | Standard                            | Decimal Places | 0               |
| Coding            | RW                                  |                |                 |

*Timer 2 Invert* (09.051) inverts the timer output to give an active state of 0 instead of 1.

See *Timer 1 Invert* (09.041) for more information.

| Parameter         | 09.052 <i>Timer 2 Output</i>               |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Shows the output state of timer function 2 |                |                  |
| Mode              | Open-Loop                                  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile                             | Update Rate    | Background write |
| Display Format    | Standard                                   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                             |                |                  |

*Timer 2 Output* (09.052) shows the output of timer function 2.

| Parameter         | 09.053 <i>Timer 2 Destination</i>                  |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the output destination of timer function 2 |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0.000  | Maximum        | 30.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save                                   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU                                     |                |                  |

*Timer 2 Destination* (09.053) defines the output destination of timer function 2.

| Parameter         | 09.055 <i>Scope Trace 1 Source</i>  |                |                  |
|-------------------|-------------------------------------|----------------|------------------|
| Short description | Defines the source of scope trace 1 |                |                  |
| Mode              | Open-Loop                           |                |                  |
| Minimum           | 0.000                               | Maximum        | 30.999           |
| Default           | 0.000                               | Units          |                  |
| Type              | 16 Bit User Save                    | Update Rate    | Drive reset read |
| Display Format    | Standard                            | Decimal Places | 3                |
| Coding            | RW, PT, BU                          |                |                  |

Up to four scope sources can be selected using *Scope Trace 1 Source* (09.055) to *Scope Trace 4 Source* (09.058). If the source value is set to 0.000, or the source parameter does not exist or is non-visible, then no source is selected. The sources do not operate in the same way as normal source parameters in that the input to the scope is the actual value of the parameter and not a value scaled to a percentage based on the range of the parameter. If a scope trace source parameter is modified the actual change is not effective until the drive is reset.

# Menu 10 Single Line Descriptions – *Status and Trips*

Mode: Open-Loop



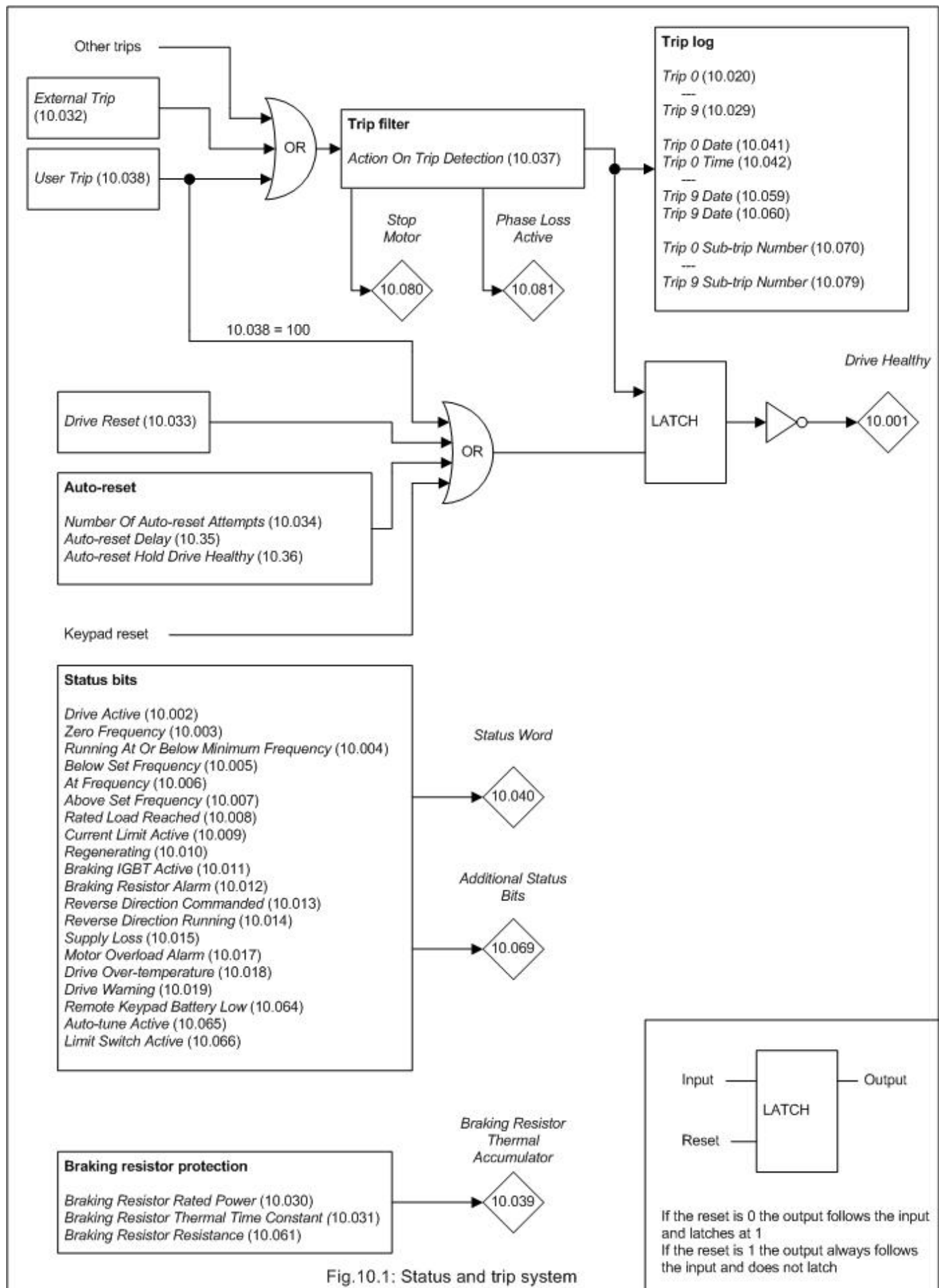
| Parameter |  | Range  | Default  | Type |      |    |    |    |    |
|-----------|--|--|----------|------|------|----|----|----|----|
| 10.001    | Drive Healthy                          | Off (0) or On (1)                                    |          | RO   | Bit  | ND | NC | PT |    |
| 10.002    | Drive Active                           | Off (0) or On (1)                                    |          | RO   | Bit  | ND | NC | PT |    |
| 10.003    | Zero Frequency                         | Off (0) or On (1)                                    |          | RO   | Bit  | ND | NC | PT |    |
| 10.004    | Running At Or Below Minimum Frequency  | Off (0) or On (1)                                    |          | RO   | Bit  | ND | NC | PT |    |
| 10.005    | Below Set Frequency                    | Off (0) or On (1)                                    |          | RO   | Bit  | ND | NC | PT |    |
| 10.006    | At Frequency                           | Off (0) or On (1)                                    |          | RO   | Bit  | ND | NC | PT |    |
| 10.007    | Above Set Frequency                    | Off (0) or On (1)                                    |          | RO   | Bit  | ND | NC | PT |    |
| 10.008    | Rated Load Reached                     | Off (0) or On (1)                                    |          | RO   | Bit  | ND | NC | PT |    |
| 10.009    | Current Limit Active                   | Off (0) or On (1)                                    |          | RO   | Bit  | ND | NC | PT |    |
| 10.010    | Regenerating                           | Off (0) or On (1)                                    |          | RO   | Bit  | ND | NC | PT |    |
| 10.011    | Braking IGBT Active                    | Off (0) or On (1)                                    |          | RO   | Bit  | ND | NC | PT |    |
| 10.012    | Braking Resistor Alarm                 | Off (0) or On (1)                                    |          | RO   | Bit  | ND | NC | PT |    |
| 10.013    | Reverse Direction Commanded            | Off (0) or On (1)                                    |          | RO   | Bit  | ND | NC | PT |    |
| 10.014    | Reverse Direction Running              | Off (0) or On (1)                                    |          | RO   | Bit  | ND | NC | PT |    |
| 10.015    | Supply Loss                            | Off (0) or On (1)                                    |          | RO   | Bit  | ND | NC | PT |    |
| 10.016    | Under Voltage Active                   | Off (0) or On (1)                                    |          | RO   | Bit  | ND | NC | PT |    |
| 10.017    | Motor Overload Alarm                   | Off (0) or On (1)                                    |          | RO   | Bit  | ND | NC | PT |    |
| 10.018    | Drive Over-temperature Alarm           | Off (0) or On (1)                                    |          | RO   | Bit  | ND | NC | PT |    |
| 10.019    | Drive Warning                          | Off (0) or On (1)                                    |          | RO   | Bit  | ND | NC | PT |    |
| 10.020    | Trip 0                                 | 0 to 255   |          | RO   | Txt  | ND | NC | PT | PS |
| 10.021    | Trip 1                                 | 0 to 255   |          | RO   | Txt  | ND | NC | PT | PS |
| 10.022    | Trip 2                                 | 0 to 255   |          | RO   | Txt  | ND | NC | PT | PS |
| 10.023    | Trip 3                                 | 0 to 255   |          | RO   | Txt  | ND | NC | PT | PS |
| 10.024    | Trip 4                                 | 0 to 255   |          | RO   | Txt  | ND | NC | PT | PS |
| 10.025    | Trip 5                                 | 0 to 255   |          | RO   | Txt  | ND | NC | PT | PS |
| 10.026    | Trip 6                                 | 0 to 255   |          | RO   | Txt  | ND | NC | PT | PS |
| 10.027    | Trip 7                                 | 0 to 255   |          | RO   | Txt  | ND | NC | PT | PS |
| 10.028    | Trip 8                                 | 0 to 255   |          | RO   | Txt  | ND | NC | PT | PS |
| 10.029    | Trip 9                                 | 0 to 255   |          | RO   | Txt  | ND | NC | PT | PS |
| 10.030    | Braking Resistor Rated Power           | 0.0 to 99999.9 kW                                    | 0.0 kW   | RW   | Num  |    |    |    | US |
| 10.031    | Braking Resistor Thermal Time Constant | 0.00 to 1500.00 s                                    | 0.00 s   | RW   | Num  |    |    |    | US |
| 10.032    | External Trip                          | Off (0) or On (1)                                    | Off (0)  | RW   | Bit  |    | NC |    |    |
| 10.033    | Drive Reset                            | Off (0) or On (1)                                    | Off (0)  | RW   | Bit  |    | NC |    |    |
| 10.034    | Number Of Auto-reset Attempts          | None (0), 1 (1), 2 (2), 3 (3), 4 (4), 5 (5), inF (6) | None (0) | RW   | Txt  |    |    |    | US |
| 10.035    | Auto-reset Delay                       | 1.0 to 600.0 s                                       | 1.0 s    | RW   | Num  |    |    |    | US |
| 10.036    | Auto-reset Hold Drive Healthy          | Off (0) or On (1)                                    | Off (0)  | RW   | Bit  |    |    |    | US |
| 10.037    | Action On Trip Detection               | 00000 to 11111                                       | 00000    | RW   | Bin  |    |    |    | US |
| 10.038    | User Trip                              | 0 to 255   |          | RW   | Num  | ND | NC |    |    |
| 10.039    | Braking Resistor Thermal Accumulator   | 0.0 to 100.0 %                                       |          | RO   | Num  | ND | NC | PT |    |
| 10.040    | Status Word                            | 0000000000000000 to 1111111111111111                 |          | RO   | Bin  | ND | NC | PT |    |
| 10.041    | Trip 0 Date                            | 00-00-00 to 31-12-99                                 |          | RO   | Date | ND | NC | PT | PS |
| 10.042    | Trip 0 Time                            | 00:00:00 to 23:59:59                                 |          | RO   | Time | ND | NC | PT | PS |
| 10.043    | Trip 1 Date                            | 00-00-00 to 31-12-99                                 |          | RO   | Date | ND | NC | PT | PS |
| 10.044    | Trip 1 Time                            | 00:00:00 to 23:59:59                                 |          | RO   | Time | ND | NC | PT | PS |
| 10.045    | Trip 2 Date                            | 00-00-00 to 31-12-99                                 |          | RO   | Date | ND | NC | PT | PS |
| 10.046    | Trip 2 Time                            | 00:00:00 to 23:59:59                                 |          | RO   | Time | ND | NC | PT | PS |
| 10.047    | Trip 3 Date                            | 00-00-00 to 31-12-99                                 |          | RO   | Date | ND | NC | PT | PS |
| 10.048    | Trip 3 Time                            | 00:00:00 to 23:59:59                                 |          | RO   | Time | ND | NC | PT | PS |
| 10.049    | Trip 4 Date                            | 00-00-00 to 31-12-99                                 |          | RO   | Date | ND | NC | PT | PS |
| 10.050    | Trip 4 Time                            | 00:00:00 to 23:59:59                                 |          | RO   | Time | ND | NC | PT | PS |
| 10.051    | Trip 5 Date                            | 00-00-00 to 31-12-99                                 |          | RO   | Date | ND | NC | PT | PS |
| 10.052    | Trip 5 Time                            | 00:00:00 to 23:59:59                                 |          | RO   | Time | ND | NC | PT | PS |
| 10.053    | Trip 6 Date                            | 00-00-00 to 31-12-99                                 |          | RO   | Date | ND | NC | PT | PS |
| 10.054    | Trip 6 Time                            | 00:00:00 to 23:59:59                                 |          | RO   | Time | ND | NC | PT | PS |
| 10.055    | Trip 7 Date                            | 00-00-00 to 31-12-99                                 |          | RO   | Date | ND | NC | PT | PS |
| 10.056    | Trip 7 Time                            | 00:00:00 to 23:59:59                                 |          | RO   | Time | ND | NC | PT | PS |
| 10.057    | Trip 8 Date                            | 00-00-00 to 31-12-99                                 |          | RO   | Date | ND | NC | PT | PS |
| 10.058    | Trip 8 Time                            | 00:00:00 to 23:59:59                                 |          | RO   | Time | ND | NC | PT | PS |
| 10.059    | Trip 9 Date                            | 00-00-00 to 31-12-99                                 |          | RO   | Date | ND | NC | PT | PS |
| 10.060    | Trip 9 Time                            | 00:00:00 to 23:59:59                                 |          | RO   | Time | ND | NC | PT | PS |
| 10.061    | Braking Resistor Resistance            | 0.00 to 10000.00 Ω                                   | 0.00 Ω   | RW   | Num  |    |    |    | US |
| 10.064    | Remote Keypad Battery Low              | Off (0) or On (1)                                    |          | RO   | Bit  | ND | NC | PT |    |
| 10.065    | Auto-tune Active                       | Off (0) or On (1)                                    |          | RO   | Bit  | ND | NC | PT |    |

|        |                                     |  |         |    |     |    |    |    |    |
|--------|-------------------------------------|--|---------|----|-----|----|----|----|----|
| 10.066 | Limit Switch Active                 | Off (0) or On (1)  |         | RO | Bit | ND | NC | PT |    |
| 10.068 | Hold Drive Healthy on Under Voltage | Off (0) or On (1)  | Off (0) | RW | Bit |    |    |    | US |
| 10.069 | Additional Status Bits              | 00000000000 to 11111111111   |         | RO | Bin | ND | NC | PT |    |
| 10.070 | Trip 0 Sub-trip Number              | 0 to 65535   |         | RO | Num | ND | NC | PT | PS |
| 10.071 | Trip 1 Sub-trip Number              | 0 to 65535   |         | RO | Num | ND | NC | PT | PS |
| 10.072 | Trip 2 Sub-trip Number              | 0 to 65535   |         | RO | Num | ND | NC | PT | PS |
| 10.073 | Trip 3 Sub-trip Number              | 0 to 65535   |         | RO | Num | ND | NC | PT | PS |
| 10.074 | Trip 4 Sub-trip Number              | 0 to 65535   |         | RO | Num | ND | NC | PT | PS |
| 10.075 | Trip 5 Sub-trip Number              | 0 to 65535   |         | RO | Num | ND | NC | PT | PS |
| 10.076 | Trip 6 Sub-trip Number              | 0 to 65535   |         | RO | Num | ND | NC | PT | PS |
| 10.077 | Trip 7 Sub-trip Number              | 0 to 65535   |         | RO | Num | ND | NC | PT | PS |
| 10.078 | Trip 8 Sub-trip Number              | 0 to 65535   |         | RO | Num | ND | NC | PT | PS |
| 10.079 | Trip 9 Sub-trip Number              | 0 to 65535   |         | RO | Num | ND | NC | PT | PS |
| 10.080 | Stop Motor                          | Off (0) or On (1)  |         | RO | Bit | ND | NC | PT |    |
| 10.081 | Phase Loss                          | Off (0) or On (1)  |         | RO | Bit | ND | NC | PT |    |
| 10.090 | Drive Ready                         | Off (0) or On (1)  |         | RO | Bit | ND | NC | PT |    |
| 10.101 | Drive Status                        | inh (0), rdy (1), Stop (2), ScAn (3), run (4), S.Loss (5), dEcEI (6), dc.inj (7), Res (8), Error (9), Active (10), HEAt (14), UU (15)                                |         | RO | Txt | ND | NC | PT |    |
| 10.102 | Trip Reset Source                   | 0 to 1023  |         | RO | Num | ND | NC | PT | PS |
| 10.103 | Trip Time Identifier                | -2147483648 to 2147483647 ms   |         | RO | Num | ND | NC | PT |    |
| 10.104 | Active Alarm                        | None (0), br.res (1), OV.Ld (2), Res (3), D.OV.Ld (4), tuning (5), LS (6), Res (8), OPT.Al (9), Res (10), Res (11), Res (12), Lo.AC (13), I.AC.Lt (14), 24.Lost (15) |         | RO | Txt | ND | NC | PT |    |
| 10.106 | Potential Drive Damage Conditions   | 00 to 11   |         | RO | Bin | ND | NC | PT | PS |
| 10.107 | Low AC Alarm                        | Off (0) or On (1)  |         | RO | Bit | ND | NC | PT |    |
| 10.108 | Reversed cooling fan detected       | Off (0) or On (1)  |         | RO | Bit | ND |    | PT |    |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

## Menu 10 – Status and Trips

Mode: Open-Loop



| Parameter         | 10.001 Drive Healthy                |                |                  |
|-------------------|-------------------------------------|----------------|------------------|
| Short description | Indicates that the drive is healthy |                |                  |
| Mode              | Open-Loop                           |                |                  |
| Minimum           | 0                                   | Maximum        | 1                |
| Default           |                                     | Units          |                  |
| Type              | 1 Bit Volatile                      | Update Rate    | Background write |
| Display Format    | Standard                            | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                      |                |                  |

*Drive Healthy* (10.001) indicates that the drive is not in the trip or the under voltage state if it is set to one. If *Auto-reset Hold Drive Healthy* (10.036) = 1 and auto-reset is being used, *Drive Healthy* (10.001) is not cleared until all auto-resets have been attempted and the next trip occurs.

| Parameter         | 10.002 Drive Active                   |                |                  |
|-------------------|---------------------------------------|----------------|------------------|
| Short description | Indicates that the inverter is active |                |                  |
| Mode              | Open-Loop                             |                |                  |
| Minimum           | 0                                     | Maximum        | 1                |
| Default           |                                       | Units          |                  |
| Type              | 1 Bit Volatile                        | Update Rate    | Background write |
| Display Format    | Standard                              | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                        |                |                  |

If the drive inverter is active *Drive Active* (10.002) is set to one, otherwise it is zero.

| Parameter         | 10.003 Zero Frequency  |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates that the frequency is below the zero frequency threshold |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT   |                |                  |

*Zero Frequency* (10.003) is set to one under the zero frequency conditions, otherwise it is zero. See *Zero Frequency Threshold* (03.005).

| Parameter         | 10.004 Running At Or Below Minimum Frequency                          |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that the drive is running at or below the minimum frequency |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

If *Bipolar Reference Enable* (01.010) = 1 then *Running At Or Below Minimum Frequency* (10.004) operates in the same way as *Zero Frequency* (10.003). If *Bipolar Reference Enable* (01.010) = 0 then *Running At Or Below Minimum Frequency* (10.004) is set if *Post Ramp Reference* (02.001)  $\leq$  *Minimum Reference Clamp* (01.007) + 0.5Hz.

If motor map 2 is active then *M2 Minimum Reference Clamp* (21.002) is used instead of *Minimum Reference Clamp* (01.007).

| Parameter         | 10.005 Below Set Frequency                                  |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that the drive is running below the set frequency |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

See *At Frequency Lower Limit* (03.006).

| Parameter         | 10.006 At Frequency                                      |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates that the drive is running at the set frequency |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT   |                |                  |

See *At Frequency Lower Limit* (03.006).

| Parameter         | 10.007 <i>Above Set Frequency</i>                           |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that the drive is running above the set frequency |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

See *At Frequency Lower Limit* (03.006).

| Parameter         | 10.008 <i>Rated Load Reached</i>           |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates that rated load has been reached |                |                  |
| Mode              | Open-Loop                                  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile                             | Update Rate    | Background write |
| Display Format    | Standard                                   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                             |                |                  |

*Rated Load Reached* (10.008) is set to one when the torque producing current is at or above its rated level. This condition is detected when the modulus of *Percentage Load* (04.020) is greater or equal to 100.0%. It should be noted that this is an indication based on the level of current and not torque, which means that if field weakening is active a value of one in *Rated Load Reached* (10.008) does not necessarily mean that the motor is producing rated torque.

| Parameter         | 10.009 <i>Current Limit Active</i>         |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates that the current limit is active |                |                  |
| Mode              | Open-Loop                                  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile                             | Update Rate    | Background write |
| Display Format    | Standard                                   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                             |                |                  |

*Current Limit Active* (10.009) is set to one if the current limit is active.

| Parameter         | 10.010 <i>Regenerating</i>  |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that power is being transferred from the motor to the drive |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

*Regenerating* (10.010) is set to one if power is being transferred from the motor to the drive

| Parameter         | 10.011 <i>Braking IGBT Active</i>         |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that the braking IGBT is active |                |                  |
| Mode              | Open-Loop                                 |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile                            | Update Rate    | Background write |
| Display Format    | Standard                                  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                            |                |                  |

*Braking IGBT Active* (10.011) is set to one if the braking IGBT is active. As the braking IGBT active periods may be short, each time the braking IGBT is switched on *Braking IGBT Active* (10.011) is set to one and remains at one for at least 0.5s.

| Parameter         | 10.012 <i>Braking Resistor Alarm</i>   |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates that the braking IGBT is active and the braking resistor thermal accumulator is greater than 75% |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT   |                |                  |

*Braking Resistor Alarm* (10.012) is set when the braking IGBT is active and *Braking Resistor Thermal Accumulator* (10.039) is greater than 75.00%. As the braking IGBT on periods may be short *Braking Resistor Alarm* (10.012) is always held on for at least 0.5s.

| Parameter         | 10.013 Reverse Direction Commanded                      |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that the reverse direction has been commanded |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

*Reverse Direction Commanded* (10.013) indicates the reference direction at the input to the ramp system. If the *Pre-ramp Reference* (01.003) is negative *Reverse Direction Commanded* (10.013) is one otherwise *Reverse Direction Commanded* (10.013) is zero.

| Parameter         | 10.014 Reverse Direction Running                             |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates that the drive is running in the reverse direction |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT   |                |                  |

*Reverse Direction Running* (10.014) is set to one if the *Post Ramp Reference* (02.001) is negative otherwise it is set to zero.

| Parameter         | 10.015 Supply Loss                                   |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates that the drive is in the supply loss state |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile                                       | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                                       |                |                  |

*Supply Loss* (10.015) indicates that the drive is in the supply loss state. This condition can only occur if supply loss detection is enabled, i.e. *Supply Loss Mode* (06.003) is set to a non-zero value. In the supply loss state the drive will attempt to stop the motor.

| Parameter         | 10.016 Under Voltage Active                            |                |           |
|-------------------|--|----------------|-----------|
| Short description | Indicates that the drive is in the under voltage state |                |           |
| Mode              | Open-Loop  |                |           |
| Minimum           | 0  | Maximum        | 1         |
| Default           |  | Units          |           |
| Type              | 1 Bit Volatile   | Update Rate    | 4ms write |
| Display Format    | Standard   | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT   |                |           |

*Under Voltage Active* (10.016) indicates that the drive is in the under voltage state.

| Parameter         | 10.017 Motor Overload Alarm   |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that the motor overload accumulator is above 75% and the output current is high |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

*Motor Overload Alarm* (10.017) is set if the drive output current is higher than the level that will eventually cause an *It(ac)* trip and the *Motor Protection Accumulator* (04.019) for motor control. See *Motor Thermal Time Constant 1* (04.015) for motor control modes for more details.

| Parameter         | 10.018 Drive Over-temperature Alarm                       |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that the drive over-temperature alarm is active |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

*Drive Over-temperature Alarm* (10.018) is set if *Percentage Of Drive Thermal Trip Level* (07.036) is greater than 90%.

| Parameter         | 10.019 Drive Warning  |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that one or more of the drive warning alarms are active |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

*Drive Warning* (10.019) is set to one if any of the drive warnings is active it is defined as

*Drive Warning* (10.019) = *Braking Resistor Alarm* (10.012) OR *Motor Overload Alarm* (10.017) OR *Drive Over-temperature Alarm* (10.018) OR *Low AC Alarm* (10.107)

| Parameter         | 10.020 Trip 0                                   |                |               |
|-------------------|---|----------------|---------------|
| Short description | Shows the current or last trip to have occurred |                |               |
| Mode              | Open-Loop                                       |                |               |
| Minimum           | 0   | Maximum        | 255           |
| Default           |   | Units          |               |
| Type              | 8 Bit Power Down Save                           | Update Rate    | Write on trip |
| Display Format    | Standard  | Decimal Places | 0             |
| Coding            | RO, TE, ND, NC, PT, BU                          |                |               |

[Click here to view trips in numerical order.](#)

| <b>Value</b> | <b>Text</b> |
|--------------|-------------|
| 185          | C.Acc       |
| 178          | C.by        |
| 188          | C.cPr       |
| 179          | C.d.e       |
| 183          | C.dAt       |
| 182          | C.Err       |
| 184          | C.Ful       |
| 180          | C.OPt       |
| 175          | C.Pr        |
| 181          | C.rdo       |
| 186          | C.rtg       |
| 174          | C.SI        |
| 187          | C.Typ       |
| 28           | cL.A1       |
| 29           | cL.A2       |
| 35           | CL.bt       |
| 231          | Cur.c       |
| 225          | Cur.O       |
| 97           | D.Ch        |
| 110          | dcct        |
| 246          | Der.E       |
| 248          | Der.I       |
| 199          | dEst        |
| 232          | Dr.Cf       |
| 31           | EEF         |
| 6            | Et          |
| 173          | FaN.f       |
| 247          | Fi.Ch       |
| 237          | FI.In       |
| 20           | It.ac       |
| 19           | It.br       |
| 90           | LF.Er       |
| 236          | no.PS       |
| 0            | None        |
| 26           | O.Ld1       |
| 7            | O.Spd       |
| 27           | Oh.dc       |
| 219          | Oht.C       |
| 21           | Oht.I       |
| 22           | Oht.P       |
| 189          | OI.A1       |
| 190          | OI.A2       |
| 3            | OI.aC       |
| 4            | OI.br       |
| 228          | OI.SC       |
| 92           | OI.Sn       |
| 98           | Out.P       |
| 2            | OV          |
| 220          | P.Dat       |
| 34           | Pad         |
| 245          | Pb.bt       |
| 93           | Pb.Er       |
| 235          | Pb.HF       |
| 37           | Pd.S        |
| 32           | PH.Lo       |
| 5            | PSU         |
| 227          | r.All       |
| 250          | R.b.ht      |
| 1            | Res         |
| 9            | Res         |
| 12           | Res         |
| 14           | Res         |
| 15           | Res         |



|     |       |
|-----|-------|
| 16  | Res   |
| 17  | Res   |
| 23  | Res   |
| 38  | Res   |
| 39  | Res   |
| 91  | Res   |
| 94  | Res   |
| 95  | Res   |
| 99  | Res   |
| 101 | Res   |
| 102 | Res   |
| 103 | Res   |
| 104 | Res   |
| 105 | Res   |
| 106 | Res   |
| 107 | Res   |
| 108 | Res   |
| 109 | Res   |
| 111 | Res   |
| 168 | Res   |
| 169 | Res   |
| 170 | Res   |
| 171 | Res   |
| 172 | Res   |
| 176 | Res   |
| 177 | Res   |
| 191 | Res   |
| 192 | Res   |
| 193 | Res   |
| 194 | Res   |
| 195 | Res   |
| 196 | Res   |
| 197 | Res   |
| 198 | Res   |
| 205 | Res   |
| 206 | Res   |
| 207 | Res   |
| 208 | Res   |
| 209 | Res   |
| 210 | Res   |
| 211 | Res   |
| 212 | Res   |
| 213 | Res   |
| 214 | Res   |
| 215 | Res   |
| 216 | Res   |
| 217 | Res   |
| 222 | Res   |
| 223 | Res   |
| 224 | Res   |
| 229 | Res   |
| 230 | Res   |
| 233 | Res   |
| 238 | Res   |
| 239 | Res   |
| 240 | Res   |
| 241 | Res   |
| 242 | Res   |
| 243 | Res   |
| 244 | Res   |
| 251 | Res   |
| 252 | Res   |
| 253 | Res   |
| 254 | Res   |
| 100 | Reset |

|     |       |
|-----|-------|
| 33  | rS    |
| 255 | Rst.L |
| 30  | SCL   |
| 204 | SL.dF |
| 202 | SL.Er |
| 200 | SL.HF |
| 203 | SL.nF |
| 201 | SL.tO |
| 226 | So.St |
| 221 | St.HF |
| 234 | STO   |
| 40  | t040  |
| 41  | t041  |
| 42  | t042  |
| 43  | t043  |
| 44  | t044  |
| 45  | t045  |
| 46  | t046  |
| 47  | t047  |
| 48  | t048  |
| 49  | t049  |
| 50  | t050  |
| 51  | t051  |
| 52  | t052  |
| 53  | t053  |
| 54  | t054  |
| 55  | t055  |
| 56  | t056  |
| 57  | t057  |
| 58  | t058  |
| 59  | t059  |
| 60  | t060  |
| 61  | t061  |
| 62  | t062  |
| 63  | t063  |
| 64  | t064  |
| 65  | t065  |
| 66  | t066  |
| 67  | t067  |
| 68  | t068  |
| 69  | t069  |
| 70  | t070  |
| 71  | t071  |
| 72  | t072  |
| 73  | t073  |
| 74  | t074  |
| 75  | t075  |
| 76  | t076  |
| 77  | t077  |
| 78  | t078  |
| 79  | t079  |
| 80  | t080  |
| 81  | t081  |
| 82  | t082  |
| 83  | t083  |
| 84  | t084  |
| 85  | t085  |
| 86  | t086  |
| 87  | t087  |
| 88  | t088  |
| 89  | t089  |
| 112 | t112  |
| 113 | t113  |
| 114 | t114  |
| 115 | t115  |

|     |       |
|-----|-------|
| 116 | t116  |
| 117 | t117  |
| 118 | t118  |
| 119 | t119  |
| 120 | t120  |
| 121 | t121  |
| 122 | t122  |
| 123 | t123  |
| 124 | t124  |
| 125 | t125  |
| 126 | t126  |
| 127 | t127  |
| 128 | t128  |
| 129 | t129  |
| 130 | t130  |
| 131 | t131  |
| 132 | t132  |
| 133 | t133  |
| 134 | t134  |
| 135 | t135  |
| 136 | t136  |
| 137 | t137  |
| 138 | t138  |
| 139 | t139  |
| 140 | t140  |
| 141 | t141  |
| 142 | t142  |
| 143 | t143  |
| 144 | t144  |
| 145 | t145  |
| 146 | t146  |
| 147 | t147  |
| 148 | t148  |
| 149 | t149  |
| 150 | t150  |
| 151 | t151  |
| 152 | t152  |
| 153 | t153  |
| 154 | t154  |
| 155 | t155  |
| 156 | t156  |
| 157 | t157  |
| 158 | t158  |
| 159 | t159  |
| 160 | t160  |
| 161 | t161  |
| 162 | t162  |
| 163 | t163  |
| 164 | t164  |
| 165 | t165  |
| 166 | t166  |
| 167 | t167  |
| 24  | th    |
| 10  | Th.br |
| 218 | TH.fb |
| 25  | thS   |
| 11  | Tun.1 |
| 13  | Tun.3 |
| 18  | Tun.S |
| 8   | U.OI  |
| 36  | U.S   |
| 96  | UP.us |
| 249 | UPrG  |

*Trip 0* (10.020) to *Trip 9* (10.029) store the most recent 10 trips that have occurred where *Trip 0* (10.020) is the most recent and *Trip 9* (10.029) is

the oldest. When a new trip occurs it is written to *Trip 0* (10.020) and all the other trips move down the log, with oldest being lost.

The date and time when each trip occurs are also stored in the date and time log, i.e. *Trip 0 Date* (10.041) to *Trip 9 Time* (10.060). The date and time are taken from *Date* (06.016) and *Time* (06.017) (See *Date/Time Selector* (06.019)). Some trips have sub-trip numbers which give more detail about the reason for the trip. If a trip has a sub-trip number its value is stored in the sub-trip log, i.e. *Trip 0 Sub-trip Number* (10.070) to *Trip 9 Sub-trip Number* (10.079). If the trip does not have a sub-trip number then zero is stored in the sub-trip log.

#### Trip categories and priorities

Trips are grouped into the categories given in the table below. A trip can only occur when the drive is not tripped, or if it is already tripped and the new trip has a higher priority than the active trip (i.e. lower priority number). Unless otherwise stated a trip cannot be reset until 1.0s after it has been initiated.

| Priority | Category  | Trips  | Comments  |
|----------|---|--|---|
| 1        | Internal faults                                   | HF01 - HF19  | These are fatal problems that cannot be reset. All drive features are inactive after any of these trips occur. If a basic keypad is fitted it will show the trip, but the keypad will not function. These trips are not stored in the trip log.                                       |
| 1        | Stored HF trip                                    | <i>Stored HF</i>                                   | This trip cannot be cleared unless 1299 is entered into <i>Parameter mm.000</i> (mm.000) and a reset is initiated.  |
| 2        | Non-resettable trips                              | Trip numbers 218 - 247 and <i>Slot1 HF</i>         | These trips cannot be reset.  |
| 3        | Volatile memory failure                           | <i>EEPROM Fail</i>                                 | This can only be reset if <i>Parameter mm.000</i> (mm.000) is set to 1233 or 1244, or if <i>Load Defaults</i> (11.043) is set to a non-zero value   |
| 4        | Non-volatile media trips                          | Trip numbers 174, 175 and 177 - 188                | These trips are priority 5 during power-up  |
| 5        | Trips with extended reset times                   | <i>Ol ac</i> , <i>Ol Brake</i> and <i>Reserved</i> | These trips cannot be reset until 10s after the trip was initiated.   |
| 5        | Phase loss and d.c. link power circuit protection | <i>Phase Loss</i> and <i>Oht dc bus</i>            | The drive will attempt to stop the motor before tripping if a <i>Phase Loss.000</i> trip occurs unless this feature has been disabled (see <i>Action On Trip Detection</i> (10.037)). The drive will always attempt to stop the motor before tripping if an <i>Oht dc bus</i> occurs. |
| 5        | Standard trips                                    | All other trips                                    |   |

Trips {HF01} to {HF19} are internal faults that do not have trip numbers. If one of these trips occurs, the main drive processor has detected an irrecoverable error. All drive functions are stopped and the trip message will be displayed on the drive keypad. The error can only be reset by powering the drive down and up again. The table below gives the reasons for internal faults and their corresponding trip

| Trip   | Reason   |  |
|--------|--|--|
| {HF01} | CPU hardware fault during exception processing   |  |
| {HF02} | CPU memory management fault is an exception that occurs because of a memory protection related fault   |  |
| {HF03} | CPU has detected a Bus Fault. A Bus Fault is an exception that occurs because of a memory related fault for an instruction or data memory transaction. This might be from an error detected on a bus in the memory system.   |  |
| {HF04} | <p>CPU has detected a usage fault:<br/>A Usage Fault is an exception that occurs because of a fault related to instruction execution. This includes:</p> <ul style="list-style-type: none"> <li>• an undefined instruction</li> <li>• an illegal unaligned access</li> <li>• invalid state on instruction execution</li> <li>• an error on exception return.</li> </ul> <p>The following can cause a Usage Fault when the core is configured to report them:</p> <ul style="list-style-type: none"> <li>• an unaligned address on word and half word memory access</li> <li>• division by zero.</li> </ul> |  |
| {HF05} | Reserved   |  |
| {HF06} | Reserved   |  |
| {HF07} | Watchdog failure   |  |
| {HF08} | CPU Interrupt crash. Interrupt crash level indicated by subtrip number.  |  |
| {HF09} | Free store overflow  |  |
| {HF10} | Reserved   |  |
| {HF11} | The <i>HF11</i> trip indicates that a non-volatile memory comms error has occurred.  |  |
|        | <b>Sub-trip</b>  | <b>Reason</b>  |
|        | <b>Recommended action</b>  |  |
| 1      | Non-volatile memory comms error.   | Hardware fault – contact the supplier of the drive.  |
| 2      | EEPROM size is incompatible with the user firmware.  | After 1min the drive will go to its bootloader. Re-program drive with compatible user firmware using UniMConnect |
| {HF12} | Stack overflow   |  |
|        | <b>Sub-trip</b>  | <b>Reason</b>  |
|        | 1  | User program or derivative background stack overflow   |
|        | 2  | User program or derivative timed stack overflow  |
|        | 3  | Main system interrupt stack overflow   |
|        | 4  | Main system background stack overflow  |
| {HF13} | Reserved   |  |
| {HF14} | Reserved   |  |
| {HF15} | Reserved   |  |
| {HF16} | RTOS error (the background task has returned)  |  |
| {HF17} | Reserved   |  |
|        | The <i>HF18</i> trip indicates that the internal flash memory has failed when writing option module parameter data. The reason for the trip can be identified by the sub-trip number.  |  |

| {HF18} | Sub-trip   | Reason  |
|--------|--|---|
|        | 1  | Option module initialization timed out                |
|        | 2  | Programming error while writing menu in flash         |
|        | 3  | Erase flash block containing setup menus failed       |
|        | 4  | Erase flash block containing application menus failed |
|        | 5  | Incorrect setup menu CRC contained in flash           |
|        | 6  | Incorrect application menu CRC contained in flash     |
| {HF19} | The <i>HF19</i> trip indicates that the drive firmware is partially or completely deleted. The drive is now in its bootloader and is waiting for a new image to be downloaded using UniMConnect. Once a new image is downloaded, the drive can run normally. |   |

When the drive is subsequently powered up a *Stored HF* trip is initiated where the sub-trip number is the number of the HF trip that last occurred. This trip will occur at every power-up until it is reset. The trip can only be reset by first entering 1299 into *Parameter mm.000* (mm.000).

#### Trip descriptions

Trips shown in the table below can be generated either from the drive control system or from the power system. The sub-trip number which is in the form *xyzz* is used to identify the source of the trip. The digits *xx* are 00 for a trip generated by the control system or the number of a power module if generated by the power system. If the drive is not a multi-power module drive then *xx* will always have a value of 1 the trip is related to the power system. The *y* digit is used to identify the location of a trip which is generated by a rectifier module connected to a power module. Where the *y* digit is relevant it will have a value of 1 or more, otherwise it will be 0. The *zz* digits give the reason for the trip and are defined in each trip description.

|                     |                       |
|---------------------|-----------------------|
| Over Volts          | <i>OHt dc bus</i>     |
| <i>OI ac</i>        | <i>Phase Loss</i>     |
| <i>OI Brake</i>     | <i>LF Power Comms</i> |
| <i>PSU</i>          | <i>OI Snubber</i>     |
| <i>OHt Inverter</i> | <i>Reserved</i>       |
| <i>OHt Power</i>    | <i>Temp Feedback</i>  |
|                     | <i>Power Data</i>     |

| Parameter         | 10.021 Trip 1                                 |                |               |
|-------------------|---|----------------|---------------|
| Short description | Shows the 2nd from last trip to have occurred |                |               |
| Mode              | Open-Loop                                     |                |               |
| Minimum           | 0   | Maximum        | 255           |
| Default           |   | Units          |               |
| Type              | 8 Bit Power Down Save                         | Update Rate    | Write on trip |
| Display Format    | Standard                                      | Decimal Places | 0             |
| Coding            | RO, TE, ND, NC, PT, BU                        |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.022 Trip 2                                 |                |               |
|-------------------|---|----------------|---------------|
| Short description | Shows the 3rd from last trip to have occurred |                |               |
| Mode              | Open-Loop                                     |                |               |
| Minimum           | 0   | Maximum        | 255           |
| Default           |   | Units          |               |
| Type              | 8 Bit Power Down Save                         | Update Rate    | Write on trip |
| Display Format    | Standard                                      | Decimal Places | 0             |
| Coding            | RO, TE, ND, NC, PT, BU                        |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.023 Trip 3                                 |                |               |
|-------------------|---|----------------|---------------|
| Short description | Shows the 4th from last trip to have occurred |                |               |
| Mode              | Open-Loop                                     |                |               |
| Minimum           | 0   | Maximum        | 255           |
| Default           |   | Units          |               |
| Type              | 8 Bit Power Down Save                         | Update Rate    | Write on trip |
| Display Format    | Standard                                      | Decimal Places | 0             |
| Coding            | RO, TE, ND, NC, PT, BU                        |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.024 <i>Trip 4</i>                          |                |               |
|-------------------|---|----------------|---------------|
| Short description | Shows the 5th from last trip to have occurred |                |               |
| Mode              | Open-Loop                                     |                |               |
| Minimum           | 0   | Maximum        | 255           |
| Default           |   | Units          |               |
| Type              | 8 Bit Power Down Save                         | Update Rate    | Write on trip |
| Display Format    | Standard                                      | Decimal Places | 0             |
| Coding            | RO, TE, ND, NC, PT, BU                        |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.025 <i>Trip 5</i>                          |                |               |
|-------------------|---|----------------|---------------|
| Short description | Shows the 6th from last trip to have occurred |                |               |
| Mode              | Open-Loop                                     |                |               |
| Minimum           | 0   | Maximum        | 255           |
| Default           |   | Units          |               |
| Type              | 8 Bit Power Down Save                         | Update Rate    | Write on trip |
| Display Format    | Standard                                      | Decimal Places | 0             |
| Coding            | RO, TE, ND, NC, PT, BU                        |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.026 <i>Trip 6</i>                          |                |               |
|-------------------|---|----------------|---------------|
| Short description | Shows the 7th from last trip to have occurred |                |               |
| Mode              | Open-Loop                                     |                |               |
| Minimum           | 0   | Maximum        | 255           |
| Default           |   | Units          |               |
| Type              | 8 Bit Power Down Save                         | Update Rate    | Write on trip |
| Display Format    | Standard                                      | Decimal Places | 0             |
| Coding            | RO, TE, ND, NC, PT, BU                        |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.027 <i>Trip 7</i>                          |                |               |
|-------------------|---|----------------|---------------|
| Short description | Shows the 8th from last trip to have occurred |                |               |
| Mode              | Open-Loop                                     |                |               |
| Minimum           | 0   | Maximum        | 255           |
| Default           |   | Units          |               |
| Type              | 8 Bit Power Down Save                         | Update Rate    | Write on trip |
| Display Format    | Standard                                      | Decimal Places | 0             |
| Coding            | RO, TE, ND, NC, PT, BU                        |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.028 <i>Trip 8</i>                          |                |               |
|-------------------|---|----------------|---------------|
| Short description | Shows the 9th from last trip to have occurred |                |               |
| Mode              | Open-Loop                                     |                |               |
| Minimum           | 0   | Maximum        | 255           |
| Default           |   | Units          |               |
| Type              | 8 Bit Power Down Save                         | Update Rate    | Write on trip |
| Display Format    | Standard                                      | Decimal Places | 0             |
| Coding            | RO, TE, ND, NC, PT, BU                        |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.029 <i>Trip 9</i>                           |                |               |
|-------------------|--|----------------|---------------|
| Short description | Shows the 10th from last trip to have occurred |                |               |
| Mode              | Open-Loop                                      |                |               |
| Minimum           | 0  | Maximum        | 255           |
| Default           |  | Units          |               |
| Type              | 8 Bit Power Down Save                          | Update Rate    | Write on trip |
| Display Format    | Standard                                       | Decimal Places | 0             |
| Coding            | RO, TE, ND, NC, PT, BU                         |                |               |

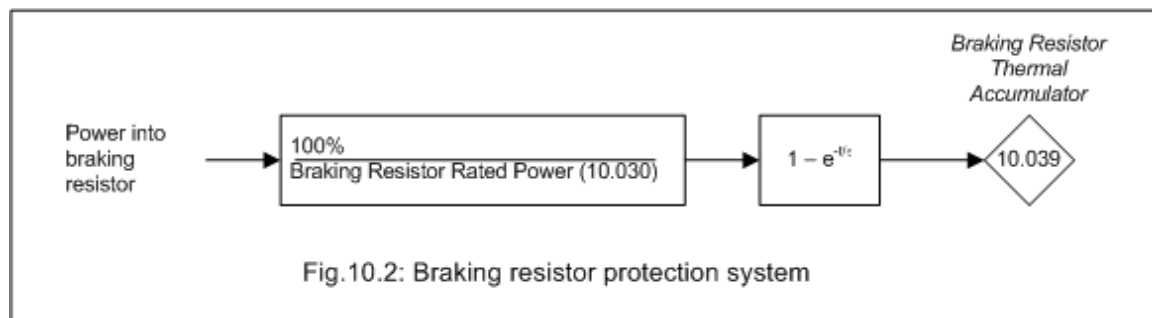
See *Trip 0* (10.020).

| Parameter         | 10.030 Braking Resistor Rated Power            |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to the rated power of the braking resistor |                |                 |
| Mode              | Open-Loop                                      |                |                 |
| Minimum           | 0.0  | Maximum        | 99999.9         |
| Default           | 0.0  | Units          | kW              |
| Type              | 32 Bit User Save                               | Update Rate    | Background read |
| Display Format    | Standard                                       | Decimal Places | 1               |
| Coding            | RW   |                |                 |

A thermal protection system is provided for the braking resistor. If *Braking Resistor Rated Power* (10.030) is set to zero this protection system is disabled and the *Braking Resistor Thermal Accumulator* (10.039) is held at zero. If braking resistor thermal protection is required the *Braking Resistor Rated Power* (10.030), *Braking Resistor Thermal Time Constant* (10.031) and *Braking Resistor Resistance* (10.061) should be set up with the braking resistor parameters. The thermal time constant of the resistor can be calculated from the single pulse energy rating (E) and continuous power rating (P) of the resistor.

$$\text{Braking Resistor Thermal Time Constant (10.031)} = \tau = E / P$$

The braking resistor is protected with a single time constant model as shown below.



