

User Guide

COMMANDER *Gp*

model sizes 1 to 4

0.75kW to 110kW
(1HP to 150HP)

COMMANDER *GpLV*

model sizes 1 to 3

0.37kW to 22kW
(0.5HP to 30HP)

General Purpose Variable Speed Drive
for induction motors

Part Number: 0451-0024

Issue Number: 2

General information

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 (Drive) with the motor.

The contents of this User Guide are believed to be correct at the time of printing. In the interests of a commitment to a policy of continuous development and improvement, the manufacturer reserves the right to change the specification of the product or its performance, or the contents of the User Guide, without notice.

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Important...

Drive software version

This product is supplied with the latest version of user-interface and machine-control software. If this product is to be used with other Control Techniques variable speed drives in an existing system, there may be some differences between their software and the software in this product. These differences will cause a difference in functions. This may also apply to variable speed drives returned from a Control Techniques Service Centre.

If there is any doubt, contact a Control Techniques Drive Centre.

| | |
|--------------|--|
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| S/W Version: | V03.XX.07 onward |

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1 Introduction

1.1 How this User Guide can help you

If this is your first encounter with a Commander Gp Drive, read this User Guide before referring to the accompanying Installation Guide.

This User Guide is arranged on a step-by-step basis to lead you through the following:

- Learning how to operate the Commander Gp (Drive)
- When to refer to the Installation Guide
- Setting up the Commander Gp for basic applications

Advanced programming of the Commander Gp

For advanced programming of the Commander Gp, refer to the *Commander Gp Advanced User Guide*. This contains descriptions of all the advanced parameters, as well as additional information, and can be obtained from the Drive Centres and distributors listed at the end of this User Guide.

The advanced parameters in software version V03.01.07 onward can be accessed by use of the UD71 *Basic serial communications* large option module (see *Serial communications* later in this chapter).



Warning

Variable speed drives may be hazardous if misused. Carefully follow the instructions in this User Guide and the Installation Guide.

1.2 Model sizes

This User Guide refers to the models listed below.

| Model size | Model code | Nominal rating for standard AC motors | |
|------------|------------|---------------------------------------|------------|
| | | kW at 380V | HP at 460V |
| | GPD 1401 | 0.75 | 1.0 |
| | GPD 1402 | 1.1 | 1.5 |
| | GPD 1403 | 1.5 | 2.0 |
| | GPD 1404 | 2.2 | 3.0 |
| | GPD 1405 | 4.0 | 5.0 |
| | GPD 2401 | 5.5 | 7.5 |
| | GPD 2402 | 7.5 | 10 |
| | GPD 2403 | 11.0 | 15 |
| | GPD 3401 | 15.0 | 25 |
| | GPD 3402 | 18.5 | 30 |
| | GPD 3403 | 22.0 | 30 |
| | GPD 3404 | 30.0 | 40 |
| | GPD 3405 | 37.0 | 50 |
| | GPD 4401 | 45.0 | 75 |
| | GPD 4402 | 55.0 | 100 |
| | GPD 4403 | 75.0 | 125 |
| | GPD 4404 | 90.0 | 150 |
| | GPD 4405 | 110.0 | 150 |

| Model size | Model code | Nominal rating for standard AC motors | |
|------------|------------|---------------------------------------|------------|
| | | KW at 380V | HP at 460V |
| | GPD 1201 | 0.37 | 0.5 |
| | GPD 1202 | 0.55 | 0.75 |
| | GPD 1203 | 0.75 | 1.0 |
| | GPD 1204 | 1.1 | 1.5 |
| | GPD 1205 | 2.2 | 3.0 |
| | GPD 2201 | 3.0 | 4.0 |
| | GPD 2202 | 4.0 | 5.0 |
| | GPD 2203 | 5.5 | 7.5 |
| | GPD 3201 | 7.5 | 10 |
| | GPD 3202 | 11 | 15 |
| | GPD 3203 | 15 | 20 |
| | GPD 3204 | 22 | 30 |

1.3 Configuration layers

The Drive has three layers of configuration, starting from the base layer (1) as follows:

1. **Default configuration**
2. **User-interface mode**
3. **Macro configuration**

Each of the upper layers (2, 3) is superimposed on its preceding layer.