The drive monitors the power flowing into the braking resistor and updates the *Braking Resistor Thermal Accumulator* (10.039). If bit 1 of *Action On Trip Detection* (10.037) = 0 and the accumulator reaches 100% an *Brake R Too Hot* trip is initiated. If bit 1 of *Action On Trip Detection* (10.037) = 1 and the accumulator reaches 100% the braking IGBT is disabled until the accumulator falls below 95.0%.

| Parameter         | 10.031 Braking Resistor Thermal Time Constant            |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to the thermal time constant of the braking resistor |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0.00   | Maximum        | 1500.00         |
| Default           | 0.00   | Units          | s               |
| Type              | 32 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 2               |
| Coding            | RW   |                |                 |

See *Braking Resistor Rated Power* (10.030) .

| Parameter         | 10.032 External Trip             |                |                 |
|-------------------|----------------------------------|----------------|-----------------|
| Short description | Set to initiate an external trip |                |                 |
| Mode              | Open-Loop                        |                |                 |
| Minimum           | 0                                | Maximum        | 1               |
| Default           | 0                                | Units          |                 |
| Type              | 1 Bit Volatile                   | Update Rate    | Background read |
| Display Format    | Standard                         | Decimal Places | 0               |
| Coding            | RW, NC                           |                |                 |

If *External Trip* (10.032) is set to one an *External Trip.003* is initiated. A digital input can be routed to *External Trip* (10.032) to provide an external trip input function.

| Parameter         | 10.033 Drive Reset            |                |                 |
|-------------------|-------------------------------|----------------|-----------------|
| Short description | Set to initiate a drive reset |                |                 |
| Mode              | Open-Loop                     |                |                 |
| Minimum           | 0                             | Maximum        | 1               |
| Default           | 0                             | Units          |                 |
| Type              | 1 Bit Volatile                | Update Rate    | Background read |
| Display Format    | Standard                      | Decimal Places | 0               |
| Coding            | RW, NC                        |                |                 |

A 0 to 1 transition in *Drive Reset* (10.033) causes a drive reset. If a drive reset terminal is required a digital input should be routed to *Drive Reset* (10.033).



| Parameter         | 10.034 Number Of Auto-reset Attempts              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to the number of required auto-reset attempts |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0   | Maximum        | 6               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save                                   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text |
|-------|------|
| 0     | None |
| 1     | 1    |
| 2     | 2    |
| 3     | 3    |
| 4     | 4    |
| 5     | 5    |
| 6     | inF  |

If *Number Of Auto-reset Attempts* (10.034) = 0 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 after a delay defined by *Auto-reset Delay* (10.035) subject to the minimum reset time allowed for the type of trip. Note that for some trips the minimum is 10s. The auto-reset count is only incremented when the trip is the same as the previous trip otherwise it is reset to 0. When the auto-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 auto-reset count is cleared. Auto reset will not occur after any trips with priority levels 1, 2 or 3 as defined in Section 4. When a manual reset occurs the auto-reset counter is reset to zero.

If *Number Of Auto-reset Attempts* (10.034) = 6 the auto-reset counter is held at zero, and so there is no limit on the number of auto-reset attempts.

| Parameter         | 10.035 Auto-reset Delay              |                |                 |
|-------------------|--------------------------------------|----------------|-----------------|
| Short description | Set to the required auto-reset delay |                |                 |
| Mode              | Open-Loop                            |                |                 |
| Minimum           | 1.0                                  | Maximum        | 600.0           |
| Default           | 1.0                                  | Units          | s               |
| Type              | 16 Bit User Save                     | Update Rate    | Background read |
| Display Format    | Standard                             | Decimal Places | 1               |
| Coding            | RW, BU                               |                |                 |

See *Number Of Auto-reset Attempts* (10.034).

| Parameter         | 10.036 Auto-reset Hold Drive Healthy                                  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to hold drive healthy if further auto-reset attempts are possible |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

If *Auto-reset Hold Drive Healthy* (10.036) = 0 then *Drive Healthy* (10.001) is cleared every time the drive trips regardless of any auto-reset that may occur. If *Auto-reset Hold Drive Healthy* (10.036) = 1 then *Drive Healthy* (10.001) is not cleared on a trip if any further auto-reset attempts are possible. Note that if the under voltage state becomes active *Drive Healthy* (10.001) is always set to zero.

| Parameter         | 10.037 Action On Trip Detection                        |                |                        |
|-------------------|--|----------------|------------------------|
| Short description | Defines the action of the drive on detection of a trip |                |                        |
| Mode              | Open-Loop  |                |                        |
| Minimum           | 0<br>(Display: 00000)                                  | Maximum        | 31<br>(Display: 11111) |
| Default           | 0<br>(Display: 00000)                                  | Units          |                        |
| Type              | 8 Bit User Save  | Update Rate    | Background read        |
| Display Format    | Binary   | Decimal Places | 0                      |
| Coding            | RW   |                |                        |

The bits in *Action On Trip Detection* (10.037) are defined as follows:

#### Bit 0: Stop on defined non-important trips

If bit 0 is set to one the drive will attempt to stop before tripping if any of the following trip conditions are detected: *I/O Overload*, *Keypad Mode*, *Motor Too Hot*, *EEPROM Fail* or user 24V failure.

#### Bit 1: Disable braking resistor overload detection

See *Braking Resistor Rated Power* (10.030).

#### Bit 2: Disable phase loss stop

Normally the drive will stop when the input phase loss condition is detected. If this bit is set to 1 the drive will continue to run and will only trip when the

drive is brought to a stop by the user.

### Bit 3: Disable braking resistor temperature monitoring

If hardware based braking resistor thermal monitoring is provided this can be disabled by setting this bit to one.

### Bit 4: Disable parameter freeze on trip

If this bit is 0 then the parameters listed below are frozen on trip until the trip is cleared. If this bit is 1 then this feature is disabled.

|                                    |
|------------------------------------|
| Reference Selected (01.001)        |
| Pre-skip Filter Reference (01.002) |
| Pre-ramp Reference (01.003)        |
| Frequency Reference (03.045)       |
| Final Demand Reference (03.001)    |
| Current Magnitude (04.001)         |
| Torque Producing Current (04.002)  |
| Magnetising Current (04.017)       |
| Output Frequency (05.001)          |
| Output Voltage (05.002)            |
| Output Power (05.003)              |
| D.c. Link Voltage (05.005)         |
| Analogue Input 1 (07.001)          |
| Analogue Input 2 (07.002)          |

| Parameter         | 10.038 User Trip                    |                |                 |
|-------------------|-------------------------------------|----------------|-----------------|
| Short description | Defines which user trip is to occur |                |                 |
| Mode              | Open-Loop                           |                |                 |
| Minimum           | 0                                   | Maximum        | 255             |
| Default           |                                     | Units          |                 |
| Type              | 8 Bit Volatile                      | Update Rate    | Background read |
| Display Format    | Standard                            | Decimal Places | 0               |
| Coding            | RW, ND, NC, BU                      |                |                 |

When a value other than zero is written to the *User Trip* (10.038) the actions described in the following table are performed. The drive immediately writes the value back to zero. If the value is not included in the table, then the action is the same as if the trip with the same number (with sub-trip zero) occurred provided the drive is not already tripped.

Because the drive clears immediately this parameter to 0, the value must be written via serial communication or user program if supported.

| Action   | User Trip (10.038)                                |
|--|---|
| No action  | Numbers corresponding to priority 1, 2 or 3 trips |
| Drive reset  | 100   |
| Clear trip logs ( <i>Trip 0</i> (10.020) to <i>Trip 9</i> (10.029), <i>Trip 0 Date</i> (10.041) to <i>Trip 9 Time</i> (10.060) and <i>Trip 0 Sub-trip Number</i> (10.070) to <i>Trip 9 Sub-trip Number</i> (10.079)) | 255   |

| Parameter         | 10.039 Braking Resistor Thermal Accumulator                 |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Shows the level of the braking resistor thermal accumulator |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0.0   | Maximum        | 100.0            |
| Default           |   | Units          | %                |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 1                |
| Coding            | RO, ND, NC, PT  |                |                  |

See *Braking Resistor Rated Power* (10.030).

| Parameter         | 10.040 Status Word                  |                |                                      |
|-------------------|-------------------------------------|----------------|--------------------------------------|
| Short description | Shows the status word for the drive |                |                                      |
| Mode              | Open-Loop                           |                |                                      |
| Minimum           | 0<br>(Display: 0000000000000000)    | Maximum        | 32767<br>(Display: 1111111111111111) |
| Default           |                                     | Units          |                                      |
| Type              | 16 Bit Volatile                     | Update Rate    | Background write                     |
| Display Format    | Binary                              | Decimal Places | 0                                    |
| Coding            | RO, ND, NC, PT                      |                |                                      |

The bits in *Status Word* (10.040) mirror the status bit parameters as shown below. Where the parameters do not exist in any mode the bit remains at zero.

| Bit | Status parameter                                      |
|-----|---|
| 0   | <i>Drive Healthy</i> (10.001)                         |
| 1   | <i>Drive Active</i> (10.002)                          |
| 2   | <i>Zero Frequency</i> (10.003)                        |
| 3   | <i>Running At Or Below Minimum Frequency</i> (10.004) |
| 4   | <i>Below Set Frequency</i> (10.005)                   |
| 5   | <i>At Frequency</i> (10.006)                          |
| 6   | <i>Above Set Frequency</i> (10.007)                   |
| 7   | <i>Rated Load Reached</i> (10.008)                    |
| 8   | <i>Current Limit Active</i> (10.009)                  |
| 9   | <i>Regenerating</i> (10.010)                          |
| 10  | <i>Braking IGBT Active</i> (10.011)                   |
| 11  | <i>Braking Resistor Alarm</i> (10.012)                |
| 12  | <i>Reverse Direction Commanded</i> (10.013)           |
| 13  | <i>Reverse Direction Running</i> (10.014)             |
| 14  | <i>Supply Loss</i> (10.015)                           |

| Parameter         | 10.041 Trip 0 Date                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the date at which trip 0 occurred |                |                               |
| Mode              | Open-Loop                               |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)                | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Date                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.042 Trip 0 Time                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the time at which trip 0 occurred |                |                               |
| Mode              | Open-Loop                               |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)                | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Time                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.043 Trip 1 Date                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the date at which trip 1 occurred |                |                               |
| Mode              | Open-Loop                               |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)                | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Date                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.044 Trip 1 Time                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the time at which trip 1 occurred |                |                               |
| Mode              | Open-Loop                               |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)                | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Time                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.045 Trip 2 Date                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the date at which trip 2 occurred |                |                               |
| Mode              | Open-Loop                               |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)                | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Date                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.046 Trip 2 Time                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the time at which trip 2 occurred |                |                               |
| Mode              | Open-Loop                               |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)                | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Time                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.047 Trip 3 Date                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the date at which trip 3 occurred |                |                               |
| Mode              | Open-Loop                               |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)                | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Date                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.048 Trip 3 Time                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the time at which trip 3 occurred |                |                               |
| Mode              | Open-Loop                               |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)                | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Time                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.049 Trip 4 Date                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the date at which trip 4 occurred |                |                               |
| Mode              | Open-Loop                               |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)                | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Date                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.050 Trip 4 Time                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the time at which trip 4 occurred |                |                               |
| Mode              | Open-Loop                               |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)                | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Time                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.051 Trip 5 Date                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the date at which trip 5 occurred |                |                               |
| Mode              | Open-Loop                               |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)                | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Date                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.052 Trip 5 Time                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the time at which trip 5 occurred |                |                               |
| Mode              | Open-Loop                               |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)                | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Time                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.053 Trip 6 Date                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the date at which trip 6 occurred |                |                               |
| Mode              | Open-Loop                               |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)                | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Date                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.054 Trip 6 Time                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the time at which trip 6 occurred |                |                               |
| Mode              | Open-Loop                               |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)                | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Time                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.055 Trip 7 Date                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the date at which trip 7 occurred |                |                               |
| Mode              | Open-Loop                               |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)                | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Date                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.056 Trip 7 Time                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the time at which trip 7 occurred |                |                               |
| Mode              | Open-Loop                               |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)                | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Time                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.057 Trip 8 Date                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the date at which trip 8 occurred |                |                               |
| Mode              | Open-Loop                               |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)                | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Date                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.058 Trip 8 Time                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the time at which trip 8 occurred |                |                               |
| Mode              | Open-Loop                               |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)                | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Time                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.059 Trip 9 Date                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the date at which trip 9 occurred |                |                               |
| Mode              | Open-Loop                               |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)                | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Date                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.060 Trip 9 Time                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the time at which trip 9 occurred |                |                               |
| Mode              | Open-Loop                               |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)                | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Time                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.061 Braking Resistor Resistance                  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to the resistance value of the braking resistor |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0.00  | Maximum        | 10000.00        |
| Default           | 0.00  | Units          | Ω               |
| Type              | 32 Bit User Save                                    | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 2               |
| Coding            | RW  |                |                 |

See *Braking Resistor Rated Power* (10.030).

| Parameter         | 10.064 Remote Keypad Battery Low                                       |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates that the real time clock battery in the remote keypad is low |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT   |                |                  |

*Remote Keypad Battery Low* (10.064) is set to one when a keypad is connected to the drive user comms port with an internal real-time clock and the battery is not fitted or the voltage is below the minimum threshold.

| Parameter         | 10.065 Auto-tune Active                        |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates that an auto-tune sequence is active |                |                  |
| Mode              | Open-Loop                                      |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile                                 | Update Rate    | Background write |
| Display Format    | Standard                                       | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                                 |                |                  |

*Auto-tune Active* (10.065) is set to one while an auto-tune sequence is active.

| Parameter         | 10.066 Limit Switch Active                          |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that a limit switch is enabled and active |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile                                      | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                                      |                |                  |

*Limit Switch Active* (10.066) is set to one when a limit switch is enabled and active.

| Parameter         | 10.068 Hold Drive Healthy on Under Voltage                           |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to hold drive healthy if the drive is in the under voltage state |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

*Hold Drive Healthy on Under Voltage* (10.068) can be used to hold the drive healthy active (*Drive Healthy* (10.001) = 1 and not flash the status LED on the front of the drive) when the drive is in the under voltage state (*Under Voltage Active* (10.016) = 1).

If *Hold Drive Healthy on Under Voltage* (10.068) = 0 and *Under Voltage Active* (10.016) = 1, then *Drive Healthy* (10.001) will be set to 0 and the status LED on the front of the drive will flash.

If *Hold Drive Healthy on Under Voltage* (10.068) = 1, *Under Voltage Active* (10.016) = 1 and the drive is not tripped (i.e. *Drive Status* (10.101) does not equal 9), then *Drive Healthy* (10.001) will be set to 1 and the status LED on the front of the drive will not flash.

If the drive is tripped then *Drive Healthy* (10.001) will be set to 0 and the status LED will flash independent of what *Hold Drive Healthy on Under Voltage* (10.068) is set to.

| Parameter         | 10.069 Additional Status Bits                  |                |                                 |
|-------------------|--|----------------|---------------------------------|
| Short description | Shows the additional status bits for the drive |                |                                 |
| Mode              | Open-Loop                                      |                |                                 |
| Minimum           | 0<br>(Display: 000000000000)                   | Maximum        | 2047<br>(Display: 111111111111) |
| Default           |  | Units          |                                 |
| Type              | 16 Bit Volatile                                | Update Rate    | Background write                |
| Display Format    | Binary   | Decimal Places | 0                               |
| Coding            | RO, ND, NC, PT                                 |                |                                 |

The bits in *Additional Status Bits* (10.069) mirror the status bits parameters as shown below. Where the parameters do not exist in any mode the bit remains at zero.

| Bit | Status parameter                             |
|-----|--|
| 0   | Reserved                                     |
| 1   | <i>Motor Overload Alarm</i> (10.017)         |
| 2   | <i>Drive Over-temperature Alarm</i> (10.018) |
| 3   | <i>Drive Warning</i> (10.019)                |
| 4   | Reserved                                     |
| 5   | Reserved                                     |
| 6   | <i>Remote Keypad Battery Low</i> (10.064)    |
| 7   | <i>Auto-tune Active</i> (10.065)             |
| 8   | <i>Limit Switch Active</i> (10.066)          |
| 9   | Reserved                                     |
| 10  | <i>Low AC Alarm</i> (10.107)                 |
| 11  | <i>Current Limit Active</i> (10.009)         |

| Parameter         | 10.070 Trip 0 Sub-trip Number        |                |               |
|-------------------|--------------------------------------|----------------|---------------|
| Short description | Shows the sub-trip number for trip 0 |                |               |
| Mode              | Open-Loop                            |                |               |
| Minimum           | 0                                    | Maximum        | 65535         |
| Default           |                                      | Units          |               |
| Type              | 16 Bit Power Down Save               | Update Rate    | Write on trip |
| Display Format    | Standard                             | Decimal Places | 0             |
| Coding            | RO, ND, NC, PT, BU                   |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.071 Trip 1 Sub-trip Number        |                |               |
|-------------------|--------------------------------------|----------------|---------------|
| Short description | Shows the sub-trip number for trip 1 |                |               |
| Mode              | Open-Loop                            |                |               |
| Minimum           | 0                                    | Maximum        | 65535         |
| Default           |                                      | Units          |               |
| Type              | 16 Bit Power Down Save               | Update Rate    | Write on trip |
| Display Format    | Standard                             | Decimal Places | 0             |
| Coding            | RO, ND, NC, PT, BU                   |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.072 Trip 2 Sub-trip Number        |                |               |
|-------------------|--------------------------------------|----------------|---------------|
| Short description | Shows the sub-trip number for trip 2 |                |               |
| Mode              | Open-Loop                            |                |               |
| Minimum           | 0                                    | Maximum        | 65535         |
| Default           |                                      | Units          |               |
| Type              | 16 Bit Power Down Save               | Update Rate    | Write on trip |
| Display Format    | Standard                             | Decimal Places | 0             |
| Coding            | RO, ND, NC, PT, BU                   |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.073 Trip 3 Sub-trip Number        |                |               |
|-------------------|--------------------------------------|----------------|---------------|
| Short description | Shows the sub-trip number for trip 3 |                |               |
| Mode              | Open-Loop                            |                |               |
| Minimum           | 0                                    | Maximum        | 65535         |
| Default           |                                      | Units          |               |
| Type              | 16 Bit Power Down Save               | Update Rate    | Write on trip |
| Display Format    | Standard                             | Decimal Places | 0             |
| Coding            | RO, ND, NC, PT, BU                   |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.074 Trip 4 Sub-trip Number        |                |               |
|-------------------|--------------------------------------|----------------|---------------|
| Short description | Shows the sub-trip number for trip 4 |                |               |
| Mode              | Open-Loop                            |                |               |
| Minimum           | 0                                    | Maximum        | 65535         |
| Default           |                                      | Units          |               |
| Type              | 16 Bit Power Down Save               | Update Rate    | Write on trip |
| Display Format    | Standard                             | Decimal Places | 0             |
| Coding            | RO, ND, NC, PT, BU                   |                |               |

See *Trip 0* (10.020).



| Parameter         | 10.075 Trip 5 Sub-trip Number        |                |               |
|-------------------|--------------------------------------|----------------|---------------|
| Short description | Shows the sub-trip number for trip 5 |                |               |
| Mode              | Open-Loop                            |                |               |
| Minimum           | 0                                    | Maximum        | 65535         |
| Default           |                                      | Units          |               |
| Type              | 16 Bit Power Down Save               | Update Rate    | Write on trip |
| Display Format    | Standard                             | Decimal Places | 0             |
| Coding            | RO, ND, NC, PT, BU                   |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.076 Trip 6 Sub-trip Number        |                |               |
|-------------------|--------------------------------------|----------------|---------------|
| Short description | Shows the sub-trip number for trip 6 |                |               |
| Mode              | Open-Loop                            |                |               |
| Minimum           | 0                                    | Maximum        | 65535         |
| Default           |                                      | Units          |               |
| Type              | 16 Bit Power Down Save               | Update Rate    | Write on trip |
| Display Format    | Standard                             | Decimal Places | 0             |
| Coding            | RO, ND, NC, PT, BU                   |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.077 Trip 7 Sub-trip Number        |                |               |
|-------------------|--------------------------------------|----------------|---------------|
| Short description | Shows the sub-trip number for trip 7 |                |               |
| Mode              | Open-Loop                            |                |               |
| Minimum           | 0                                    | Maximum        | 65535         |
| Default           |                                      | Units          |               |
| Type              | 16 Bit Power Down Save               | Update Rate    | Write on trip |
| Display Format    | Standard                             | Decimal Places | 0             |
| Coding            | RO, ND, NC, PT, BU                   |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.078 Trip 8 Sub-trip Number        |                |               |
|-------------------|--------------------------------------|----------------|---------------|
| Short description | Shows the sub-trip number for trip 8 |                |               |
| Mode              | Open-Loop                            |                |               |
| Minimum           | 0                                    | Maximum        | 65535         |
| Default           |                                      | Units          |               |
| Type              | 16 Bit Power Down Save               | Update Rate    | Write on trip |
| Display Format    | Standard                             | Decimal Places | 0             |
| Coding            | RO, ND, NC, PT, BU                   |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.079 Trip 9 Sub-trip Number        |                |               |
|-------------------|--------------------------------------|----------------|---------------|
| Short description | Shows the sub-trip number for trip 9 |                |               |
| Mode              | Open-Loop                            |                |               |
| Minimum           | 0                                    | Maximum        | 65535         |
| Default           |                                      | Units          |               |
| Type              | 16 Bit Power Down Save               | Update Rate    | Write on trip |
| Display Format    | Standard                             | Decimal Places | 0             |
| Coding            | RO, ND, NC, PT, BU                   |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.080 Stop Motor  |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates that the motor is being stopped before the drive trips |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT   |                |                  |

It is possible for some trips to cause the motor to stop before the trip is initiated (see *Action On Trip Detection* (10.037)). During the period while the motor is being stopped before the trip is initiated *Stop Motor* (10.080) is set to one. Once the motor stops *Stop Motor* (10.080) is set back to zero.

| Parameter         | 10.081 Phase Loss   |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that the drive has detected an input phase loss |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

If phase loss or imbalance is detected that would initiate a phase loss trip with sub-trip 0, i.e. *Phase Loss.000*, then *Phase Loss* (10.081) is set to one. Either the motor will be stopped and the drive tripped or the drive will continue to operate normally until the user stops the motor and the drive trips (see *Action On Trip Detection* (10.037)). In either case *Phase Loss* (10.081) is set to one when the phase loss condition is detected and remains set until the drive trips.

| Parameter         | 10.090 Drive Ready  |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that the drive is ready and a run command is not active |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

*Drive Ready* (10.090) indicates that the drive is ready and a run command is not active.

| Parameter         | 10.101 Drive Status                   |                |                  |
|-------------------|---------------------------------------|----------------|------------------|
| Short description | Shows the present status of the drive |                |                  |
| Mode              | Open-Loop                             |                |                  |
| Minimum           | 0                                     | Maximum        | 15               |
| Default           |                                       | Units          |                  |
| Type              | 8 Bit Volatile                        | Update Rate    | Background write |
| Display Format    | Standard                              | Decimal Places | 0                |
| Coding            | RO, TE, ND, NC, PT, BU                |                |                  |

| Value | Text   |
|-------|--------|
| 0     | inh    |
| 1     | rdy    |
| 2     | Stop   |
| 3     | ScAn   |
| 4     | run    |
| 5     | S.Loss |
| 6     | dEcEI  |
| 7     | dc.inj |
| 8     | Res    |
| 9     | Error  |
| 10    | Active |
| 14    | HEAt   |
| 15    | UU     |

*Drive Status* (10.101) shows the present status of the drive. The strings from this parameter are also used by the basic keypad to provide the status display text.

#### Premium only

The LED on the front of the drive gives an indication of the drive state as shown in the table below.

| Drive state | Drive Healthy (10.001) | Drive Active (10.002) | Active Alarm (10.104) | Drive Warning (10.019) | LED                               |
|-------------|------------------------|-----------------------|-----------------------|------------------------|-----------------------------------|
| Healthy     | 1                      | 0                     | 0                     | 0                      | Continuous                        |
| Tripped     | 0                      | X                     | X                     | X                      | Flashing: 0.5s on and 0.5s off    |
| HF trip     | 0                      | X                     | X                     | X                      | Flashing: 0.25s on and 0.25s off  |
| Standby     | 1                      | X                     | 0                     | 0                      | Flasing: 0.125s on and 0.125s off |

X = Don't care

| Parameter         | 10.102 Trip Reset Source                                |                |               |
|-------------------|---|----------------|---------------|
| Short description | Indicates whether a trip in the trip log has been reset |                |               |
| Mode              | Open-Loop   |                |               |
| Minimum           | 0   | Maximum        | 1023          |
| Default           |   | Units          |               |
| Type              | 16 Bit Power Down Save                                  | Update Rate    | Write on trip |
| Display Format    | Standard  | Decimal Places | 0             |
| Coding            | RO, ND, NC, PT, BU                                      |                |               |

The bits in *Trip Reset Source* (10.102) correspond to each of the trips in the trip log (i.e. bit 0 corresponds to trip 0, bit 1 corresponds to trip 1, etc.). When a trip occurs, bit 0 is set to one and the other bits corresponding to the trips already in the trip log are shifted left one bit. If the trip is reset then bit 0 is set back to zero, otherwise if a higher priority trip occurs bit 0 is shifted left by one bit. The result is that each of the bits in *Trip Reset Source* (10.102) show whether trips in the trip log were reset or moved up the trip log by a higher priority trip.

| Parameter         | 10.103 Trip Time Identifier  |                |               |
|-------------------|--|----------------|---------------|
| Short description | Shows time in milliseconds since the drive powered up when a trip occurred |                |               |
| Mode              | Open-Loop  |                |               |
| Minimum           | -2147483648  | Maximum        | 2147483647    |
| Default           |  | Units          | ms            |
| Type              | 32 Bit Volatile  | Update Rate    | Write on trip |
| Display Format    | Standard   | Decimal Places | 0             |
| Coding            | RO, ND, NC, PT   |                |               |

When a trip occurs the time in milliseconds since the drive powered up is stored in *Trip Time Identifier* (10.103). The time rolls-over when it reaches  $2^{32} - 1$ , but if the time is 0 a value of 1 is written. *Trip Time Identifier* (10.103) can be used to determine when a new trip has occurred as the value will change (unless there were exactly  $2^{32}$ ms between trips) and will be non-zero.

| Parameter         | 10.104 Active Alarm                 |                |                  |
|-------------------|-------------------------------------|----------------|------------------|
| Short description | Shows the value of the active alarm |                |                  |
| Mode              | Open-Loop                           |                |                  |
| Minimum           | 0                                   | Maximum        | 15               |
| Default           |                                     | Units          |                  |
| Type              | 8 Bit Volatile                      | Update Rate    | Background write |
| Display Format    | Standard                            | Decimal Places | 0                |
| Coding            | RO, TE, ND, NC, PT, BU              |                |                  |

| Value | Text    | Description               |
|-------|---------|---------------------------|
| 0     | None    | No alarm                  |
| 1     | br.res  | Braking overload          |
| 2     | OV.Ld   | Motor overload            |
| 3     | Res     | Inductor alarm (reserved) |
| 4     | D.OV.Ld | Drive overload            |
| 5     | tuning  | Auto tune in progress     |
| 6     | LS      | Limit switch active       |
| 8     | Res     | Low load active           |
| 9     | OPt.AL  | Slot 1 alarm              |
| 10    | Res     | Slot 2 alarm (Reserved)   |
| 11    | Res     | Slot 3 alarm (Reserved)   |
| 12    | Res     | Slot 4 alarm (Reserved)   |
| 13    | Lo.AC   | Low voltage mode          |
| 14    | I.AC.Lt | Current limit active      |
| 15    | 24.Lost | 24V backup not present    |

If there is no alarm then *Active Alarm* (10.104) = 0. If one alarm is active then *Active Alarm* (10.104) shows the value of the alarm. If more than one alarm is active then *Active Alarm* (10.104) shows the active alarm with the lowest value. The strings from this parameter are also used by the basic keypad to provide the status display text except for option slot warnings where the option module may supply the string.

| Parameter         | 10.106 Potential Drive Damage Conditions   |                |                    |
|-------------------|--|----------------|--------------------|
| Short description | Indicates that the user has put the drive in a condition that could potentially damage the drive |                |                    |
| Mode              | Open-Loop  |                |                    |
| Minimum           | 0<br>(Display: 00)   | Maximum        | 3<br>(Display: 11) |
| Default           |  | Units          |                    |
| Type              | 8 Bit Power Down Save  | Update Rate    | Background write   |
| Display Format    | Binary   | Decimal Places | 0                  |
| Coding            | RO, ND, NC, PT, BU   |                |                    |

The bits in *Potential Drive Damage Conditions* (10.106) are set under the conditions shown in the table below to indicate that the user has put the drive

in a condition that could potentially damage the drive. The bits in this parameter cannot be cleared by users.

| <b>Potential Drive Damage Conditions (10.106)</b> | <b>Condition</b>   |
|---|--|
| 0   | Reserved   |
| 1   | If <i>Cooling Fan control</i> (06.045) = 0 and the control board gets too hot, the drive trips <i>OHt Control</i> and the option module is put in standby. |
| 2   | Reserved   |
| 3   | Reserved   |

| <b>Parameter</b>  | <b>10.107 Low AC Alarm</b>                |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that the low AC alarm is active |                |                  |
| Mode              | Open-Loop                                 |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile                            | Update Rate    | Background write |
| Display Format    | Standard                                  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                            |                |                  |

See *Low DC Link Operation* (06.077).

| <b>Parameter</b>  | <b>10.108 Reversed cooling fan detected</b>  |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates that the drive cooling fan may be fitted with the air being blown in the wrong direction |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, PT   |                |                  |

The *Reversed cooling fan detected* (10.108) detected flag is used to indicate that the pattern of IGBT temperatures shows that the cooling fan could be reversed. The fan is user replaceable so should be checked if this flag is set.

## Menu 11 Single Line Descriptions – *Miscellaneous*

Mode: Open-Loop

| Parameter |  | Range  | Default        | Type |     |    |    |    |    |
|-----------|--|--|----------------|------|-----|----|----|----|----|
| 11.018    | Status Mode Parameter 1                | 0.000 to 30.999  | 2.001          | RW   | Num |    |    | PT | US |
| 11.019    | Status Mode Parameter 2                | 0.000 to 30.999  | 4.020          | RW   | Num |    |    | PT | US |
| 11.020    | Reset Serial Communications            | Off (0) or On (1)  |                | RW   | Bit | ND | NC |    |    |
| 11.021    | Customer defined scaling               | 0.000 to 10.000  | 1.000          | RW   | Num |    |    |    | US |
| 11.022    | Active Parameter At Power-up           | 0.000 to 0.080   | 0.010          | RW   | Num |    |    | PT | US |
| 11.023    | Serial Address                         | 1 to 247   | 1              | RW   | Num |    |    |    | US |
| 11.024    | Serial Mode                            | 8.2NP (0), 8.1NP (1), 8.1EP (2),<br>8.1OP (3), 8.2NP E (4),<br>8.1NP E (5), 8.1EP E (6),<br>8.1OP E (7), 7.1EP (8), 7.1OP (9),<br>7.1EP E (10), 7.1OP E (11) | 8.2NP (0)      | RW   | Txt |    |    |    | US |
| 11.025    | Serial Baud Rate                       | 600 (1), 1200 (2), 2400 (3),<br>4800 (4), 9600 (5), 19200 (6),<br>38400 (7), 57600 (8), 76800 (9),<br>115200 (10) Baud                                       | 19200 (6) Baud | RW   | Txt |    |    |    | US |
| 11.026    | Minimum Comms Transmit Delay           | 0 to 250 ms  | 2 ms           | RW   | Num |    |    |    | US |
| 11.027    | Silent Period                          | 0 to 250 ms  | 0 ms           | RW   | Num |    |    |    | US |
| 11.028    | Drive Derivative                       | 0 to 255   |                | RO   | Num | ND | NC | PT |    |
| 11.029    | Software Version                       | 0 to 99999999  |                | RO   | Num | ND | NC | PT |    |
| 11.030    | User Security Code                     | 0 to 9999  |                | RW   | Num | ND | NC | PT | US |
| 11.031    | User Drive Mode                        | OPEn.LP (1), RFC-A (2)   |                | RW   | Txt | ND | NC | PT |    |
| 11.032    | Maximum Heavy Duty Rating              | 0.00 to 9999.99 A  |                | RO   | Num | ND | NC | PT |    |
| 11.033    | Drive Rated Voltage                    | 110 (0), 200 (1), 400 (2), 575 (3),<br>690 (4)   |                | RO   | Txt | ND | NC | PT |    |
| 11.034    | Drive Configuration                    | AV (0), AI (1), AV.Pr (2), AI.Pr (3),<br>Preset (4), Pad (5), Pad.Ref (6),<br>E.Pot (7), Torque (8), Pid (9)   | AV (0)         | RW   | Txt |    |    | PT | US |
| 11.035    | Power Software Version                 | 0 to 99999999  |                | RO   | Num | ND | NC | PT |    |
| 11.036    | NV Media Card File Previously Loaded   | 0 to 999   | 0              | RO   | Num |    | NC | PT |    |
| 11.037    | NV Media Card File Number              | 0 to 999   | 0              | RW   | Num |    |    |    |    |
| 11.038    | NV Media Card File Type                | None (0), OPEn.LP (1),<br>RFC-A (2)  |                | RO   | Txt | ND | NC | PT |    |
| 11.039    | NV Media Card File Version             | 0 to 9999  |                | RO   | Num | ND | NC | PT |    |
| 11.042    | Parameter Cloning                      | None (0), rEAd (1), Prog (2),<br>Auto (3), boot (4)  | None (0)       | RW   | Txt |    | NC |    | US |
| 11.043    | Load Defaults                          | None (0), Std (1), US (2)  | None (0)       | RW   | Txt |    | NC |    |    |
| 11.044    | User Security Status                   | LEVEL.0 (0), ALL (1), r.only.0 (2),<br>r.only.A (3), StatUs (4), no.acc (5)  |                | RW   | Txt | ND |    | PT |    |
| 11.045    | Select Motor 2 Parameters              | 1 (0), 2 (1)   | 1 (0)          | RW   | Txt |    |    |    | US |
| 11.046    | Defaults Previously Loaded             | 0 to 2000  |                | RO   | Num | ND | NC | PT | US |
| 11.052    | Serial Number LS                       | 000000 to 999999   |                | RO   | Num | ND | NC | PT |    |
| 11.053    | Serial Number MS                       | 0 to 999999  |                | RO   | Num | ND | NC | PT |    |
| 11.054    | Drive Date Code                        | 0000 to 9999   |                | RO   | Num | ND | NC | PT |    |
| 11.060    | Maximum Rated Current                  | 0.000 to 999.999 A   |                | RO   | Num | ND | NC | PT |    |
| 11.061    | Full Scale Current Kc                  | 0.000 to 999.999 A   |                | RO   | Num | ND | NC | PT |    |
| 11.063    | Product Type                           | 0 to 255   |                | RO   | Num | ND | NC | PT |    |
| 11.064    | Product Identifier Characters          | 1295134768 to 2147483647   |                | RO   | Num | ND | NC | PT |    |
| 11.065    | Frame size and voltage code            | 000 to 999   |                | RO   | Num | ND | NC | PT |    |
| 11.066    | Power Stage Identifier                 | 0 to 255   |                | RO   | Num | ND | NC | PT |    |
| 11.067    | Control Board Identifier               | 0 to 255   |                | RO   | Num | ND | NC | PT |    |
| 11.068    | Drive current rating                   | 00000 to 32767   |                | RO   | Num | ND | NC | PT |    |
| 11.070    | Core Parameter Database Version        | 0.00 to 99.99  |                | RO   | Num | ND | NC | PT |    |
| 11.072    | NV Media Card Create Special File      | 0 to 1   | 0              | RW   | Num |    | NC |    |    |
| 11.073    | NV Card Type Fitted                    | None (0), Res (1), Sd.Card (2)   |                | RO   | Txt | ND | NC | PT |    |
| 11.075    | NV Media Card Read-only Flag           | Off (0) or On (1)  |                | RO   | Bit | ND | NC | PT |    |
| 11.076    | NV Media Card Warning Suppression Flag | Off (0) or On (1)  |                | RO   | Bit | ND | NC | PT |    |
| 11.077    | NV Media Card File Required Version    | 0 to 9999  |                | RW   | Num | ND | NC | PT |    |
| 11.079    | Drive Name Characters 1-4              | -2147483648 to 2147483647  | 757935405      | RW   | Num |    |    | PT | US |
| 11.080    | Drive Name Characters 5-8              | -2147483648 to 2147483647  | 757935405      | RW   | Num |    |    | PT | US |
| 11.081    | Drive Name Characters 9-12             | -2147483648 to 2147483647  | 757935405      | RW   | Num |    |    | PT | US |
| 11.082    | Drive Name Characters 13-16            | -2147483648 to 2147483647  | 757935405      | RW   | Num |    |    | PT | US |
| 11.084    | Drive Mode                             | OPEn.LP (1), RFC-A (2)   |                | RO   | Txt | ND | NC | PT | US |
| 11.085    | Security Status                        | None (0), r.only.A (1), StatUs (2),<br>no.acc (3)  |                | RO   | Txt | ND | NC | PT | PS |
| 11.086    | Menu Access Status                     | LEVEL.0 (0), ALL (1)   |                | RO   | Txt | ND | NC | PT | PS |
| 11.091    | Additional Identifier Characters 1     | -2147483648 to 2147483647  |                | RO   | Num | ND | NC | PT |    |
| 11.092    | Additional Identifier Characters 2     | -2147483648 to 2147483647  |                | RO   | Num | ND | NC | PT |    |

|        |                                    |   |         |    |     |    |    |    |    |
|--------|------------------------------------|---|---------|----|-----|----|----|----|----|
| 11.093 | Additional Identifier Characters 3 | -2147483648 to 2147483647                               |         | RO | Num | ND | NC | PT |    |
| 11.094 | Disable String Mode                | Off (0) or On (1)                                       | Off (0) | RW | Bit |    |    | PT | US |
| 11.097 | AI ID Code                         | None (0), Sd.Card (1), RS-485 (2), boot (3), RS-485 (4) |         | RO | Txt | ND | NC | PT |    |
| 11.098 | 24V Alarm Loss Enable              | Off (0) or On (1)                                       | Off (0) | RW | Bit |    |    |    | US |
| 11.099 | Modbus Parameter Conversion        | 0000 to 1111  | 0000    | RW | Bin |    |    |    | US |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

## Menu 11 – Miscellaneous

Mode: Open-Loop

| Parameter         | 11.018 Status Mode Parameter 1   |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the parameter displayed on the upper row of the keypad when in status mode |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0.000  | Maximum        | 30.999          |
| Default           | 2.001  | Units          |                 |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 3               |
| Coding            | RW, PT, BU   |                |                 |

Status Mode Parameter 1 (11.018) and Status Mode Parameter 2 (11.019) defines which parameters are displayed in Status mode.

The values can be alternated by pressing the Escape key if the drive status is RUN.

If one of the two Status parameter does not exist or is 0.000, only one Status parameter is displayed.

If the two Status parameters do not exist or are 0.000, the active parameter is displayed.

| Parameter         | 11.019 Status Mode Parameter 2   |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the parameter displayed on the lower row of the keypad when in status mode |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0.000  | Maximum        | 30.999          |
| Default           | 4.020  | Units          |                 |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 3               |
| Coding            | RW, PT, BU   |                |                 |

See Status Mode Parameter 1 (11.018).

| Parameter         | 11.020 Reset Serial Communications         |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to one to update communications set-up |                |                 |
| Mode              | Open-Loop                                  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           |  | Units          |                 |
| Type              | 1 Bit Volatile                             | Update Rate    | Background read |
| Display Format    | Standard                                   | Decimal Places | 0               |
| Coding            | RW, ND, NC                                 |                |                 |

When Serial Address (11.023), Serial Mode (11.024), Serial Baud Rate (11.025), Minimum Comms Transmit Delay (11.026) or Silent Period (11.027) are modified the changes do not have an immediate effect on the serial communications system. The new values are used after the next power-up or if Reset Serial Communications (11.020) is set to one. Reset Serial Communications (11.020) is automatically cleared to zero after the communications system is updated.

| Parameter         | 11.021 Customer defined scaling              |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the scaling of 11.018 in status view |                |                 |
| Mode              | Open-Loop                                    |                |                 |
| Minimum           | 0.000  | Maximum        | 10.000          |
| Default           | 1.000  | Units          |                 |
| Type              | 16 Bit User Save                             | Update Rate    | Background read |
| Display Format    | Standard                                     | Decimal Places | 3               |
| Coding            | RW   |                |                 |

Customer defined scaling (11.021) defines the scaling applied to Status Mode Parameter 1 (11.018). The scaling is only applied in the Status mode.

| Parameter         | 11.022 Active Parameter At Power-up                           |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines which parameter is displayed at power-up in view mode |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0.000   | Maximum        | 0.080           |
| Default           | 0.010   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 3               |
| Coding            | RW, PT, BU  |                |                 |

Active Parameter At Power-up (11.022) defines which Menu 0 parameter is initially active at power-up in view mode.

See Status Mode Parameter 1 (11.018).



| Parameter         | 11.023 Serial Address                   |                |                                     |
|-------------------|---|----------------|-------------------------------------|
| Short description | Defines the serial address of the drive |                |                                     |
| Mode              | Open-Loop                               |                |                                     |
| Minimum           | 1                                       | Maximum        | 247                                 |
| Default           | 1                                       | Units          |                                     |
| Type              | 8 Bit User Save                         | Update Rate    | Read on serial communications reset |
| Display Format    | Standard                                | Decimal Places | 0                                   |
| Coding            | RW, BU                                  |                |                                     |

*Serial Address* (11.023) defines the node address for the serial comms interface in the range from 1 to 247.

*Serial Address* (11.023) to *Silent Period* (11.027) can be used to change the configuration of the drive 485 serial interface if present on the MFP adapter. The master should wait at least 20ms before sending a new message using the new protocol.

Changing the parameters does not immediately change the serial communications settings. See *Reset Serial Communications* (11.020) for more details.

| Parameter         | 11.024 Serial Mode                   |                |                                     |
|-------------------|--------------------------------------|----------------|-------------------------------------|
| Short description | Defines the serial mode of the drive |                |                                     |
| Mode              | Open-Loop                            |                |                                     |
| Minimum           | 0                                    | Maximum        | 11                                  |
| Default           | 0                                    | Units          |                                     |
| Type              | 8 Bit User Save                      | Update Rate    | Read on serial communications reset |
| Display Format    | Standard                             | Decimal Places | 0                                   |
| Coding            | RW, TE                               |                |                                     |

| Value | Text    |
|-------|---------|
| 0     | 8.2NP   |
| 1     | 8.1NP   |
| 2     | 8.1EP   |
| 3     | 8.1OP   |
| 4     | 8.2NP E |
| 5     | 8.1NP E |
| 6     | 8.1EP E |
| 7     | 8.1OP E |
| 8     | 7.1EP   |
| 9     | 7.1OP   |
| 10    | 7.1EP E |
| 11    | 7.1OP E |

The core drive always uses the Modbus rtu protocol and is always a slave. *Serial Mode* (11.024) defines the data format used by the serial comms interface. The bits in the value of *Serial Mode* (11.024) define the data format as follows. Bit 3 is always 0 in the core product as 8 data bits are required for Modbus rtu. The parameter value can be extended in derivative products which provide alternative communications protocols if required.

| Bits   | 3                                 | 2   | 1 and 0  |
|--------|-----------------------------------|---|--|
| Format | Number of data bits<br>0 = 8 bits | Register mode<br>0 = Standard<br>1 = Modified | Stop bits and parity<br>0 = 2 stop bits, no parity<br>1 = 1 stop bit, no parity<br>2 = 1 stop bit, even parity<br>3 = 1 stop bit, odd parity |

Bit 2 selects either standard or modified register mode. The menu and parameter numbers are derived for each mode as given in the table below. Standard mode is compatible with Commander SK. Modified mode is provided to allow register numbers up to 255 to be addressed. If any menus with numbers above 63 should contain more than 99 parameters, then these parameters cannot be accessed via Modbus rtu.

| Register mode | Register address                                 |
|---------------|--|
| Standard      | (mm x 100) + ppp - 1 where mm ≤ 162 and ppp ≤ 99 |
| Modified      | (mm x 256) + ppp - 1 where mm ≤ 63 and ppp ≤ 255 |

Changing the parameters does not immediately change the serial communications settings. See *Reset Serial Communications* (11.020) for more details.

| Parameter         | 11.025 Serial Baud Rate                   |                |                                     |
|-------------------|---|----------------|-------------------------------------|
| Short description | Defines the serial baud rate of the drive |                |                                     |
| Mode              | Open-Loop                                 |                |                                     |
| Minimum           | 1   | Maximum        | 10                                  |
| Default           | 6   | Units          | Baud                                |
| Type              | 8 Bit User Save                           | Update Rate    | Read on serial communications reset |
| Display Format    | Standard                                  | Decimal Places | 0                                   |
| Coding            | RW, TE                                    |                |                                     |

| Value | Text   |
|-------|--------|
| 1     | 600    |
| 2     | 1200   |
| 3     | 2400   |
| 4     | 4800   |
| 5     | 9600   |
| 6     | 19200  |
| 7     | 38400  |
| 8     | 57600  |
| 9     | 76800  |
| 10    | 115200 |

*Serial Baud Rate* (11.025) defines the baud rate used by the serial comms interface.

Changing the parameters does not immediately change the serial communications settings. See *Reset Serial Communications* (11.020) for more details.

| Parameter         | 11.026 <i>Minimum Comms Transmit Delay</i>           |                |                                     |
|-------------------|--|----------------|-------------------------------------|
| Short description | Defines the minimum delay between the host and drive |                |                                     |
| Mode              | Open-Loop  |                |                                     |
| Minimum           | 0  | Maximum        | 250                                 |
| Default           | 2  | Units          | ms                                  |
| Type              | 8 Bit User Save                                      | Update Rate    | Read on serial communications reset |
| Display Format    | Standard   | Decimal Places | 0                                   |
| Coding            | RW, BU   |                |                                     |

There will always be a finite delay between the end of a message from the host (master) and the time at which the host is ready to receive the response from the drive (slave). The drive does not respond until at least 1ms after the message has been received from the host allowing 1ms for the host to change from transmit to receive mode. This initial delay can be extended using *Minimum Comms Transmit Delay* (11.026) if required.

| <i>Minimum Comms Transmit Delay</i> (11.026) | Action   |
|--|--|
| 0  | The transmitters are turned on and data transmission begins immediately after the initial delay ( $\geq 1\text{ms}$ )  |
| 1  | The transmitters are turned on after the initial delay ( $\geq 1\text{ms}$ ) and data transmission begins 1ms later  |
| 2 or more                                    | The transmitters are turned on after a delay of at least the time specified by <i>Minimum Comms Transmit Delay</i> (11.026) and data transmission begins 1ms later |

The drive holds its own transmitters active for up to 1ms after it has transmitted data before switching to the receive mode; the host should not send any data during this time.

Changing the parameters does not immediately change the serial communications settings. See *Reset Serial Communications* (11.020) for more details.

| Parameter         | 11.027 <i>Silent Period</i>   |                |                                     |
|-------------------|---|----------------|-------------------------------------|
| Short description | Defines the idle time required to detect the end of a received data message |                |                                     |
| Mode              | Open-Loop   |                |                                     |
| Minimum           | 0   | Maximum        | 250                                 |
| Default           | 0   | Units          | ms                                  |
| Type              | 8 Bit User Save   | Update Rate    | Read on serial communications reset |
| Display Format    | Standard  | Decimal Places | 0                                   |
| Coding            | RW, BU  |                |                                     |

The silent period defines the idle time required to detect the end of a received data message. If *Silent Period* (11.027) = 0 then the silent period is at least 3.5 characters at the selected baud rate. This is the standard silent period for Modbus rtu. If *Silent Period* (11.027) is non-zero it defines the minimum silent period in milliseconds.

Changing the parameters does not immediately change the serial communications settings. See *Reset Serial Communications* (11.020) for more details.

| Parameter         | 11.028 <i>Drive Derivative</i>           |                |                |
|-------------------|--|----------------|----------------|
| Short description | Displays the drive derivative identifier |                |                |
| Mode              | Open-Loop                                |                |                |
| Minimum           | 0  | Maximum        | 255            |
| Default           |  | Units          |                |
| Type              | 8 Bit Volatile                           | Update Rate    | Power-up write |
| Display Format    | Standard                                 | Decimal Places | 0              |
| Coding            | RO, ND, NC, PT, BU                       |                |                |

A drive can be made into a derivative drive by adding a derivative customisation image. The derivative software should specify a derivative identifier which is put into *Drive Derivative* (11.028) at power-up. Each derivative should have a unique identifier.

| Parameter         | 11.029 Software Version                    |                |                |
|-------------------|--|----------------|----------------|
| Short description | Displays the software version in the drive |                |                |
| Mode              | Open-Loop                                  |                |                |
| Minimum           | 0  | Maximum        | 99999999       |
| Default           |  | Units          |                |
| Type              | 32 Bit Volatile                            | Update Rate    | Power-up write |
| Display Format    | Version                                    | Decimal Places | 0              |
| Coding            | RO, ND, NC, PT                             |                |                |

*Software Version* (11.029) displays the drive software version number as a decimal number wwxxyy.

| Parameter         | 11.030 User Security Code                   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the user security code of the drive |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0   | Maximum        | 9999            |
| Default           |   | Units          |                 |
| Type              | 32 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 0               |
| Coding            | RW, ND, NC, PT                              |                |                 |

Defines the user security code of the drive.

| Parameter         | 11.031 User Drive Mode        |                |                 |
|-------------------|-------------------------------|----------------|-----------------|
| Short description | Defines the mode of the drive |                |                 |
| Mode              | Open-Loop                     |                |                 |
| Minimum           | 1                             | Maximum        | 2               |
| Default           |                               | Units          |                 |
| Type              | 8 Bit Volatile                | Update Rate    | Background read |
| Display Format    | Standard                      | Decimal Places | 0               |
| Coding            | RW, TE, ND, NC, PT            |                |                 |

| Value | Text    |
|-------|---------|
| 1     | OPEn.LP |
| 2     | RFC-A   |

Select the drive mode on drive reset. The drive must be inactive (*Drive Active* (10.002) = 0) to take effect.

This parameter will change *Drive Mode* (11.084) to the active mode.

| Parameter         | 11.032 Maximum Heavy Duty Rating                            |                |                |
|-------------------|---|----------------|----------------|
| Short description | Displays the maximum heavy duty current rating of the drive |                |                |
| Mode              | Open-Loop   |                |                |
| Minimum           | 0.00  | Maximum        | 9999.99        |
| Default           |   | Units          | A              |
| Type              | 32 Bit Volatile   | Update Rate    | Power-up write |
| Display Format    | Standard  | Decimal Places | 2              |
| Coding            | RO, ND, NC, PT  |                |                |

*Maximum Heavy Duty Rating* (11.032) defines the maximum setting for *Motor Rated Current* that gives heavy duty operation. If *Maximum Heavy Duty Rating* (11.032) = 0.00 then heavy duty operation is not possible. If *Maximum Heavy Duty Rating* (11.032) = VM\_RATED\_CURRENT[MAX] then normal duty operation is not possible.

| Parameter         | 11.033 Drive Rated Voltage               |                |                |
|-------------------|--|----------------|----------------|
| Short description | Displays the voltage rating of the drive |                |                |
| Mode              | Open-Loop                                |                |                |
| Minimum           | 0  | Maximum        | 4              |
| Default           |  | Units          |                |
| Type              | 8 Bit Volatile                           | Update Rate    | Power-up write |
| Display Format    | Standard                                 | Decimal Places | 0              |
| Coding            | RO, TE, ND, NC, PT                       |                |                |

| Value | Text |
|-------|------|
| 0     | 110  |
| 1     | 200  |
| 2     | 400  |
| 3     | 575  |
| 4     | 690  |

*Drive Rated Voltage* (11.033) shows the input voltage rating of the drive.

| Parameter         | 11.034 Drive Configuration             |                |  |
|-------------------|--|----------------|--|
| Short description | Defines the configuration of the drive |                |  |
| Mode              | Open-Loop                              |                |  |
| Minimum           | 0                                      | Maximum        | 9  |
| Default           | 0                                      | Units          |  |
| Type              | 8 Bit User Save                        | Update Rate    | Actioned on exit of edit mode and on drive reset |
| Display Format    | Standard                               | Decimal Places | 0  |
| Coding            | RW, TE, PT, BU                         |                |  |

| Value | Text    | Description   |
|-------|---------|---|
| 0     | AV      | Analog input 1 (voltage) Analog input 2 (voltage) selected by terminal (Local/Remote)                                       |
| 1     | AI      | Analog input 1 (current) or Analog input 2 (voltage) selected by terminal (Local/Remote)                                    |
| 2     | AV.Pr   | Analog input 1 (voltage) or 3 presets selected by terminal  |
| 3     | AI.Pr   | Analog input 1 (current) or 3 presets selected by terminal  |
| 4     | Preset  | Four presets selected by terminal   |
| 5     | Pad     | Keypad reference  |
| 6     | Pad.Ref | Keypad reference with terminal control  |
| 7     | E.Pot   | Electronic Potentiometer  |
| 8     | Torque  | Torque mode, Analog input 1 (current frequency reference) or Analog input 2 (voltage torque reference) selected by terminal |
| 9     | Pid     | PID mode, Analog input 1 (current feedback source) and Analog input 2 (voltage reference source)                            |

This parameter is used to automatically setup the user programmable area in the level 2 parameter set according to drive configurations. Other default values may also be changed by drive configuration. Parameters are stored in EEPROM automatically following a configuration change. Defaults are loaded before drive configuration changes are made. Defaults loaded are defined by *Defaults Previously Loaded* (11.046).

Action will only occur if the drive is inactive, not in UU state and no User Actions are running. Otherwise, the parameter will return to its pre altered value on exit from edit mode.

All parameters are saved if this parameter changes.

| Parameter number                                 | AV     | AI     | AV.Pr  | AI.Pr  | Preset | Pad    | Pad.ref | E.Pot  | Tor    | PID    |
|--|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|
| <i>Reference Selector</i> (01.014)               | 0      | 0      | 1      | 1      | 3      | 4      | 6       | 3      | 0      | 1      |
| <i>Start/Stop Logic Select</i> (06.004)          | Note 1 | Note 1 | Note 1 | Note 1 | Note 1 | Note 1 | Note 1  | Note 1 | Note 1 | Note 1 |
| <i>Analogue Input 1 Mode</i> (07.007)            | 6      | 4      | 6      | 4      | 6      | 6      | 6       | 6      | 4      | 4      |
| <i>Analogue Input 2 Mode</i> (07.011)            | 6      | 6      | 7      | 7      | 7      | 6      | 6       | 7      | 6      | 6      |
| <i>Analogue Input 1 Control</i> (07.051)         | 0      | 0      | 0      | 0      | 0      | 0      | 0       | 0      | 0      | 0      |
| <i>Analogue Input 1 Destination A</i> (07.010)   | 1.036  | 1.036  | 1.036  | 1.036  | 1.036  | 1.036  | 1.036   | 1.036  | 1.036  | 0.000  |
| <i>Analogue Input 2 Destination A</i> (07.014)   | 1.037  | 1.037  | 1.046  | 1.046  | 1.046  | 1.037  | 1.037   | 9.027  | 4.008  | 0.000  |
| <i>Digital IO2 Source/Destination A</i> (08.022) | Note 2 | Note 2 | Note 2 | Note 2 | Note 2 | Note 2 | Note 2  | Note 2 | Note 2 | Note 2 |
| <i>DI2 Control</i> (08.082)                      | 0      | 0      | 0      | 0      | 0      | 0      | 0       | 0      | 0      |        |
| <i>Digital Input 05 Destination A</i> (08.025)   | 1.041  | 1.041  | 1.045  | 1.045  | 1.045  | 1.041  | 1.041   | 9.026  | 4.011  | 14.008 |
| <i>DI5 Control</i> (08.085)                      | 0      | 0      | 0      | 0      | 0      | 0      | 0       | 0      | 0      | 0      |
| <i>Motorised Pot Destination</i> (09.025)        | 0      | 0      | 0      | 0      | 0      | 0      | 0       | 1.021  | 0      | 0      |
| <i>PID1 Reference Source</i> (14.003)            | 0      | 0      | 0      | 0      | 0      | 0      | 0       | 0      | 0      | 7.0021 |
| <i>PID1 Feedback Source</i> (14.004)             | 0      | 0      | 0      | 0      | 0      | 0      | 0       | 0      | 0      | 7.001  |
| <i>PID1 Destination</i> (14.016)                 | 0      | 0      | 0      | 0      | 0      | 0      | 0       | 0      | 0      | 1.036  |

Note 1: If last default setting was 50Hz or in Pad or Pad.ref configuration:

- o Pr 6.004 is 0.

If last default setting was 60Hz and any other modes:

- o Pr 6.004 is 4.

Note 2: If last default setting was 50Hz or Pad or Pad.ref configuration:

- o Pr 8.022 is 6.038.

If last default setting was 60Hz and any other modes:

- o Pr 8.022 is 6.039.

| Parameter         | 11.035 Power Software Version         |                |                |
|-------------------|---------------------------------------|----------------|----------------|
| Short description | Displays the power processor firmware |                |                |
| Mode              | Open-Loop                             |                |                |
| Minimum           | 0                                     | Maximum        | 99999999       |
| Default           |                                       | Units          |                |
| Type              | 32 Bit Volatile                       | Update Rate    | Power-up write |
| Display Format    | Version                               | Decimal Places | 0              |
| Coding            | RO, ND, NC, PT                        |                |                |

Indicates the version of power processor software fitted.

| Parameter         | 11.036 NV Media Card File Previously Loaded   |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the number of the last parameter file transferred from an NV Media Card to the drive |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0   | Maximum        | 999              |
| Default           | 0   | Units          |                  |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, NC, PT  |                |                  |

*NV Media Card File Previously Loaded* (11.036) shows the number of the last parameter file transferred from an NV Media Card to the drive. If defaults are subsequently reloaded *NV Media Card File Previously Loaded* (11.036) is set to 0.

| Parameter         | 11.037 NV Media Card File Number                 |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Selects a file by its file identification number |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0  | Maximum        | 999             |
| Default           | 0  | Units          |                 |
| Type              | 16 Bit Volatile                                  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

*NV Media Card File Number* (11.037) is used to select a file by its file identification number and can only be changed to values that correspond to files that are recognised by the drive on the NV media card or a value of 0. When *NV Media Card File Number* (11.037) corresponds to the number of a file the following data about the file is shown.

| Parameter                                  |
|--|
| <i>NV Media Card File Type</i> (11.038)    |
| <i>NV Media Card File Version</i> (11.039) |

The actions of erasing a card, erasing a file, creating a new file, changing a Menu 0 parameter or removing a card resets *NV Media Card File Number* (11.037) to 0.

| Parameter         | 11.038 NV Media Card File Type              |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the file type of the file selected |                |                  |
| Mode              | Open-Loop                                   |                |                  |
| Minimum           | 0   | Maximum        | 5                |
| Default           |   | Units          |                  |
| Type              | 8 Bit Volatile                              | Update Rate    | Background write |
| Display Format    | Standard                                    | Decimal Places | 0                |
| Coding            | RO, TE, ND, NC, PT                          |                |                  |

| Value | Text    |
|-------|---------|
| 0     | None    |
| 1     | OPEn.LP |
| 2     | RFC-A   |

*NV Media Card File Type* (11.038) shows the file type of the file selected with *NV Media Card File Number* (11.037) as shown in the table below.

| <i>NV Media Card File Type</i> (11.038) | File                          |
|---|-------------------------------|
| 0                                       | No file selected              |
| 1                                       | Open-loop mode parameter file |
| 2                                       | RFC-A mode parameter file     |
| 3                                       | Reserved                      |
| 4                                       | Reserved                      |
| 5                                       | Onboard user program file     |

| Parameter         | 11.039 NV Media Card File Version                         |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the version number stored with the file selected |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0   | Maximum        | 9999             |
| Default           |   | Units          |                  |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

NV Media Card File Version (11.039) shows the version number stored with the file selected with NV Media Card File Number (11.037).

| Parameter         | 11.042 Parameter Cloning                             |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the behaviour of cloning to an NV media card |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0  | Maximum        | 4                |
| Default           | 0  | Units          |                  |
| Type              | 8 Bit User Save                                      | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RW, TE, NC   |                |                  |

| Value | Text |
|-------|------|
| 0     | None |
| 1     | rEAd |
| 2     | Prog |
| 3     | Auto |
| 4     | boot |

Parameter Cloning (11.042) can also be used to initiate data transfer to or from an NV media card as described below for each possible value of this parameter.

#### 1: Read

Provided a parameter file with file identification number 1 exists on the NV media card then setting *Parameter Cloning* (11.042) = 1 and initiating a drive reset will transfer the parameter data to the drive (i.e. the same action as writing 6001 to Parameter mm.000 (mm.000)). When the action is complete *Parameter Cloning* (11.042) is automatically reset to zero.

#### 2: Program

Setting *Parameter Cloning* (11.042) = 2 and initiating a drive reset will transfer the parameter data from the drive to a parameter file with file identification number 1. This is the same action as writing 4001 to Parameter mm.000 (mm.000) except that the file will be overwritten if it already exists. When the action is complete *Parameter Cloning* (11.042) is automatically reset to zero.

#### 3: Auto

Setting *Parameter Cloning* (11.042) = 3 and initiating a drive reset will transfer the parameter data from the drive to a parameter file with file identification number 1. This is the same action as writing 4001 to Parameter mm.000 (mm.000) except that the file will be overwritten if it already exists. When the action is complete *Parameter Cloning* (11.042) remains at 3.

If the card is removed when *Parameter Cloning* (11.042) = 3, then *Parameter Cloning* (11.042) is set to 0, which forces the user to change *Parameter Cloning* (11.042) back to 3 if auto mode is still required. The user will need to set *Parameter Cloning* (11.042) = 3 and initiate a drive reset to write the complete parameter set to the new card.

When a parameter in Menu zero is changed via the keypad and *Parameter Cloning* (11.042) = 3 the parameter is saved both to the drive non-volatile memory and to the parameter file with identification number 1 on the card. Only the new value of the modified parameter, and not the value of all the other drive parameters, is stored each time. If *Parameter Cloning* (11.042) is not cleared automatically when a card is removed, then when a new card is inserted that contains a parameter file with identification number 1 the modified parameter would be written to the existing file on the new card and the rest of the parameters in this file may not be the same as those in the drive.

When *Parameter Cloning* (11.042) = 3 and the drive parameters are saved to non-volatile memory, the file on the card is also updated, therefore this file becomes a copy of the drive parameters. At power up, if *Parameter Cloning* (11.042) = 3, the drive will save its complete parameter set to the card. This is done to ensure that if a card is inserted whilst the drive is powered down the new card will have the correct data after the drive is powered up again.

#### 4: Boot

When *Parameter Cloning* (11.042) = 4 the drive operates in the same way as with *Parameter Cloning* (11.042) = 3 and automatically creates a copy of it parameters on the NV Media card. The NC (not clonable) attribute for *Parameter Cloning* (11.042) is 1, and so it does not have a value stored in the parameter file on the card in the normal way. However, the value of *Parameter Cloning* (11.042) is held in the parameter file header. If *Parameter Cloning* (11.042) = 4 in the parameter file with a file identification value of 1 on an NV media card fitted to a drive at power-up then the following actions are taken:

1. The parameters from the parameter file with file identification number 1 are transferred to the drive and then saved in non-volatile memory.
2. If an onboard user program file with file identification number 2 exists then the onboard user program from this file is transferred to the drive.
3. *Parameter Cloning* (11.042) is set to 0 after the data transfer is complete.

It is possible to create a bootable parameter file by setting Parameter mm.000 (mm.000) = 2001 and initiating a drive reset. This file is created in one operation and is not updated when further parameter changes are made.

When the drive is powered up it detects which option modules are fitted before loading parameters from an NV media card which has been set up for boot mode. If a new option module has been fitted since the last time the drive was powered up, a *Slot1 Different* trip is initiated and then the parameters are transferred from the card. If the parameter file includes the parameters for the newly fitted option module then these are also transferred to the drive and the *Slot1 Different* trip is reset. If the parameter file does not include the parameters for the newly fitted option module then the drive does not reset the *Slot1 Different* trip. Once the transfer is complete the drive parameters are saved to non-volatile memory. The trip can be reset either by initiating a drive reset or by powering down and then powering up again.

| Parameter         | 11.043 Load Defaults                                   |                |   |
|-------------------|--|----------------|---|
| Short description | Defines which defaults are to be loaded into the drive |                |   |
| Mode              | Open-Loop  |                |   |
| Minimum           | 0  | Maximum        | 2   |
| Default           | 0  | Units          |   |
| Type              | 8 Bit Volatile   | Update Rate    | Exit from edit of menus 0 or a drive reset. |
| Display Format    | Standard   | Decimal Places | 0   |
| Coding            | RW, TE, NC   |                |   |

| Value | Text |
|-------|------|
| 0     | None |
| 1     | Std  |
| 2     | US   |

If *Load Defaults* (11.043) is non-zero and a drive reset (or exit from edit on menu 0) is initiated then the drive will load and save default parameters. If *Load Defaults* (11.043) = 1 then standard defaults are loaded and if *Load Defaults* (11.043) = 2 then US defaults are loaded. This parameter has priority over actions defined by *Parameter mm.000* (mm.000) and *Parameter Cloning* (11.042). If *Load Defaults* (11.043) is used to initiate loading defaults then it is cleared along with *Parameter mm.00* and *Parameter Cloning* (11.042) when the action is completed.

| Parameter         | 11.044 User Security Status                 |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the security level within the drive |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0   | Maximum        | 5               |
| Default           |   | Units          |                 |
| Type              | 8 Bit Volatile                              | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 0               |
| Coding            | RW, TE, ND, PT                              |                |                 |

| Value | Text     |
|-------|----------|
| 0     | LEVEL.0  |
| 1     | ALL      |
| 2     | r.only.0 |
| 3     | r.only.A |
| 4     | StatUs   |
| 5     | no.acc   |

| Parameter         | 11.045 Select Motor 2 Parameters      |                |                 |
|-------------------|---------------------------------------|----------------|-----------------|
| Short description | Set to 1 to select motor 2 parameters |                |                 |
| Mode              | Open-Loop                             |                |                 |
| Minimum           | 0                                     | Maximum        | 1               |
| Default           | 0                                     | Units          |                 |
| Type              | 8 Bit User Save                       | Update Rate    | Background read |
| Display Format    | Standard                              | Decimal Places | 0               |
| Coding            | RW, TE                                |                |                 |

| Value | Text |
|-------|------|
| 0     | 1    |
| 1     | 2    |

*Select Motor 2 Parameters* (11.045) is used to select the motor map 2 parameters from Menu 21 to be substituted for the standard motor parameters. If *Select Motor 2 Parameters* (11.045) is modified when *Drive Active* (10.002) = 1 the change only becomes effective when *Drive Active* (10.002) = 0. When *Select Motor 2 Parameters* (11.045) = 1 the results from auto-tuning are written to the motor map 2 parameters in Menu 21 instead of to the standard parameters. Each time *Select Motor 2 Parameters* (11.045) is changed *Motor Protection Accumulator* (04.019) is reset to zero. *Motor 2 Active* (21.015) shows the motor map that is active.

| Parameter         | 11.046 Defaults Previously Loaded                    |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the defaults previously loaded in the drive |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0  | Maximum        | 2000             |
| Default           |  | Units          |                  |
| Type              | 16 Bit User Save                                     | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                                       |                |                  |

*Defaults Previously Loaded* (11.046) shows the value used to load the previously loaded defaults (i.e. 1233 for standard defaults, or 1244 for US defaults).

| Parameter         | 11.052 <i>Serial Number LS</i>  |                |                             |
|-------------------|---|----------------|-----------------------------|
| Short description | Shows the least significant 9 decimal digits of the drive serial number |                |                             |
| Mode              | Open-Loop   |                |                             |
| Minimum           | 0<br>(Display: 000000)  | Maximum        | 999999<br>(Display: 999999) |
| Default           |   | Units          |                             |
| Type              | 32 Bit Volatile   | Update Rate    | Power-up write              |
| Display Format    | Lead Zero Pad   | Decimal Places | 0                           |
| Coding            | RO, ND, NC, PT  |                |                             |

The drive serial number is available as a pair of 32 bit values where *Serial Number LS* (11.052) provides the least significant 6 decimal digits and *Serial Number MS* (11.053) provides the most significant 4 decimal digits. The reconstructed serial number is ((*Serial Number MS* (11.053) x 1000000) + *Serial Number LS* (11.052)).

#### Example 1

Serial number "1234567890" would be stored as 11.053 = 1234, 11.052 = 567890.

#### Example 2

Serial number "1234000056" would be stored as 11.053 = 1234, 11.052 = 56. *Serial Number LS* (11.052) will be shown on the keypad as 000056 (i.e. including the leading zeros).

| Parameter         | 11.053 <i>Serial Number MS</i>   |                |                |
|-------------------|--|----------------|----------------|
| Short description | Shows the most significant 9 decimal digits of the drive serial number |                |                |
| Mode              | Open-Loop  |                |                |
| Minimum           | 0  | Maximum        | 999999         |
| Default           |  | Units          |                |
| Type              | 32 Bit Volatile  | Update Rate    | Power-up write |
| Display Format    | Standard   | Decimal Places | 0              |
| Coding            | RO, ND, NC, PT   |                |                |

See *Serial Number LS* (11.052).

| Parameter         | 11.054 <i>Drive Date Code</i> |                |                         |
|-------------------|-------------------------------|----------------|-------------------------|
| Short description | Shows the drive date code     |                |                         |
| Mode              | Open-Loop                     |                |                         |
| Minimum           | 0<br>(Display: 0000)          | Maximum        | 9999<br>(Display: 9999) |
| Default           |                               | Units          |                         |
| Type              | 16 Bit Volatile               | Update Rate    | Background write        |
| Display Format    | Lead Zero Pad                 | Decimal Places | 0                       |
| Coding            | RO, ND, NC, PT, BU            |                |                         |

*Drive Date Code* (11.054) is a four-digit number in the form yyww where yy is the year and ww is the week.

| Parameter         | 11.060 <i>Maximum Rated Current</i>                                   |                |                |
|-------------------|---|----------------|----------------|
| Short description | Displays the maximum rated current or normal duty rating of the drive |                |                |
| Mode              | Open-Loop   |                |                |
| Minimum           | 0.000   | Maximum        | 999.999        |
| Default           |   | Units          | A              |
| Type              | 32 Bit Volatile   | Update Rate    | Power-up write |
| Display Format    | Standard  | Decimal Places | 3              |
| Coding            | RO, ND, NC, PT  |                |                |

*Maximum Rated Current* (11.060) defines the variable maximum VM\_RATED\_CURRENT[MAX] which defines the maximum *Motor Rated Current* (05.007). Therefore Maximum *Maximum Rated Current* (11.060) is the maximum rated current for normal duty operation (if normal duty operation is allowed).

| Parameter         | 11.061 <i>Full Scale Current Kc</i> |                |                |
|-------------------|-------------------------------------|----------------|----------------|
| Short description | Displays the full scale current Kc  |                |                |
| Mode              | Open-Loop                           |                |                |
| Minimum           | 0.000                               | Maximum        | 999.999        |
| Default           |                                     | Units          | A              |
| Type              | 32 Bit Volatile                     | Update Rate    | Power-up write |
| Display Format    | Standard                            | Decimal Places | 3              |
| Coding            | RO, ND, NC, PT                      |                |                |

*Full Scale Current Kc* (11.061) shows the full scale current in r.m.s. Amps. If the drive current exceeds this level it will cause an over-current trip.



| Parameter         | 11.063 Product Type            |                |                |
|-------------------|--------------------------------|----------------|----------------|
| Short description | Displays the core product type |                |                |
| Mode              | Open-Loop                      |                |                |
| Minimum           | 0                              | Maximum        | 255            |
| Default           |                                | Units          |                |
| Type              | 8 Bit Volatile                 | Update Rate    | Power-up write |
| Display Format    | Standard                       | Decimal Places | 0              |
| Coding            | RO, ND, NC, PT, BU             |                |                |

*Product Type* (11.063) shows the core product type as given in the table below. The drive could be the basic product or a derivative of the basic product as defined by *Drive Derivative* (11.028).

| Product Type (11.063) | Core product range    |
|-----------------------|-----------------------|
| 0                     | Unidrive M600 to M800 |
| 1                     | Unidrive M100 to M400 |

| Parameter         | 11.064 Product Identifier Characters       |                |                |
|-------------------|--|----------------|----------------|
| Short description | Displays the product identifier characters |                |                |
| Mode              | Open-Loop                                  |                |                |
| Minimum           | 1295134768                                 | Maximum        | 2147483647     |
| Default           |  | Units          |                |
| Type              | 32 Bit Volatile                            | Update Rate    | Power-up write |
| Display Format    | String                                     | Decimal Places | 0              |
| Coding            | RO, ND, NC, PT                             |                |                |

The drive model and rating can be identified as AAAAnnnppppBBBBCCCCDDDD where each section of the model identifier is taken from a parameter. 'AAAA', 'BBBB', 'CCCC' and 'DDDD' is alpha-numeric characters. 'nnn' and 'pppp' are decimal digits.

The drive model and rating can be identified as AAAA B nnnpppp CCCC DD EE FFF where each section of the model identifier is taken from a parameter. AAAA, B, CCCC, DDDD, EE and FFF are alpha-numeric characters. nnn and pppp are decimal digits.

| Section of identifier | Parameter  |
|-----------------------|--|
| AAAA                  | <i>Product Identifier Characters</i> (11.064)      |
| nnn                   | <i>Frame size and voltage code</i> (11.065)        |
| ppppp                 | <i>Drive current rating</i> (11.068)               |
| CCCC                  | <i>Additional Identifier Characters 1</i> (11.091) |
| DDEE                  | <i>Additional Identifier Characters 2</i> (11.092) |
| FFFB                  | <i>Additional Identifier Characters 3</i> (11.093) |

*Product Identifier Characters* (11.064) as defined in the table below.

| Digits | Meaning                              |
|--------|--------------------------------------|
| 3 to 0 | Product identifier (i.e. M100, M201) |

*Frame size and voltage code* (11.065) is split into two fields as defined in the table below.

| Digits | Meaning   |
|--------|---|
| 2 to 1 | Frame size determined by Derivative or required current.        |
| 0      | Voltage code (1 = 110V, 2 = 230V, 4 = 400V, 5 = 575V, 6 = 690V) |

*Drive current rating* (11.068) is as defined in the table below.

| Digits | Meaning                                   |
|--------|---|
| 4 to 0 | Drive current rating (i.e. 00133 = 13.3A) |

#### Example

The model number M101-04200133 A101 00 AB100 would be displayed in parameters as follows

| Parameter  | Value |
|--|-------|
| <i>Product Identifier Characters</i> (11.064)      | M101  |
| <i>Frame size and voltage code</i> (11.065)        | 042   |
| <i>Drive current rating</i> (11.068)               | 00133 |
| <i>Additional Identifier Characters 1</i> (11.091) | A101  |
| <i>Additional Identifier Characters 2</i> (11.092) | 00AB  |
| <i>Additional Identifier Characters 3</i> (11.093) | 100-  |

| Parameter         | 11.065 <i>Frame size and voltage code</i> |                |                       |
|-------------------|---|----------------|-----------------------|
| Short description | Displays the frame size and voltage code  |                |                       |
| Mode              | Open-Loop                                 |                |                       |
| Minimum           | 0<br>(Display: 000)                       | Maximum        | 999<br>(Display: 999) |
| Default           |   | Units          |                       |
| Type              | 16 Bit Volatile                           | Update Rate    | Power-up write        |
| Display Format    | Lead Zero Pad                             | Decimal Places | 0                     |
| Coding            | RO, ND, NC, PT                            |                |                       |

See *Product Identifier Characters* (11.064).

| Parameter         | 11.066 <i>Power Stage Identifier</i>                  |                |                |
|-------------------|---|----------------|----------------|
| Short description | Displays the power stage identifiers within the drive |                |                |
| Mode              | Open-Loop   |                |                |
| Minimum           | 0   | Maximum        | 255            |
| Default           |   | Units          |                |
| Type              | 8 Bit Volatile  | Update Rate    | Power-up write |
| Display Format    | Standard  | Decimal Places | 0              |
| Coding            | RO, ND, NC, PT, BU                                    |                |                |

*Power Stage Identifier* (11.066) is used to show power stages that require changes to the drive user parameters (i.e. visibility, range or defaults). It is anticipated that all power stages will require the same parameter structure, and so *Power Stage Identifier* (11.066) will always be equal to zero. It should be noted that this parameter does not identify the rating of the power stage.

| <i>Power Stage Identifier</i> (11.066) | Power stage        |
|--|--------------------|
| 0                                      | Standard M600-M800 |
| 1                                      | Standard M100-M400 |

| Parameter         | 11.067 <i>Control Board Identifier</i>                  |                |                |
|-------------------|---|----------------|----------------|
| Short description | Displays the control board identifiers within the drive |                |                |
| Mode              | Open-Loop   |                |                |
| Minimum           | 0   | Maximum        | 255            |
| Default           |   | Units          |                |
| Type              | 8 Bit Volatile  | Update Rate    | Power-up write |
| Display Format    | Standard  | Decimal Places | 0              |
| Coding            | RO, ND, NC, PT, BU                                      |                |                |

*Control Board Identifier* (11.067) identifies the main control board hardware as given in the table below.

| <i>Control Board Identifier</i> (11.067) | Control board |
|--|---------------|
| 0  | Reserved      |
| 1  | Reserved      |
| 2  | M100          |
| 3  | Reserved      |
| 4  | Reserved      |
| 5  | M101          |
| 6  | Reserved      |
| 7  | Reserved      |
| 8  | M200          |
| 9  | Reserved      |
| 10                                       | Reserved      |
| 11                                       | M201          |
| 12                                       | Reserved      |
| 13                                       | Reserved      |
| 14                                       | M300          |
| 15                                       | Reserved      |
| 16                                       | Reserved      |
| 17                                       | M400          |
| 18                                       | Reserved      |

| Parameter         | 11.068 Drive current rating         |                |                           |
|-------------------|-------------------------------------|----------------|---------------------------|
| Short description | Drive current rating in 0.1 of Amps |                |                           |
| Mode              | Open-Loop                           |                |                           |
| Minimum           | 0<br>(Display: 00000)               | Maximum        | 32767<br>(Display: 32767) |
| Default           |                                     | Units          |                           |
| Type              | 16 Bit Volatile                     | Update Rate    | Power-up write            |
| Display Format    | Lead Zero Pad                       | Decimal Places | 0                         |
| Coding            | RO, ND, NC, PT                      |                |                           |

See *Product Identifier Characters* (11.064).

| Parameter         | 11.070 Core Parameter Database Version                        |                |                |
|-------------------|---|----------------|----------------|
| Short description | Displays the core parameter database version within the drive |                |                |
| Mode              | Open-Loop   |                |                |
| Minimum           | 0.00  | Maximum        | 99.99          |
| Default           |   | Units          |                |
| Type              | 16 Bit Volatile   | Update Rate    | Power-up write |
| Display Format    | Standard  | Decimal Places | 2              |
| Coding            | RO, ND, NC, PT  |                |                |

*Core Parameter Database Version* (11.070) gives the version number of the parameter database used to define the core parameter menus in the drive (Menu 1 to 14 and 21 to 23) in 2 digit BCD format. All other menus are customisable and if these menus are changed their default values are automatically loaded. However, if the drive software is changed it may be necessary to load defaults for all menus, although this will only be required rarely. Defaults for all menus are loaded when the most significant digit of *Core Parameter Database Version* (11.070) changes. Therefore if the drive firmware is modified and the most significant digit of the core database version has changed an *EEPROM Fail.001* trip is initiated and default parameters are loaded.

| Parameter         | 11.072 NV Media Card Create Special File                               |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines if a parameter file is created as a macro file during transfer |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit Volatile   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, NC   |                |                 |

If *NV Media Card Create Special File* (11.072) = 1 when a parameter file is transferred to an NV media card the file is created as a macro file. *NV Media Card Create Special File* (11.072) is reset to 0 after the file is created or the transfer fails.

| Parameter         | 11.073 NV Card Type Fitted                              |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the type of the currently fitted NV media card |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0   | Maximum        | 2                |
| Default           |   | Units          |                  |
| Type              | 8 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, TE, ND, NC, PT                                      |                |                  |

| Value | Text    |
|-------|---------|
| 0     | None    |
| 1     | Res     |
| 2     | Sd.Card |

*NV Card Type Fitted* (11.073) shows the type of non-volatile media card inserted in the drive.

| Parameter         | 11.075 NV Media Card Read-only Flag                                    |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the state of the read-only flag for the currently fitted card |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT   |                |                  |

*NV Media Card Read-only Flag* (11.075) shows the state of the read-only flag for the currently fitted card.

| Parameter         | <b>11.076 NV Media Card Warning Suppression Flag</b>                 |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the state of the warning flag for the currently fitted card |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT   |                |                  |

*NV Media Card Warning Suppression Flag* (11.076) shows the state of the warning flag for the currently fitted card.

| Parameter         | <b>11.077 NV Media Card File Required Version</b>                             |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the version number for a file when it is created on an NV media card |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0   | Maximum        | 9999             |
| Default           |   | Units          |                  |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RW, ND, NC, PT  |                |                  |

The value of *NV Media Card File Required Version* (11.077) is used as the version number for a file when it is created on an NV media card. *NV Media Card File Required Version* (11.077) is reset to 0 when the file is created or the transfer fails.

| Parameter         | <b>11.079 Drive Name Characters 1-4</b>                                    |                |            |
|-------------------|--|----------------|------------|
| Short description | Defines characters 1-4 of a string which can be used to identify the drive |                |            |
| Mode              | Open-Loop  |                |            |
| Minimum           | -2147483648  | Maximum        | 2147483647 |
| Default           | 757935405  | Units          |            |
| Type              | 32 Bit User Save   | Update Rate    | N/A        |
| Display Format    | String   | Decimal Places | 0          |
| Coding            | RW, PT   |                |            |

*Drive Name Characters 1-4* (11.079) to *Drive Name Characters 13-16* (11.082) can be used to store a 16 character string which can be used to identify the drive. The string is arranged as shown below.

|           |   |           |   |           |    |           |    |
|-----------|---|-----------|---|-----------|----|-----------|----|
| 1         | 4 | 5         | 8 | 9         | 12 | 13        | 16 |
| Pr 11.079 |   | Pr 11.080 |   | Pr 11.082 |    | Pr 11.083 |    |

This uses the standard ASCII character set.