1.4 Default configurations

The Drive has a separate *default configuration* for the AC supply conditions in Europe or in the USA. These two default configurations are distinguished as follows:

- European AC supply voltage at 50Hz
- USA AC supply voltage at 60Hz

The Drive is despatched from the factory in the appropriate default configuration for the continent in which it is to be sold. The default configuration is *Macro 0* (described in *Macro configurations* later in this chapter).

The default configuration also defines the following functions:

Europe

- Ability to select positive-logic for the digital control inputs
- Ability to adjust the current-loop PI gains

USA

- Ability to select digital control by two or three wires
- Frequency demand indication

(These functions apply to Macro 0 only.)

Key used in this User Guide

The following key denotes the default configuration:

- EUR**> 50Hz AC supply (Europe)
- USA**> 60Hz AC supply (USA)

When no key is stated, the information applies to both default configurations.

1.5 Operating mode

For use with standard AC induction motors.

The Drive applies power to the motor at frequencies which are controlled by the user. The motor speed is a result of the output frequency of the Drive and slip due to the mechanical load.

The Drive can power a number of motors connected in parallel (each motor must be protected against overload; this is described in the *Installation Guide*).

The Drive can improve the performance of the motor by applying the following:

- Slip compensation
- Fixed boost or Open-loop Vector operation

Fixed boost applies a fixed voltage boost at low frequencies.

Open-loop Vector operation maintains almost constant flux by dynamically adjusting the motor voltage according to the load on the motor.

1.6 User-interface modes

The motor can be started and stopped, the direction of rotation reversed and the speed changed by operation of the Drive in either of the following user-interface modes:

Terminal mode

Applying signals from electrical contacts, a system controller or PLC to digital and analog inputs on the Drive.

For the USA default configuration, the Drive can be configured for digital control by momentary contacts.

Keypad mode

Manual operation of the keypad on the front panel of the Drive. Minimal signal connections are made to the Drive.

1.7 Macro configurations

The Drive can be used to control the motor speed in various ways for different types of application. To reduce the number of adjustments to the Drive for each type of application, eight macro configurations (0 to 7) are available.

Each macro configuration requires specific signal connections to be made to the Drive.

The macro configurations are as follows:

Macro 0 **General purpose (default configuration)**

Analog frequency control for general-purpose applications.

The *output frequency* of the Drive is controlled by a *frequency reference*. The motor speed will follow the frequency reference so long as the maximum permissible output current of the Drive is not exceeded. These principles also apply to all other macro configurations except Macro 4.

The macro configuration can be used in either Keypad or Terminal mode.

The frequency can be controlled in either of the following ways...

- Terminal mode: An analog frequency reference signal applied to the Drive
- Keypad mode: By a user pressing keys on the front panel of the Drive

Macro 1 **Easy mode**

Frequency control for basic applications. This is similar to Macro 0, except, for simplicity, fewer adjustments are required.

The macro configuration can be used in either Keypad or Terminal mode.

The principles of controlling motor speed are the same as for Macro 0.

Macro 2 **Motorized potentiometer**

The frequency is controlled incrementally by operation of *up* and *down* contacts.

The macro configuration can be used in Terminal mode only.

The principles of controlling motor speed are the same as for Macro 0.

Macro 3 **Preset frequencies**

Four preset frequencies that are selected by external contacts.

The macro configuration can be used in Terminal mode only.

The principles of controlling motor speed are the same as for Macro 0.

Macro 4 **Torque control**

The motor torque is defined by a torque demand. The motor speed will vary continuously as a result of the difference between the load torque and the torque demand up to a maximum speed which is defined by a speed over-ride level.