If *Status Mode Parameter 1* (11.018) or *Status Mode Parameter 2* (11.019) are set to 11.079 then the drive name is fully displayed in status view using *Drive Name Characters 1-4* (11.079) to *Drive Name Characters 13-16* (11.082). Note that only 15 characters can be displayed on M400 and only 6 characters on M100-M300.

| Parameter         | <b>11.080 Drive Name Characters 5-8</b>                                    |                |            |
|-------------------|--|----------------|------------|
| Short description | Defines characters 5-8 of a string which can be used to identify the drive |                |            |
| Mode              | Open-Loop  |                |            |
| Minimum           | -2147483648  | Maximum        | 2147483647 |
| Default           | 757935405  | Units          |            |
| Type              | 32 Bit User Save   | Update Rate    | N/A        |
| Display Format    | String   | Decimal Places | 0          |
| Coding            | RW, PT   |                |            |

See *Drive Name Characters 1-4* (11.079).

| Parameter         | <b>11.081 Drive Name Characters 9-12</b>                                    |                |            |
|-------------------|---|----------------|------------|
| Short description | Defines characters 9-12 of a string which can be used to identify the drive |                |            |
| Mode              | Open-Loop   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 757935405   | Units          |            |
| Type              | 32 Bit User Save  | Update Rate    | N/A        |
| Display Format    | String  | Decimal Places | 0          |
| Coding            | RW, PT  |                |            |

See *Drive Name Characters 1-4* (11.079).

| Parameter         | 11.082 Drive Name Characters 13-16   |                |            |
|-------------------|--|----------------|------------|
| Short description | Defines characters 13-16 of a string which can be used to identify the drive |                |            |
| Mode              | Open-Loop  |                |            |
| Minimum           | -2147483648  | Maximum        | 2147483647 |
| Default           | 757935405  | Units          |            |
| Type              | 32 Bit User Save   | Update Rate    | N/A        |
| Display Format    | String   | Decimal Places | 0          |
| Coding            | RW, PT   |                |            |

See *Drive Name Characters 1-4* (11.079).

| Parameter         | 11.084 Drive Mode                           |                |                       |
|-------------------|---|----------------|-----------------------|
| Short description | Defines and displays the current drive mode |                |                       |
| Mode              | Open-Loop                                   |                |                       |
| Minimum           | 1   | Maximum        | 2                     |
| Default           |   | Units          |                       |
| Type              | 8 Bit User Save                             | Update Rate    | Background read/write |
| Display Format    | Standard                                    | Decimal Places | 0                     |
| Coding            | RO, TE, ND, NC, PT                          |                |                       |

| Value | Text    |
|-------|---------|
| 1     | OPEn.LP |
| 2     | RFC-A   |

*Drive Mode* (11.084) is used to hold the currently active drive mode.

| Parameter         | 11.085 Security Status                        |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the security status within the drive |                |                  |
| Mode              | Open-Loop                                     |                |                  |
| Minimum           | 0   | Maximum        | 3                |
| Default           |   | Units          |                  |
| Type              | 8 Bit Power Down Save                         | Update Rate    | Background write |
| Display Format    | Standard                                      | Decimal Places | 0                |
| Coding            | RO, TE, ND, NC, PT                            |                |                  |

| Value | Text     |
|-------|----------|
| 0     | None     |
| 1     | r.only.A |
| 2     | StatUs   |
| 3     | no.acc   |

*Security Status* (11.085) shows the security that will apply when security is enabled by setting a non-zero value for *User Security Code* (11.030).

| Parameter         | 11.086 Menu Access Status                                   |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the amount of access of the menus within the drive |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 8 Bit Power Down Save                                       | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, TE, ND, NC, PT  |                |                  |

| Value | Text    |
|-------|---------|
| 0     | LEVEL.0 |
| 1     | ALL     |

If *Menu Access Status* (11.086) = 0 then only Menu 0 can be accessed with a keypad. If *Menu Access Status* (11.086) = 1 then all menus can be accessed with a keypad.

| Parameter         | 11.091 Additional Identifier Characters 1     |                |                |
|-------------------|---|----------------|----------------|
| Short description | Displays the additional identifier characters |                |                |
| Mode              | Open-Loop                                     |                |                |
| Minimum           | -2147483648                                   | Maximum        | 2147483647     |
| Default           |   | Units          |                |
| Type              | 32 Bit Volatile                               | Update Rate    | Power-up write |
| Display Format    | String  | Decimal Places | 0              |
| Coding            | RO, ND, NC, PT                                |                |                |

See *Product Identifier Characters* (11.064).

| Parameter         | 11.092 Additional Identifier Characters 2     |                |                |
|-------------------|---|----------------|----------------|
| Short description | Displays the additional identifier characters |                |                |
| Mode              | Open-Loop                                     |                |                |
| Minimum           | -2147483648                                   | Maximum        | 2147483647     |
| Default           |   | Units          |                |
| Type              | 32 Bit Volatile                               | Update Rate    | Power-up write |
| Display Format    | String  | Decimal Places | 0              |
| Coding            | RO, ND, NC, PT                                |                |                |

See *Product Identifier Characters* (11.064).

| Parameter         | 11.093 Additional Identifier Characters 3     |                |                |
|-------------------|---|----------------|----------------|
| Short description | Displays the additional identifier characters |                |                |
| Mode              | Open-Loop                                     |                |                |
| Minimum           | -2147483648                                   | Maximum        | 2147483647     |
| Default           |   | Units          |                |
| Type              | 32 Bit Volatile                               | Update Rate    | Power-up write |
| Display Format    | String  | Decimal Places | 0              |
| Coding            | RO, ND, NC, PT                                |                |                |

See *Product Identifier Characters* (11.064).

| Parameter         | 11.094 Disable String Mode                |                |            |
|-------------------|---|----------------|------------|
| Short description | Set to disable text strings on the keypad |                |            |
| Mode              | Open-Loop                                 |                |            |
| Minimum           | 0   | Maximum        | 1          |
| Default           | 0   | Units          |            |
| Type              | 1 Bit User Save                           | Update Rate    | Background |
| Display Format    | Standard                                  | Decimal Places | 0          |
| Coding            | RW, PT                                    |                |            |

For all displays.

If *Disable String Mode* (11.094) = 0 then mnemonic strings are on showing the English mnemonic (i.e. Ol ac)

If *Disable String Mode* (11.094) = 1 then mnemonic strings are off therefore numbers are used instead.

| Parameter         | 11.097 AI ID Code                                  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Indicates the AI module type fitted in the AI slot |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0  | Maximum        | 4               |
| Default           |  | Units          |                 |
| Type              | 8 Bit Volatile                                     | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RO, TE, ND, NC, PT, BU                             |                |                 |

| Value | Text    |
|-------|---------|
| 0     | None    |
| 1     | Sd.Card |
| 2     | RS-485  |
| 3     | boot    |
| 4     | RS-485  |

*AI ID Code* (11.097) indicates the Adaptor Interface module type fitted in the AI slot.

| Parameter         | 11.098 24V Alarm Loss Enable              |                |            |
|-------------------|---|----------------|------------|
| Short description | Indicate if the 24V alarm loss is enabled |                |            |
| Mode              | Open-Loop                                 |                |            |
| Minimum           | 0   | Maximum        | 1          |
| Default           | 0   | Units          |            |
| Type              | 1 Bit User Save                           | Update Rate    | background |
| Display Format    | Standard                                  | Decimal Places | 0          |
| Coding            | RW  |                |            |

*24V Alarm Loss Enable* (11.098) enable the 24V alarm loss. If *24V Supply Input State* (08.043) = 0 and *24V Alarm Loss Enable* (11.098) = 1 then the 24V is active.

| Parameter         | 11.099 Modbus Parameter Conversion                   |                |                       |
|-------------------|--|----------------|-----------------------|
| Short description | Convert read/write parameter via Modbus serial comm. |                |                       |
| Mode              | Open-Loop  |                |                       |
| Minimum           | 0<br>(Display: 0000)                                 | Maximum        | 15<br>(Display: 1111) |
| Default           | 0<br>(Display: 0000)                                 | Units          |                       |
| Type              | 16 Bit User Save                                     | Update Rate    |                       |
| Display Format    | Binary   | Decimal Places | 0                     |
| Coding            | RW   |                |                       |

If *Modbus Parameter Conversion* (11.099) bits are turned on then the following parameters are converted when read or written by modbus serial comm.

This is NOT a full comms compatibility to previous drive generations. Only the following parameters are converted.

| Modbus Parameter Conversion (11.099) bits | Effect   |
|---|--|
| 0   | Frequency parameters:<br>1.001,1.002,1.003,1.004,1.005,1.006,1.007,1.017,1.021,1.022,<br>1.023,1.024,1.025,1.026,1.027,1.028,1.029,1.030,1.031,1.032,<br>1.033,1.034,1.036,1.037,1.038,2.001,3.005,3.006,3.022,3.043,<br>3.045,5.001,5.006,12.044,12.045,21.001,21.002,21.006 scaled by 10.  |
| 1   | Source/Destination parameters:<br>7.010,7.014,7.019,8.021,8.022,8.023,8.024,8.025,8.028,9.004,9.006,<br>9.010,9.014,9.016,9.020,9.025,9.033,12.003,12.007,12.008,12.009,<br>12.011,12.023,12.027,12.028,12.029,12.031,14.002,14.003,14.004,14.009,14.016.<br>Parameter number is converted from 3 to 2 digits (i.e. #1.01 is #1.001) |
| 2   | Percentage parameters:<br>7.001,7.002,7.030,7.031,9.003,12.004,12.005,12.012,12.024,12.025,<br>12.032,14.001,14.013,14.014,14.019,14.020,14.021,14.022 scaled by 10  |
| 3   | Motor parameters: 5.008,5.017,5.024,21.008,21.012,21.014 scaled by 10  |

Examples:

#### **bit 0:**

01.021 = 1.23Hz and *Modbus Parameter Conversion* (11.099) = 1 then value read is 12 equivalent of 1.20Hz

01.021 = 1.23Hz and *Modbus Parameter Conversion* (11.099) = 0 then value read is 123 equivalent of 1.23Hz

Value 123 is written to 01.021 and *Modbus Parameter Conversion* (11.099) = 1 then 01.021 = 12.30Hz

Value 123 is written to 01.021 and *Modbus Parameter Conversion* (11.099) = 0 then 01.021 = 1.23Hz

## Menu 12 Single Line Descriptions – User Functions 2 and Brake Control

Mode: Open-Loop

| Parameter |                                       | Range   | Default | Type |     |    |    |    |    |
|-----------|---------------------------------------|---|---------|------|-----|----|----|----|----|
| 12.001    | Threshold Detector 1 Output           | Off (0) or On (1)   |         | RO   | Bit | ND | NC | PT |    |
| 12.002    | Threshold Detector 2 Output           | Off (0) or On (1)   |         | RO   | Bit | ND | NC | PT |    |
| 12.003    | Threshold Detector 1 Source           | 0.000 to 30.999   | 0.000   | RW   | Num |    |    | PT | US |
| 12.004    | Threshold Detector 1 Level            | 0.00 to 100.00 %  | 0.00 %  | RW   | Num |    |    |    | US |
| 12.005    | Threshold Detector 1 Hysteresis       | 0.00 to 25.00 %   | 0.00 %  | RW   | Num |    |    |    | US |
| 12.006    | Threshold Detector 1 Output Invert    | Off (0) or On (1)   | Off (0) | RW   | Bit |    |    |    | US |
| 12.007    | Threshold Detector 1 Destination      | 0.000 to 30.999   | 0.000   | RW   | Num | DE |    | PT | US |
| 12.008    | Variable Selector 1 Source 1          | 0.000 to 30.999   | 0.000   | RW   | Num |    |    | PT | US |
| 12.009    | Variable Selector 1 Source 2          | 0.000 to 30.999   | 0.000   | RW   | Num |    |    | PT | US |
| 12.010    | Variable Selector 1 Mode              | 0 (0), 1 (1), 2 (2), 3 (3), 4 (4),<br>5 (5), 6 (6), 7 (7), 8 (8), 9 (9) | 0 (0)   | RW   | Txt |    |    |    | US |
| 12.011    | Variable Selector 1 Destination       | 0.000 to 30.999   | 0.000   | RW   | Num | DE |    | PT | US |
| 12.012    | Variable Selector 1 Output            | ±100.00 %   |         | RO   | Num | ND | NC | PT |    |
| 12.013    | Variable Selector 1 Source 1 Scaling  | ±4.000  | 1.000   | RW   | Num |    |    |    | US |
| 12.014    | Variable Selector 1 Source 2 Scaling  | ±4.000  | 1.000   | RW   | Num |    |    |    | US |
| 12.015    | Variable Selector 1 Control           | 0.00 to 100.00  | 0.00    | RW   | Num |    |    |    | US |
| 12.016    | Variable Selector 1 Enable            | Off (0) or On (1)   | On (1)  | RW   | Bit |    |    |    | US |
| 12.023    | Threshold Detector 2 Source           | 0.000 to 30.999   | 0.000   | RW   | Num |    |    | PT | US |
| 12.024    | Threshold Detector 2 Level            | 0.00 to 100.00 %  | 0.00 %  | RW   | Num |    |    |    | US |
| 12.025    | Threshold Detector 2 Hysteresis       | 0.00 to 25.00 %   | 0.00 %  | RW   | Num |    |    |    | US |
| 12.026    | Threshold Detector 2 Output Invert    | Off (0) or On (1)   | Off (0) | RW   | Bit |    |    |    | US |
| 12.027    | Threshold Detector 2 Destination      | 0.000 to 30.999   | 0.000   | RW   | Num | DE |    | PT | US |
| 12.028    | Variable Selector 2 Source 1          | 0.000 to 30.999   | 0.000   | RW   | Num |    |    | PT | US |
| 12.029    | Variable Selector 2 Source 2          | 0.000 to 30.999   | 0.000   | RW   | Num |    |    | PT | US |
| 12.030    | Variable Selector 2 Mode              | 0 (0), 1 (1), 2 (2), 3 (3), 4 (4),<br>5 (5), 6 (6), 7 (7), 8 (8), 9 (9) | 0 (0)   | RW   | Txt |    |    |    | US |
| 12.031    | Variable Selector 2 Destination       | 0.000 to 30.999   | 0.000   | RW   | Num | DE |    | PT | US |
| 12.032    | Variable Selector 2 Output            | ±100.00 %   |         | RO   | Num | ND | NC | PT |    |
| 12.033    | Variable Selector 2 Source 1 Scaling  | ±4.000  | 1.000   | RW   | Num |    |    |    | US |
| 12.034    | Variable Selector 2 Source 2 Scaling  | ±4.000  | 1.000   | RW   | Num |    |    |    | US |
| 12.035    | Variable Selector 2 Control           | 0.00 to 100.00  | 0.00    | RW   | Num |    |    |    | US |
| 12.036    | Variable Selector 2 Enable            | Off (0) or On (1)   | On (1)  | RW   | Bit |    |    |    | US |
| 12.040    | BC Brake Release                      | Off (0) or On (1)   |         | RO   | Bit | ND | NC | PT |    |
| 12.041    | BC Enable                             | Dis (0), Relay (1), dig IO (2),<br>USER (3)                             | Dis (0) | RW   | Txt |    |    |    | US |
| 12.042    | BC Upper Current Threshold            | 0 to 200 %  | 50 %    | RW   | Num |    |    |    | US |
| 12.043    | BC Lower Current Threshold            | 0 to 200 %  | 10 %    | RW   | Num |    |    |    | US |
| 12.044    | BC Brake Release Frequency            | 0.00 to 20.00 Hz  | 1.00 Hz | RW   | Num |    |    |    | US |
| 12.045    | BC Brake Apply Frequency              | 0.00 to 20.00 Hz  | 2.00 Hz | RW   | Num |    |    |    | US |
| 12.046    | BC Brake Delay                        | 0.0 to 25.0 s   | 1.0 s   | RW   | Num |    |    |    | US |
| 12.047    | BC Post-brake Release Delay           | 0.0 to 25.0 s   | 1.0 s   | RW   | Num |    |    |    | US |
| 12.050    | BC Initial Direction                  | reF (0), For (1), Rev (2)   | reF (0) | RW   | Txt |    |    |    | US |
| 12.051    | BC Brake Apply Through Zero Threshold | 0.00 to 20.00 Hz  | 1.00 Hz | RW   | Num |    |    |    | US |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |



## Menu 12 – User Functions 2 and Brake Control

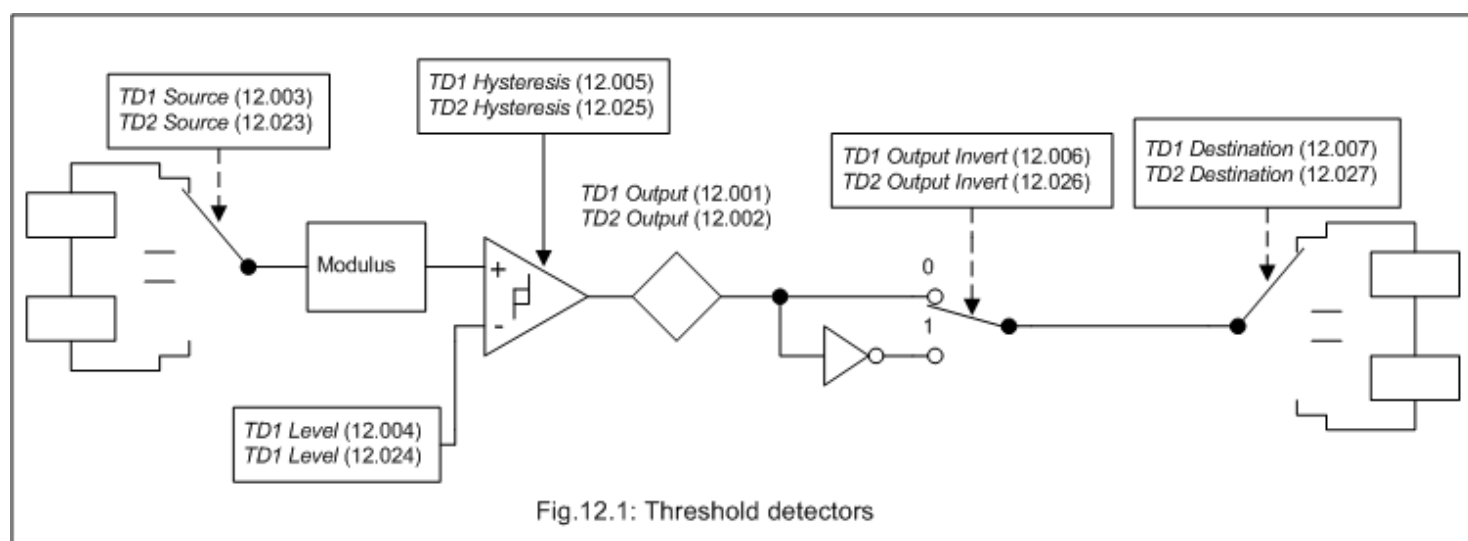
Mode: Open-Loop

Menu 12 provides parameters for the following features:

1. Threshold detectors
2. Variable selectors
3. Mechanical brake controller

| Parameter         | 12.001 Threshold Detector 1 Output          |                |           |
|-------------------|---|----------------|-----------|
| Short description | Displays the output of threshold detector 1 |                |           |
| Mode              | Open-Loop                                   |                |           |
| Minimum           | 0   | Maximum        | 1         |
| Default           |   | Units          |           |
| Type              | 1 Bit Volatile                              | Update Rate    | 4ms write |
| Display Format    | Standard                                    | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                              |                |           |

The threshold detector functions are always active even if the source and destination are not routed to valid parameters. If the source is not a valid parameter then the source value is taken as 0. The update rate for each of the threshold detector functions is always 4ms.



The following description is for threshold detector 1, but threshold detector 2 operates in the same way. The level of the parameter defined by *Threshold Detector 1 Source* (12.003) is converted to a percentage and compared to *Threshold Detector 1 Level* (12.004) with hysteresis to give *Threshold Detector 1 Output* (12.001) as follows:

| Source                   | Threshold Detector 1 Output (12.001) |
|--------------------------|--------------------------------------|
| Source                   | 0                                    |
| Lower threshold ≤ Source | No change of state                   |
| Source ≥ Upper threshold | 1                                    |

Lower threshold = *Threshold Detector 1 Level* (12.004) - (*Threshold Detector 1 Hysteresis* (12.005) / 2)

Upper threshold = *Threshold Detector 1 Level* (12.004) + (*Threshold Detector 1 Hysteresis* (12.005) / 2)

The output value can then be inverted with *Threshold Detector 1 Output Invert* (12.006) before being routed to the destination defined by *Threshold Detector 1 Destination* (12.007).

| Parameter         | 12.002 Threshold Detector 2 Output          |                |           |
|-------------------|---|----------------|-----------|
| Short description | Displays the output of threshold detector 2 |                |           |
| Mode              | Open-Loop                                   |                |           |
| Minimum           | 0   | Maximum        | 1         |
| Default           |   | Units          |           |
| Type              | 1 Bit Volatile                              | Update Rate    | 4ms write |
| Display Format    | Standard                                    | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                              |                |           |

See *Threshold Detector 1 Output* (12.001).

| Parameter         | 12.003 Threshold Detector 1 Source                    |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the source parameter for threshold detector 1 |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0.000   | Maximum        | 30.999           |
| Default           | 0.000   | Units          |                  |
| Type              | 16 Bit User Save                                      | Update Rate    | Drive reset read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, PT, BU  |                |                  |

See *Threshold Detector 1 Output* (12.001).

| Parameter         | 12.004 Threshold Detector 1 Level                    |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the reference level for threshold detector 1 |                |          |
| Mode              | Open-Loop  |                |          |
| Minimum           | 0.00   | Maximum        | 100.00   |
| Default           | 0.00   | Units          | %        |
| Type              | 16 Bit User Save                                     | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 2        |
| Coding            | RW   |                |          |

See *Threshold Detector 1 Output* (12.001).

| Parameter         | 12.005 Threshold Detector 1 Hysteresis        |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the hysteresis for threshold detector |                |          |
| Mode              | Open-Loop                                     |                |          |
| Minimum           | 0.00  | Maximum        | 25.00    |
| Default           | 0.00  | Units          | %        |
| Type              | 16 Bit User Save                              | Update Rate    | 4ms read |
| Display Format    | Standard                                      | Decimal Places | 2        |
| Coding            | RW  |                |          |

See *Threshold Detector 1 Output* (12.001).

| Parameter         | 12.006 Threshold Detector 1 Output Invert             |                |          |
|-------------------|---|----------------|----------|
| Short description | Set to 1 to invert the output of threshold detector 1 |                |          |
| Mode              | Open-Loop   |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit User Save                                       | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW  |                |          |

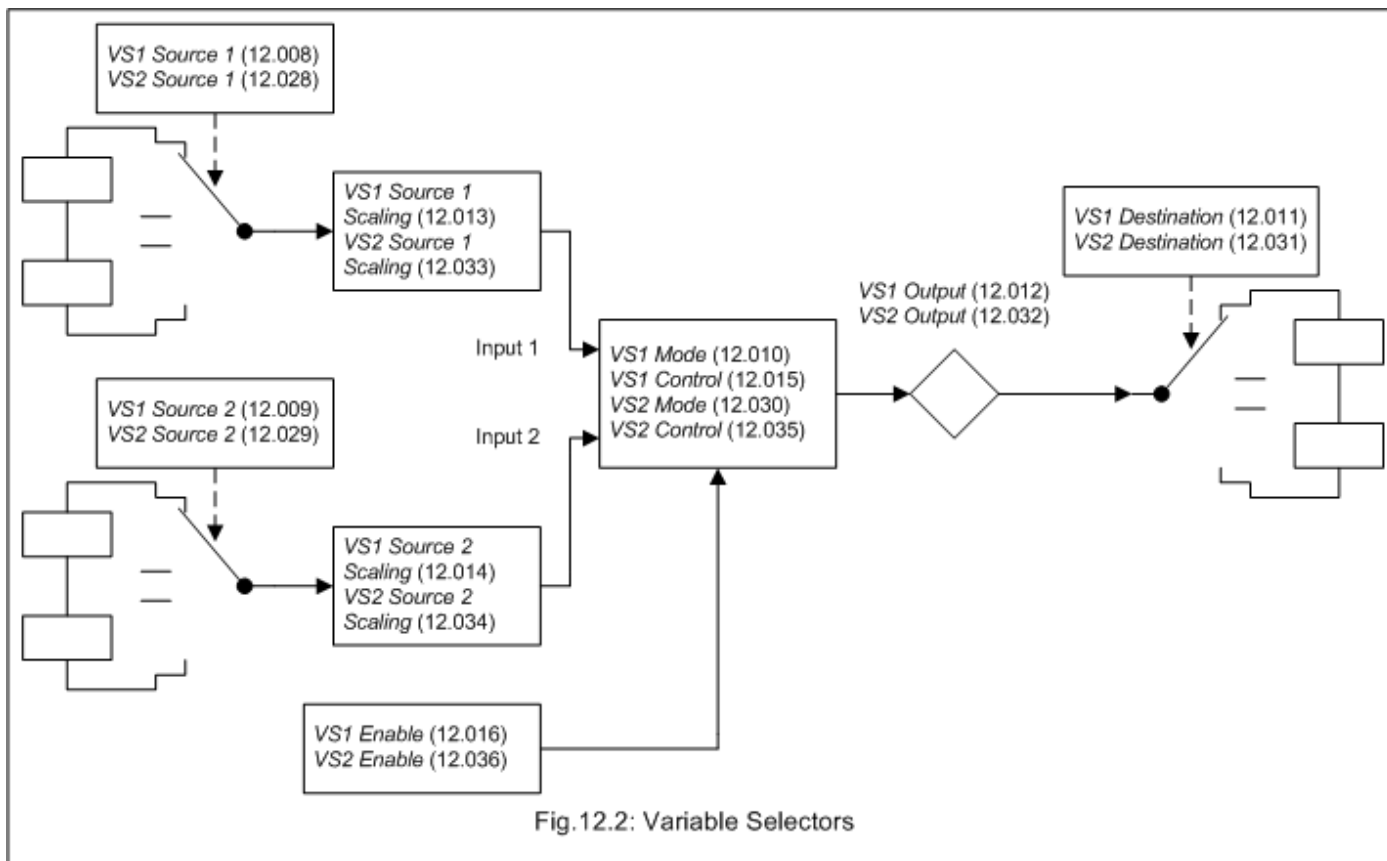
See *Threshold Detector 1 Output* (12.001).

| Parameter         | 12.007 Threshold Detector 1 Destination                    |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the destination parameter for threshold detector 1 |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0.000  | Maximum        | 30.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU   |                |                  |

See *Threshold Detector 1 Output* (12.001).

| Parameter         | 12.008 Variable Selector 1 Source 1                      |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the 1st source parameter for variable selector 1 |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0.000  | Maximum        | 30.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, PT, BU   |                |                  |

The variable selector functions are always active even if the source and destination are not routed to valid parameters. If a source is not a valid parameter then the source value is taken as 0. The update rate for each of the variable selector functions is always 4ms.



The following description is for variable selector 1, but variable selector 2 operates in the same way. The source parameters selected with *Variable Selector 1 Source 1* (12.008) and *Variable Selector 1 Source 2* (12.009) are converted to a percentage value, scaled with *Variable Selector 1 Source 1 Scaling* (12.013) and *Variable Selector 1 Source 2 Scaling* (12.014) respectively and then combined with a function defined by *Variable Selector 1 Mode* (12.010) to give *Variable Selector 1 Output* (12.012) as a percentage value. If *Variable Selector 1 Enable* (12.016) = 1 then the function operates normally. If *Variable Selector 1 Enable* (12.016) = 0 then *Variable Selector 1 Output* (12.012) = 0.00% and any states within the function are reset (i.e. the time constant function accumulator is held at zero). If the value of *Variable Selector 1 Mode* (12.010) is changed then all internal function state are also reset.

The table below shows the functions that can be selected with *Variable Selector 1 Mode* (12.010).

| <b>Variable Selector 1 Mode (12.010)</b> | <b>Variable Selector 1 Output (12.012)</b>  |
|--|---|
| 0: Input 1                               | Input 1   |
| 1: Input 2                               | Input 2   |
| 2: Add                                   | Input 1 + Input 2   |
| 3: Subtract                              | Input 1 - Input 2   |
| 4: Multiply                              | (Input 1 x Input 2) x 100.00%   |
| 5: Divide                                | (Input 1 x 100.00%) / Input 2   |
| 6: Time Const                            | Input 1 / (1 + ts) where τ <i>Variable Selector 1 Control</i> (12.015) seconds  |
| 7: Ramp                                  | Input 1 as an input to a linear ramp function where the time to ramp 0.00% to 100.00% is defined by <i>Variable Selector 1 Control</i> (12.015)   |
| 8: Modulus                               | Input 1   |
| 9: Powers                                | If <i>Variable Selector 1 Control</i> (12.015) = 0.02 then Input <sup>2</sup> / 100.00%<br>Else if <i>Variable Selector 1 Control</i> (12.015) = 0.03 then Input <sup>3</sup> / 100.00%<br>Else Input 1 |

| Parameter         | 12.009 <i>Variable Selector 1 Source 2</i>               |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the 2nd source parameter for variable selector 1 |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0.000  | Maximum        | 30.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, PT, BU   |                |                  |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.010 Variable Selector 1 Mode        |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the mode for variable selector |                |                 |
| Mode              | Open-Loop                              |                |                 |
| Minimum           | 0                                      | Maximum        | 9               |
| Default           | 0                                      | Units          |                 |
| Type              | 8 Bit User Save                        | Update Rate    | Background read |
| Display Format    | Standard                               | Decimal Places | 0               |
| Coding            | RW, TE                                 |                |                 |

| Value | Text |
|-------|------|
| 0     | 0    |
| 1     | 1    |
| 2     | 2    |
| 3     | 3    |
| 4     | 4    |
| 5     | 5    |
| 6     | 6    |
| 7     | 7    |
| 8     | 8    |
| 9     | 9    |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.011 Variable Selector 1 Destination                    |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the destination parameter for variable selector 1 |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0.000   | Maximum        | 30.999           |
| Default           | 0.000   | Units          |                  |
| Type              | 16 Bit User Save  | Update Rate    | Drive reset read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU  |                |                  |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.012 Variable Selector 1 Output          |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays the output of variable selector 1 |                |           |
| Mode              | Open-Loop                                  |                |           |
| Minimum           | -100.00                                    | Maximum        | 100.00    |
| Default           |  | Units          | %         |
| Type              | 16 Bit Volatile                            | Update Rate    | 4ms write |
| Display Format    | Standard                                   | Decimal Places | 2         |
| Coding            | RO, ND, NC, PT                             |                |           |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.013 Variable Selector 1 Source 1 Scaling                   |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the scaling for the 1st input for variable selector 1 |                |          |
| Mode              | Open-Loop   |                |          |
| Minimum           | -4.000  | Maximum        | 4.000    |
| Default           | 1.000   | Units          |          |
| Type              | 16 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 3        |
| Coding            | RW  |                |          |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.014 Variable Selector 1 Source 2 Scaling                   |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the scaling for the 2nd input for variable selector 1 |                |          |
| Mode              | Open-Loop   |                |          |
| Minimum           | -4.000  | Maximum        | 4.000    |
| Default           | 1.000   | Units          |          |
| Type              | 16 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 3        |
| Coding            | RW  |                |          |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.015 Variable Selector 1 Control          |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the control for variable selector 1 |                |          |
| Mode              | Open-Loop                                   |                |          |
| Minimum           | 0.00  | Maximum        | 100.00   |
| Default           | 0.00  | Units          |          |
| Type              | 16 Bit User Save                            | Update Rate    | 4ms read |
| Display Format    | Standard                                    | Decimal Places | 2        |
| Coding            | RW  |                |          |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.016 Variable Selector 1 Enable |                |          |
|-------------------|-----------------------------------|----------------|----------|
| Short description | Enables variable selector 1       |                |          |
| Mode              | Open-Loop                         |                |          |
| Minimum           | 0                                 | Maximum        | 1        |
| Default           | 1                                 | Units          |          |
| Type              | 1 Bit User Save                   | Update Rate    | 4ms read |
| Display Format    | Standard                          | Decimal Places | 0        |
| Coding            | RW, BU                            |                |          |

See *Variable Selector 1 Source 1* (12.008) for more details. *Variable Selector 1 Enable* (12.016) and *Variable Selector 2 Enable* (12.036) have a default of 1 so that if these parameters are not used the variable selectors will still function.

| Parameter         | 12.023 Threshold Detector 2 Source                    |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the source parameter for threshold detector 2 |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0.000   | Maximum        | 30.999           |
| Default           | 0.000   | Units          |                  |
| Type              | 16 Bit User Save                                      | Update Rate    | Drive reset read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, PT, BU  |                |                  |

See *Threshold Detector 1 Output* (12.001).

| Parameter         | 12.024 Threshold Detector 2 Level                    |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the reference level for threshold detector 2 |                |          |
| Mode              | Open-Loop  |                |          |
| Minimum           | 0.00   | Maximum        | 100.00   |
| Default           | 0.00   | Units          | %        |
| Type              | 16 Bit User Save                                     | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 2        |
| Coding            | RW   |                |          |

See *Threshold Detector 1 Output* (12.001).

| Parameter         | 12.025 Threshold Detector 2 Hysteresis          |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the hysteresis for threshold detector 2 |                |          |
| Mode              | Open-Loop                                       |                |          |
| Minimum           | 0.00  | Maximum        | 25.00    |
| Default           | 0.00  | Units          | %        |
| Type              | 16 Bit User Save                                | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 2        |
| Coding            | RW  |                |          |

See *Threshold Detector 1 Output* (12.001).

| Parameter         | 12.026 Threshold Detector 2 Output Invert             |                |          |
|-------------------|---|----------------|----------|
| Short description | Set to 1 to invert the output of threshold detector 2 |                |          |
| Mode              | Open-Loop   |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit User Save                                       | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW  |                |          |

See *Threshold Detector 1 Output* (12.001).

| Parameter         | 12.027 Threshold Detector 2 Destination                    |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the destination parameter for threshold detector 2 |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0.000  | Maximum        | 30.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU   |                |                  |

See *Threshold Detector 1 Output* (12.001).

| Parameter         | 12.028 Variable Selector 2 Source 1                      |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the 1st source parameter for variable selector 2 |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0.000  | Maximum        | 30.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, PT, BU   |                |                  |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.029 Variable Selector 2 Source 2                      |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the 2nd source parameter for variable selector 2 |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0.000  | Maximum        | 30.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, PT, BU   |                |                  |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.030 Variable Selector 2 Mode          |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the mode for variable selector 2 |                |                 |
| Mode              | Open-Loop                                |                |                 |
| Minimum           | 0  | Maximum        | 9               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save                          | Update Rate    | Background read |
| Display Format    | Standard                                 | Decimal Places | 0               |
| Coding            | RW, TE                                   |                |                 |

| Value | Text |
|-------|------|
| 0     | 0    |
| 1     | 1    |
| 2     | 2    |
| 3     | 3    |
| 4     | 4    |
| 5     | 5    |
| 6     | 6    |
| 7     | 7    |
| 8     | 8    |
| 9     | 9    |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.031 Variable Selector 2 Destination                    |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the destination parameter for variable selector 2 |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0.000   | Maximum        | 30.999           |
| Default           | 0.000   | Units          |                  |
| Type              | 16 Bit User Save  | Update Rate    | Drive reset read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU  |                |                  |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.032 Variable Selector 2 Output          |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays the output of variable selector 2 |                |           |
| Mode              | Open-Loop                                  |                |           |
| Minimum           | -100.00                                    | Maximum        | 100.00    |
| Default           |  | Units          | %         |
| Type              | 16 Bit Volatile                            | Update Rate    | 4ms write |
| Display Format    | Standard                                   | Decimal Places | 2         |
| Coding            | RO, ND, NC, PT                             |                |           |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.033 Variable Selector 2 Source 1 Scaling                   |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the scaling for the 1st input for variable selector 2 |                |          |
| Mode              | Open-Loop   |                |          |
| Minimum           | -4.000  | Maximum        | 4.000    |
| Default           | 1.000   | Units          |          |
| Type              | 16 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 3        |
| Coding            | RW  |                |          |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.034 Variable Selector 2 Source 2 Scaling                   |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the scaling for the 2nd input for variable selector 2 |                |          |
| Mode              | Open-Loop   |                |          |
| Minimum           | -4.000  | Maximum        | 4.000    |
| Default           | 1.000   | Units          |          |
| Type              | 16 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 3        |
| Coding            | RW  |                |          |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.035 Variable Selector 2 Control          |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the control for variable selector 2 |                |          |
| Mode              | Open-Loop                                   |                |          |
| Minimum           | 0.00  | Maximum        | 100.00   |
| Default           | 0.00  | Units          |          |
| Type              | 16 Bit User Save                            | Update Rate    | 4ms read |
| Display Format    | Standard                                    | Decimal Places | 2        |
| Coding            | RW, BU                                      |                |          |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.036 Variable Selector 2 Enable |                |          |
|-------------------|-----------------------------------|----------------|----------|
| Short description | Enables variable selector 2       |                |          |
| Mode              | Open-Loop                         |                |          |
| Minimum           | 0                                 | Maximum        | 1        |
| Default           | 1                                 | Units          |          |
| Type              | 1 Bit User Save                   | Update Rate    | 4ms read |
| Display Format    | Standard                          | Decimal Places | 0        |
| Coding            | RW, BU                            |                |          |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.040 BC Brake Release   |                |           |
|-------------------|---|----------------|-----------|
| Short description | Indicates that the brake controller has released the mechanical brake |                |           |
| Mode              | Open-Loop   |                |           |
| Minimum           | 0   | Maximum        | 1         |
| Default           |   | Units          |           |
| Type              | 1 Bit Volatile  | Update Rate    | 4ms write |
| Display Format    | Standard  | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT  |                |           |

The functions of *BC Brake Release* (12.040) and *BC Enable* (12.041) are the same in all drive modes and are described below. The functions of other brake controller parameters vary between drive modes, and these are described in separate sections.

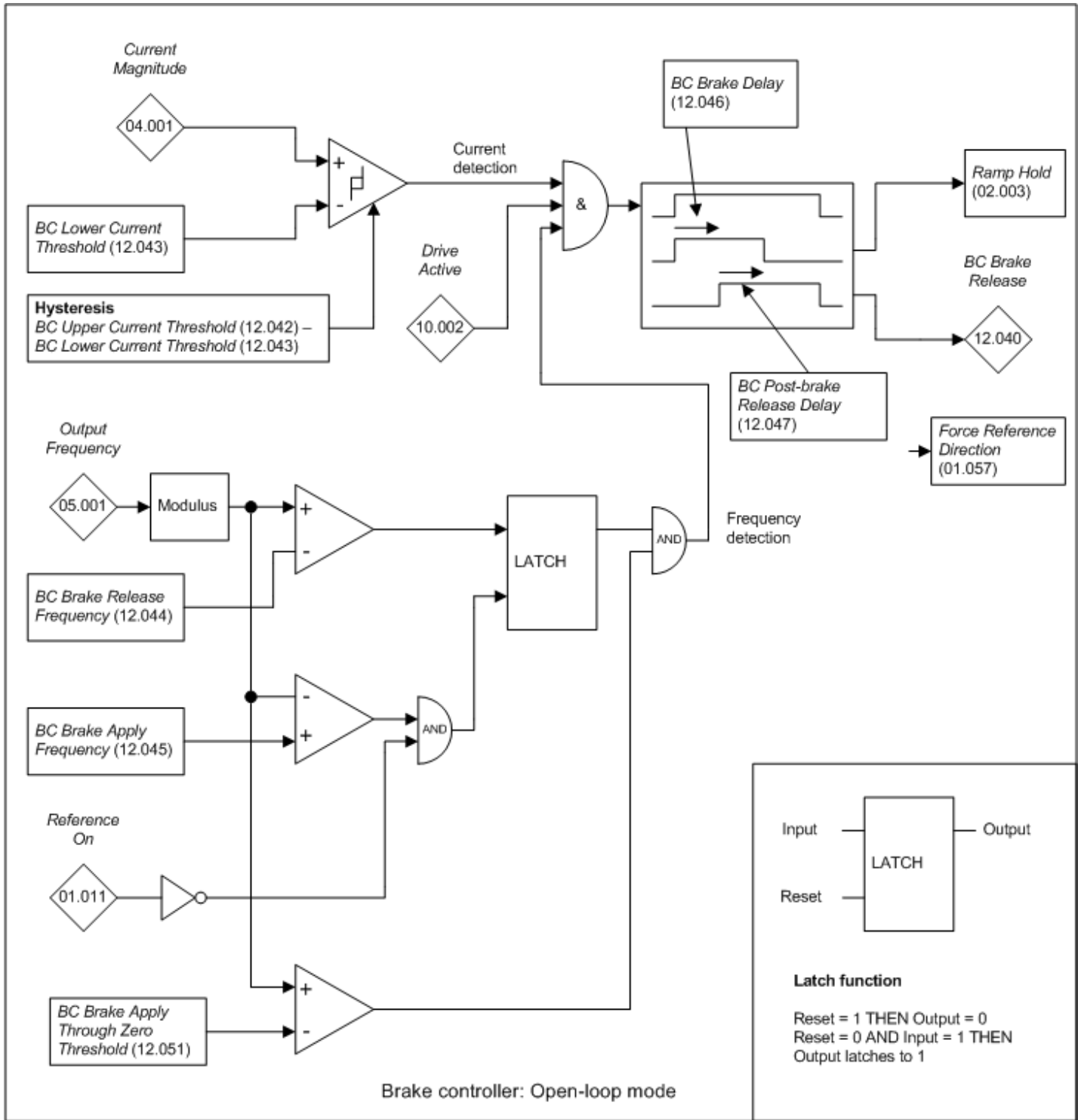
The mechanical brake control function can be used to control an electro-mechanical brake via digital I/O.

*BC Brake Release* (12.040) = 0 when the brake should be applied and 1 when the brake should be released. Normally this should be routed to a digital output to control the mechanical brake.

If *BC Enable* (12.041) = 0 then the brake controller is disabled. The following parameters which are used by the brake controller to operate the drive are reset to 0 on the transition of *BC Enable* (12.041) from 1 to 0.

| Parameter                                 |
|---|
| <i>Force Reference Direction</i> (01.057) |
| <i>Ramp Hold</i> (02.003)                 |

**Open loop mode**



**Current detection**

The *Current Magnitude* (04.001) is compared to an upper and lower threshold by a comparator with hysteresis to give torque present and drive output open detection functions respectively. *BC Lower Current Threshold* (12.043) and *BC Upper Current Threshold* (12.042) are given as a percentage of *Motor Rated Current* (05.007). *BC Upper Current Threshold* (12.042) should be set to the current level that indicates that there is magnetising current and sufficient torque producing current in the motor to deliver the required amount of torque when the brake is released. The output of the comparator remains active after this level has been reached unless the current subsequently falls below *BC Lower Current Threshold* (12.043) which should be set to the required level to detect the condition where the motor has been disconnected from the drive. If *BC Lower Current Threshold* (12.043)  $\geq$  *BC Upper Current Threshold* (12.042) then the upper threshold applies with a hysteresis band of 0. If *BC Lower Current Threshold* (12.043) = *BC Upper Current Threshold* (12.042) = 0 then the output of the comparator is always one.

**Frequency detection**

The frequency comparator is used on starting, to detect when the motor frequency has reached a level where the motor can produce the required amount of torque to ensure that the motor rotates in the demanded direction when the brake is released. *BC Brake Release Frequency* (12.044) should be set to

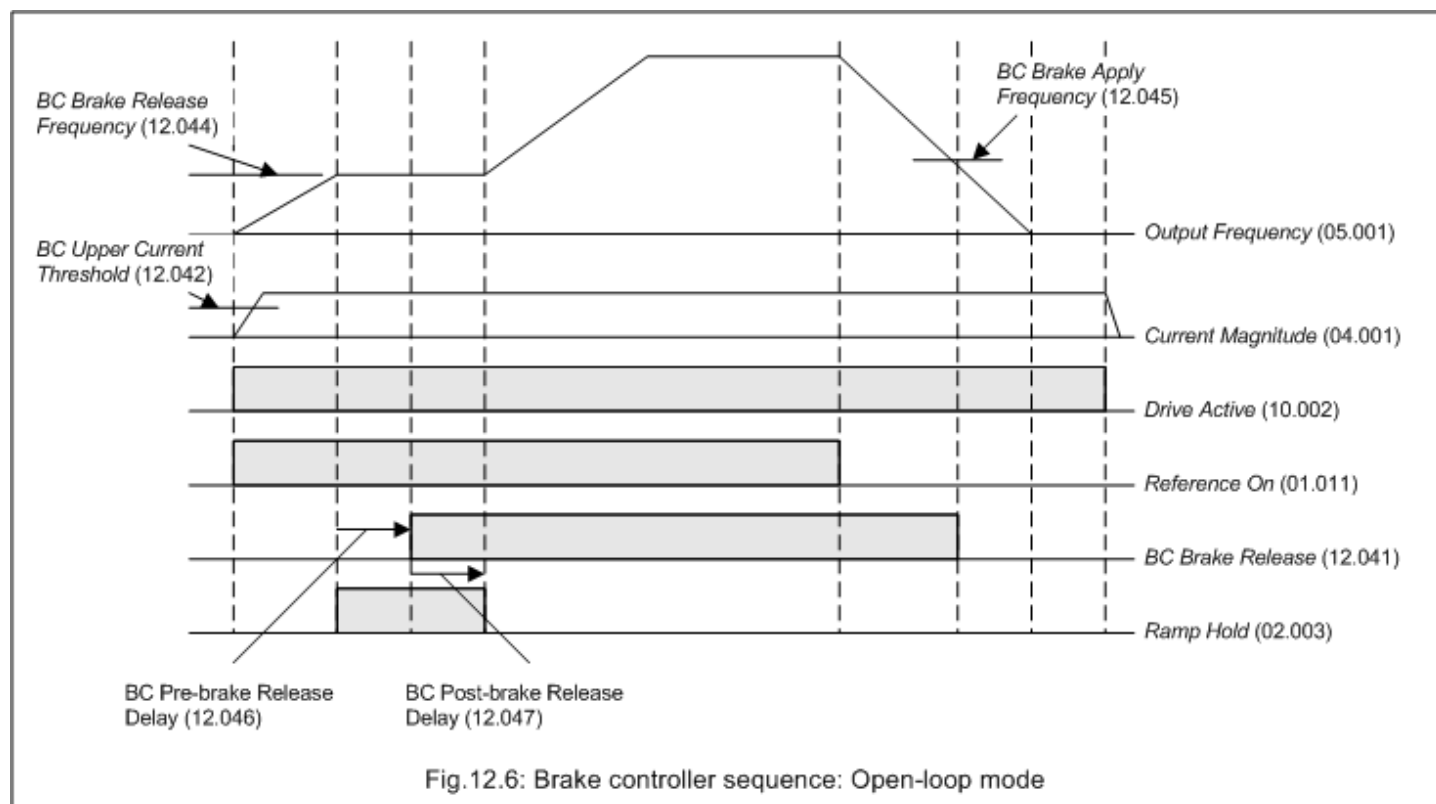


a level slightly above the motor slip frequency that is likely to occur under the highest expected load that is applied to the motor when the brake is released.

The brake apply frequency threshold is used to ensure that the brake is applied before the motor frequency reaches zero and to prevent the motor rotating (in the reverse direction due to an overhauling load for example) during the brake apply time. If the frequency falls below *BC Brake Apply Frequency* (12.045), but the motor is not required to stop (i.e. reversing direction without stopping) then *Reference On* (01.011) will be one, and so the brake is not applied. This prevents the brake from activating and de-activating as the motor passes through zero speed. If the frequency falls below *BC Brake Apply Frequency* (12.045) and *Reference On* (01.011) = 0 then the brake will be applied.

#### Brake controller sequence

The brake controller sequence is shown for forward movement in the diagram below.



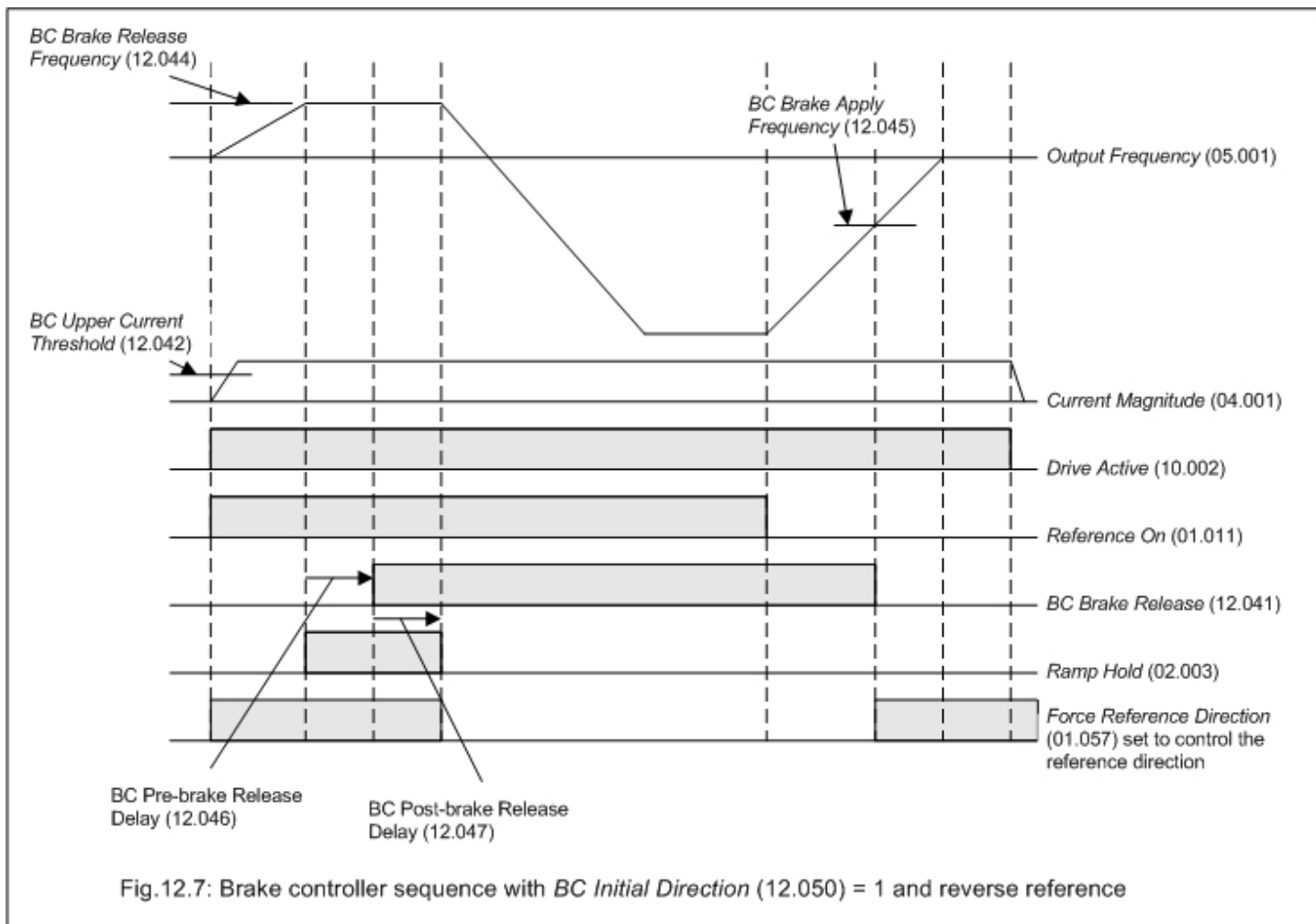
The current detection, frequency detection and *Drive Active* (10.002) levels are used to allow the brake to be released. *BC Brake Delay* (12.046) is the delay allowed after the correct current and frequency levels have been detected before the brake is released. *BC Post-brake Release Delay* (12.047) is the time allowed for the brake to be released before the frequency is allowed to increase above the *BC Brake Release Frequency* (12.044).

#### Applying the brake as the frequency passes through zero

In Open-loop mode the torque produced may reduce as the frequency passes through zero. To prevent the load from falling during this period in a vertical application, it is possible to apply the brake momentarily to hold the load. If *BC Brake Apply Through Zero Threshold* (12.051) = 0 then the brake is not applied when the frequency passes through zero unless *Reference On* (01.011) = 0. If *BC Brake Apply Through Zero Threshold* (12.051) is non-zero then the brake is always applied when the modulus of frequency is less than *BC Brake Apply Through Zero Threshold* (12.051) even if *Reference On* (01.011) = 1. This ensures that the brake is applied and then released as the frequency passes through zero. *BC Brake Apply Through Zero Threshold* (12.051) should be set to a value that is lower than both *BC Brake Release Frequency* (12.044) and *BC Brake Apply Frequency* (12.045) so that it does not interfere with the control of the brake when starting and stopping.

#### Forced initial direction

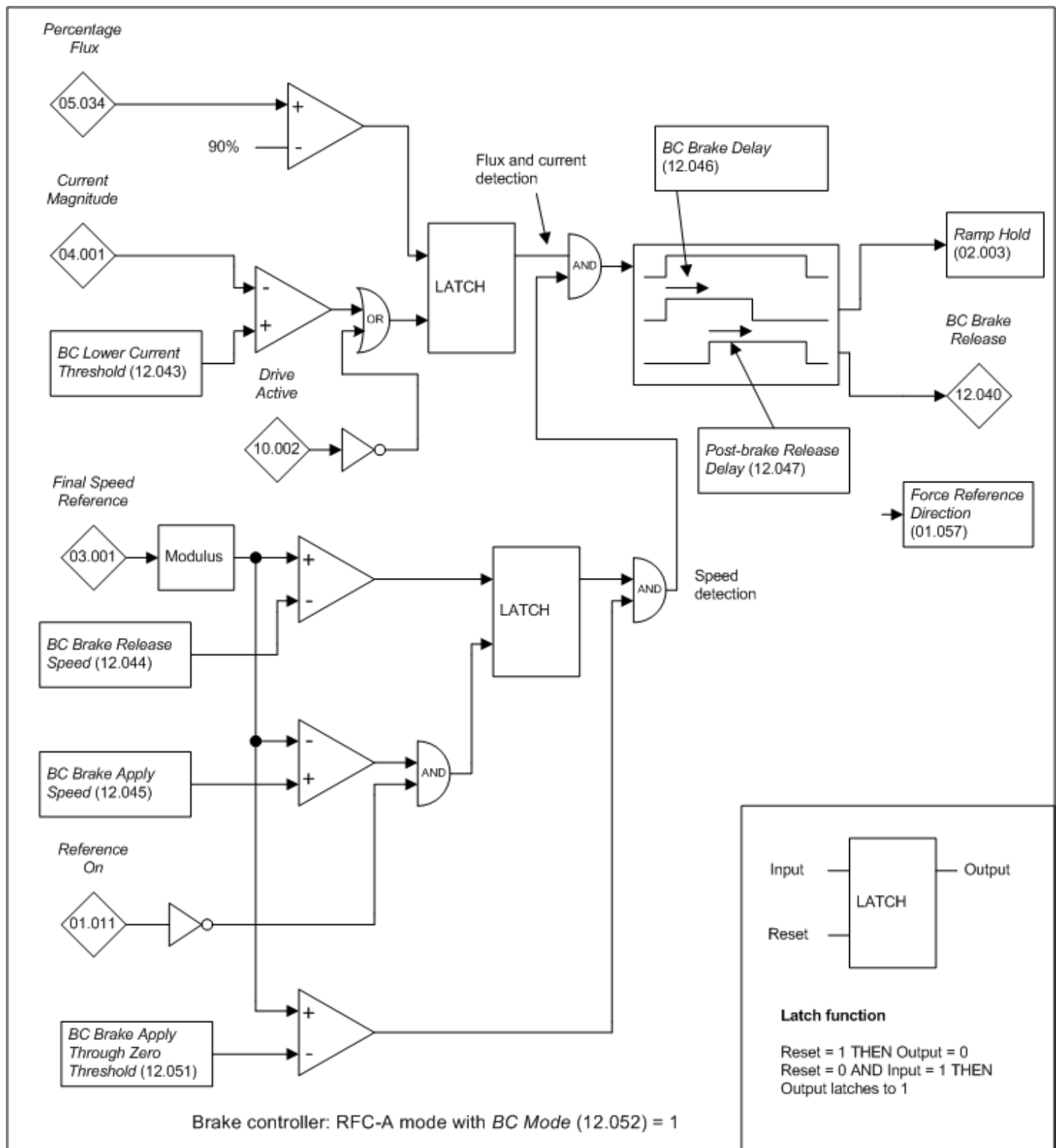
If *BC Initial Direction* (12.050) = 0 then the brake controller operates as described above and the user reference is used to define the direction of operation. If *BC Initial Direction* (12.050) = 1 then *Force Reference Direction* (01.057) is used force the frequency reference to the positive modulus of its value until the end of the post-brake release period whatever the direction of the reference from the user. This can be used for example to ensure that in a vertical application the motor will definitely hold the load at the point when the brake is released. The diagram below shows the brake controller sequence when *BC Initial Direction* (12.050) = 1, but the user reference direction is reverse. It should be noted that *BC Initial Direction* (12.050) has no effect if *BC Brake Apply Through Zero Threshold* (12.051) is non-zero, and that the reference direction is always used as the initial direction, to prevent a condition where the brake would release then apply repeatedly.



If *BC Initial Direction* (12.050) = 2 then *Force Reference Direction* (01.057) is used to force the frequency reference to minus the modulus of its value until the end of the post-brake release period to ensure that the output frequency is negative during this period.

#### RFC-A

In closed loop mode, the torque produced may reduce as the frequency passes through zero. A brake controller similar to the one used for open loop mode is provided as shown in the diagram below.



The brake controller operates in the same way as the open loop mode brake controller except for the following differences.

1. *Final Demand Reference* (03.001) is used instead of *Output Frequency* (05.001).
2. The frequency thresholds are replaced with estimated frequency thresholds.
3. Current detection is replaced with flux and current detection as described below.

#### Flux and current detection

The flux and current detection signal is made active to allow the brake to be released when the motor flux exceeds 90% of its rated level. The flux and current detection signal remains active unless the motor current falls below *BC Lower Current Threshold* (12.043) or the drive is disabled. *BC Lower Current Threshold* (12.043) is used to detect if the motor has been disconnected from the drive and should be set to a suitable level to detect this condition.

| Parameter         | 12.041 BC Enable                   |                |                                    |
|-------------------|------------------------------------|----------------|------------------------------------|
| Short description | Enables the brake control function |                |                                    |
| Mode              | Open-Loop                          |                |                                    |
| Minimum           | 0                                  | Maximum        | 3                                  |
| Default           | 0                                  | Units          |                                    |
| Type              | 8 Bit User Save                    | Update Rate    | Action on exit from edit and reset |
| Display Format    | Standard                           | Decimal Places | 0                                  |
| Coding            | RW, TE                             |                |                                    |

| Value | Text   |
|-------|--------|
| 0     | Dis    |
| 1     | Relay  |
| 2     | dig IO |
| 3     | USEr   |

If *BC Enable* (12.041) = 0, the brake controller is disabled.

If *BC Enable* (12.041) = 1, the brake controller is enabled with I/O set up to control the brake via the relay output. Drive healthy is re-routed to digital I/O.

If *BC Enable* (12.041) = 2, the brake controller is enabled with I/O set up to control the brake via digital I/O. Drive healthy is routed to the relay output.

If *BC Enable* (12.041) = 3, the brake controller is enabled, but no parameters are set up to select the brake output.

| Previous value of BC Enable (12.041) | New value of BC Enable (12.041) | Digital I/O 1 Invert (08.011) | Relay 1 Invert (08.018) | Digital I/O 01 mode (08.031) | DO1 Control (08.091) | Relay 1 Control (08.098) |
|--------------------------------------|---------------------------------|-------------------------------|-------------------------|------------------------------|----------------------|--------------------------|
| Any                                  | 0                               | 0                             | 0                       | 1                            | 0                    | 0                        |
| Any                                  | 1                               | 0                             | 0                       | 1                            | 15                   | 18                       |
| Not 1                                | 2                               | 0                             | No change               | 1                            | 18                   | No change                |
| 1                                    | 2                               | 0                             | 0                       | 1                            | 18                   | 15                       |
| 0 or 1                               | 3                               | 0                             | 0                       | 1                            | 0                    | 0                        |
| 2                                    | 3                               | 0                             | No change               | 1                            | 0                    | 0                        |

Action will only occur if the drive is inactive, not in UU state and no User Actions are running. Otherwise, the parameter will return to its pre altered value on exit from edit mode.

All parameters are saved if this parameter changes.

See *BC Brake Release* (12.040)

| Parameter         | 12.042 BC Upper Current Threshold                 |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the upper current threshold for the brake |                |          |
| Mode              | Open-Loop   |                |          |
| Minimum           | 0   | Maximum        | 200      |
| Default           | 50  | Units          | %        |
| Type              | 8 Bit User Save                                   | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW, BU  |                |          |

See *BC Brake Release* (12.040).

| Parameter         | 12.043 BC Lower Current Threshold             |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the lower current limit for the brake |                |          |
| Mode              | Open-Loop                                     |                |          |
| Minimum           | 0   | Maximum        | 200      |
| Default           | 10  | Units          | %        |
| Type              | 8 Bit User Save                               | Update Rate    | 4ms read |
| Display Format    | Standard                                      | Decimal Places | 0        |
| Coding            | RW, BU  |                |          |

See *BC Brake Release* (12.040).

| Parameter         | 12.044 BC Brake Release Frequency   |                |          |
|-------------------|-------------------------------------|----------------|----------|
| Short description | Defines the brake release frequency |                |          |
| Mode              | Open-Loop                           |                |          |
| Minimum           | 0.00                                | Maximum        | 20.00    |
| Default           | 1.00                                | Units          | Hz       |
| Type              | 16 Bit User Save                    | Update Rate    | 4ms read |
| Display Format    | Standard                            | Decimal Places | 2        |
| Coding            | RW, BU                              |                |          |

See *BC Brake Release* (12.040).

| Parameter         | 12.045 BC Brake Apply Frequency   |                |          |
|-------------------|-----------------------------------|----------------|----------|
| Short description | Defines the brake apply frequency |                |          |
| Mode              | Open-Loop                         |                |          |
| Minimum           | 0.00                              | Maximum        | 20.00    |
| Default           | 2.00                              | Units          | Hz       |
| Type              | 16 Bit User Save                  | Update Rate    | 4ms read |
| Display Format    | Standard                          | Decimal Places | 2        |
| Coding            | RW, BU                            |                |          |

See BC Brake Release (12.040).

| Parameter         | 12.046 BC Brake Delay               |                |          |
|-------------------|-------------------------------------|----------------|----------|
| Short description | Defines the pre-brake release delay |                |          |
| Mode              | Open-Loop                           |                |          |
| Minimum           | 0.0                                 | Maximum        | 25.0     |
| Default           | 1.0                                 | Units          | s        |
| Type              | 16 Bit User Save                    | Update Rate    | 4ms read |
| Display Format    | Standard                            | Decimal Places | 1        |
| Coding            | RW, BU                              |                |          |

See BC Brake Release (12.040).

| Parameter         | 12.047 BC Post-brake Release Delay   |                |          |
|-------------------|--------------------------------------|----------------|----------|
| Short description | Defines the post-brake release delay |                |          |
| Mode              | Open-Loop                            |                |          |
| Minimum           | 0.0                                  | Maximum        | 25.0     |
| Default           | 1.0                                  | Units          | s        |
| Type              | 16 Bit User Save                     | Update Rate    | 4ms read |
| Display Format    | Standard                             | Decimal Places | 1        |
| Coding            | RW, BU                               |                |          |

See BC Brake Release (12.040).

| Parameter         | 12.050 BC Initial Direction                |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the initial direction of the brake |                |          |
| Mode              | Open-Loop                                  |                |          |
| Minimum           | 0  | Maximum        | 2        |
| Default           | 0  | Units          |          |
| Type              | 8 Bit User Save                            | Update Rate    | 4ms read |
| Display Format    | Standard                                   | Decimal Places | 0        |
| Coding            | RW, TE                                     |                |          |

| Value | Text |
|-------|------|
| 0     | reF  |
| 1     | For  |
| 2     | Rev  |

See BC Brake Release (12.040).

| Parameter         | 12.051 BC Brake Apply Through Zero Threshold           |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines if the brake is applied through zero threshold |                |          |
| Mode              | Open-Loop  |                |          |
| Minimum           | 0.00   | Maximum        | 20.00    |
| Default           | 1.00   | Units          | Hz       |
| Type              | 16 Bit User Save                                       | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 2        |
| Coding            | RW, BU   |                |          |

See BC Brake Release (12.040).

## Menu 14 Single Line Descriptions – User PID Controller

Mode: Open-Loop

| Parameter |                                     | Range             | Default   | Type |     |    |    |    |    |
|-----------|-------------------------------------|-------------------|-----------|------|-----|----|----|----|----|
| 14.001    | PID1 Output                         | ±100.00 %         |           | RO   | Num | ND | NC | PT |    |
| 14.002    | PID1 Feed-forwards Reference Source | 0.000 to 59.999   | 0.000     | RW   | Num |    |    | PT | US |
| 14.003    | PID1 Reference Source               | 0.000 to 59.999   | 0.000     | RW   | Num |    |    | PT | US |
| 14.004    | PID1 Feedback Source                | 0.000 to 59.999   | 0.000     | RW   | Num |    |    | PT | US |
| 14.005    | PID1 Reference Invert               | Off (0) or On (1) | Off (0)   | RW   | Bit |    |    |    | US |
| 14.006    | PID1 Feedback Invert                | Off (0) or On (1) | Off (0)   | RW   | Bit |    |    |    | US |
| 14.007    | PID1 Reference Slew Rate            | 0.0 to 3200.0 s   | 0.0 s     | RW   | Num |    |    |    | US |
| 14.008    | PID1 Enable                         | Off (0) or On (1) | Off (0)   | RW   | Bit |    |    |    | US |
| 14.009    | PID1 Enable Source 1                | 0.000 to 59.999   | 0.000     | RW   | Num |    |    | PT | US |
| 14.010    | PID1 Proportional Gain              | 0.000 to 4.000    | 1.000     | RW   | Num |    |    |    | US |
| 14.011    | PID1 Integral Gain                  | 0.000 to 4.000    | 0.500     | RW   | Num |    |    |    | US |
| 14.012    | PID1 Differential Gain              | 0.000 to 4.000    | 0.000     | RW   | Num |    |    |    | US |
| 14.013    | PID1 Output Upper Limit             | 0.00 to 100.00 %  | 100.00 %  | RW   | Num |    |    |    | US |
| 14.014    | PID1 Output Lower Limit             | ±100.00 %         | -100.00 % | RW   | Num |    |    |    | US |
| 14.015    | PID1 Output Scaling                 | 0.000 to 4.000    | 1.000     | RW   | Num |    |    |    | US |
| 14.016    | PID1 Destination                    | 0.000 to 59.999   | 0.000     | RW   | Num | DE |    | PT | US |
| 14.017    | PID1 Integral Hold                  | Off (0) or On (1) | Off (0)   | RW   | Bit |    |    |    |    |
| 14.018    | PID1 Symmetrical Limit Enable       | Off (0) or On (1) | Off (0)   | RW   | Bit |    |    |    | US |
| 14.019    | PID1 Feed-forwards Reference        | ±100.00 %         |           | RO   | Num | ND | NC | PT |    |
| 14.020    | PID1 Reference                      | ±100.00 %         |           | RO   | Num | ND | NC | PT |    |
| 14.021    | PID1 Feedback                       | ±100.00 %         |           | RO   | Num | ND | NC | PT |    |
| 14.022    | PID1 Error                          | ±100.00 %         |           | RO   | Num | ND | NC | PT |    |
| 14.023    | PID1 Reference Scaling              | 0.000 to 4.000    | 1.000     | RW   | Num |    |    |    | US |
| 14.024    | PID1 Feedback Scaling               | 0.000 to 4.000    | 1.000     | RW   | Num |    |    |    | US |
| 14.025    | PID1 Digital Reference              | ±100.00 %         | 0.00 %    | RW   | Num |    |    |    | US |
| 14.026    | PID1 Digital Feedback               | ±100.00 %         | 0.00 %    | RW   | Num |    |    |    | US |
| 14.027    | PID1 Enable Source 2                | 0.000 to 59.999   | 0.000     | RW   | Num |    |    | PT | US |

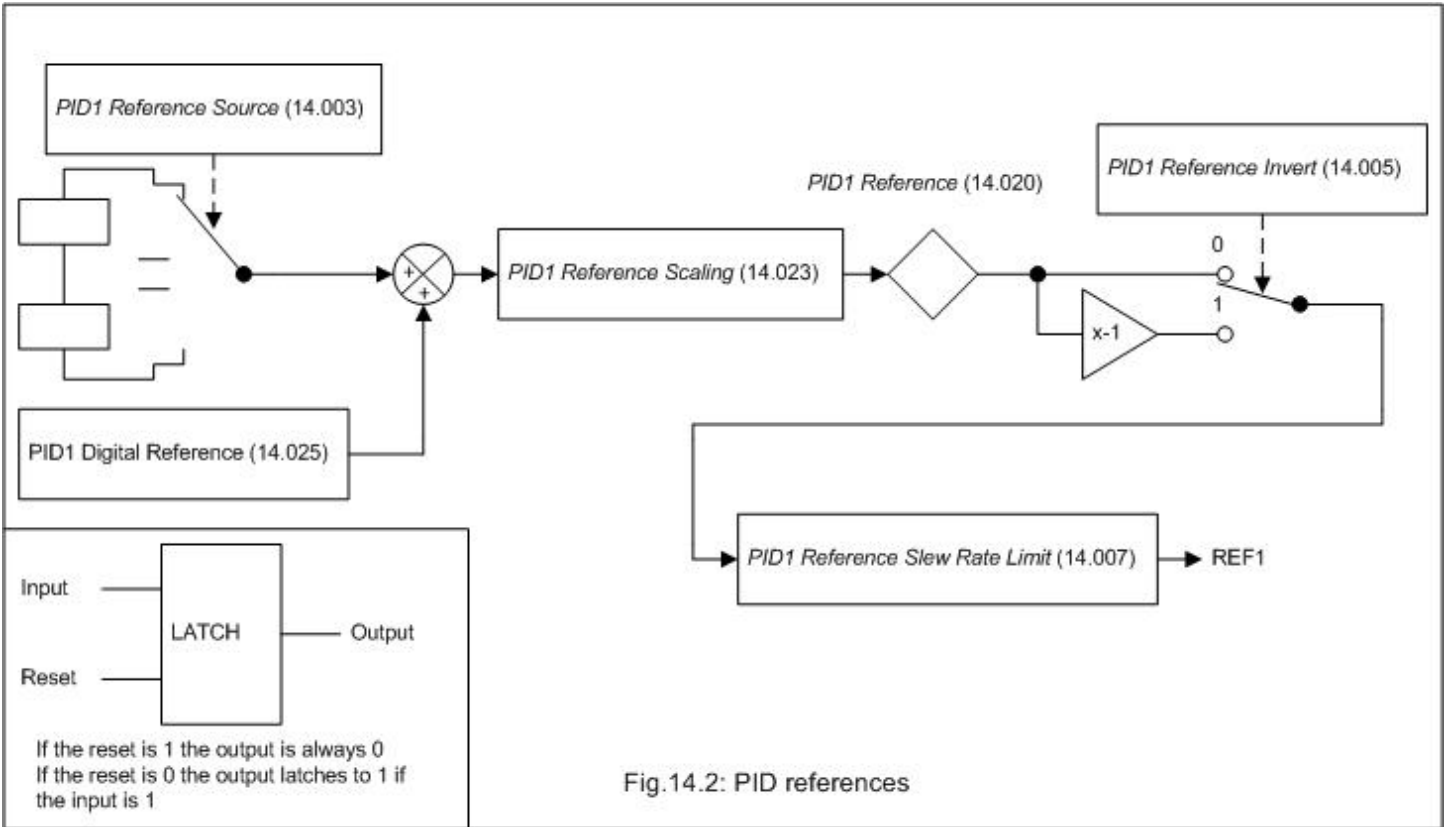
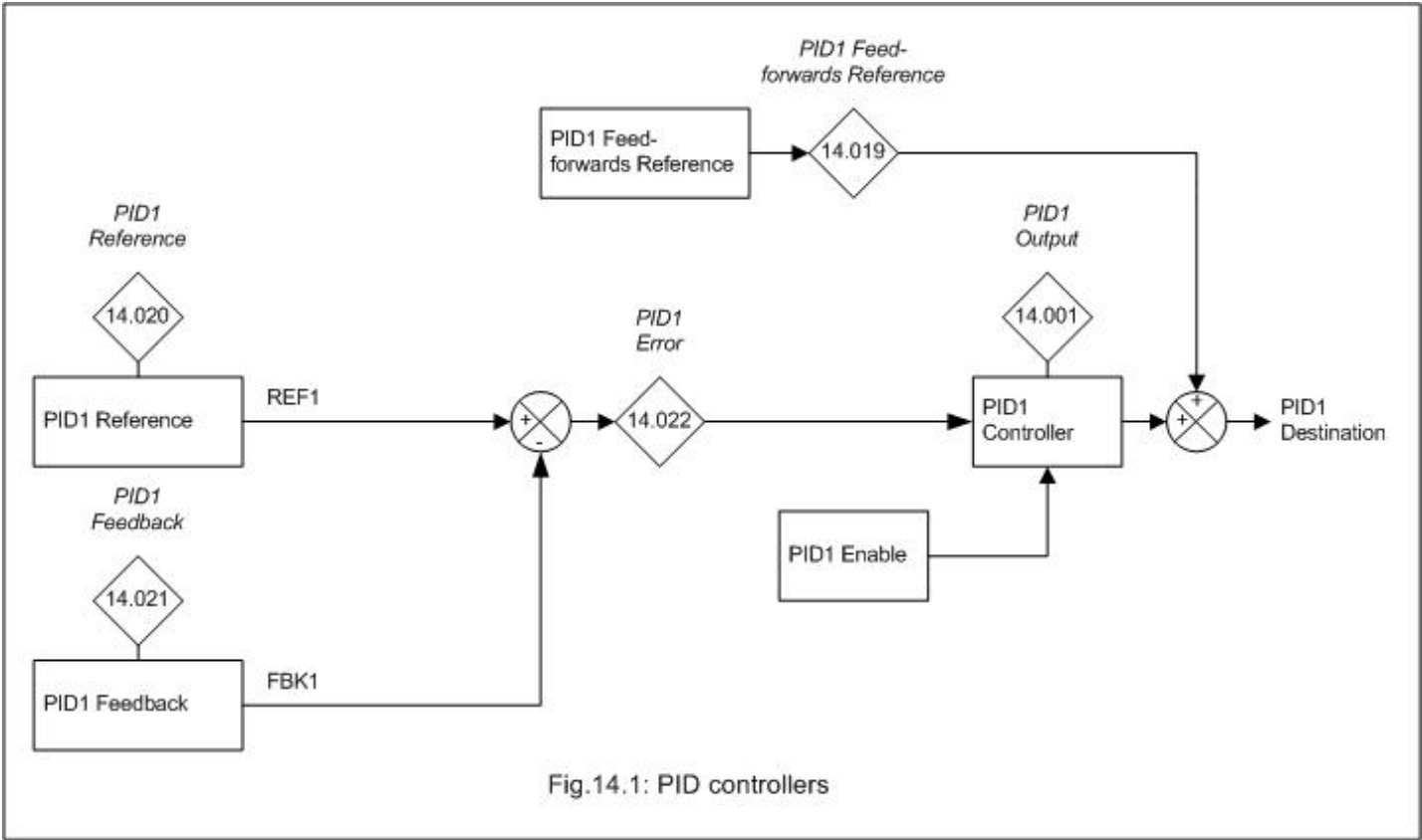
| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

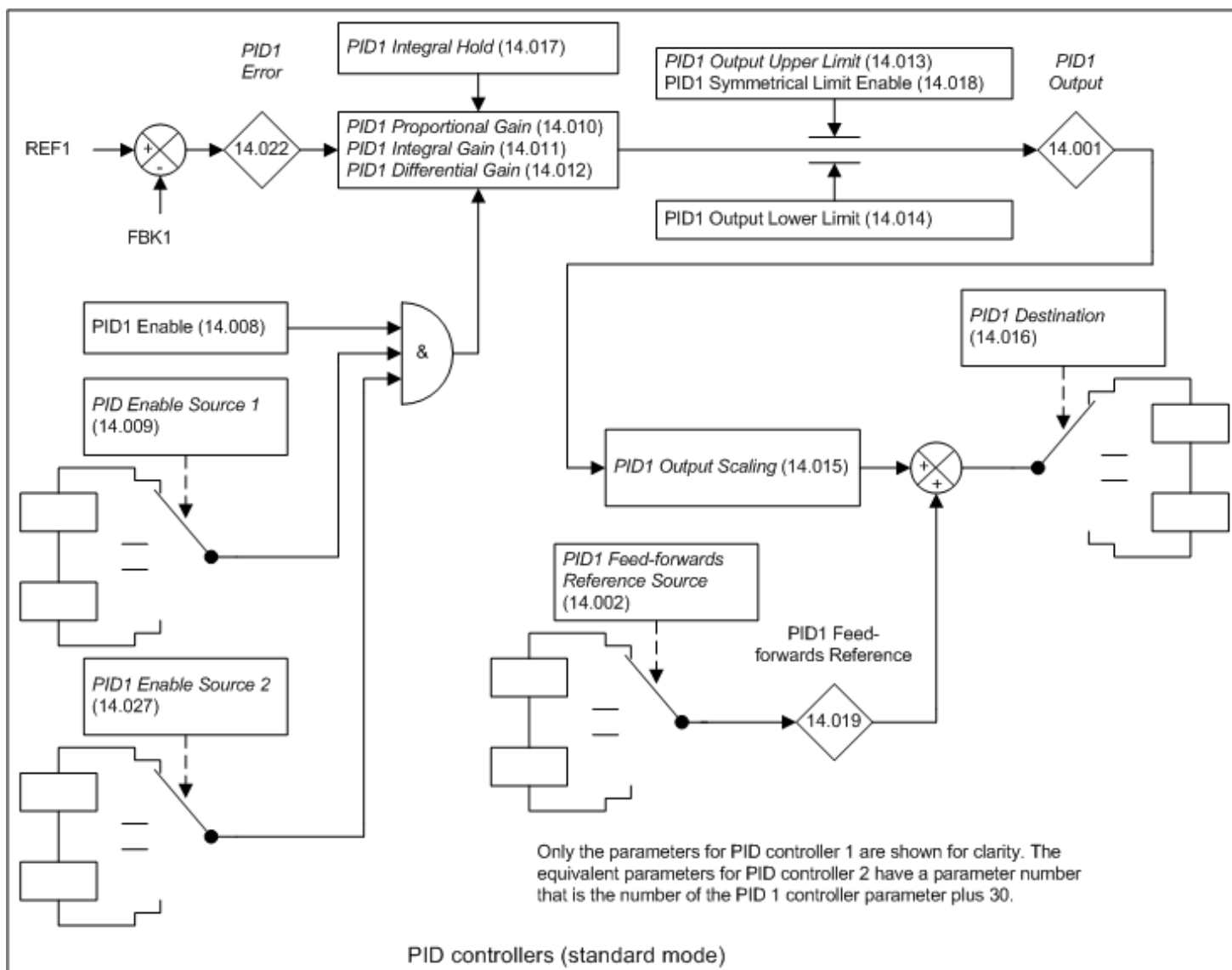
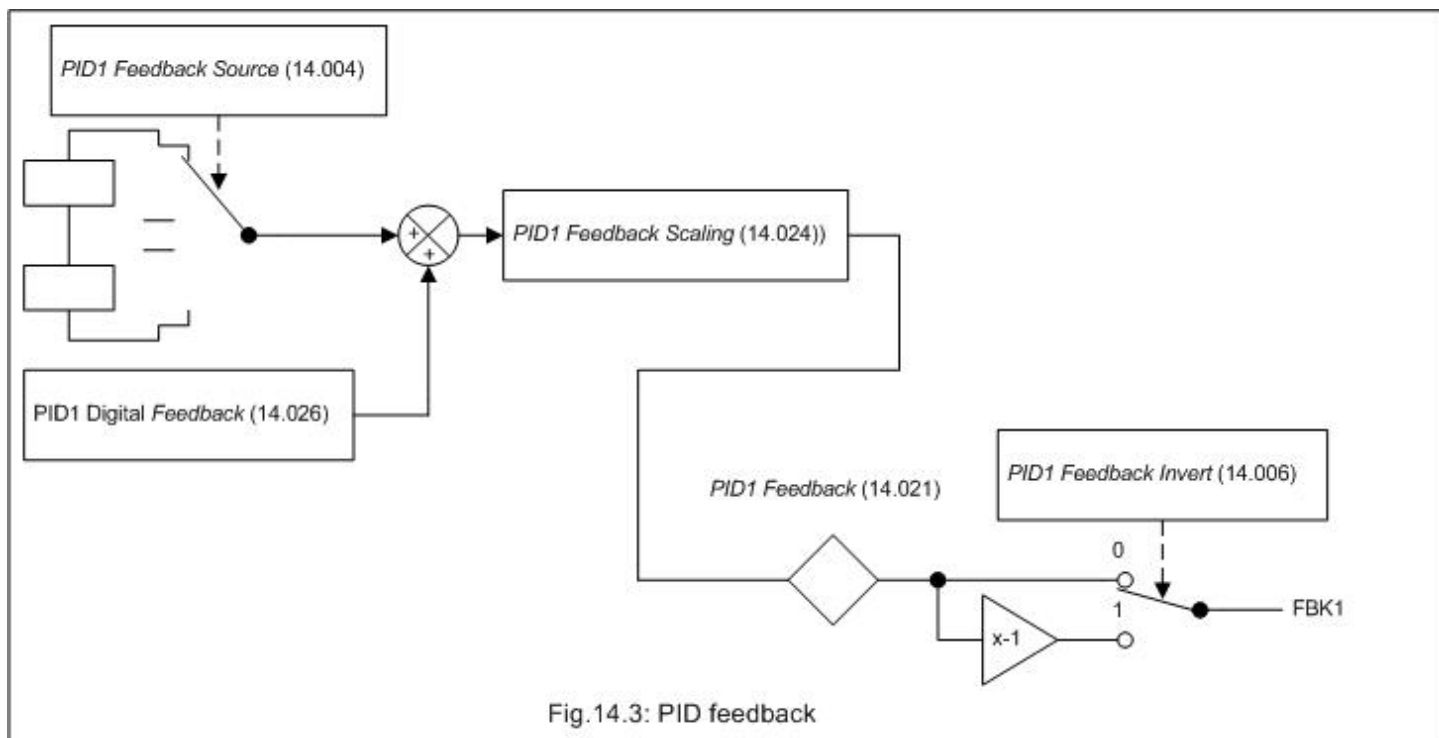
# Menu 14 – User PID Controller

Mode: Open-Loop

## PID controllers

One general purpose PID controllers is provided as shown in the diagram below. The sample rate for the PID controllers is always 4ms.







| Parameter         | 14.001 <i>PID1 Output</i>    |                |           |
|-------------------|------------------------------|----------------|-----------|
| Short description | Displays the output for PID1 |                |           |
| Mode              | Open-Loop                    |                |           |
| Minimum           | -100.00                      | Maximum        | 100.00    |
| Default           |                              | Units          | %         |
| Type              | 16 Bit Volatile              | Update Rate    | 4ms write |
| Display Format    | Standard                     | Decimal Places | 2         |
| Coding            | RO, ND, NC, PT               |                |           |

## Controller

The controller section for the PID controllers is shown in the introduction. If the enable is active the PID controller is active even if the destination is not routed to a valid parameter or to 0.000. It should be noted that if either of the enable sources is routed to 0.000 or to a non-valid parameter the source value is taken as 1, therefore with default settings, *PID1 Enable Source 1* (14.009) = 0.000 and *PID1 Enable Source 2* (14.027) = 0.000, the PID controller can be enabled by simply setting *PID1 Enable* (14.008).

*PID1 Error* (14.022) is the difference between the reference and feedback produced by the reference and feedback systems described in the previous sections. The PID controller output is defined as follows:

$$PID1\ Output\ (14.001) = PID1\ Error\ (14.022) \times [K_p + K_i/s + sK_d/(0.064s + 1)]$$

$K_p$  = *PID1 Proportional Gain* (14.010)

$K_i$  = *PID1 Integral Gain* (14.011)

$K_d$  = *PID1 Differential Gain* (14.012)

Therefore:

1. If *PID1 Error* (14.022) = 100.00% the proportional term gives a value of 100.00% if *PID1 Proportional Gain* (14.010) = 1.000.
2. If *PID1 Error* (14.022) = 100.00% the integral term gives a value that increases linearly by 100.00% per second if *PID1 Integral Gain* (14.011) = 1.000.
3. If *PID1 Error* (14.022) increases linearly by 100.00% per second the differential term gives a value of 100.00% if *PID1 Differential Gain* (14.012) = 1.000. (A filter with a time constant of 64ms is provided on the differential gain to reduce the noise produced by this term.)

The output may be limited to a range that is less than the maximum range of *PID1 Output* (14.001) using *PID1 Output Upper Limit* (14.013) and *PID1 Output Lower Limit* (14.014). If *PID1 Output Lower Limit* (14.014) > *PID1 Output Upper Limit* (14.013) then the output is held at the value defined by *PID1 Output Upper Limit* (14.013). If *PID1 Symmetrical Limit Enable* (14.018) = 1 then the lower limit = -(*PID1 Output Upper Limit* (14.013)). If the output reaches either of these limits the integral term accumulator is frozen until the output moves away from the limit to prevent integral wind-up. The integral hold function can also be enabled by the user by setting *PID1 Integral Hold* (14.017) = 1.

*PID1 Output Scaling* (14.015) can be used to scale the output, which is limited to a range from -100.00% to 100.00% after this function. The output is then added to *PID1 Feed-forwards Reference* (14.019) and is again limited to the range from -100.00% to 100.00% before being routed to the destination defined by *PID1 Destination* (14.016).

| Parameter         | 14.002 <i>PID1 Feed-forwards Reference Source</i>                        |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the input source for the feed-forwards reference source for PID1 |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0.000  | Maximum        | 59.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, PT, BU   |                |                  |

See *PID1 Output* (14.001).

| Parameter         | 14.003 <i>PID1 Reference Source</i>                 |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the input source for the reference for PID1 |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0.000   | Maximum        | 59.999           |
| Default           | 0.000   | Units          |                  |
| Type              | 16 Bit User Save                                    | Update Rate    | Drive reset read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, PT, BU  |                |                  |

The reference section for the PID controllers is shown in the introduction. The pre-sleep boost control is only included in PID controller 1. The reference sections are always active even if the PID controller itself is disabled or the reference sources are not routed to valid parameters. If a reference source is not a valid parameter or is 0.000 then the value is taken as zero.