The torque demand is supplied by an analog *torque reference* signal that is applied to the Drive.

The macro configuration can be used in Terminal mode only.

Macro 5 **PID control**

The Drive is operated with a frequency reference and an analog feedback device in order to dynamically maintain the speed to a user-defined set-point under PID control.

The macro configuration can be used in Terminal mode only.

The principles of controlling motor speed are the same as for Macro 0.

Macro 6 **Axis-limit control**

Axis-limit control is used for applications which require the process to be automatically stopped when a position limit has been reached. A bipolar or unipolar frequency reference can be used.

The macro configuration can be used in Terminal mode only.

The principles of controlling motor speed are the same as for Macro 0.

Macro 7 **Brake control**

Frequency control with brake control for crane or hoist applications.

The macro configuration can be used in Terminal mode or Keypad mode.

The principles of controlling motor speed are the same as for Macro 0.

1.8 Plug-in option modules

Operation of the Drive can be extended by the use of plug-in option modules. The following modules are available from the supplier of the Drive; an appropriate User Guide is included with each module:

Small option modules

| | |
|------|-----------------------------|
| UD50 | Additional I/O |
| UD55 | Cloning (parameter copying) |

Large option modules

| | |
|------|-----------------------------------|
| UD71 | RS232/RS485 serial communications |
|------|-----------------------------------|

1.9 Serial communications

The Drive can be configured and fully controlled from a system controller or PLC operating on a RS232 or a 4-wire RS485 serial communications link. A *Basic serial communications* large option module must be fitted in the Drive. More information can be obtained from a Drive Centre or distributor listed at the end of this User Guide.

Serial communications can be used in conjunction with Terminal mode or Keypad mode.