The reference *PID1 Digital Reference* (14.025) is multiplied by *PID1 Reference Scaling* (14.023) and then limited to +/-100.00%. The reference can then be inverted if required (*PID1 Reference Invert* (14.005) = 1) and then a slew rate limit is applied with *PID1 Reference Slew Rate* (14.007). This limits the maximum rate of change so that a change from 0.00 to 100.00% takes the time given in *PID1 Reference Slew Rate* (14.007).

| Parameter         | 14.004 <i>PID1 Feedback Source</i>                 |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the input source for the feedback for PID1 |                |                  |
| Mode              | Open-Loop  |                |                  |
| Minimum           | 0.000  | Maximum        | 59.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save                                   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, PT, BU   |                |                  |

## Feedback

The feedback section for the PID controllers is shown in the introduction. The feedback sections are always active even if the PID controller itself is disabled or the feedback sources are not routed to valid parameters. If a reference source is not a valid parameter or is 0.000 then the value is taken as zero.

The feedback is the sum of the feedback source and the *PID1 Digital Feedback* (14.026). The result is multiplied by *PID1 Feedback Scaling* (14.024) and then limited to +/-100.00%. The feedback can be inverted if required (*PID1 Feedback Invert* (14.006) = 1).

| Parameter         | 14.005 <i>PID1 Reference Invert</i> |                |          |
|-------------------|-------------------------------------|----------------|----------|
| Short description | Set to 1 to invert PID1 reference   |                |          |
| Mode              | Open-Loop                           |                |          |
| Minimum           | 0                                   | Maximum        | 1        |
| Default           | 0                                   | Units          |          |
| Type              | 1 Bit User Save                     | Update Rate    | 4ms read |
| Display Format    | Standard                            | Decimal Places | 0        |
| Coding            | RW                                  |                |          |

See *PID1 Reference Source* (14.003).

| Parameter         | 14.006 <i>PID1 Feedback Invert</i>   |                |          |
|-------------------|--------------------------------------|----------------|----------|
| Short description | Set to 1 to invert the PID1 feedback |                |          |
| Mode              | Open-Loop                            |                |          |
| Minimum           | 0                                    | Maximum        | 1        |
| Default           | 0                                    | Units          |          |
| Type              | 1 Bit User Save                      | Update Rate    | 4ms read |
| Display Format    | Standard                             | Decimal Places | 0        |
| Coding            | RW                                   |                |          |

See *PID1 Feedback Source* (14.004).

| Parameter         | 14.007 <i>PID1 Reference Slew Rate</i>        |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the rate in change of output for PID1 |                |                 |
| Mode              | Open-Loop                                     |                |                 |
| Minimum           | 0.0   | Maximum        | 3200.0          |
| Default           | 0.0   | Units          | s               |
| Type              | 16 Bit User Save                              | Update Rate    | Background read |
| Display Format    | Standard                                      | Decimal Places | 1               |
| Coding            | RW  |                |                 |

See *PID1 Reference Source* (14.003).

| Parameter         | 14.008 <i>PID1 Enable</i> |                |          |
|-------------------|---------------------------|----------------|----------|
| Short description | Enables the use of PID1   |                |          |
| Mode              | Open-Loop                 |                |          |
| Minimum           | 0                         | Maximum        | 1        |
| Default           | 0                         | Units          |          |
| Type              | 1 Bit User Save           | Update Rate    | 4ms read |
| Display Format    | Standard                  | Decimal Places | 0        |
| Coding            | RW                        |                |          |

See *PID1 Output* (14.001).

| Parameter         | 14.009 <i>PID1 Enable Source 1</i>         |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the input source for enabling PID1 |                |                  |
| Mode              | Open-Loop                                  |                |                  |
| Minimum           | 0.000                                      | Maximum        | 59.999           |
| Default           | 0.000                                      | Units          |                  |
| Type              | 16 Bit User Save                           | Update Rate    | Drive reset read |
| Display Format    | Standard                                   | Decimal Places | 3                |
| Coding            | RW, PT, BU                                 |                |                  |

See *PID1 Output* (14.001).

| Parameter         | 14.010 <i>PID1 Proportional Gain</i> |                |                 |
|-------------------|--------------------------------------|----------------|-----------------|
| Short description | Defines the Kp gain used for PID1    |                |                 |
| Mode              | Open-Loop                            |                |                 |
| Minimum           | 0.000                                | Maximum        | 4.000           |
| Default           | 1.000                                | Units          |                 |
| Type              | 16 Bit User Save                     | Update Rate    | Background read |
| Display Format    | Standard                             | Decimal Places | 3               |
| Coding            | RW                                   |                |                 |

See *PID1 Output* (14.001).

| Parameter         | 14.011 <i>PID1 Integral Gain</i>  |                |                 |
|-------------------|-----------------------------------|----------------|-----------------|
| Short description | Defines the Ki gain used for PID1 |                |                 |
| Mode              | Open-Loop                         |                |                 |
| Minimum           | 0.000                             | Maximum        | 4.000           |
| Default           | 0.500                             | Units          |                 |
| Type              | 16 Bit User Save                  | Update Rate    | Background read |
| Display Format    | Standard                          | Decimal Places | 3               |
| Coding            | RW                                |                |                 |

See *PID1 Output* (14.001).

| Parameter         | 14.012 <i>PID1 Differential Gain</i> |                |                 |
|-------------------|--------------------------------------|----------------|-----------------|
| Short description | Defines the Kd gain used for PID1    |                |                 |
| Mode              | Open-Loop                            |                |                 |
| Minimum           | 0.000                                | Maximum        | 4.000           |
| Default           | 0.000                                | Units          |                 |
| Type              | 16 Bit User Save                     | Update Rate    | Background read |
| Display Format    | Standard                             | Decimal Places | 3               |
| Coding            | RW                                   |                |                 |

See *PID1 Output* (14.001).

| Parameter         | 14.013 <i>PID1 Output Upper Limit</i>            |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the maximum value of the output for PID1 |                |          |
| Mode              | Open-Loop  |                |          |
| Minimum           | 0.00   | Maximum        | 100.00   |
| Default           | 100.00   | Units          | %        |
| Type              | 16 Bit User Save                                 | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 2        |
| Coding            | RW   |                |          |

See *PID1 Output* (14.001).

| Parameter         | 14.014 <i>PID1 Output Lower Limit</i>            |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the minimum value of the output for PID1 |                |          |
| Mode              | Open-Loop  |                |          |
| Minimum           | -100.00  | Maximum        | 100.00   |
| Default           | -100.00  | Units          | %        |
| Type              | 16 Bit User Save                                 | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 2        |
| Coding            | RW   |                |          |

See *PID1 Output* (14.001).

| Parameter         | 14.015 <i>PID1 Output Scaling</i>                 |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the scaling factor of the output for PID1 |                |          |
| Mode              | Open-Loop   |                |          |
| Minimum           | 0.000   | Maximum        | 4.000    |
| Default           | 1.000   | Units          |          |
| Type              | 16 Bit User Save                                  | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 3        |
| Coding            | RW  |                |          |

See *PID1 Output* (14.001).

| Parameter         | 14.016 <i>PID1 Destination</i>        |                |                  |
|-------------------|---------------------------------------|----------------|------------------|
| Short description | Defines the output parameter for PID1 |                |                  |
| Mode              | Open-Loop                             |                |                  |
| Minimum           | 0.000                                 | Maximum        | 59.999           |
| Default           | 0.000                                 | Units          |                  |
| Type              | 16 Bit User Save                      | Update Rate    | Drive reset read |
| Display Format    | Standard                              | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU                        |                |                  |

See *PID1 Output* (14.001).

| Parameter         | 14.017 <i>PID1 Integral Hold</i>            |                |          |
|-------------------|---|----------------|----------|
| Short description | Enables the integral hold function for PID1 |                |          |
| Mode              | Open-Loop                                   |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit Volatile                              | Update Rate    | 4ms read |
| Display Format    | Standard                                    | Decimal Places | 0        |
| Coding            | RW  |                |          |

See *PID1 Output* (14.001).

| Parameter         | 14.018 <i>PID1 Symmetrical Limit Enable</i> |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Enables the symmetrical limit for PID1      |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit User Save                             | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See *PID1 Output* (14.001).

| Parameter         | 14.019 <i>PID1 Feed-forwards Reference</i>                 |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays the value of the feed-forwards reference for PID1 |                |           |
| Mode              | Open-Loop  |                |           |
| Minimum           | -100.00  | Maximum        | 100.00    |
| Default           |  | Units          | %         |
| Type              | 16 Bit Volatile  | Update Rate    | 4ms write |
| Display Format    | Standard   | Decimal Places | 2         |
| Coding            | RO, ND, NC, PT   |                |           |

See *PID1 Output* (14.001).

| Parameter         | 14.020 <i>PID1 Reference</i>                 |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays the value of the reference for PID1 |                |           |
| Mode              | Open-Loop                                    |                |           |
| Minimum           | -100.00                                      | Maximum        | 100.00    |
| Default           |  | Units          | %         |
| Type              | 16 Bit Volatile                              | Update Rate    | 4ms write |
| Display Format    | Standard                                     | Decimal Places | 2         |
| Coding            | RO, ND, NC, PT                               |                |           |

See *PID1 Reference Source* (14.003).

| Parameter         | 14.021 <i>PID1 Feedback</i>                 |                |           |
|-------------------|---|----------------|-----------|
| Short description | Displays the value of the feedback for PID1 |                |           |
| Mode              | Open-Loop                                   |                |           |
| Minimum           | -100.00                                     | Maximum        | 100.00    |
| Default           |   | Units          | %         |
| Type              | 16 Bit Volatile                             | Update Rate    | 4ms write |
| Display Format    | Standard                                    | Decimal Places | 2         |
| Coding            | RO, ND, NC, PT                              |                |           |

See *PID1 Feedback Source* (14.004).

| Parameter         | 14.022 PID1 Error                        |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays the value of the error for PID1 |                |           |
| Mode              | Open-Loop                                |                |           |
| Minimum           | -100.00                                  | Maximum        | 100.00    |
| Default           |  | Units          | %         |
| Type              | 16 Bit Volatile                          | Update Rate    | 4ms write |
| Display Format    | Standard                                 | Decimal Places | 2         |
| Coding            | RO, ND, NC, PT                           |                |           |

See *PID1 Output* (14.001).

| Parameter         | 14.023 PID1 Reference Scaling                         |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the scaling factor for the reference for PID1 |                |          |
| Mode              | Open-Loop   |                |          |
| Minimum           | 0.000   | Maximum        | 4.000    |
| Default           | 1.000   | Units          |          |
| Type              | 16 Bit User Save                                      | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 3        |
| Coding            | RW  |                |          |

See *PID1 Reference Source* (14.003).

| Parameter         | 14.024 PID1 Feedback Scaling                        |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the scaling factor of the feedback for PID1 |                |          |
| Mode              | Open-Loop   |                |          |
| Minimum           | 0.000   | Maximum        | 4.000    |
| Default           | 1.000   | Units          |          |
| Type              | 16 Bit User Save                                    | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 3        |
| Coding            | RW  |                |          |

See *PID1 Feedback Source* (14.004).

| Parameter         | 14.025 PID1 Digital Reference                       |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the value of the digital reference for PID1 |                |          |
| Mode              | Open-Loop   |                |          |
| Minimum           | -100.00   | Maximum        | 100.00   |
| Default           | 0.00  | Units          | %        |
| Type              | 16 Bit User Save                                    | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 2        |
| Coding            | RW  |                |          |

See *PID1 Reference Source* (14.003).

| Parameter         | 14.026 PID1 Digital Feedback                       |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the value of the digital feedback for PID1 |                |          |
| Mode              | Open-Loop  |                |          |
| Minimum           | -100.00  | Maximum        | 100.00   |
| Default           | 0.00   | Units          | %        |
| Type              | 16 Bit User Save                                   | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 2        |
| Coding            | RW   |                |          |

See *PID1 Feedback Source* (14.004).

| Parameter         | 14.027 PID1 Enable Source 2                |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the input source for enabling PID1 |                |                  |
| Mode              | Open-Loop                                  |                |                  |
| Minimum           | 0.000                                      | Maximum        | 59.999           |
| Default           | 0.000                                      | Units          |                  |
| Type              | 16 Bit User Save                           | Update Rate    | Drive reset read |
| Display Format    | Standard                                   | Decimal Places | 3                |
| Coding            | RW, PT, BU                                 |                |                  |

See *PID1 Output* (14.001).

# Menu 18 Single Line Descriptions – Application Menu 1

Mode: Open-Loop

| Parameter |  | Range             | Default | Type |     |    |    |    |
|-----------|--|-------------------|---------|------|-----|----|----|----|
| 18.001    | Application Menu 1 Power-down Save Integer | -32768 to 32767   | 0       | RW   | Num |    |    | PS |
| 18.002    | Application Menu 1 Read-only Integer 2     | -32768 to 32767   |         | RO   | Num | ND | NC |    |
| 18.003    | Application Menu 1 Read-only Integer 3     | -32768 to 32767   |         | RO   | Num | ND | NC |    |
| 18.004    | Application Menu 1 Read-only Integer 4     | -32768 to 32767   |         | RO   | Num | ND | NC |    |
| 18.005    | Application Menu 1 Read-only Integer 5     | -32768 to 32767   |         | RO   | Num | ND | NC |    |
| 18.006    | Application Menu 1 Read-only Integer 6     | -32768 to 32767   |         | RO   | Num | ND | NC |    |
| 18.007    | Application Menu 1 Read-only Integer 7     | -32768 to 32767   |         | RO   | Num | ND | NC |    |
| 18.008    | Application Menu 1 Read-only Integer 8     | -32768 to 32767   |         | RO   | Num | ND | NC |    |
| 18.009    | Application Menu 1 Read-only Integer 9     | -32768 to 32767   |         | RO   | Num | ND | NC |    |
| 18.010    | Application Menu 1 Read-only Integer 10    | -32768 to 32767   |         | RO   | Num | ND | NC |    |
| 18.011    | Application Menu 1 Read-write Integer 11   | -32768 to 32767   | 0       | RW   | Num |    |    | US |
| 18.012    | Application Menu 1 Read-write Integer 12   | -32768 to 32767   | 0       | RW   | Num |    |    | US |
| 18.013    | Application Menu 1 Read-write Integer 13   | -32768 to 32767   | 0       | RW   | Num |    |    | US |
| 18.014    | Application Menu 1 Read-write Integer 14   | -32768 to 32767   | 0       | RW   | Num |    |    | US |
| 18.015    | Application Menu 1 Read-write Integer 15   | -32768 to 32767   | 0       | RW   | Num |    |    | US |
| 18.016    | Application Menu 1 Read-write Integer 16   | -32768 to 32767   | 0       | RW   | Num |    |    | US |
| 18.017    | Application Menu 1 Read-write Integer 17   | -32768 to 32767   | 0       | RW   | Num |    |    | US |
| 18.018    | Application Menu 1 Read-write Integer 18   | -32768 to 32767   | 0       | RW   | Num |    |    | US |
| 18.019    | Application Menu 1 Read-write Integer 19   | -32768 to 32767   | 0       | RW   | Num |    |    | US |
| 18.020    | Application Menu 1 Read-write Integer 20   | -32768 to 32767   | 0       | RW   | Num |    |    | US |
| 18.021    | Application Menu 1 Read-write Integer 21   | -32768 to 32767   | 0       | RW   | Num |    |    | US |
| 18.022    | Application Menu 1 Read-write Integer 22   | -32768 to 32767   | 0       | RW   | Num |    |    | US |
| 18.023    | Application Menu 1 Read-write Integer 23   | -32768 to 32767   | 0       | RW   | Num |    |    | US |
| 18.024    | Application Menu 1 Read-write Integer 24   | -32768 to 32767   | 0       | RW   | Num |    |    | US |
| 18.025    | Application Menu 1 Read-write Integer 25   | -32768 to 32767   | 0       | RW   | Num |    |    | US |
| 18.026    | Application Menu 1 Read-write Integer 26   | -32768 to 32767   | 0       | RW   | Num |    |    | US |
| 18.027    | Application Menu 1 Read-write Integer 27   | -32768 to 32767   | 0       | RW   | Num |    |    | US |
| 18.028    | Application Menu 1 Read-write Integer 28   | -32768 to 32767   | 0       | RW   | Num |    |    | US |
| 18.029    | Application Menu 1 Read-write Integer 29   | -32768 to 32767   | 0       | RW   | Num |    |    | US |
| 18.030    | Application Menu 1 Read-write Integer 30   | -32768 to 32767   | 0       | RW   | Num |    |    | US |
| 18.031    | Application Menu 1 Read-write bit 31       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    | US |
| 18.032    | Application Menu 1 Read-write bit 32       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    | US |
| 18.033    | Application Menu 1 Read-write bit 33       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    | US |
| 18.034    | Application Menu 1 Read-write bit 34       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    | US |
| 18.035    | Application Menu 1 Read-write bit 35       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    | US |
| 18.036    | Application Menu 1 Read-write bit 36       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    | US |
| 18.037    | Application Menu 1 Read-write bit 37       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    | US |
| 18.038    | Application Menu 1 Read-write bit 38       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    | US |
| 18.039    | Application Menu 1 Read-write bit 39       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    | US |
| 18.040    | Application Menu 1 Read-write bit 40       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    | US |
| 18.041    | Application Menu 1 Read-write bit 41       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    | US |
| 18.042    | Application Menu 1 Read-write bit 42       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    | US |
| 18.043    | Application Menu 1 Read-write bit 43       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    | US |
| 18.044    | Application Menu 1 Read-write bit 44       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    | US |
| 18.045    | Application Menu 1 Read-write bit 45       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    | US |
| 18.046    | Application Menu 1 Read-write bit 46       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    | US |
| 18.047    | Application Menu 1 Read-write bit 47       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    | US |
| 18.048    | Application Menu 1 Read-write bit 48       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    | US |
| 18.049    | Application Menu 1 Read-write bit 49       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    | US |
| 18.050    | Application Menu 1 Read-write bit 50       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    | US |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

## Menu 18 – Application Menu 1

Mode: Open-Loop

### General option module application menus

Menus 18 and 20 are general application menus that can be used by one of the option modules fitted to the drive. These menus are customisable and the following RAM is provided to be shared between all 2 menus.

|                        | 1  | 8 | 16 | 32 |
|------------------------|----|---|----|----|
| <b>Volatile</b>        | 0  | 0 | 8  | 9  |
| <b>User save</b>       | 19 | 0 | 19 | 0  |
| <b>Power-down save</b> | 0  | 0 | 1  | 0  |

If no option modules provide customisation tables for these menus then the drive provides the customisation tables to give the following parameters.

| Parameter         | <b>18.001 Application Menu 1 Power-down Save Integer</b> |                |       |
|-------------------|--|----------------|-------|
| Short description | General power-down save integer application parameter    |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit Power Down Save                                   | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | <b>18.002 Application Menu 1 Read-only Integer 2</b> |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-only integer application parameter      |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           |  | Units          |       |
| Type              | 16 Bit Volatile                                      | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RO, PR, ND, NC                                       |                |       |

| Parameter         | <b>18.003 Application Menu 1 Read-only Integer 3</b> |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-only integer application parameter      |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           |  | Units          |       |
| Type              | 16 Bit Volatile                                      | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RO, PR, ND, NC                                       |                |       |

| Parameter         | <b>18.004 Application Menu 1 Read-only Integer 4</b> |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-only integer application parameter      |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           |  | Units          |       |
| Type              | 16 Bit Volatile                                      | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RO, PR, ND, NC                                       |                |       |

| Parameter         | <b>18.005 Application Menu 1 Read-only Integer 5</b> |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-only integer application parameter      |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           |  | Units          |       |
| Type              | 16 Bit Volatile                                      | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RO, PR, ND, NC                                       |                |       |

| Parameter         | <b>18.006 Application Menu 1 Read-only Integer 6</b> |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-only integer application parameter      |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           |  | Units          |       |
| Type              | 16 Bit Volatile                                      | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RO, PR, ND, NC                                       |                |       |

| Parameter         | <b>18.007 Application Menu 1 Read-only Integer 7</b> |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-only integer application parameter      |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           |  | Units          |       |
| Type              | 16 Bit Volatile                                      | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RO, PR, ND, NC                                       |                |       |

| Parameter         | <b>18.008 Application Menu 1 Read-only Integer 8</b> |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-only integer application parameter      |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           |  | Units          |       |
| Type              | 16 Bit Volatile                                      | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RO, PR, ND, NC                                       |                |       |

| Parameter         | <b>18.009 Application Menu 1 Read-only Integer 9</b> |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-only integer application parameter      |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           |  | Units          |       |
| Type              | 16 Bit Volatile                                      | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RO, PR, ND, NC                                       |                |       |

| Parameter         | <b>18.010 Application Menu 1 Read-only Integer 10</b> |                |       |
|-------------------|---|----------------|-------|
| Short description | General read-only integer application parameter       |                |       |
| Mode              | Open-Loop   |                |       |
| Minimum           | -32768  | Maximum        | 32767 |
| Default           |   | Units          |       |
| Type              | 16 Bit Volatile                                       | Update Rate    | N/A   |
| Display Format    | Standard  | Decimal Places | 0     |
| Coding            | RO, PR, ND, NC  |                |       |

| Parameter         | <b>18.011 Application Menu 1 Read-write Integer 11</b> |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter       |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                       | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | <b>18.012 Application Menu 1 Read-write Integer 12</b> |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter       |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                       | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |



| Parameter         | 18.013 Application Menu 1 Read-write Integer 13  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.014 Application Menu 1 Read-write Integer 14  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.015 Application Menu 1 Read-write Integer 15  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.016 Application Menu 1 Read-write Integer 16  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.017 Application Menu 1 Read-write Integer 17  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.018 Application Menu 1 Read-write Integer 18  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.019 Application Menu 1 Read-write Integer 19  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.020 Application Menu 1 Read-write Integer 20  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.021 Application Menu 1 Read-write Integer 21  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.022 Application Menu 1 Read-write Integer 22  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.023 Application Menu 1 Read-write Integer 23  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.024 Application Menu 1 Read-write Integer 24  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.025 Application Menu 1 Read-write Integer 25  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.026 Application Menu 1 Read-write Integer 26  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.027 Application Menu 1 Read-write Integer 27  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.028 Application Menu 1 Read-write Integer 28  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.029 Application Menu 1 Read-write Integer 29  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.030 Application Menu 1 Read-write Integer 30  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | Open-Loop  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.031 Application Menu 1 Read-write bit 31  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | Open-Loop                                    |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| Parameter         | 18.032 Application Menu 1 Read-write bit 32  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | Open-Loop                                    |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| Parameter         | 18.033 Application Menu 1 Read-write bit 33  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | Open-Loop                                    |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| Parameter         | 18.034 Application Menu 1 Read-write bit 34  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | Open-Loop                                    |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| Parameter         | 18.035 Application Menu 1 Read-write bit 35  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | Open-Loop                                    |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| Parameter         | 18.036 Application Menu 1 Read-write bit 36  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | Open-Loop                                    |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| Parameter         | 18.037 Application Menu 1 Read-write bit 37  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | Open-Loop                                    |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| Parameter         | 18.038 Application Menu 1 Read-write bit 38  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | Open-Loop                                    |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| Parameter         | 18.039 Application Menu 1 Read-write bit 39  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | Open-Loop                                    |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| Parameter         | 18.040 Application Menu 1 Read-write bit 40  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | Open-Loop                                    |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| Parameter         | 18.041 Application Menu 1 Read-write bit 41  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | Open-Loop                                    |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| Parameter         | 18.042 Application Menu 1 Read-write bit 42  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | Open-Loop                                    |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| Parameter         | 18.043 Application Menu 1 Read-write bit 43  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | Open-Loop                                    |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| Parameter         | 18.044 Application Menu 1 Read-write bit 44  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | Open-Loop                                    |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| Parameter         | 18.045 Application Menu 1 Read-write bit 45  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | Open-Loop                                    |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| Parameter         | 18.046 Application Menu 1 Read-write bit 46  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | Open-Loop                                    |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| Parameter         | 18.047 Application Menu 1 Read-write bit 47  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | Open-Loop                                    |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| Parameter         | 18.048 Application Menu 1 Read-write bit 48  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | Open-Loop                                    |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| Parameter         | 18.049 Application Menu 1 Read-write bit 49  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | Open-Loop                                    |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| Parameter         | 18.050 Application Menu 1 Read-write bit 50  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | Open-Loop                                    |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

## Menu 20 Single Line Descriptions – Application Menu 2

Mode: Open-Loop

| Parameter |   | Range                     | Default | Type |     |  |  |  |  |
|-----------|---|---------------------------|---------|------|-----|--|--|--|--|
| 20.021    | Application Menu 3 Read-write Long Integer 21 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |  |  |
| 20.022    | Application Menu 3 Read-write Long Integer 22 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |  |  |
| 20.023    | Application Menu 3 Read-write Long Integer 23 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |  |  |
| 20.024    | Application Menu 3 Read-write Long Integer 24 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |  |  |
| 20.025    | Application Menu 3 Read-write Long Integer 25 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |  |  |
| 20.026    | Application Menu 3 Read-write Long Integer 26 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |  |  |
| 20.027    | Application Menu 3 Read-write Long Integer 27 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |  |  |
| 20.028    | Application Menu 3 Read-write Long Integer 28 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |  |  |
| 20.029    | Application Menu 3 Read-write Long Integer 29 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |  |  |
| 20.030    | Application Menu 3 Read-write Long Integer 30 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |  |  |

|     |                     |     |                  |     |                  |     |                  |      |                |      |                       |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

## Menu 20 – Application Menu 2

Mode: Open-Loop

See introduction to menu 18.

| Parameter         | <b>20.021 Application Menu 3 Read-write Long Integer 21</b> |                |            |
|-------------------|---|----------------|------------|
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | Open-Loop   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

| Parameter         | <b>20.022 Application Menu 3 Read-write Long Integer 22</b> |                |            |
|-------------------|---|----------------|------------|
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | Open-Loop   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

| Parameter         | <b>20.023 Application Menu 3 Read-write Long Integer 23</b> |                |            |
|-------------------|---|----------------|------------|
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | Open-Loop   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

| Parameter         | <b>20.024 Application Menu 3 Read-write Long Integer 24</b> |                |            |
|-------------------|---|----------------|------------|
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | Open-Loop   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

| Parameter         | <b>20.025 Application Menu 3 Read-write Long Integer 25</b> |                |            |
|-------------------|---|----------------|------------|
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | Open-Loop   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

| Parameter         | <b>20.026 Application Menu 3 Read-write Long Integer 26</b> |                |            |
|-------------------|---|----------------|------------|
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | Open-Loop   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |



| Parameter         | <b>20.027 Application Menu 3 Read-write Long Integer 27</b> |                |            |
|-------------------|---|----------------|------------|
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | Open-Loop   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

| Parameter         | <b>20.028 Application Menu 3 Read-write Long Integer 28</b> |                |            |
|-------------------|---|----------------|------------|
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | Open-Loop   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

| Parameter         | <b>20.029 Application Menu 3 Read-write Long Integer 29</b> |                |            |
|-------------------|---|----------------|------------|
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | Open-Loop   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

| Parameter         | <b>20.030 Application Menu 3 Read-write Long Integer 30</b> |                |            |
|-------------------|---|----------------|------------|
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | Open-Loop   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

## Menu 21 Single Line Descriptions – Motor 2 Parameters

Mode: Open-Loop

| Parameter |  | Range  | Default  | Type |     |    |    |    |    |
|-----------|--|--|--|------|-----|----|----|----|----|
| 21.001    | M2 Maximum Reference Clamp               | ±VM_POSITIVE_REF_CLAMP Hz  | 50Hz: 50.00 Hz<br>60Hz: 60.00 Hz   | RW   | Num |    |    |    | US |
| 21.002    | M2 Minimum Reference Clamp               | ±VM_NEGATIVE_REF_CLAMP2 Hz   | 0.00 Hz  | RW   | Num |    |    |    | US |
| 21.003    | M2 Reference Selector                    | A1.A2 (0), A1.Pr (1), A2.Pr (2),<br>Preset (3), Pad (4), Res (5),<br>Pad.Ref (6) | A1.A2 (0)  | RW   | Txt |    |    |    | US |
| 21.004    | M2 Acceleration Rate 1                   | ±VM_ACCEL_RATE   | 5.0  | RW   | Num |    |    |    | US |
| 21.005    | M2 Deceleration Rate 1                   | ±VM_ACCEL_RATE   | 10.0   | RW   | Num |    |    |    | US |
| 21.006    | M2 Motor Rated Frequency                 | 0.00 to 550.00 Hz  | 50Hz: 50.00 Hz<br>60Hz: 60.00 Hz   | RW   | Num |    |    |    | US |
| 21.007    | M2 Motor Rated Current                   | ±VM_RATED_CURRENT A  | 0.00 A   | RW   | Num |    | RA |    | US |
| 21.008    | M2 Motor Rated Speed                     | 0.0 to 80000.0 rpm   | 50Hz: 1500.0 rpm<br>60Hz: 1800.0 rpm   | RW   | Num |    |    |    | US |
| 21.009    | M2 Motor Rated Voltage                   | ±VM_AC_VOLTAGE_SET V   | 110V drive: 230 V<br>200V drive: 230 V<br>400V drive 50Hz: 400 V<br>400V drive 60Hz: 460 V<br>575V drive: 575 V<br>690V drive: 690 V | RW   | Num |    | RA |    | US |
| 21.010    | M2 Motor Rated Power Factor              | 0.00 to 1.00   | 0.85   | RW   | Num |    | RA |    | US |
| 21.011    | M2 Number of Motor Poles                 | Automatic (0) to 32 (16) Poles   | Automatic (0) Poles  | RW   | Txt |    |    |    | US |
| 21.012    | M2 Stator Resistance                     | 0.0000 to 99.9999 Ω  | 0.0000 Ω   | RW   | Num |    | RA |    | US |
| 21.014    | M2 Transient Inductance                  | 0.000 to 500.000 mH  | 0.000 mH   | RW   | Num |    | RA |    | US |
| 21.015    | Motor 2 Active                           | Off (0) or On (1)  |  | RO   | Bit | ND | NC | PT |    |
| 21.016    | M2 Motor Thermal Time Constant 1         | 1 to 3000 s  | 179 s  | RW   | Num |    |    |    | US |
| 21.022    | M2 Current Controller Kp Gain            | 0.00 to 4000.00  | 20.00  | RW   | Num |    |    |    | US |
| 21.023    | M2 Current Controller Ki Gain            | 0.000 to 600.000   | 40.000   | RW   | Num |    |    |    | US |
| 21.024    | M2 Stator Inductance                     | 0.00 to 5000.00 mH   | 0.00 mH  | RW   | Num |    | RA |    | US |
| 21.027    | M2 Motoring Current Limit                | ±VM_MOTOR2_CURRENT_LIMIT %   | 165.0 %  | RW   | Num |    | RA |    | US |
| 21.028    | M2 Regenerating Current Limit            | ±VM_MOTOR2_CURRENT_LIMIT %   | 165.0 %  | RW   | Num |    | RA |    | US |
| 21.029    | M2 Symmetrical Current Limit             | ±VM_MOTOR2_CURRENT_LIMIT %   | 165.0 %  | RW   | Num |    | RA |    | US |
| 21.033    | M2 Low Frequency Thermal Protection Mode | 0 to 1   | 0  | RW   | Num |    |    |    | US |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

## Menu 21 – Motor 2 Parameters

Mode: Open-Loop

If *Select Motor 2 Parameters* (11.045) = 1 then the motor set-up parameters given in the table below are used instead of the equivalent parameters in other menus. The motor 2 parameters have the same attributes etc. as the equivalent parameters in other menus.

| Parameter | Motor map 2 parameter                             | Equivalent parameter                           |
|-----------|---|--|
| 21.001    | M2 Maximum Reference Clamp (21.001)               | Maximum Reference Clamp (01.006)               |
| 21.002    | M2 Minimum Reference Clamp (21.002)               | Minimum Reference Clamp (01.007)               |
| 21.003    | M2 Reference Selector (21.003)                    | Reference Selector (01.014)                    |
| 21.004    | M2 Acceleration Rate 1 (21.004)                   | Acceleration Rate 1 (02.011)                   |
| 21.005    | M2 Deceleration Rate 1 (21.005)                   | Deceleration Rate 1 (02.021)                   |
| 21.006    | M2 Motor Rated Frequency (21.006)                 | Motor Rated Frequency (05.006)                 |
| 21.007    | M2 Motor Rated Current (21.007)                   | Motor Rated Current (05.007)                   |
| 21.008    | M2 Motor Rated Speed (21.008)                     | Motor Rated Speed (05.008)                     |
| 21.009    | M2 Motor Rated Voltage (21.009)                   | Motor Rated Voltage (05.009)                   |
| 21.010    | M2 Motor Rated Power Factor (21.010)              | Motor Rated Power Factor (05.010)              |
| 21.011    | M2 Number of Motor Poles (21.011)                 | Number Of Motor Poles (05.011)                 |
| 21.012    | M2 Stator Resistance (21.012)                     | Stator Resistance                              |
| 21.014    | M2 Transient Inductance (21.014)                  | Transient Inductance (05.024)                  |
| 21.015    | Motor 2 Active (21.015)                           | N/A  |
| 21.016    | M2 Motor Thermal Time Constant 1 (21.016)         | Motor Thermal Time Constant 1                  |
| 21.022    | M2 Current Controller Kp Gain (21.022)            | Current Controller Kp Gain (04.013)            |
| 21.023    | M2 Current Controller Ki Gain (21.023)            | Current Controller Ki Gain (04.014)            |
| 21.024    | M2 Stator Inductance (21.024)                     | Stator Inductance (05.025)                     |
| 21.027    | M2 Motoring Current Limit (21.027)                | Motoring Current Limit (04.005)                |
| 21.028    | M2 Regenerating Current Limit (21.028)            | Regenerating Current Limit (04.006)            |
| 21.029    | M2 Symmetrical Current Limit (21.029)             | Symmetrical Current Limit (04.007)             |
| 21.033    | M2 Low Frequency Thermal Protection Mode (21.033) | Low Frequency Thermal Protection Mode (04.025) |

| Parameter         | 21.001 M2 Maximum Reference Clamp                   |                |                       |
|-------------------|---|----------------|-----------------------|
| Short description | Defines the maximum reference clamp for motor map 2 |                |                       |
| Mode              | Open-Loop   |                |                       |
| Minimum           | -VM_POSITIVE_REF_CLAMP                              | Maximum        | VM_POSITIVE_REF_CLAMP |
| Default           | See exceptions below                                | Units          | Hz                    |
| Type              | 32 Bit User Save                                    | Update Rate    | Background read       |
| Display Format    | Standard  | Decimal Places | 2                     |
| Coding            | RW, VM  |                |                       |

| Region | Default Value |
|--------|---------------|
| 50Hz   | 50.00         |
| 60Hz   | 60.00         |

This is the motor map 2 equivalent parameter for *Maximum Reference Clamp* (01.006).

| Parameter         | 21.002 M2 Minimum Reference Clamp                   |                |                        |
|-------------------|---|----------------|------------------------|
| Short description | Defines the minimum reference clamp for motor map 2 |                |                        |
| Mode              | Open-Loop   |                |                        |
| Minimum           | -VM_NEGATIVE_REF_CLAMP2                             | Maximum        | VM_NEGATIVE_REF_CLAMP2 |
| Default           | 0.00  | Units          | Hz                     |
| Type              | 32 Bit User Save                                    | Update Rate    | Background read        |
| Display Format    | Standard  | Decimal Places | 2                      |
| Coding            | RW, VM  |                |                        |

This is the motor map 2 equivalent for *Minimum Reference Clamp* (01.007).

| Parameter         | 21.003 M2 Reference Selector                    |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines which reference is used for motor map 2 |                |          |
| Mode              | Open-Loop                                       |                |          |
| Minimum           | 0   | Maximum        | 6        |
| Default           | 0   | Units          |          |
| Type              | 8 Bit User Save                                 | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW, TE  |                |          |

| Value | Text    | Description  |
|-------|---------|--|
| 0     | A1.A2   | Analogue reference 1 or 2 selected by terminal input       |
| 1     | A1.Pr   | Analogue reference 1 or Presets selected by terminal input |
| 2     | A2.Pr   | Analogue reference 2 or Presets selected by terminal input |
| 3     | Preset  | Preset reference selected by terminal                      |
| 4     | Pad     | Keypad reference selected                                  |
| 5     | Res     | Reserved   |
| 6     | Pad.Ref | Keypad reference selected but no control mode              |

This is the motor map 2 equivalent for *Reference Selector* (01.014).

| Parameter         | 21.004 M2 Acceleration Rate 1                      |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the acceleration rate used for motor map 2 |                |               |
| Mode              | Open-Loop  |                |               |
| Minimum           | -VM_ACCEL_RATE                                     | Maximum        | VM_ACCEL_RATE |
| Default           | 5.0  | Units          |               |
| Type              | 32 Bit User Save                                   | Update Rate    | 16ms          |
| Display Format    | Standard   | Decimal Places | 1             |
| Coding            | RW, VM   |                |               |

This is the motor map 2 equivalent for *Acceleration Rate 1* (02.011).

| Parameter         | 21.005 M2 Deceleration Rate 1                      |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the deceleration rate used for motor map 2 |                |               |
| Mode              | Open-Loop  |                |               |
| Minimum           | -VM_ACCEL_RATE                                     | Maximum        | VM_ACCEL_RATE |
| Default           | 10.0   | Units          |               |
| Type              | 32 Bit User Save                                   | Update Rate    | 16ms          |
| Display Format    | Standard   | Decimal Places | 1             |
| Coding            | RW, VM   |                |               |

This is the motor map 2 equivalent for *Acceleration Rate 1* (02.011).

| Parameter         | 21.006 M2 Motor Rated Frequency                        |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the motor rated frequency used for motor map 2 |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0.00   | Maximum        | 550.00          |
| Default           | See exceptions below                                   | Units          | Hz              |
| Type              | 32 Bit User Save                                       | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 2               |
| Coding            | RW   |                |                 |

| Region | Default Value |
|--------|---------------|
| 50Hz   | 50.00         |
| 60Hz   | 60.00         |

This is the motor map 2 equivalent for *Motor Rated Frequency* (05.006).

| Parameter         | 21.007 M2 Motor Rated Current                |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the motor rated used for motor map 2 |                |                  |
| Mode              | Open-Loop                                    |                |                  |
| Minimum           | -VM_RATED_CURRENT                            | Maximum        | VM_RATED_CURRENT |
| Default           | 0.00   | Units          | A                |
| Type              | 32 Bit User Save                             | Update Rate    | Background read  |
| Display Format    | Standard                                     | Decimal Places | 2                |
| Coding            | RW, VM, RA                                   |                |                  |

This is the motor map 2 equivalent for *Motor Rated Current* (05.007).

| Parameter         | 21.008 M2 Motor Rated Speed                        |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the motor rated speed used for motor map 2 |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0.0  | Maximum        | 80000.0         |
| Default           | See exceptions below                               | Units          | rpm             |
| Type              | 32 Bit User Save                                   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 1               |
| Coding            | RW   |                |                 |

| Region | Default Value |
|--------|---------------|
| 50Hz   | 1500.0        |
| 60Hz   | 1800.0        |

This is the motor map 2 equivalent for *Motor Rated Speed* (05.008).

| Parameter         | 21.009 M2 Motor Rated Voltage                        |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Defines the motor rated voltage used for motor map 2 |                |                   |
| Mode              | Open-Loop  |                |                   |
| Minimum           | -VM_AC_VOLTAGE_SET                                   | Maximum        | VM_AC_VOLTAGE_SET |
| Default           | See exceptions below                                 | Units          | V                 |
| Type              | 16 Bit User Save                                     | Update Rate    | 16ms              |
| Display Format    | Standard   | Decimal Places | 0                 |
| Coding            | RW, VM, RA   |                |                   |

| Voltage | Region | Default Value |
|---------|--------|---------------|
| 110V    | All    | 230           |
| 200V    | All    | 230           |
| 400V    | 50Hz   | 400           |
| 400V    | 60Hz   | 460           |
| 575V    | All    | 575           |
| 690V    | All    | 690           |

This is the motor map 2 equivalent for *Motor Rated Voltage* (05.009).

| Parameter         | 21.010 M2 Motor Rated Power Factor                        |                |                       |
|-------------------|---|----------------|-----------------------|
| Short description | Defines the motor rated power factor used for motor map 2 |                |                       |
| Mode              | Open-Loop   |                |                       |
| Minimum           | 0.00  | Maximum        | 1.00                  |
| Default           | 0.85  | Units          |                       |
| Type              | 16 Bit User Save  | Update Rate    | Background read/write |
| Display Format    | Standard  | Decimal Places | 2                     |
| Coding            | RW, RA  |                |                       |

This is the motor map 2 equivalent for *Motor Rated Power Factor* (05.010).

| Parameter         | 21.011 M2 Number of Motor Poles                        |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the number of motor poles used for motor map 2 |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0  | Maximum        | 16              |
| Default           | 0  | Units          | PolePairs       |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, BU   |                |                 |

This is the motor map 2 equivalent for *Number Of Motor Poles* (05.011).

| Parameter         | 21.012 M2 Stator Resistance                        |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the stator resistance used for motor map 2 |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0.0000   | Maximum        | 99.9999         |
| Default           | 0.0000   | Units          | Ω               |
| Type              | 32 Bit User Save                                   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 4               |
| Coding            | RW, RA   |                |                 |

This is the motor map 2 equivalent for *Stator Resistance* (05.017).

| Parameter         | 21.014 M2 Transient Inductance                        |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the transient inductance used for motor map 2 |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0.000   | Maximum        | 500.000         |
| Default           | 0.000   | Units          | mH              |
| Type              | 32 Bit User Save                                      | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 3               |
| Coding            | RW, RA  |                |                 |

This is the motor map 2 equivalent for *Transient Inductance* (05.024).

| Parameter         | 21.015 Motor 2 Active                                       |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates if motor 2 parameters are being used by the drive |                |                  |
| Mode              | Open-Loop   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

If *Motor 2 Active* (21.015) = 0 then the standard motor set-up parameters are being used or if *Motor 2 Active* (21.015) = 1 then the motor 2 parameters are being used. The motor set-up parameters do not necessarily change immediately when *Select Motor 2 Parameters* (11.045) is changed (i.e. the drive may be enabled). *Motor 2 Active* (21.015) shows the actual motor parameters being used and only changes when the new parameters start being used by the drive.

| Parameter         | 21.016 M2 Motor Thermal Time Constant 1                             |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the thermal time constant of the motor used for motor map 2 |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 1   | Maximum        | 3000            |
| Default           | 179   | Units          | s               |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

This is the motor map 2 equivalent of *Motor Thermal Time Constant 1* (04.015).

| Parameter         | 21.022 M2 Current Controller Kp Gain                                |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the Kp value of the current controller used for motor map 2 |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0.00  | Maximum        | 4000.00         |
| Default           | 20.00   | Units          |                 |
| Type              | 32 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 2               |
| Coding            | RW  |                |                 |

This is the motor map 2 equivalent for *Current Controller Kp Gain* (04.013).

| Parameter         | 21.023 M2 Current Controller Ki Gain                                |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the Ki value of the current controller used for motor map 2 |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0.000   | Maximum        | 600.000         |
| Default           | 40.000  | Units          |                 |
| Type              | 32 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 3               |
| Coding            | RW  |                |                 |

This is the motor map 2 equivalent for *Current Controller Ki Gain* (04.014).

| Parameter         | 21.024 M2 Stator Inductance                                     |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the stator inductance of the motor used for motor map 2 |                |                 |
| Mode              | Open-Loop   |                |                 |
| Minimum           | 0.00  | Maximum        | 5000.00         |
| Default           | 0.00  | Units          | mH              |
| Type              | 32 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 2               |
| Coding            | RW, RA  |                |                 |

This is the motor map 2 equivalent for *Stator Inductance* (05.025).

| Parameter         | 21.027 M2 Motoring Current Limit                        |                |                         |
|-------------------|---|----------------|-------------------------|
| Short description | Defines the motoring current limit used for motor map 2 |                |                         |
| Mode              | Open-Loop   |                |                         |
| Minimum           | -VM_MOTOR2_CURRENT_LIMIT                                | Maximum        | VM_MOTOR2_CURRENT_LIMIT |
| Default           | 165.0   | Units          | %                       |
| Type              | 16 Bit User Save  | Update Rate    | 16ms                    |
| Display Format    | Standard  | Decimal Places | 1                       |
| Coding            | RW, VM, RA  |                |                         |

This is the motor map 2 equivalent for *Motoring Current Limit* (04.005).

| Parameter         | 21.028 M2 Regenerating Current Limit |                |                         |
|-------------------|--------------------------------------|----------------|-------------------------|
| Short description |                                      |                |                         |
| Mode              | Open-Loop                            |                |                         |
| Minimum           | -VM_MOTOR2_CURRENT_LIMIT             | Maximum        | VM_MOTOR2_CURRENT_LIMIT |
| Default           | 165.0                                | Units          | %                       |
| Type              | 16 Bit User Save                     | Update Rate    | 16ms                    |
| Display Format    | Standard                             | Decimal Places | 1                       |
| Coding            | RW, VM, RA                           |                |                         |

This is the motor map 2 equivalent for *Regenerating Current Limit* (04.006).

| Parameter         | 21.029 M2 Symmetrical Current Limit                        |                |                         |
|-------------------|--|----------------|-------------------------|
| Short description | Defines the symmetrical current limit used for motor map 2 |                |                         |
| Mode              | Open-Loop  |                |                         |
| Minimum           | -VM_MOTOR2_CURRENT_LIMIT                                   | Maximum        | VM_MOTOR2_CURRENT_LIMIT |
| Default           | 165.0  | Units          | %                       |
| Type              | 16 Bit User Save   | Update Rate    | 16ms                    |
| Display Format    | Standard   | Decimal Places | 1                       |
| Coding            | RW, VM, RA   |                |                         |

This is the motor map 2 equivalent for *Symmetrical Current Limit* (04.007).

| Parameter         | 21.033 M2 Low Frequency Thermal Protection Mode    |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to enable low frequency thermal protection mod |                |                 |
| Mode              | Open-Loop  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save                                    | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

This is the motor map 2 equivalent for *Low Frequency Thermal Protection Mode* (04.025).

# Menu 22 Single Line Descriptions – *Menu 0 Setup*

Mode: Open-Loop



| Parameter |                         | Range           | Default | Type |     |  |  |    |    |
|-----------|-------------------------|-----------------|---------|------|-----|--|--|----|----|
| 22.001    | Parameter 00.001 Set-up | 0.000 to 30.999 | 1.007   | RW   | Num |  |  | PT | US |
| 22.002    | Parameter 00.002 Set-up | 0.000 to 30.999 | 1.006   | RW   | Num |  |  | PT | US |
| 22.003    | Parameter 00.003 Set-up | 0.000 to 30.999 | 2.011   | RW   | Num |  |  | PT | US |
| 22.004    | Parameter 00.004 Set-up | 0.000 to 30.999 | 2.021   | RW   | Num |  |  | PT | US |
| 22.005    | Parameter 00.005 Set-up | 0.000 to 30.999 | 11.034  | RW   | Num |  |  | PT | US |
| 22.006    | Parameter 00.006 Set-up | 0.000 to 30.999 | 5.007   | RW   | Num |  |  | PT | US |
| 22.007    | Parameter 00.007 Set-up | 0.000 to 30.999 | 5.008   | RW   | Num |  |  | PT | US |
| 22.008    | Parameter 00.008 Set-up | 0.000 to 30.999 | 5.009   | RW   | Num |  |  | PT | US |
| 22.009    | Parameter 00.009 Set-up | 0.000 to 30.999 | 5.010   | RW   | Num |  |  | PT | US |
| 22.010    | Parameter 00.010 Set-up | 0.000 to 30.999 | 11.044  | RW   | Num |  |  | PT | US |
| 22.011    | Parameter 00.011 Set-up | 0.000 to 30.999 | 0.000   | RW   | Num |  |  | PT | US |
| 22.012    | Parameter 00.012 Set-up | 0.000 to 30.999 | 0.000   | RW   | Num |  |  | PT | US |
| 22.013    | Parameter 00.013 Set-up | 0.000 to 30.999 | 0.000   | RW   | Num |  |  | PT | US |
| 22.014    | Parameter 00.014 Set-up | 0.000 to 30.999 | 0.000   | RW   | Num |  |  | PT | US |
| 22.015    | Parameter 00.015 Set-up | 0.000 to 30.999 | 1.005   | RW   | Num |  |  | PT | US |
| 22.016    | Parameter 00.016 Set-up | 0.000 to 30.999 | 7.007   | RW   | Num |  |  | PT | US |
| 22.017    | Parameter 00.017 Set-up | 0.000 to 30.999 | 1.010   | RW   | Num |  |  | PT | US |
| 22.018    | Parameter 00.018 Set-up | 0.000 to 30.999 | 1.021   | RW   | Num |  |  | PT | US |
| 22.019    | Parameter 00.019 Set-up | 0.000 to 30.999 | 0.000   | RW   | Num |  |  | PT | US |
| 22.020    | Parameter 00.020 Set-up | 0.000 to 30.999 | 0.000   | RW   | Num |  |  | PT | US |
| 22.021    | Parameter 00.021 Set-up | 0.000 to 30.999 | 0.000   | RW   | Num |  |  | PT | US |
| 22.022    | Parameter 00.022 Set-up | 0.000 to 30.999 | 0.000   | RW   | Num |  |  | PT | US |
| 22.023    | Parameter 00.023 Set-up | 0.000 to 30.999 | 0.000   | RW   | Num |  |  | PT | US |
| 22.024    | Parameter 00.024 Set-up | 0.000 to 30.999 | 0.000   | RW   | Num |  |  | PT | US |
| 22.025    | Parameter 00.025 Set-up | 0.000 to 30.999 | 11.030  | RW   | Num |  |  | PT | US |
| 22.026    | Parameter 00.026 Set-up | 0.000 to 30.999 | 0.000   | RW   | Num |  |  | PT | US |
| 22.027    | Parameter 00.027 Set-up | 0.000 to 30.999 | 1.051   | RW   | Num |  |  | PT | US |
| 22.028    | Parameter 00.028 Set-up | 0.000 to 30.999 | 2.004   | RW   | Num |  |  | PT | US |
| 22.029    | Parameter 00.029 Set-up | 0.000 to 30.999 | 2.002   | RW   | Num |  |  | PT | US |
| 22.030    | Parameter 00.030 Set-up | 0.000 to 30.999 | 11.042  | RW   | Num |  |  | PT | US |
| 22.031    | Parameter 00.031 Set-up | 0.000 to 30.999 | 6.001   | RW   | Num |  |  | PT | US |
| 22.032    | Parameter 00.032 Set-up | 0.000 to 30.999 | 5.013   | RW   | Num |  |  | PT | US |
| 22.033    | Parameter 00.033 Set-up | 0.000 to 30.999 | 6.009   | RW   | Num |  |  | PT | US |
| 22.034    | Parameter 00.034 Set-up | 0.000 to 30.999 | 8.035   | RW   | Num |  |  | PT | US |
| 22.035    | Parameter 00.035 Set-up | 0.000 to 30.999 | 8.091   | RW   | Num |  |  | PT | US |
| 22.036    | Parameter 00.036 Set-up | 0.000 to 30.999 | 7.055   | RW   | Num |  |  | PT | US |
| 22.037    | Parameter 00.037 Set-up | 0.000 to 30.999 | 5.018   | RW   | Num |  |  | PT | US |
| 22.038    | Parameter 00.038 Set-up | 0.000 to 30.999 | 5.012   | RW   | Num |  |  | PT | US |
| 22.039    | Parameter 00.039 Set-up | 0.000 to 30.999 | 5.006   | RW   | Num |  |  | PT | US |
| 22.040    | Parameter 00.040 Set-up | 0.000 to 30.999 | 5.011   | RW   | Num |  |  | PT | US |
| 22.041    | Parameter 00.041 Set-up | 0.000 to 30.999 | 5.014   | RW   | Num |  |  | PT | US |
| 22.042    | Parameter 00.042 Set-up | 0.000 to 30.999 | 5.015   | RW   | Num |  |  | PT | US |
| 22.043    | Parameter 00.043 Set-up | 0.000 to 30.999 | 11.025  | RW   | Num |  |  | PT | US |
| 22.044    | Parameter 00.044 Set-up | 0.000 to 30.999 | 11.023  | RW   | Num |  |  | PT | US |
| 22.045    | Parameter 00.045 Set-up | 0.000 to 30.999 | 11.020  | RW   | Num |  |  | PT | US |
| 22.046    | Parameter 00.046 Set-up | 0.000 to 30.999 | 12.042  | RW   | Num |  |  | PT | US |
| 22.047    | Parameter 00.047 Set-up | 0.000 to 30.999 | 12.043  | RW   | Num |  |  | PT | US |
| 22.048    | Parameter 00.048 Set-up | 0.000 to 30.999 | 12.044  | RW   | Num |  |  | PT | US |
| 22.049    | Parameter 00.049 Set-up | 0.000 to 30.999 | 12.045  | RW   | Num |  |  | PT | US |
| 22.050    | Parameter 00.050 Set-up | 0.000 to 30.999 | 12.046  | RW   | Num |  |  | PT | US |
| 22.051    | Parameter 00.051 Set-up | 0.000 to 30.999 | 12.047  | RW   | Num |  |  | PT | US |
| 22.052    | Parameter 00.052 Set-up | 0.000 to 30.999 | 12.048  | RW   | Num |  |  | PT | US |
| 22.053    | Parameter 00.053 Set-up | 0.000 to 30.999 | 12.050  | RW   | Num |  |  | PT | US |
| 22.054    | Parameter 00.054 Set-up | 0.000 to 30.999 | 12.051  | RW   | Num |  |  | PT | US |
| 22.055    | Parameter 00.055 Set-up | 0.000 to 30.999 | 12.041  | RW   | Num |  |  | PT | US |
| 22.056    | Parameter 00.056 Set-up | 0.000 to 30.999 | 0.000   | RW   | Num |  |  | PT | US |
| 22.057    | Parameter 00.057 Set-up | 0.000 to 30.999 | 0.000   | RW   | Num |  |  | PT | US |
| 22.058    | Parameter 00.058 Set-up | 0.000 to 30.999 | 0.000   | RW   | Num |  |  | PT | US |
| 22.059    | Parameter 00.059 Set-up | 0.000 to 30.999 | 0.000   | RW   | Num |  |  | PT | US |
| 22.060    | Parameter 00.060 Set-up | 0.000 to 30.999 | 0.000   | RW   | Num |  |  | PT | US |
| 22.061    | Parameter 00.061 Set-up | 0.000 to 30.999 | 0.000   | RW   | Num |  |  | PT | US |
| 22.062    | Parameter 00.062 Set-up | 0.000 to 30.999 | 0.000   | RW   | Num |  |  | PT | US |
| 22.063    | Parameter 00.063 Set-up | 0.000 to 30.999 | 0.000   | RW   | Num |  |  | PT | US |

|        |                         |                 |        |    |     |  |  |    |    |
|--------|-------------------------|-----------------|--------|----|-----|--|--|----|----|
| 22.064 | Parameter 00.064 Set-up | 0.000 to 30.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.065 | Parameter 00.065 Set-up | 0.000 to 30.999 | 3.010  | RW | Num |  |  | PT | US |
| 22.066 | Parameter 00.066 Set-up | 0.000 to 30.999 | 3.011  | RW | Num |  |  | PT | US |
| 22.067 | Parameter 00.067 Set-up | 0.000 to 30.999 | 3.079  | RW | Num |  |  | PT | US |
| 22.068 | Parameter 00.068 Set-up | 0.000 to 30.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.069 | Parameter 00.069 Set-up | 0.000 to 30.999 | 5.040  | RW | Num |  |  | PT | US |
| 22.070 | Parameter 00.070 Set-up | 0.000 to 30.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.071 | Parameter 00.071 Set-up | 0.000 to 30.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.072 | Parameter 00.072 Set-up | 0.000 to 30.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.073 | Parameter 00.073 Set-up | 0.000 to 30.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.074 | Parameter 00.074 Set-up | 0.000 to 30.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.075 | Parameter 00.075 Set-up | 0.000 to 30.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.076 | Parameter 00.076 Set-up | 0.000 to 30.999 | 10.037 | RW | Num |  |  | PT | US |
| 22.077 | Parameter 00.077 Set-up | 0.000 to 30.999 | 11.032 | RW | Num |  |  | PT | US |
| 22.078 | Parameter 00.078 Set-up | 0.000 to 30.999 | 11.029 | RW | Num |  |  | PT | US |
| 22.079 | Parameter 00.079 Set-up | 0.000 to 30.999 | 11.031 | RW | Num |  |  | PT | US |
| 22.080 | Parameter 00.080 Set-up | 0.000 to 30.999 | 0.000  | RW | Num |  |  | PT | US |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

## Menu 22 – Menu 0 Setup

Mode: Open-Loop

| Parameter         | 22.001 Parameter 00.001 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.001 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 1.007                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.002 Parameter 00.002 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.002 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 1.006                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.003 Parameter 00.003 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.003 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 2.011                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.004 Parameter 00.004 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.004 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 2.021                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.005 Parameter 00.005 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.005 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 11.034                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.006 Parameter 00.006 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.006 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 5.007                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.007 Parameter 00.007 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.007 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 5.008                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.008 Parameter 00.008 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.008 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 5.009                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.009 Parameter 00.009 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.009 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 5.010                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.010 Parameter 00.010 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.010 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 11.044                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.011 Parameter 00.011 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.011 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.012 Parameter 00.012 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.012 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.013 Parameter 00.013 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.013 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.014 Parameter 00.014 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.014 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.015 Parameter 00.015 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.015 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 1.005                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.016 Parameter 00.016 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.016 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 7.007                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.017 Parameter 00.017 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.017 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 1.010                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.018 Parameter 00.018 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.018 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 1.021                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.019 Parameter 00.019 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.019 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.020 Parameter 00.020 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.020 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.021 Parameter 00.021 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.021 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.022 Parameter 00.022 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.022 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.023 Parameter 00.023 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.023 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.024 Parameter 00.024 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.024 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.025 Parameter 00.025 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.025 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 11.030                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.026 Parameter 00.026 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.026 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.027 Parameter 00.027 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.027 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 1.051                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.028 Parameter 00.028 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.028 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 2.004                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.029 Parameter 00.029 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.029 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 2.002                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.030 Parameter 00.030 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.030 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 11.042                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.031 Parameter 00.031 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.031 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 6.001                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.032 Parameter 00.032 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.032 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 5.013                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.033 Parameter 00.033 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.033 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 6.009                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.034 Parameter 00.034 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.034 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 8.035                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.035 Parameter 00.035 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.035 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 8.091                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.036 Parameter 00.036 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.036 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 7.055                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.037 Parameter 00.037 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.037 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 5.018                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.038 Parameter 00.038 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.038 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 5.012                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.039 Parameter 00.039 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.039 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 5.006                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.040 Parameter 00.040 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.040 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 5.011                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.041 Parameter 00.041 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.041 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 5.014                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |



| Parameter         | 22.042 Parameter 00.042 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.042 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 5.015                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.043 Parameter 00.043 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.043 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 11.025                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.044 Parameter 00.044 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.044 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 11.023                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.045 Parameter 00.045 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.045 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 11.020                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.046 Parameter 00.046 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.046 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 12.042                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.047 Parameter 00.047 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.047 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 12.043                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.048 Parameter 00.048 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.048 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 12.044                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.049 Parameter 00.049 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.049 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 12.045                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.050 Parameter 00.050 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.050 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 12.046                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.051 Parameter 00.051 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.051 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 12.047                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.052 Parameter 00.052 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.052 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 12.048                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.053 Parameter 00.053 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.053 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 12.050                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.054 Parameter 00.054 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.054 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 12.051                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.055 Parameter 00.055 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.055 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 12.041                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.056 Parameter 00.056 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.056 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.057 Parameter 00.057 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.057 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.058 Parameter 00.058 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.058 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.059 Parameter 00.059 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.059 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.060 Parameter 00.060 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.060 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.061 Parameter 00.061 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.061 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.062 Parameter 00.062 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.062 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.063 Parameter 00.063 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.063 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.064 Parameter 00.064 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.064 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.065 Parameter 00.065 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.065 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 3.010                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.066 Parameter 00.066 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.066 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 3.011                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.067 Parameter 00.067 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.067 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 3.079                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.068 Parameter 00.068 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.068 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.069 Parameter 00.069 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.069 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 5.040                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.070 Parameter 00.070 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.070 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.071 Parameter 00.071 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.071 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.072 Parameter 00.072 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.072 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.073 Parameter 00.073 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.073 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.074 Parameter 00.074 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.074 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.075 Parameter 00.075 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.075 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.076 Parameter 00.076 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.076 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 10.037                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.077 Parameter 00.077 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.077 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 11.032                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.078 Parameter 00.078 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.078 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 11.029                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.079 Parameter 00.079 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.079 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 11.031                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

| Parameter         | 22.080 Parameter 00.080 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.080 |                |                 |
| Mode              | Open-Loop                                   |                |                 |
| Minimum           | 0.000                                       | Maximum        | 30.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

# Trips

Mode: Open-Loop

*Trip 0* (10.020) to *Trip 9* (10.029) store the most recent 10 trips that have occurred where *Trip 0* (10.020) is the most recent and *Trip 9* (10.029) is the oldest. When a new trip occurs it is written to *Trip 0* (10.020) and all the other trips move down the log, with oldest being lost.

The date and time when each trip occurs are also stored in the date and time log, i.e. *Trip 0 Date* (10.041) to *Trip 9 Time* (10.060). The date and time are taken from *Date* (06.016) and *Time* (06.017) (See *Date/Time Selector* (06.019)). Some trips have sub-trip numbers which give more detail about the reason for the trip. If a trip has a sub-trip number its value is stored in the sub-trip log, i.e. *Trip 0 Sub-trip Number* (10.070) to *Trip 9 Sub-trip Number* (10.079). If the trip does not have a sub-trip number then zero is stored in the sub-trip log.

## Trip categories and priorities

Trips are grouped into the categories given in the table below. A trip can only occur when the drive is not tripped, or if it is already tripped and the new trip has a higher priority than the active trip (i.e. lower priority number). Unless otherwise stated a trip cannot be reset until 1.0s after it has been initiated.

| Priority | Category  | Trips  | Comments  |
|----------|---|--|---|
| 1        | Internal faults                                   | HF01 - HF19  | These are fatal problems that cannot be reset. All drive features are inactive after any of these trips occur. If a basic keypad is fitted it will show the trip, but the keypad will not function. These trips are not stored in the trip log.                                       |
| 1        | Stored HF trip                                    | <i>Stored HF</i>                                   | This trip cannot be cleared unless 1299 is entered into <i>Parameter mm.000</i> (mm.000) and a reset is initiated.  |
| 2        | Non-resettable trips                              | Trip numbers 218 - 247 and <i>Slot1 HF</i>         | These trips cannot be reset.  |
| 3        | Volatile memory failure                           | <i>EEPROM Fail</i>                                 | This can only be reset if <i>Parameter mm.000</i> (mm.000) is set to 1233 or 1244, or if <i>Load Defaults</i> (11.043) is set to a non-zero value   |
| 4        | Non-volatile media trips                          | Trip numbers 174, 175 and 177 - 188                | These trips are priority 5 during power-up  |
| 5        | Trips with extended reset times                   | <i>Ol ac</i> , <i>Ol Brake</i> and <i>Reserved</i> | These trips cannot be reset until 10s after the trip was initiated.   |
| 5        | Phase loss and d.c. link power circuit protection | <i>Phase Loss</i> and <i>Oht dc bus</i>            | The drive will attempt to stop the motor before tripping if a <i>Phase Loss.000</i> trip occurs unless this feature has been disabled (see <i>Action On Trip Detection</i> (10.037)). The drive will always attempt to stop the motor before tripping if an <i>Oht dc bus</i> occurs. |
| 5        | Standard trips                                    | All other trips                                    |   |

Trips {HF01} to {HF19} are internal faults that do not have trip numbers. If one of these trips occurs, the main drive processor has detected an irrecoverable error. All drive functions are stopped and the trip message will be displayed on the drive keypad. The error can only be reset by powering the drive down and up again. The table below gives the reasons for internal faults and their corresponding trip

| Trip   | Reason   |  |
|--------|--|--|
| {HF01} | CPU hardware fault during exception processing   |  |
| {HF02} | CPU memory management fault is an exception that occurs because of a memory protection related fault   |  |
| {HF03} | CPU has detected a Bus Fault. A Bus Fault is an exception that occurs because of a memory related fault for an instruction or data memory transaction. This might be from an error detected on a bus in the memory system.   |  |
| {HF04} | <p>CPU has detected a usage fault:<br/>A Usage Fault is an exception that occurs because of a fault related to instruction execution. This includes:</p> <ul style="list-style-type: none"> <li>• an undefined instruction</li> <li>• an illegal unaligned access</li> <li>• invalid state on instruction execution</li> <li>• an error on exception return.</li> </ul> <p>The following can cause a Usage Fault when the core is configured to report them:</p> <ul style="list-style-type: none"> <li>• an unaligned address on word and half word memory access</li> <li>• division by zero.</li> </ul> |  |
| {HF05} | Reserved   |  |
| {HF06} | Reserved   |  |
| {HF07} | Watchdog failure   |  |
| {HF08} | CPU Interrupt crash. Interrupt crash level indicated by subtrip number.  |  |
| {HF09} | Free store overflow  |  |
| {HF10} | Reserved   |  |
| {HF11} | The <i>HF11</i> trip indicates that a non-volatile memory comms error has occurred.  |  |
|        | <b>Sub-trip</b>  | <b>Reason</b>  |
|        | <b>Recommended action</b>  |  |
| 1      | Non-volatile memory comms error.   | Hardware fault – contact the supplier of the drive.  |
| 2      | EEPROM size is incompatible with the user firmware.  | After 1min the drive will go to its bootloader. Re-program drive with compatible user firmware using UniMConnect |
| {HF12} | Stack overflow   |  |
|        | <b>Sub-trip</b>  | <b>Reason</b>  |
|        | 1  | User program or derivative background stack overflow   |
|        | 2  | User program or derivative timed stack overflow  |
|        | 3  | Main system interrupt stack overflow   |
|        | 4  | Main system background stack overflow  |
| {HF13} | Reserved   |  |
| {HF14} | Reserved   |  |
| {HF15} | Reserved   |  |
| {HF16} | RTOS error (the background task has returned)  |  |
| {HF17} | Reserved   |  |
|        | The <i>HF18</i> trip indicates that the internal flash memory has failed when writing option module parameter data. The reason for the trip can be identified by the sub-trip number.  |  |



|        |  |   |
|--------|--|---|
| {HF18} | <b>Sub-trip</b>  | <b>Reason</b>   |
|        | 1  | Option module initialization timed out                |
|        | 2  | Programming error while writing menu in flash         |
|        | 3  | Erase flash block containing setup menus failed       |
|        | 4  | Erase flash block containing application menus failed |
|        | 5  | Incorrect setup menu CRC contained in flash           |
|        | 6  | Incorrect application menu CRC contained in flash     |
| {HF19} | The <i>HF19</i> trip indicates that the drive firmware is partially or completely deleted. The drive is now in its bootloader and is waiting for a new image to be downloaded using UniMConnect. Once a new image is downloaded, the drive can run normally. |   |

When the drive is subsequently powered up a *Stored HF* trip is initiated where the sub-trip number is the number of the HF trip that last occurred. This trip will occur at every power-up until it is reset. The trip can only be reset by first entering 1299 into *Parameter mm.000* (mm.000).

#### Trip descriptions

Trips shown in the table below can be generated either from the drive control system or from the power system. The sub-trip number which is in the form xxyz is used to identify the source of the trip. The digits xx are 00 for a trip generated by the control system or the number of a power module if generated by the power system. If the drive is not a multi-power module drive then xx will always have a value of 1 the trip is related to the power system. The y digit is used to identify the location of a trip which is generated by a rectifier module connected to a power module. Where the y digit is relevant it will have a value of 1 or more, otherwise it will be 0. The zz digits give the reason for the trip and are defined in each trip description.

|                     |                       |
|---------------------|-----------------------|
| <i>Over Volts</i>   | <i>OHt dc bus</i>     |
| <i>OI ac</i>        | <i>Phase Loss</i>     |
| <i>OI Brake</i>     | <i>LF Power Comms</i> |
| <i>PSU</i>          | <i>OI Snubber</i>     |
| <i>OHt Inverter</i> | <i>Reserved</i>       |
| <i>OHt Power</i>    | <i>Temp Feedback</i>  |
|                     | <i>Power Data</i>     |

#### Trips Summary (numerical order)

| Value | Trip  |
|-------|-------|
| 0     | None  |
| 1     | Res   |
| 2     | OV    |
| 3     | Ol.aC |
| 4     | Ol.br |
| 5     | PSU   |
| 6     | Et    |
| 7     | O.Spd |
| 8     | U.OI  |
| 9     | Res   |
| 10    | Th.br |
| 11    | Tun.1 |
| 12    | Res   |
| 14    | Res   |
| 15    | Res   |
| 16    | Res   |
| 17    | Res   |
| 18    | Tun.S |
| 19    | It.br |
| 20    | It.ac |
| 21    | Oht.l |
| 22    | Oht.P |
| 23    | Res   |
| 24    | th    |
| 25    | thS   |
| 26    | O.Ld1 |
| 27    | Oh.dc |
| 28    | cL.A1 |
| 29    | cL.A2 |
| 30    | SCL   |
| 31    | EEF   |
| 32    | PH.Lo |
| 33    | rS    |
| 34    | Pad   |
| 35    | CL.bt |
| 36    | U.S   |
| 37    | Pd.S  |
| 38    | Res   |
| 39    | Res   |
| 40    | t040  |
| 41    | t041  |
| 42    | t042  |
| 43    | t043  |
| 44    | t044  |
| 45    | t045  |
| 46    | t046  |
| 47    | t047  |
| 48    | t048  |
| 49    | t049  |
| 50    | t050  |
| 51    | t051  |
| 52    | t052  |
| 53    | t053  |
| 54    | t054  |
| 55    | t055  |
| 56    | t056  |
| 57    | t057  |
| 58    | t058  |
| 59    | t059  |
| 60    | t060  |
| 61    | t061  |
| 62    | t062  |
| 63    | t063  |

|     |       |
|-----|-------|
| 64  | t064  |
| 65  | t065  |
| 66  | t066  |
| 67  | t067  |
| 68  | t068  |
| 69  | t069  |
| 70  | t070  |
| 71  | t071  |
| 72  | t072  |
| 73  | t073  |
| 74  | t074  |
| 75  | t075  |
| 76  | t076  |
| 77  | t077  |
| 78  | t078  |
| 79  | t079  |
| 80  | t080  |
| 81  | t081  |
| 82  | t082  |
| 83  | t083  |
| 84  | t084  |
| 85  | t085  |
| 86  | t086  |
| 87  | t087  |
| 88  | t088  |
| 89  | t089  |
| 90  | LF.Er |
| 91  | Res   |
| 92  | Ol.Sn |
| 93  | Pb.Er |
| 94  | Res   |
| 95  | Res   |
| 96  | UP.us |
| 97  | D.Ch  |
| 98  | Out.P |
| 99  | Res   |
| 100 | Reset |
| 101 | Res   |
| 102 | Res   |
| 103 | Res   |
| 104 | Res   |
| 105 | Res   |
| 106 | Res   |
| 107 | Res   |
| 108 | Res   |
| 109 | Res   |
| 110 | dcct  |
| 111 | Res   |
| 112 | t112  |
| 113 | t113  |
| 114 | t114  |
| 115 | t115  |
| 116 | t116  |
| 117 | t117  |
| 118 | t118  |
| 119 | t119  |
| 120 | t120  |
| 121 | t121  |
| 122 | t122  |
| 123 | t123  |
| 124 | t124  |
| 125 | t125  |
| 126 | t126  |
| 127 | t127  |
| 128 | t128  |

|     |       |
|-----|-------|
| 129 | t129  |
| 130 | t130  |
| 131 | t131  |
| 132 | t132  |
| 133 | t133  |
| 134 | t134  |
| 135 | t135  |
| 136 | t136  |
| 137 | t137  |
| 138 | t138  |
| 139 | t139  |
| 140 | t140  |
| 141 | t141  |
| 142 | t142  |
| 143 | t143  |
| 144 | t144  |
| 145 | t145  |
| 146 | t146  |
| 147 | t147  |
| 148 | t148  |
| 149 | t149  |
| 150 | t150  |
| 151 | t151  |
| 152 | t152  |
| 153 | t153  |
| 154 | t154  |
| 155 | t155  |
| 156 | t156  |
| 157 | t157  |
| 158 | t158  |
| 159 | t159  |
| 160 | t160  |
| 161 | t161  |
| 162 | t162  |
| 163 | t163  |
| 164 | t164  |
| 165 | t165  |
| 166 | t166  |
| 167 | t167  |
| 168 | Res   |
| 169 | Res   |
| 170 | Res   |
| 171 | Res   |
| 172 | Res   |
| 173 | FaN.f |
| 174 | C.SI  |
| 175 | C.Pr  |
| 176 | Res   |
| 177 | Res   |
| 178 | C.by  |
| 179 | C.d.e |
| 180 | C.OPt |
| 181 | C.rdo |
| 182 | C.Err |
| 183 | C.dAt |
| 184 | C.Ful |
| 185 | C.Acc |
| 186 | C.rtg |
| 187 | C.Typ |
| 188 | C.cPr |
| 189 | OI.A1 |
| 190 | OI.A2 |
| 191 | Res   |
| 192 | Res   |
| 193 | Res   |

|     |        |
|-----|--------|
| 194 | Res    |
| 195 | Res    |
| 196 | Res    |
| 197 | Res    |
| 198 | Res    |
| 199 | dESt   |
| 200 | SL.HF  |
| 201 | SL.tO  |
| 202 | SL.Er  |
| 203 | SL.nF  |
| 204 | SL.dF  |
| 205 | Res    |
| 206 | Res    |
| 207 | Res    |
| 208 | Res    |
| 209 | Res    |
| 210 | Res    |
| 211 | Res    |
| 212 | Res    |
| 213 | Res    |
| 214 | Res    |
| 215 | Res    |
| 216 | Res    |
| 217 | Res    |
| 218 | TH.fb  |
| 219 | Oht.C  |
| 220 | P.Dat  |
| 221 | St.HF  |
| 222 | Res    |
| 223 | Res    |
| 224 | Res    |
| 225 | Cur.O  |
| 226 | So.St  |
| 227 | r.All  |
| 228 | Ol.SC  |
| 229 | Res    |
| 230 | Res    |
| 231 | Cur.c  |
| 232 | Dr.Cf  |
| 233 | Res    |
| 234 | STO    |
| 235 | Pb.HF  |
| 236 | no.PS  |
| 237 | Fl.In  |
| 238 | Res    |
| 239 | Res    |
| 240 | Res    |
| 241 | Res    |
| 242 | Res    |
| 243 | Res    |
| 244 | Res    |
| 245 | Pb.bt  |
| 246 | Der.E  |
| 247 | Fi.Ch  |
| 248 | Der.l  |
| 249 | UPrG   |
| 250 | R.b.ht |
| 251 | Res    |
| 252 | Res    |
| 253 | Res    |
| 254 | Res    |
| 255 | Rst.L  |

**Trips** (alphabetical order)

| Trip              | C.Acc |
|-------------------|-------|
| Value             | 185   |
| Short description |       |

A communications failure has occurred with a NV media card. If this occurs during a data transfer to the card then the file being written may be corrupted. If this occurs when data is being transferred from the card then the data transfer may be incomplete. If a parameter file is transferred to the drive and this trip occurs during the transfer the parameters are not saved to non-volatile memory, and so the original parameters can be restored by powering the drive down and up again.

**Recommended actions:**

- Check the NV media card is installed / located correctly.
- Replace the NV media card.

| Trip              | C.by |
|-------------------|------|
| Value             | 178  |
| Short description |      |

An attempt has been made to access a file on a NV media card, but the file is already being accessed by an Option Module, such as one of the Applications modules. No data is transferred.

**Recommended actions:**

- Wait for the Option Module to finish accessing the NV media card and re-attempt the required function.

| Trip              | C.cPr |
|-------------------|-------|
| Value             | 188   |
| Short description |       |

A compare has been carried out between a file on a NV media card and the drive and these are different and no other NV media card related trips have occurred.

**Recommended actions:**

- Set Pr *mm.000* to 0 to reset the trip.
- Check to ensure the correct data block on the NV media card has been used for the compare.

| Trip              | C.d.e |
|-------------------|-------|
| Value             | 179   |
| Short description |       |

An attempt has been made to store data on a NV media card, but the file already exists. No data is transferred. The file should be erased first to prevent this trip.

**Recommended actions:**

- Erase the data in data location.
- Write data to an alternative data location.

| Trip              | C.dAt |
|-------------------|-------|
| Value             | 183   |
| Short description |       |

An attempt has been made to access a non-existent file on a NV media card. No data is transferred.

**Recommended actions:**

- Ensure data block number is correct.

| Trip              | C.Err |
|-------------------|-------|
| Value             | 182   |
| Short description |       |

An attempt has been made to access a NV media card, but an error has been detected in the data structure on the card. Resetting this trip will cause the drive to erase the <MCDF> folder from the NV media card (if it exists) and create the correct folder structure. On an SD card, whilst this trip is still present, missing directories will be created, and if the header file is missing it will be created. The following sub-trip numbers are used with this trip.

| Sub-trip | Reason   |
|----------|--|
| 1        | The required folder and file structure is not present.                           |
| 2        | The <000> file is corrupted.   |
| 3        | Two or more files in the <MCDF> folder have the same file identification number. |

**Recommended actions:**

- Erase all the data block and re-attempt the process.
- Ensure the card is located correctly.
- Replace the NV media card.

| Trip              | <i>C.Ful</i> |
|-------------------|--------------|
| Value             | 184          |
| Short description |              |

An attempt has been made to write to a NV media card, but there is insufficient space available. No data is transferred.

**Recommended actions:**

- Delete a data block or the entire NV media card to create space.
- Replace the NV media card.

| Trip              | <i>C.Opt</i> |
|-------------------|--------------|
| Value             | 180          |
| Short description |              |

A parameter file has been transferred from a NV media card to the drive, but at least one of the option modules are difference between source and target drives. This trip does not stop the data transfer, but is a warning that the data for the option modules that are different will be set to the default values and not the values from the card. This trip also applies if a compare is performed between a parameter file on a card and the drive and the option modules fitted are different between the source and target.

**Recommended actions:**

- Ensure the correct option modules are installed.
- Ensure the option modules are in the same option module slot as the parameter set stored.
- Press the red reset button to acknowledge that the parameters for one or more of the option modules installed will be at their default vaules.
- This trip can be suppressed by setting Pr *mm.000* to 9666 and resetting the drive.

| Trip              | <i>C.Pr</i> |
|-------------------|-------------|
| Value             | 175         |
| Short description |             |

Product or derivative are incompatible between the source and target drives.

| Sub-trip | Reason   |
|----------|--|
| 1        | If <i>Drive Derivative</i> (11.028) is different between the source and target drives. This trip is initiated either at power-up or when the SDcard is accessed. This trip can be reset and data can be transferred in either direction between the drive and the card.                                      |
| 2        | If <i>Product Type</i> (11.063) is different between the source and target drives or the file is corrupted or incompatible. This trip is initiated either at power-up or when the SDcard is accessed. This trip can be reset but no data are transferred in either direction between the drive and the card. |
| 3        | Reserved   |

**Recommended actions:**

| Sub-trip | Actions   |
|----------|---|
| 1        | <ul style="list-style-type: none"> <li>• Use a different NV media card or choose a file compatible between the source and target drives.</li> <li>• This trip can be suppressed by setting Pr <i>mm.000</i> to 9666 and resetting the drive.</li> </ul> |
| 2        | <ul style="list-style-type: none"> <li>• Use a different NV media card or choose a file compatible between the source and target drives.</li> </ul>   |

| Trip              | <i>C.rdo</i> |
|-------------------|--------------|
| Value             | 181          |
| Short description |              |

An attempt has been made to modify data on a read-only NV media card or to modify a read-only file (i.e. erase the card, erase a file or create a file). No data is transferred.

**Recommended actions:**

- Clear the read only flag by setting Pr *mm.000* to 9777 and reset the drive. This will clear the read only flag for all data blocks in the NV media card.

| Trip              | C.rtg |
|-------------------|-------|
| Value             | 186   |
| Short description |       |

A parameter file has been transferred from a NV media card to the drive, but the current and/or voltage rating are different between source and target drive. This trip does not stop the data transfer, but is a warning that the data for rating dependent parameters may not be the same on the target as the source drive. This trip also applies if a compare (using Pr *mm.000* set to 8yyy) is performed between a parameter file on the card on the drive.

#### Recommended actions:

- Reset the drive to clear the trip.
- This trip can be suppressed by setting Pr *mm.000* to 9666 and resetting the drive.

| Trip              | C.SI |
|-------------------|------|
| Value             | 174  |
| Short description |      |

The transfer of an option module application program to or from an application module can fail because the option module does not respond correctly. If this happens this trip is produced with the sub-trip indicating the option module slot number.

| Sub-trip number | Reason                 |
|-----------------|------------------------|
| 1               | Error in option slot 1 |

#### Recommended actions:

- Ensure the source / destination option module is installed on the correct slot.

| Trip              | C.Type |
|-------------------|--------|
| Value             | 187    |
| Short description |        |

This trip is produced during a compare if the drive mode in the file on the NV media card is different from the current drive mode and the file is a parameter file. This trip is also produced if an attempt is made to transfer a parameter file where the source and target drive modes are different and the drive mode is outside the range allowed for the target drive.

#### Recommended actions:

- Ensure the destination drive supports the drive operating mode in the parameter file.
- Clear the value in Pr *mm.000* and reset the drive.
- Ensure destination drive operating mode is the same as the source parameter file.

| Trip              | cL.A1 |
|-------------------|-------|
| Value             | 28    |
| Short description |       |

Indicates that a current loss was detected in current mode on Analog Input 1. In 4-20mA and 20-4mA modes. loss of input is detected if the current falls below 3mA. See *Analogue Input 1 Mode* (07.007) for further details.

#### Recommended actions:

- Check control wiring is correct.
- Check control wiring is undamaged.
- Check *Analogue Input 1 Mode* (07.007).
- Check that the current signal is present and greater than 3mA

| Trip              | cL.A2 |
|-------------------|-------|
| Value             | 29    |
| Short description |       |

Indicates that a current loss was detected in current mode on Analog Input 2. In 4-20mA and 20-4mA modes. loss of input is detected if the current falls below 3mA. See *Analogue Input 2 Mode* (07.011) for further details.

#### Recommended actions:

- Check control wiring is correct.
- Check control wiring is undamaged.
- Check *Analogue Input 2 Mode* (07.011).
- Check that the current signal is present and greater than 3mA

| Trip              | CL.bt |
|-------------------|-------|
| Value             | 35    |
| Short description |       |

This trip is initiated by setting bit 12 on the control word in *Control Word* (06.042) when the control word is enabled (*Control Word Enable* (06.043) = On).



**Recommended actions:**

- Check the value of *Control Word* (06.042).
- Disable the control word in *Control Word Enable* (06.043).

| Trip              | <i>Cur.c</i> |
|-------------------|--------------|
| Value             | 231          |
| Short description |              |

Current calibration range error.

**Recommended actions:**

- Hardware fault - contact the supplier of the drive.

| Trip              | <i>Cur.O</i> |
|-------------------|--------------|
| Value             | 225          |
| Short description |              |

The current feedback offset is too large to be trimmed correctly.

**Recommended actions:**

- Ensure that there is no possibility of current flowing in the output phase of the drive when the drive is not enabled.
- Hardware fault - contact the supplier of the drive.

| Trip              | <i>D.Ch</i> |
|-------------------|-------------|
| Value             | 97          |
| Short description |             |

A user action or a file system write is active that is changing the drive parameters and the drive has become active, i.e. *Drive Active* (10.002) = 1. The user actions that change drive parameters are loading defaults, changing drive mode, or transferring data from an NV memory card or a position feedback device to the drive. The file system actions that will cause this trip to be initiated if the drive is enabled during the transfer are writing a parameter or macro file to the drive, or transferring a derivative or user program to the drive. It should be noted that none of these actions can be started if the drive is active, and so the trip only occurs if the action is started and then the drive is enabled.

**Recommended actions:**

- Ensure the drive is not enabled when one of the following is being carried out:
  - Loading defaults
  - Transferring user programs

| Trip              | <i>dcct</i> |
|-------------------|-------------|
| Value             | 110         |
| Short description |             |

DCCT reference out of range for large frames only.

**Recommended actions:**

- Hardware fault - contact the supplier of the drive.

| Trip              | <i>Der.E</i> |
|-------------------|--------------|
| Value             | 246          |
| Short description |              |

An error has been detected in the derivative product image. The sub-trip indicated the reason for the trip.

| Sub-trip | Reason   | Comments  |
|----------|--|---|
| 1        | The derivative image is missing or is invalid  | Occurs when the drive powers-up. Load valid derivative image matching the control board hardware. |
| 2        | The derivative image does not match the control board hardware                         | Occurs when the drive powers-up. Load valid derivative image matching the control board hardware. |
| 3        | The derivative image has been changed for an image with a different derivative number. | Occurs when the drive powers-up or the image is programmed. The image tasks will not run.         |

| <b>Trip</b>       | <b><i>Der.I</i></b> |
|-------------------|---------------------|
| Value             | 248                 |
| Short description |                     |

An error has been detected in the derivative product image. The sub-trip indicated the reason for the trip.

| Sub-trip | Reason  | Comments   |
|----------|---|--|
| 1        | Divide by zero  |  |
| 2        | Undefined trip  |  |
| 3        | Attempted fast parameter access set-up with non-existent parameter  |  |
| 4        | Attempted access to non-existent parameter  |  |
| 5        | Attempted write to read-only parameter  |  |
| 6        | Attempted and over-range write  |  |
| 7        | Attempted read from write-only parameter  |  |
|          |   |  |
| 30       | The image has failed because either its CRC is incorrect, or there are less than 6 bytes in the image or the image header version is less than 5. | Occurs when the drive powers-up or the image is programmed. The image tasks will not run.  |
| 31       | The image requires more RAM for heap and stack than can be provided by the drive.   | As 30.   |
| 32       | The image requires an OS function call that is higher than the maximum allowed.   | As 30.   |
| 33       | The ID code within the image is not valid   | As 30.   |
| 34       | The derivative image has been changed for an image with a different derivative number.  | As 30.   |
|          |   |  |
| 40       | The timed task has not completed in time and has been suspended.  |  |
| 41       | Undefined function called, i.e. a function in the host system vector table that has not been assigned.  |  |
|          |   |  |
| 51       | Core menu customisation table CRC check failed  | As 30.   |
| 52       | Customisable menu table CRC check failed  | As 30.   |
| 53       | Customisable menu table changed   | Occurs when the drive powers-up or the image is programmed and the table has changed. Defaults are loaded for the derivative menu and the trip will keep occurring until drive parameters are saved. |
|          |   |  |

|    |  |                                       |
|----|--|---------------------------------------|
| 61 | The option module fitted in slot 1 is not allowed with the derivative image.         | As 30.                                |
| 62 | The option module fitted in slot 2 is not allowed with the derivative image.         | As 30.                                |
| 63 | The option module fitted in slot 3 is not allowed with the derivative image.         | As 30.                                |
| 64 | The option module fitted in slot 4 is not allowed with the derivative image.         | As 30.                                |
|    |  |                                       |
| 70 | An option module that is required by the derivative image is not fitted in any slot. | As 30.                                |
| 71 | An option module specifically required to be fitted in slot 1 not present.           | As 30.                                |
| 72 | An option module specifically required to be fitted in slot 2 not present.           | As 30.                                |
| 73 | An option module specifically required to be fitted in slot 3 not present.           | As 30.                                |
| 74 | An option module specifically required to be fitted in slot 4 not present.           | As 30.                                |
|    |  |                                       |
| 80 | *Image is not compatible with the control board                                      | Initiated from within the image code. |
| 81 | *Image is not compatible with the control board serial number                        | As 80.                                |

#### Recommended actions:

- Contact the supplier of the drive.

| Trip              | <i>dESt</i> |
|-------------------|-------------|
| Value             | 199         |
| Short description |             |

This trip indicated that destination output parameters of two or more logic functions within the drive are writing to the same parameter.