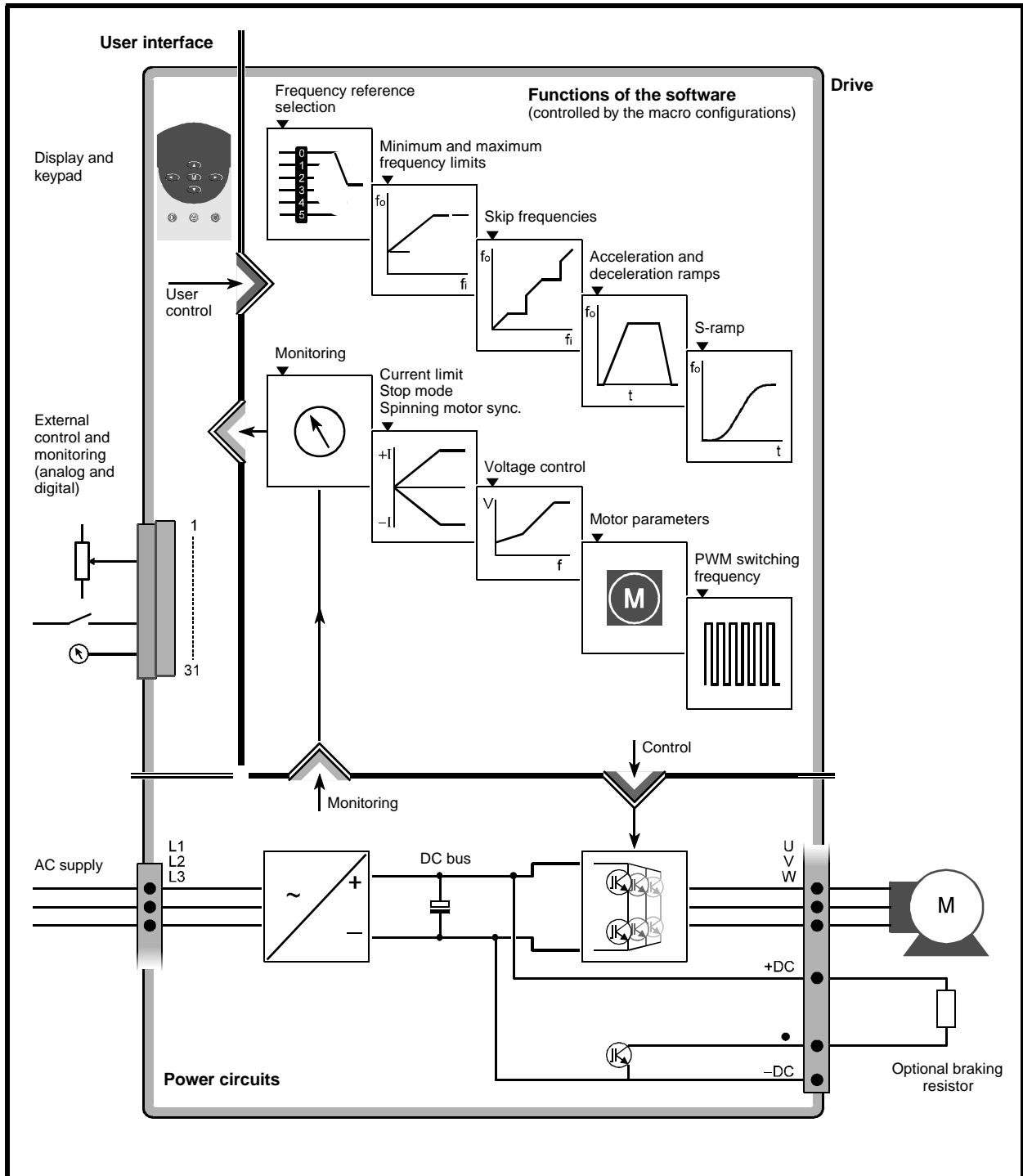






Figure 1-1 Block diagram of the Drive showing the main functions of the software, and power connections (signal connections vary according to the macro configuration)

2 Getting Started

2.1 How to use this chapter

It is recommended that you follow the instructions in this chapter in the order that they appear. You will be led through the initial stages of setting up the Drive (in Macro 1 *Easy mode*) as well as being able to familiarize yourself with operating the Drive.

- **Warning** The Drive must be operated only by personnel having the necessary training or experience.
- **Warning** If this is the first time the Drive has been operated, ensure that no damage or safety hazard could arise from the motor starting unexpectedly.
- **Warning** The motor must be fixed down and the shaft guarded against inadvertent contact.
- **Warning** Do not change parameter values without careful consideration; wrong values may cause damage or a safety hazard.

Notes



Keep a note of changes

When changing the values of parameters, make a note of the new values in case they need to be entered again.

Saving the changes

For new parameter-values to apply after the AC supply to the Drive is interrupted, new values must be saved. This is described in *Saving new parameter-values* in Appendix A *Programming Instructions*.

2.2 Making signal and power connections

- **Warning** **Stored charge**
The Drive contains capacitors that remain charged to a potentially lethal voltage after the AC supply has been disconnected. If the Drive has been energized, the AC supply must be isolated at least ten minutes before work may continue.
- **Warning** **Isolation**
The control circuits and terminals are isolated from the power circuits only by basic insulation to IEC664-1. The installer must ensure that all external control circuits are separated from human contact by at least one layer of insulation rated for use at the AC supply voltage.

For instructions on removing the terminal covers, see *Mounting the Drive and RFI filter* in Chapter 2 *Installing the Drive* in the Installation Guide.