#### Recommended actions:

- Set Pr *mm.000* to "Destinations" or 12001 and check all visible parameters in all menus for parameter write conflicts

| Trip              | <i>Dr.Cf</i> |
|-------------------|--------------|
| Value             | 232          |
| Short description |              |

The power stage ID does not match the rating table ID

| Sub-trip | Reason  |
|----------|---|
| 1        | The power stage ID does not match the rating table ID (Large frame only). |
| 2        | Invalid power stage ID.   |
| 3        | The power stage ID does not match the rating table ID (Size A-D)          |

#### Recommended actions:

- Check the personality file matches the hardware

| Trip              | EEF |
|-------------------|-----|
| Value             | 31  |
| Short description |     |

This trip indicates that default parameters have been loaded because of the reasons given below.

| Sub-trip | Reason   |
|----------|--|
| 1        | The most significant digit of the internal parameter database version number has changed.  |
| 2        | The CRC's applied to the parameter data stored in internal non-volatile memory indicate that a valid set of parameters cannot be loaded.                               |
| 3        | The drive mode restored from internal non-volatile memory is outside the allowed range for the product or the derivative image does not allow the previous drive mode. |
| 4        | The drive derivative image has been changed and it has changed the customisation of the drive core menus.  |
| 5        | The power stage hardware has been change and changed the customisation of the drive core menus.  |
| 6        | Reserved   |
| 7        | Reserved   |
| 8        | The control board hardware has been change and changed the customisation of the drive core menus.  |
| 9        | The checksum on the non-parameter area of the EEPROM has failed.   |

The drive holds two banks of user save parameters and two banks of power down save parameters in non-volatile memory. If the last bank of either set of parameters that was saved is corrupted a *User Save* or *Power Down Save* trip is produced. If one of these trips occurs the parameters values that were last saved successfully are used. It can take some time to save parameters when requested by the user and if the power is removed from the drive during this process it is possible to corrupt the data in the non-volatile memory.

If both banks of user save parameters or both banks of power down save parameters are corrupted or one of the other conditions given in the table above occurs *EEPROM Fail.xxx* trip is produced. If this trip occurs it is not possible to use the data that has been saved previously, and so the drive will be loaded with default parameters. The trip can only be reset if *Parameter mm.000* (mm.000) is set to 10, 11, 1233 or 1244 or if *Load Defaults* (11.043) is set to a non-zero value

| Trip              | Et |
|-------------------|----|
| Value             | 6  |
| Short description |    |

External trip is initiated as shown in the table below.

| Sub-trip | Reason                            |
|----------|-----------------------------------|
| 3        | <i>External Trip</i> (10.032) = 1 |

#### Recommended actions:

- Check the value of *External Trip* (10.032).
- Select "Destinations" (or enter 12001) in Pr *mm.000* and check for a parameter controlling *External Trip* (10.032).
- Ensure *External Trip* (10.032) or *User Trip* (10.038) (=6) is not being used by serial comms.

| Trip              | FaN.f |
|-------------------|-------|
| Value             | 173   |
| Short description |       |

Fan failure

#### Recommended actions:

- Check that the fan is fitted and connected correctly.

- Contact the supplier of the drive to replace the fan.

| Trip              | <i>Fi.Ch</i> |
|-------------------|--------------|
| Value             | 247          |
| Short description |              |

Rating table changed

#### Recommended actions:

- Power cycle drive

| Trip              | <i>FI.In</i> |
|-------------------|--------------|
| Value             | 237          |
| Short description |              |

Firmware version between user board and power board does not match.

| Trip              | <i>It.ac</i> |
|-------------------|--------------|
| Value             | 20           |
| Short description |              |

This trip indicates a motor thermal overload based on the *Motor Rated Current* (05.007) and *Motor Thermal Time Constant 1* (04.015). *Motor Protection Accumulator* (04.019) displays the motor temperature as a percentage of the maximum value. The drive will trip on *Motor Too Hot* when *Motor Protection Accumulator* (04.019) gets to 100%.

#### Recommended actions:

- Ensure the load is not jammed / sticking.
- Check the load on the motor has not changed.
- Tune the *Motor Rated Speed* (05.008) (RFC-A mode only).
- Ensure the motor rated current is not zero.

| Trip              | <i>It.br</i> |
|-------------------|--------------|
| Value             | 19           |
| Short description |              |

This trip indicates that braking resistor overload has timed out. The value in *Braking Resistor Thermal Accumulator* (10.039) is calculated using *Braking Resistor Rated Power* (10.030), *Braking Resistor Thermal Time Constant* (10.031) and *Braking Resistor Resistance* (10.061). This trip is initiated when *Braking Resistor Thermal Accumulator* (10.039) reaches 100%.

#### Recommended actions:

- Ensure the values entered in *Braking Resistor Rated Power* (10.030), *Braking Resistor Thermal Time Constant* (10.031) and *Braking Resistor Resistance* (10.061) are correct.
- If an external thermal protection device is being used and the braking resistor software overload protection is not required, set *Braking Resistor Rated Power* (10.030), *Braking Resistor Thermal Time Constant* (10.031) and *Braking Resistor Resistance* (10.061) to 0 to disable the trip.

| Trip              | <i>LF.Er</i> |
|-------------------|--------------|
| Value             | 90           |
| Short description |              |

This trip is initiated if there is no communications between power, control or the rectifier module or if excessive communication errors have been detected. The reason for the trip can be identified by the sub-trip number.

| Source         | xx | y | zz  |
|----------------|----|---|---|
| Control system | 00 | 0 | 01: No communications between the control system and the power system.          |
| Control system | 00 | 0 | 02: Excessive communication errors between the control system and power system. |
| Control system | 01 | 1 | 00: Excessive communications errors detected by the rectifier module.           |

#### Recommended actions:

- Hardware fault - contact the supplier of the drive.

|                   |              |
|-------------------|--------------|
| <b>Trip</b>       | <b>no.PS</b> |
| Value             | 236          |
| Short description |              |

Reserved trip number.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>None</b> |
| Value             | 0           |
| Short description |             |

|                   |              |
|-------------------|--------------|
| <b>Trip</b>       | <b>O.Ld1</b> |
| Value             | 26           |
| Short description |              |

This trip indicates that the total current drawn from the AI adaptor 24V or from the digital output has exceeded the limit.

| Sub-trip | Reason   |
|----------|--|
| 1        | Digital output or 24V supply load on control terminal is too high. |
| 2        | AI adaptor 24V load is too high                                    |

#### Recommended actions:

- Check total loads on digital outputs and 24V.
- Check control wiring is correct.
- Check output wiring is undamaged

|                   |              |
|-------------------|--------------|
| <b>Trip</b>       | <b>O.Spd</b> |
| Value             | 7            |
| Short description |              |

If the *Post Ramp Reference* (02.001) exceeds the threshold set in *Over Frequency Threshold* (03.008) in either direction, a *Reserved* trip is produced.

If *Over Frequency Threshold* (03.008) is set to 0.0 the threshold is based on the variable minimum/maximum for the references and is equal to 1.2 x VM\_SPEED\_FREQ\_REF[*MAX*].

#### Recommended actions:

- Reduce the *Frequency Controller Proportional Gain Kp1* (03.010) to reduce the frequency overshoot.

|                   |              |
|-------------------|--------------|
| <b>Trip</b>       | <b>Oh.dc</b> |
| Value             | 27           |
| Short description |              |

This trip indicates a DC bus component over temperature based on a firmware thermal model. The drive includes a thermal protection system to protect the DC bus components within the drive. This includes the effects of the output current and DC bus ripple. The estimated temperature is displayed as a percentage of the trip level in *Percentage Of d.c. Link Thermal Trip Level* (07.035). If this parameter reaches 100% then an *OHt dc bus* trip is initiated. The drive will attempt to stop the motor before tripping. If the motor does not stop in 10 seconds then the drive trips immediately.

| Source         | xx | y | zz  |
|----------------|----|---|---|
| Control system | 00 | 2 | 00: D.c. link thermal model gives <i>OHt dc bus</i> trip with sub-trip 0. |

#### Recommended actions:

- Check the AC supply voltage balance and levels.
- Check the DC bus ripple level.
- Reduce duty cycle.
- Reduce motor load.
- Check output current stability. If unstable;
  - Check the motor map settings with motor nameplate (*Motor Rated Frequency* (05.006), *Motor Rated Current* (05.007), *Motor Rated Speed* (05.008), *Motor Rated Voltage* (05.009), *Motor Rated Power Factor* (05.010) and *Number Of Motor Poles* (05.011))
  - Disable slip compensation (*Slip Compensation Level* (05.027) = 0.0%)
  - Disable dynamic V to F operation (*Flux Optimisation Select, Dynamic V To F Select* (05.013) = Off (0))
  - Select fixed boost (*Control Mode* (05.014) = Fixed (2))
  - Select high stability space vector modulation (*High Stability Space Vector Modulation* (05.019) = On (1))
  - Disconnect the load and complete a rotating auto-tune (*Auto-tune* (05.012) = 2)
  - Reduce frequency loop gains (*Frequency Controller Proportional Gain Kp1* (03.010), *Frequency Controller Integral Gain Ki1* (03.011) and *Frequency Controller Differential Feedback Gain Kd1* (03.012))
  - Add a current demand filter (*Current Reference Filter 1 Time Constant* (04.012))

| Trip              | <i>Oht.C</i> |
|-------------------|--------------|
| Value             | 219          |
| Short description |              |

This trip indicates that a control stage over-temperature has been detected if *Cooling Fan control* (06.045) = 0.

This trip causes the option module to go to standby and *Potential Drive Damage Conditions* (10.106) bit 1 to be set.

**Recommended actions:**

- Increase ventilation by setting *Cooling Fan control* (06.045) > 0.

| Trip              | <i>Oht.I</i> |
|-------------------|--------------|
| Value             | 21           |
| Short description |              |

This trip indicates that an IGBT junction over-temperature has been detected based on a firmware thermal model.

| Source         | xx | y | zz   |
|----------------|----|---|--|
| Control system | 00 | 1 | 00: Inverter thermal model gives <i>Oht Inverter</i> trip with sub-trip 0. |

**Recommended actions:**

- Reduce the selected drive switching frequency.
- Ensure *Auto-switching Frequency Change Disable* (05.035) is set to Off.
- Reduce duty cycle.
- Decrease acceleration / deceleration rates.
- Reduce motor load.
- Check DC bus ripple.
- Ensure all three input phases are present and balanced

| Trip              | <i>Oht.P</i> |
|-------------------|--------------|
| Value             | 22           |
| Short description |              |

This trip indicates that a power stage over-temperature has been detected. From the sub-trip "xyzz", the thermistor location is identified by "zz".

| Source       | xx | y | zz   |
|--------------|----|---|--|
| Power system | 01 | 0 | zz: Thermistor location defined by zz in the power system gives <i>Oht Power</i> trip with sub-trip xx0zz. |

**Recommended actions:**

- Check enclosure / drive fans are still functioning correctly.
- Force the heatsink fans to run at maximum speed.
- Check enclosure ventilation paths.
- Check enclosure door filters.
- Increase ventilation.
- Reduce duty cycle.
- Decrease acceleration / deceleration rates.
- Reduce motor loads.
- Check the derating tables and confirm the drive is correctly sized for the application.
- Use a drive with larger current / power rating.

| Trip              | <i>OI.A1</i> |
|-------------------|--------------|
| Value             | 189          |
| Short description |              |

Analogue input 1 over current.

| Trip              | <i>OI.A2</i> |
|-------------------|--------------|
| Value             | 190          |
| Short description |              |

Not supported



| Trip              | <i>Ol.aC</i> |
|-------------------|--------------|
| Value             | 3            |
| Short description |              |

This trip indicates that the instantaneous drive output current has exceeded the drive over current threshold.

| Source         | xx | y | zz   |
|----------------|----|---|--|
| Control system | 00 | 0 | 00: Instantaneous over-current trip when the measured a.c. current exceeds the over current threshold. |

The over current threshold is the maximum current the drive can measure and is defined by VM\_DRIVE\_CURRENT[MAX]

#### Recommended actions:

- Acceleration / deceleration rate is too short.
- If seen during auto-tune reduce the voltage boost.
- Check for short circuit on the output cabling.
- Check integrity of the motor insulation using a Megger.
- Check motor cable is within limits for the frame size.
- Reduce frequency loop gains (*Frequency Controller Proportional Gain Kp1* (03.010), *Frequency Controller Integral Gain Ki1* (03.011) and *Frequency Controller Differential Feedback Gain Kd1* (03.012))
- Reduce the current loop gains.

| Trip              | <i>Ol.br</i> |
|-------------------|--------------|
| Value             | 4            |
| Short description |              |

This trip indicates that an over-current has been detected in braking IGBT or braking IGBT protection has been activated.

| Source       | xx | y | zz   |
|--------------|----|---|--|
| Power system | 01 | 0 | 00: Braking IGBT instantaneous over-current trip |

#### Recommended actions:

- Check brake resistor wiring.
- Check braking resistor value is greater than or equal to the minimum resistance value.
- Check braking resistor insulation.

| Trip              | <i>Ol.SC</i> |
|-------------------|--------------|
| Value             | 228          |
| Short description |              |

Output phase short circuit.

#### Recommended actions:

- Check motor and connection to motor

| Trip              | <i>Ol.Sn</i> |
|-------------------|--------------|
| Value             | 92           |
| Short description |              |

This trip indicates that an over-current condition has been detected in the rectifier snubbing circuit, The exact cause of the trip can be identified by the sub-trip number.

| Source       | xx | y | zz  |
|--------------|----|---|---|
| Power system | 01 | 1 | 00: Rectifier snubber over-current trip detected. |

#### Recommended actions:

- Ensure the internal EMC filter is installed.
- Ensure the motor cable length does not exceed the maximum for selected switching frequency.
- Check for supply voltage imbalance.
- Check for supply disturbance such as notching from a DC drive.
- Check the motor and motor cable insulation with a Megger.
- Fit an output line reactor or sinusoidal filter

| Trip              | <i>Out.P</i> |
|-------------------|--------------|
| Value             | 98           |
| Short description |              |

Output phase loss detected. A test can be made for output phase loss when the drive is enabled or the output phase loss condition can be detected

while the drive is running as defined by *Output Phase Loss Detection Enable* (06.059).

| Sub-trip | Reason   |
|----------|--|
| 1        | Phase U is not connected when drive is enabled   |
| 2        | Phase V is not connected when drive is enabled   |
| 3        | Phase W is not connected when drive is enabled   |
| 4        | The drive output frequency is above 4Hz and a phase is disconnected for the time specified by <i>Output Phase Loss Detection Time</i> (06.058) |

**Recommended actions:**

- Check motor and drive connections.
- To disable the trip set *Output Phase Loss Detection Enable* (06.059) to Off.

| Trip              | OV |
|-------------------|----|
| Value             | 2  |
| Short description |    |

This trip indicates the the DC bus voltage has exceeded VM\_DC\_VOLTAGE[MAX] instantaneously or VM\_DC\_VOLTAGE\_SET[MAX] for 15s. The trip threshold varies depending on voltage rating of the drive as shows below.

| Voltage rating | VM_DC_VOLTAGE[MAX] | VM_DC_VOLTAGE_SET[MAX] |
|----------------|--------------------|------------------------|
| 200            | 415                | 410                    |
| 400            | 830                | 815                    |
| 575            | 990                | 970                    |

The exact cause of the trip can be identified by the sub-trip number.

| Source         | xx | y | zz   |
|----------------|----|---|--|
| Control system | 00 | 0 | 01: Instantaneous trip when the d.c. link voltage exceeds VM_DC_VOLTAGE[MAX].                |
| Control system | 00 | 0 | 02: Time delayed trip indicating that the d.c. link voltage is above VM_DC_VOLTAGE_SET[MAX]. |
| Power system   | 01 | 0 | 00: Instantaneous trip when the d.c. link voltage exceeds VM_DC_VOLTAGE[MAX].                |

**Recommended actions:**

- Increase deceleration ramp.
- Decrease the braking resistor value (staying above the minimum value).
- Check nominal AC supply level.
- Check for supply disturbances which could cause the DC bus level to rise.
- Check motor insulation using a Megger.

| Trip              | P.Dat |
|-------------------|-------|
| Value             | 220   |
| Short description |       |

This trip can be generated either from the drive control system or from the power system.

This trip is produced if there is an error in the configuration data stored in the power system. If the source of the trip is the control system then the trip related to the table that is uploaded from the power system at power-up.

| Source         | xx | y | zz   |
|----------------|----|---|--|
| Control system | 00 | 0 | 01: No data was obtained because this was skipped.   |
| Control system | 00 | 0 | 02: There is no data table in node 1.  |
| Control system | 00 | 0 | 03: The power system data table is bigger than the space available in the control pod to store it.   |
| Control system | 00 | 0 | 04: The size of the table given in the table is incorrect  |
| Control system | 00 | 0 | 05: Table CRC error.   |
| Control system | 00 | 0 | 06: The version number of the generator software that produced the table is too low, i.e. a table from a newer generator is required that includes features that have been added to the table that may not be present. |
| Control system | 00 | 0 | 07: The power data table failed to be stored in the power board.   |
| Power system   | 01 | 0 | 00: The power data table used internally by the power module has an error.   |
| Power system   | 01 | 0 | 01: The power data table that is uploaded to the control system on power up has an error.  |
| Power system   | 01 | 0 | 02: The power data table used internally by the power module does not match the hardware identification of the power module.   |

#### Recommended actions:

- Hardware fault - contact the supplier of the drive.

| Trip              | Pad |
|-------------------|-----|
| Value             | 34  |
| Short description |     |

If keypad reference mode is enabled (*Reference Selected Indicator* (01.049) = 4 or 6) (i.e. *Reference Selector* (01.014) is set to 4 or 6 if motor map 1 is selected, or *M2 Reference Selector* (21.003) is set to 4 or 6 if motor map 2 is selected) and the keypad removed, then this trip is initiated.

#### Recommended actions:

- Re-install keypad and reset.
- Change *Reference Selector* (01.014) to select the reference from another source.

| Trip              | Pb.bt |
|-------------------|-------|
| Value             | 245   |
| Short description |       |

Power board is in its bootloader

#### Recommended actions:

- Send power board firmware file to reprogram the power board and power cycle drive.

| Trip              | Pb.Er |
|-------------------|-------|
| Value             | 93    |
| Short description |       |

Communication between the flavour and the olympian power board was lost. The exact cause of the trip can be identified by the sub-trip number.

| Sub-trip number | Reason   |
|-----------------|--|
| 1               | PLL operating region out of lock               |
| 2               | Power board lost communication with user board |
| 3               | User board lost communication with power board |
| 4               | Communication CRC error                        |

#### Recommended actions:

- Hardware fault - contact the supplier of the drive.

| Trip              | <b>Pb.HF</b> |
|-------------------|--------------|
| Value             | 235          |
| Short description |              |

Reserved trip number.

| Trip              | <b>Pd.S</b> |
|-------------------|-------------|
| Value             | 37          |
| Short description |             |

This trip indicates that an error has been detected in the power down save parameters stored in non-volatile memory.

#### Recommended actions:

- Perform a 1001 save in Pr *mm.000* to ensure that the trip doesn't occur the next time the drive is powered up.

| Trip              | <b>PH.Lo</b> |
|-------------------|--------------|
| Value             | 32           |
| Short description |              |

This trip indicates that the drive has detected an input phase loss or large supply imbalance. The drive will attempt to stop the motor before the trip is initiated. If the motor cannot be stopped in 10 seconds the trip occurs immediately. This trip works by monitoring the ripple voltage on the DC bus of the drive, if the DC buss ripple exceeds the threshold, the drive will trip on *Phase Loss*. Potential causes of the DC bus ripple are input phase loss, large supply impedance and severe output current instability.

| Source         | xx | y | zz   |
|----------------|----|---|--|
| Control system | 00 | 0 | 00: Phase loss detected based on control system feedback. The drive attempts to stop the drive before tripping unless bit 2 of <i>Action On Trip Detection</i> (10.037) is set to one. |
| Power system   | 01 | 0 | 00: Phase loss has been detected by the rectifier module.  |
| Control system | 01 | 1 | 01: Supply loss has been detected by the rectifier module in a multi-power module system, where this must be treated as a phase loss condition to prevent damage to the drive.         |

Input phase loss detection can be disabled when the drive required to operate from the DC supply or from a single phase supply in *Input Phase Loss Detection Mode* (06.047).

#### Recommended actions:

- Check the AC supply voltage balance and level at full load.
- Check the DC bus ripple level with an isolated oscilloscope.
- Check the output current stability.
- Reduce the duty cycle.
- Reduce the motor load.
- Disable the phase loss detection by setting *Input Phase Loss Detection Mode* (06.047) to Disabled.

| Trip              | <b>PSU</b> |
|-------------------|------------|
| Value             | 5          |
| Short description |            |

This trip indicates that one or more internal power supply rails are outside limits or overloaded.

| Source         | xx | y | zz                                 |
|----------------|----|---|------------------------------------|
| Control system | 00 | 0 | 00: Internal power supply overload |
| Power system   | 01 | 1 | 00: Internal power supply overload |

#### Recommended actions:

- Remove any option modules and perform a reset.
- Hardware fault within the drive - return the drive to the supplier.

| Trip              | <i>r.All</i> |
|-------------------|--------------|
| Value             | 227          |
| Short description |              |

An option module, derivative image or user program image has requested more parameter RAM than is allowed. The RAM allocation is checked in order of resulting sub-trip numbers, and so the failure with the highest sub-trip number is given. The sub-trip is calculated as (parameter size x 1000) + (parameter type x 100) + sub-array number. Note that if this trip occurs, all menu customisation provided by option modules, the derivative image or the user program image is not used. The tables below show the values corresponding to the parts of the sub-trip number.

| Parameter size | Value |
|----------------|-------|
| 1 bit          | 1     |
| 8 bit          | 2     |
| 16 bit         | 3     |
| 32 bit         | 4     |
| 64 bit         | 5     |

| Parameter type  | Value |
|-----------------|-------|
| Volatile        | 0     |
| User save       | 1     |
| Power-down save | 2     |

Derivatives can customise menus 18 and 20.

| Sub-array                  | Menus | Value |
|----------------------------|-------|-------|
| Applications menus         | 18-20 | 1     |
| Derivative image           | 29    | 2     |
| User program image         | 30    | 3     |
| Option slot 1 set-up       | 15    | 4     |
| Option slot 1 applications | 25    | 5     |

| Trip              | <i>R.b.ht</i> |
|-------------------|---------------|
| Value             | 250           |
| Short description |               |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 1   |
| Short description |     |

The under voltage condition is now a drive state, and so this trip is no longer used by the drive.

| Trip              | Res |
|-------------------|-----|
| Value             | 9   |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 12  |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 14  |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 15  |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 16  |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 17  |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 23  |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 38  |
| Short description |     |

Reserved

| Trip              | Res |
|-------------------|-----|
| Value             | 39  |
| Short description |     |

Indicates that a current loss was detected in current mode on Analog Input 3. In 4-20mA and 20-4mA modes. loss of input is detected if the current falls below 3mA. See *Analogue I/O 3 Mode* (07.015) for further details.

#### Recommended actions:

- Check control wiring is correct.
- Check control wiring is undamaged.
- Check *Analogue I/O 3 Mode* (07.015)
- Check that the current signal is present and greater than 3mA

| Trip              | Res |
|-------------------|-----|
| Value             | 91  |
| Short description |     |

Reserved

| <b>Trip</b>       | <b>Res</b> |
|-------------------|------------|
| Value             | 94         |
| Short description |            |

Reserved trip number.

| <b>Trip</b>       | <b>Res</b> |
|-------------------|------------|
| Value             | 95         |
| Short description |            |

Reserved trip number.

| <b>Trip</b>       | <b>Res</b> |
|-------------------|------------|
| Value             | 99         |
| Short description |            |

Reserved trip number.

| <b>Trip</b>       | <b>Res</b> |
|-------------------|------------|
| Value             | 101        |
| Short description |            |

Reserved trip number.

| <b>Trip</b>       | <b>Res</b> |
|-------------------|------------|
| Value             | 102        |
| Short description |            |

Reserved trip number.

| <b>Trip</b>       | <b>Res</b> |
|-------------------|------------|
| Value             | 103        |
| Short description |            |

Reserved trip number.

| <b>Trip</b>       | <b>Res</b> |
|-------------------|------------|
| Value             | 104        |
| Short description |            |

Reserved trip number.

| <b>Trip</b>       | <b>Res</b> |
|-------------------|------------|
| Value             | 105        |
| Short description |            |

Reserved trip number.

| <b>Trip</b>       | <b>Res</b> |
|-------------------|------------|
| Value             | 106        |
| Short description |            |

Reserved trip number.

| <b>Trip</b>       | <b>Res</b> |
|-------------------|------------|
| Value             | 107        |
| Short description |            |

Reserved trip number.

| <b>Trip</b>       | <b>Res</b> |
|-------------------|------------|
| Value             | 108        |
| Short description |            |

Reserved trip number.

| <b>Trip</b>       | <b>Res</b> |
|-------------------|------------|
| Value             | 109        |
| Short description |            |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 111 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 168 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 169 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 170 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 171 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 172 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 176 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 177 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 191 |
| Short description |     |

Not supported

| Trip              | Res |
|-------------------|-----|
| Value             | 192 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 193 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 194 |
| Short description |     |

Reserved trip number.



| <b>Trip</b>       | <b>Res</b> |
|-------------------|------------|
| Value             | 195        |
| Short description |            |

Reserved trip number.

| <b>Trip</b>       | <b>Res</b> |
|-------------------|------------|
| Value             | 196        |
| Short description |            |

Reserved trip number.

| <b>Trip</b>       | <b>Res</b> |
|-------------------|------------|
| Value             | 197        |
| Short description |            |

Reserved trip number.

| <b>Trip</b>       | <b>Res</b> |
|-------------------|------------|
| Value             | 198        |
| Short description |            |

Reserved trip number.

| <b>Trip</b>       | <b>Res</b> |
|-------------------|------------|
| Value             | 205        |
| Short description |            |

Reserved trip number.

| <b>Trip</b>       | <b>Res</b> |
|-------------------|------------|
| Value             | 206        |
| Short description |            |

Reserved trip number.

| <b>Trip</b>       | <b>Res</b> |
|-------------------|------------|
| Value             | 207        |
| Short description |            |

Reserved trip number.

| <b>Trip</b>       | <b>Res</b> |
|-------------------|------------|
| Value             | 208        |
| Short description |            |

Reserved trip number.

| <b>Trip</b>       | <b>Res</b> |
|-------------------|------------|
| Value             | 209        |
| Short description |            |

Reserved trip number.

| <b>Trip</b>       | <b>Res</b> |
|-------------------|------------|
| Value             | 210        |
| Short description |            |

Reserved trip number.

| <b>Trip</b>       | <b>Res</b> |
|-------------------|------------|
| Value             | 211        |
| Short description |            |

Reserved trip number.

| <b>Trip</b>       | <b>Res</b> |
|-------------------|------------|
| Value             | 212        |
| Short description |            |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 213 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 214 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 215 |
| Short description |     |

During drive mode changeover option modules must acknowledge that they have stopped accessing the communications system between the option slots and the drive. If an option module does not do this in the allowed time then this trip is produced.

#### Recommended actions:

- Reset the trip.
- If the trip persists, replace the option module.

| Trip              | Res |
|-------------------|-----|
| Value             | 216 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 217 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 222 |
| Short description |     |

Reserved

| Trip              | Res |
|-------------------|-----|
| Value             | 223 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 224 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 229 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 230 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 233 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 238 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 239 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 240 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 241 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 242 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 243 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 244 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 251 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 252 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 253 |
| Short description |     |

Reserved trip number.

| Trip              | Res |
|-------------------|-----|
| Value             | 254 |
| Short description |     |

Reserved trip number.

| Trip              | Reset |
|-------------------|-------|
| Value             | 100   |
| Short description |       |

This is not a valid trip number as this value is used in *User Trip* (10.038) to reset the drive.

| Trip              | <i>rS</i> |
|-------------------|-----------|
| Value             | 33        |
| Short description |           |

During auto-tune it is possible to attempt to measure the resistance of the motor connected to the drive. If the measured value or a value written to this parameter by the user exceeds  $(V_{FS} / \sqrt{2}) / \text{Full Scale Current } K_c$  (11.061), where  $V_{FS}$  is the full scale d.c. link voltage then this trip is initiated.

#### Recommended actions:

- Check the motor cable / connections.
- Check the integrity of the motor stator winding using an insulation tester.
- Check the motor phase to phase resistance at the drive terminals.
- Check the motor phase to phase resistance at the motor terminals.
- Ensure the stator resistance of the motor falls within the range of the drive model.
- Select fixed boost mode (*Control Mode* (05.014) = Fixed) and verify the output current waveforms with an oscilloscope.
- Replace the motor.

| Trip              | <i>Rst.L</i> |
|-------------------|--------------|
| Value             | 255          |
| Short description |              |

This is not a valid trip number as this value is used in *User Trip* (10.038) to reset the trip logs.

| Trip              | <i>SCL</i> |
|-------------------|------------|
| Value             | 30         |
| Short description |            |

This trip indicates that the control word watchdog has been enabled and has timed out.

| Trip              | <i>SL.dF</i> |
|-------------------|--------------|
| Value             | 204          |
| Short description |              |

If the option module fitted in option slot 1 is different to the option module present at the last power-down then this trip is produced. The sub-trip number gives the identification code of the module that was originally fitted. Drive user parameters must be saved to prevent this trip on the next power-up if the module has changed. If the menus have been changed, but not the module, the trip will not occur on the next power-up. The sub-trip number gives the following indications of the reason for the trip.

| Sub-trip | Reason  |
|----------|---|
| 1        | No module was fitted previously   |
| 2        | A module with the same identifier is fitted, but the set-up menu for this option slot has been changed, and so default parameters have been loaded for this menu.                     |
| 3        | A module with the same identifier is fitted, but the applications menu for this option slot has been changed, and so default parameters have been loaded for this menu.               |
| 4        | A module with the same identifier is fitted, but the set-up and applications menu for this option slot have been changed, and so default parameters have been loaded for these menus. |
| >99      | Shows the identifier of the module previously fitted.   |

#### Recommended actions:

- Turn off the power, ensure the correct option modules are installed in the correct option slots and re-apply the power.
- Confirm that the currently installed option module is correct, ensure option module parameters are set correctly and perform a user save in *Pr mm.000*.

| Trip              | <i>SL.Er</i> |
|-------------------|--------------|
| Value             | 202          |
| Short description |              |

The option module in option slot 1 has indicated an error. The option module can give the reason for the error and this is shown in the sub-trip number. As default the sub-trip number is shown as a number on the display, however, it is possible for the option module to supply sub-trip number strings which will be displayed instead of the number if available.

#### Recommended actions:

- See relevant *Option Module User Guide* for details of the trip.

| Trip              | <b>SL.HF</b> |
|-------------------|--------------|
| Value             | 200          |
| Short description |              |

This trip indicates that there is a fault with the option module in option slot 1 that means that this module cannot operate. The possible causes of the trip are given by the sub-trip value.

| Sub-trip | Reason  |
|----------|---|
| 1        | The module category cannot be identified  |
| 2        | All the required customisable menu table information has not been supplied or the tables supplied are corrupt           |
| 3        | There is insufficient memory available to allocate the comms buffers for this module.                                   |
| 4        | The module has not indicated that it is running correctly during drive power-up   |
| 5        | The module has been removed after power-up or it has ceased to indicate to the drive processor that it is still active. |
| 6        | The module has not indicated that it has stopped accessing drive parameters during a drive mode change                  |
| 7        | The module has failed to acknowledge that a request has been made to reset the drive processor.                         |
| 8        | The drive failed to read correctly the menu table from the module during drive power-up.                                |
| 9        | The drive failed to upload menu tables from the module and timed-out (5s).  |
| 10       | Menu table CRC invalid.   |

#### Recommended actions:

- Ensure the option module is installed correctly.
- Replace the option module.
- Replace the drive.

| Trip              | <b>SL.nF</b> |
|-------------------|--------------|
| Value             | 203          |
| Short description |              |

Each option module fitted in the drive is identified at power-up and the option fitted is stored by the drive in its non-volatile memory. If an option module was fitted in slot 1 at power-down, but that option module has subsequently been removed before power up then this trip is produced. The sub-trip number gives the identification code of the option module that has been removed. Drive user parameters must be saved to prevent this trip on the next power-up.

#### Recommended actions:

- Ensure the option module is installed correctly.
- Re-install the option module.
- To confirm that the removed option module is no longer required perform a save function in Pr *mm.000*.

| Trip              | <b>SL.tO</b> |
|-------------------|--------------|
| Value             | 201          |
| Short description |              |

This trip indicates that the option module in option slot 1 has started the option watchdog function and then failed to service this watchdog correctly.

#### Recommended actions:

- Replace the option module.

| Trip              | <b>So.St</b> |
|-------------------|--------------|
| Value             | 226          |
| Short description |              |

This trip indicates that the soft start system has remained active when it should be inactive. For a resistor based soft start this means that the soft start shorting relay has not closed.

#### Recommended actions:

- Hardware fault - contact the supplier of the drive.

| Trip              | <i>St.HF</i> |
|-------------------|--------------|
| Value             | 221          |
| Short description |              |

If an HF01 to HF17 trip occurs then a *Stored HF* trip occurs each time the drive is powered up until this trip is reset. The sub-trip code is the number of the original HF trip. The *Stored HF* trip can only be reset by first writing 1299 to Pr *mm.000* and resetting the drive.

**Recommended actions:**

- Enter 1299 into Pr *mm.000* and press reset to clear the trip.

| Trip              | <i>STO</i> |
|-------------------|------------|
| Value             | 234        |
| Short description |            |

STO board not fitted.

**Recommended actions:**

- Hardware fault - contact the supplier of the drive.

| Trip              | <i>t040</i> |
|-------------------|-------------|
| Value             | 40          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

| Trip              | <i>t041</i> |
|-------------------|-------------|
| Value             | 41          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

| Trip              | <i>t042</i> |
|-------------------|-------------|
| Value             | 42          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

| Trip              | <i>t043</i> |
|-------------------|-------------|
| Value             | 43          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

| Trip              | <i>t044</i> |
|-------------------|-------------|
| Value             | 44          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

| Trip              | <i>t045</i> |
|-------------------|-------------|
| Value             | 45          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

| Trip              | <i>t046</i> |
|-------------------|-------------|
| Value             | 46          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

| Trip              | <i>t047</i> |
|-------------------|-------------|
| Value             | 47          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t048</b> |
| Value             | 48          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t049</b> |
| Value             | 49          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t050</b> |
| Value             | 50          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t051</b> |
| Value             | 51          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t052</b> |
| Value             | 52          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t053</b> |
| Value             | 53          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t054</b> |
| Value             | 54          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t055</b> |
| Value             | 55          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t056</b> |
| Value             | 56          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t057</b> |
| Value             | 57          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t058</b> |
| Value             | 58          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t059</b> |
| Value             | 59          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t060</b> |
| Value             | 60          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t061</b> |
| Value             | 61          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t062</b> |
| Value             | 62          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t063</b> |
| Value             | 63          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t064</b> |
| Value             | 64          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t065</b> |
| Value             | 65          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t066</b> |
| Value             | 66          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t067</b> |
| Value             | 67          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t068</b> |
| Value             | 68          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t069</b> |
| Value             | 69          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t070</b> |
| Value             | 70          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t071</b> |
| Value             | 71          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.



|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t072</b> |
| Value             | 72          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t073</b> |
| Value             | 73          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t074</b> |
| Value             | 74          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t075</b> |
| Value             | 75          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t076</b> |
| Value             | 76          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t077</b> |
| Value             | 77          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t078</b> |
| Value             | 78          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t079</b> |
| Value             | 79          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t080</b> |
| Value             | 80          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t081</b> |
| Value             | 81          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t082</b> |
| Value             | 82          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t083</b> |
| Value             | 83          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t084</b> |
| Value             | 84          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t085</b> |
| Value             | 85          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t086</b> |
| Value             | 86          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t087</b> |
| Value             | 87          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t088</b> |
| Value             | 88          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t089</b> |
| Value             | 89          |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t112</b> |
| Value             | 112         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t113</b> |
| Value             | 113         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t114</b> |
| Value             | 114         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t115</b> |
| Value             | 115         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t116</b> |
| Value             | 116         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t117</b> |
| Value             | 117         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t118</b> |
| Value             | 118         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t119</b> |
| Value             | 119         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t120</b> |
| Value             | 120         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t121</b> |
| Value             | 121         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t122</b> |
| Value             | 122         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t123</b> |
| Value             | 123         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t124</b> |
| Value             | 124         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t125</b> |
| Value             | 125         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t126</b> |
| Value             | 126         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t127</b> |
| Value             | 127         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t128</b> |
| Value             | 128         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t129</b> |
| Value             | 129         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t130</b> |
| Value             | 130         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t131</b> |
| Value             | 131         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t132</b> |
| Value             | 132         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t133</b> |
| Value             | 133         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t134</b> |
| Value             | 134         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t135</b> |
| Value             | 135         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t136</b> |
| Value             | 136         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t137</b> |
| Value             | 137         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t138</b> |
| Value             | 138         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t139</b> |
| Value             | 139         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t140</b> |
| Value             | 140         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t141</b> |
| Value             | 141         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t142</b> |
| Value             | 142         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t143</b> |
| Value             | 143         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t144</b> |
| Value             | 144         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t145</b> |
| Value             | 145         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t146</b> |
| Value             | 146         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t147</b> |
| Value             | 147         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t148</b> |
| Value             | 148         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t149</b> |
| Value             | 149         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t150</b> |
| Value             | 150         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t151</b> |
| Value             | 151         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t152</b> |
| Value             | 152         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t153</b> |
| Value             | 153         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t154</b> |
| Value             | 154         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t155</b> |
| Value             | 155         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t156</b> |
| Value             | 156         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t157</b> |
| Value             | 157         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t158</b> |
| Value             | 158         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t159</b> |
| Value             | 159         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t160</b> |
| Value             | 160         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t161</b> |
| Value             | 161         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t162</b> |
| Value             | 162         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t163</b> |
| Value             | 163         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t164</b> |
| Value             | 164         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t165</b> |
| Value             | 165         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t166</b> |
| Value             | 166         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |             |
|-------------------|-------------|
| <b>Trip</b>       | <b>t167</b> |
| Value             | 167         |
| Short description |             |

This trip is not used by the drive and can be used for a user trip.

|                   |           |
|-------------------|-----------|
| <b>Trip</b>       | <b>th</b> |
| Value             | 24        |
| Short description |           |

This trip indicates that the motor thermistor has indicated a motor over-temperature.

If *Digital input 5 mode* (08.035) is 2 then a *Thermistor* trip is initiated if the feedback value is higher than *Thermistor Trip Threshold* (07.048).

**Recommended actions:**

- Check motor temperature.
- Check thermistor continuity.

|                   |              |
|-------------------|--------------|
| <b>Trip</b>       | <b>Th.br</b> |
| Value             | 10           |
| Short description |              |

If hardware based braking resistor thermal monitoring is provided and the resistor overheats this trip is initiated. If the braking resistor is not present then this trip must be disabled with bit 3 of *Action On Trip Detection* (10.037) to prevent this trip.

**Recommended actions:**

- Check braking resistor wiring.
- Check braking resistor value is greater than or equal to the minimum resistance value.
- Check braking resistor insulation.

|                   |              |
|-------------------|--------------|
| <b>Trip</b>       | <b>TH.fb</b> |
| Value             | 218          |
| Short description |              |

This trip indicates a fault with a thermistor in the drive (i.e. open circuit or short circuit).

| Source       | xx | y | zz  |
|--------------|----|---|---|
| Power system | 01 | 0 | zz: Thermistor location defined by zz in the power system |
| Power system | 01 | 1 | zz: Thermistor location defined by zz in the rectifier    |

**Recommended actions:**

- Hardware fault - contact the supplier of the drive.

|                   |            |
|-------------------|------------|
| <b>Trip</b>       | <b>thS</b> |
| Value             | 25         |
| Short description |            |

This trip indicates that the motor thermistor is short circuited or has a low impedance.

*Digital input 5 mode* (08.035) and the resistance of the thermistor connected to DI 5 is less than 500.

**Recommended actions:**

- Check thermistor continuity.
- Replace motor / motor thermistor

|                   |              |
|-------------------|--------------|
| <b>Trip</b>       | <b>Tun.1</b> |
| Value             | 11           |
| Short description |              |

The drive has tripped during an auto-tune. The cause of the trip can be identified from the sub-trip number.

| Sub-trip | Reason   |
|----------|--|
| 1        | Reserved   |
| 2        | The motor did not reach the required speed during rotating auto-tune or mechanical load measurement. |

**Recommended actions:**

- Ensure the motor is free to turn i.e. mechanical brake is released.

| Trip              | <i>Tun.S</i> |
|-------------------|--------------|
| Value             | 18           |
| Short description |              |

The drive was prevented from completing an auto-tune, because either the Final drive enable or the Final drive run were removed.

**Recommended actions:**

- Check the drive enable signal (Terminal 31&34) was active during the auto-tune.
- Check the run command was active in *Digital Input 5 State* (08.005) during the auto-tune.

| Trip              | <i>U.OI</i> |
|-------------------|-------------|
| Value             | 8           |
| Short description |             |

Reserved trip number.

| Trip              | <i>U.S</i> |
|-------------------|------------|
| Value             | 36         |
| Short description |            |

This trip indicates that an error has been detected in the user save parameters saved in non-volatile memory. For example, following a user save command, if the power to the drive was removed when the user parameters were being saved.

**Recommended actions:**

- Perform a user save in *Pr mm.000* to ensure that the trip doesn't occur the next time the drive is powered up.
- Ensure that the drive has enough time to complete the save before removing the power to the drive.

| Trip              | <i>UP.us</i> |
|-------------------|--------------|
| Value             | 96           |
| Short description |              |

This trip can be initiated from within an onboard user program using a function call which defines the sub-trip number.

**Recommended actions:**

- Check the user program

| Trip              | <i>UPrG</i> |
|-------------------|-------------|
| Value             | 249         |
| Short description |             |

Not supported