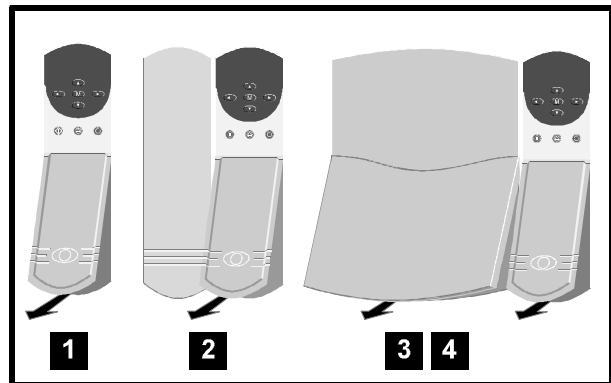


Figure 2-1 Removing the terminal covers for access to the connectors

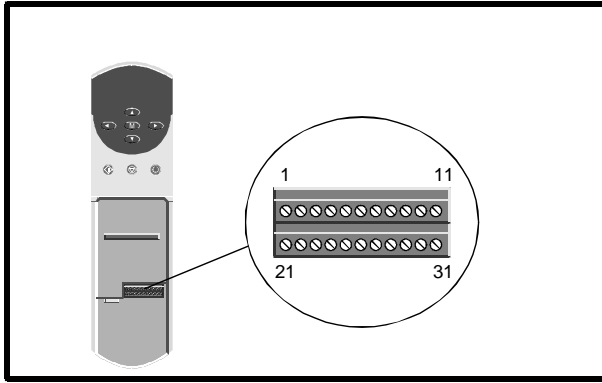


Figure 2-2 Location of the signal connector

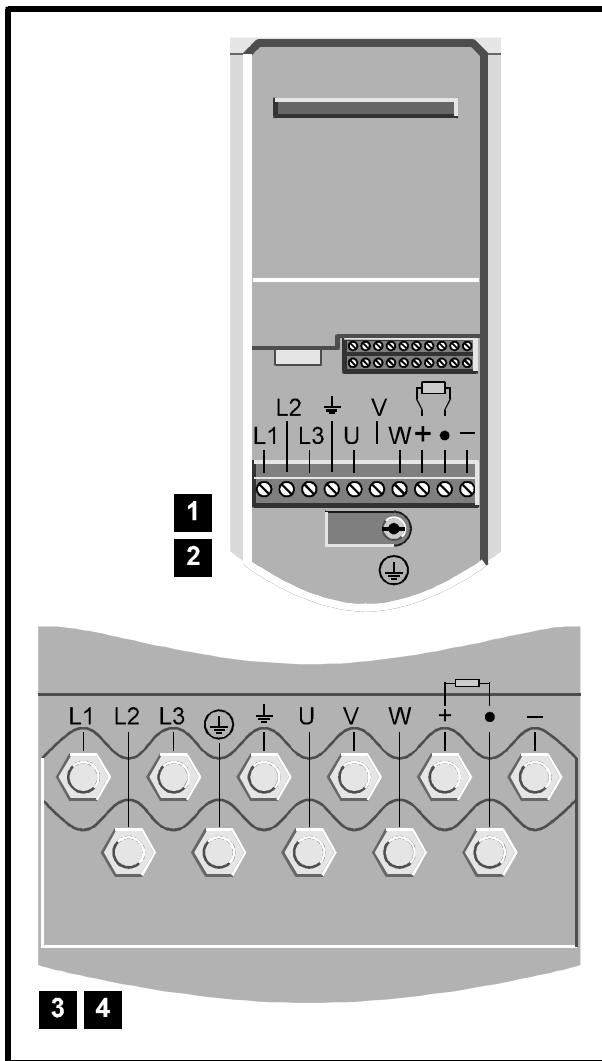


Figure 2-3 Locations of the power connectors

1. Observe the safety warnings and cautions given in Chapter 1 *Safety information* of the Installation Guide and in this chapter.
2. Refer to the following:
 - Chapter 2 of the Installation Guide in order to install the Drive
 - Figure 2-2 for the location of the signal connector
 - Figure 2-3 for the locations of the power connections
 - Figure 2-5 or 2-6 in this chapter in order to make the signal and power connections for operation in Terminal or Keypad mode. Note that Macros 2, 3, 4, 5, 6 operate only in Terminal mode. If one of these macro configurations is to be enabled after the initial setting up covered in this chapter, you may wish to set up the Drive now in Terminal mode in order to learn how to operate it in this mode.

Signal connector for all models The two terminal blocks of the signal connector can be unplugged from the Drive by pulling them downward.

Power connector for model sizes 1 and 2 The power connector can be unplugged from the Drive by pulling it downward.

Power connections to model sizes 3 and 4 The power connections are made to M10 studs located in the power section of the Drive.

3. Note that the default user-interface mode is as follows:

| Continent | User-interface mode |
|-----------|---------------------|
| EUR | Terminal |
| USA | Keypad |

(Instructions for changing the user-interface mode are given later.)

4. When connecting a motor to the Drive, observe the following:
 - Preferably the motor should be identical to the motor that is to be used in the application, but this is not essential.
 - The motor shaft must not be attached to any equipment, or exposed.
5. No motor thermistor connection is required at this stage, but a thermistor will be required later if the Drive is to be operated in any macro configuration except Macros 1 and 5. When Macro 1 or Macro 5 is enabled, the thermistor is ignored by the Drive. (Instructions for connecting a motor thermistor to the signal connector are given for each macro configuration in Chapter 3 *Setting Up the Drive*.)



Warning

After having made control connections, carefully check that terminal 30 is open-circuit to ensure the Drive is in the Stop state when the AC supply is first connected.

6. After re-fitting the terminal cover, connect the Drive to the AC supply.

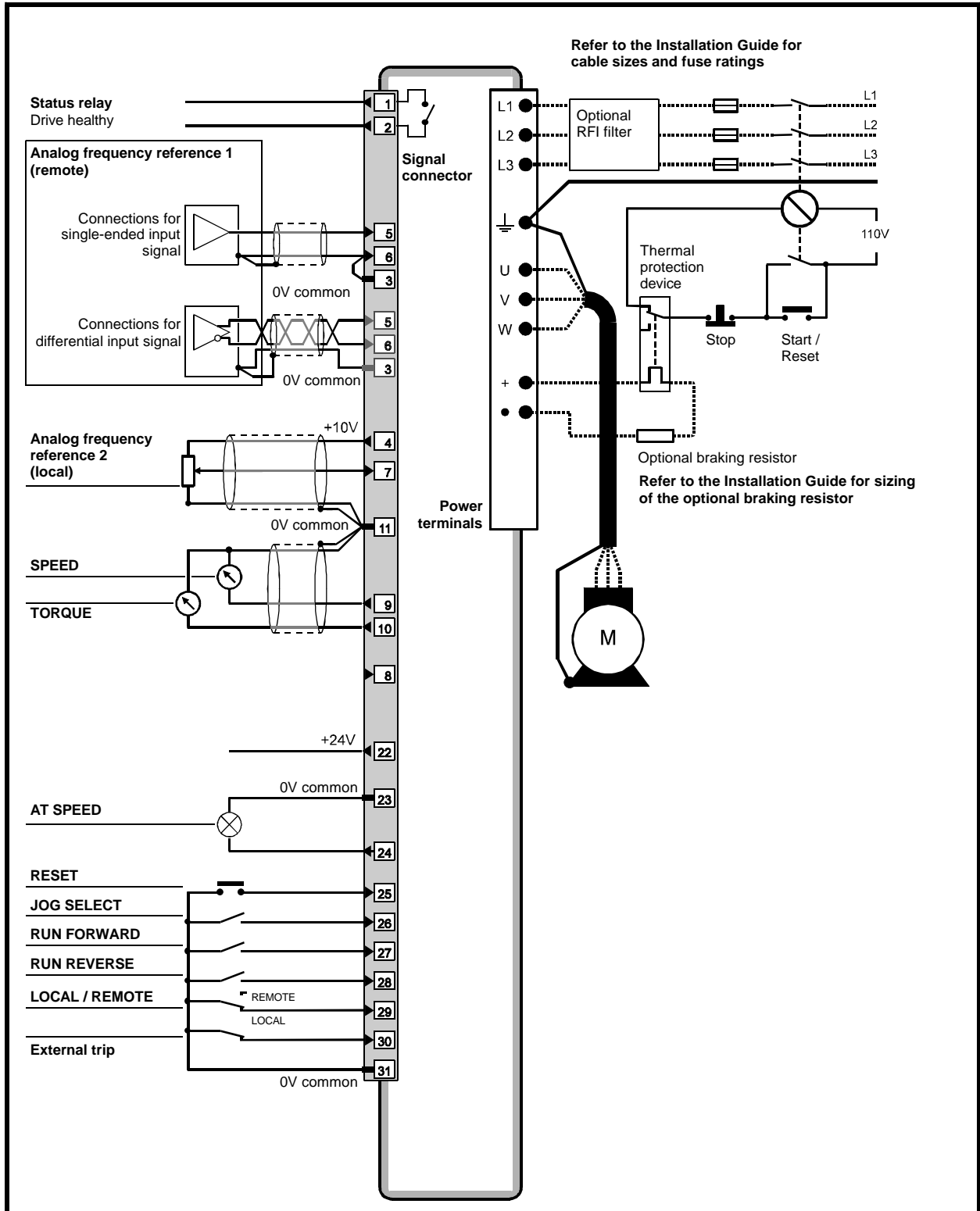


Figure 2-5 Power connections, and signal connections for Terminal mode (Macro 1 only)

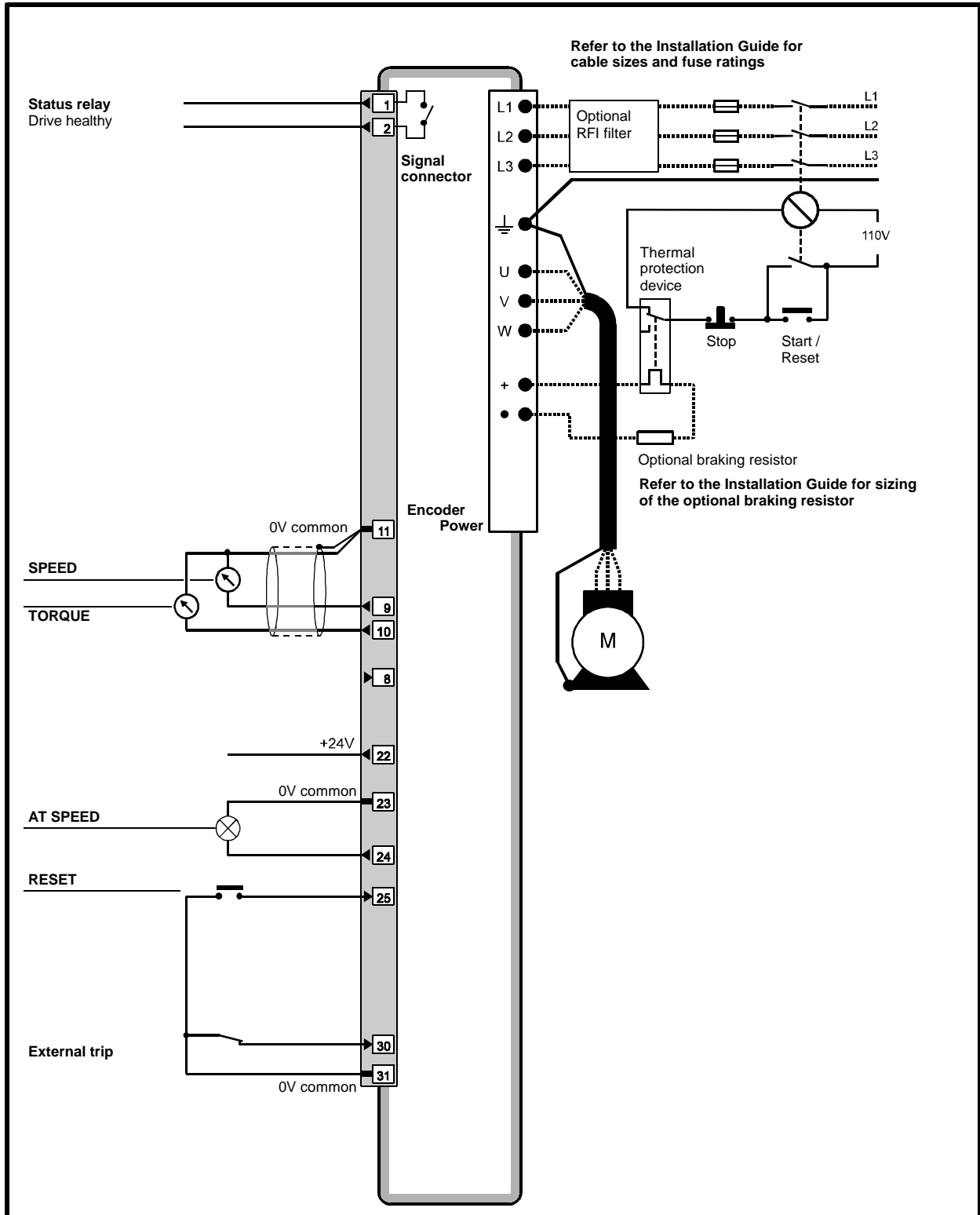


Figure 2–6 Power connections, and signal connections for Keypad mode (Macro 1 only)

2.3 Introduction to the display and keypad

Display and keypad

The display and keypad are used for the following:

- Reading and changing the values of software parameters that are used to configure, control and monitor the Drive
- Displaying the operating status of the Drive
- Displaying fault and trip codes

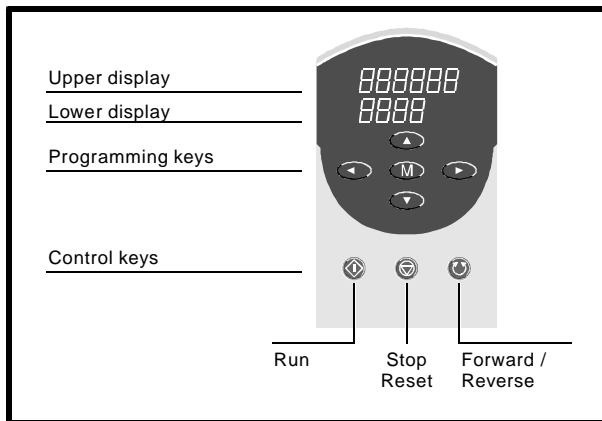


Figure 2-7 Display and keypad

Display

The display has three *display modes* as follows...

- Status mode
Used to indicate the status of the Drive
- Parameter mode
Used for selecting a parameter to edit
- Edit mode
Used for editing the selected parameter

... and shows the following:

| Display | Display mode | | |
|---------|-----------------------------------|-------------------------|---|
| | Status | Parameter | Edit |
| Upper | Value of parameter (0) | Value of parameter (0) | Value of parameter (0) (selected digit flashes) |
| Lower | Status of the Drive rdY | Parameter number (0.10) | Parameter number (0.10) |

Operating instructions for the display and keypad are given in Appendix A *Programming Instructions*.

Programming keys

These are used for the following:

- Changing the mode of operation of the display
- Selecting a parameter to edit
- Editing the selected parameter
- Saving new values given to parameters

The functions of the programming keys are as follows:

- M** Change the display mode
- ▲** Select a parameter
Increase the value of a digit
- ▼** Select a parameter
Decrease the value of a digit
- ◀** Display the parameter number
Select the next left display digit
- ▶** Display the parameter number
Select the next right display digit

Control keys

The functions of the control keys are as follows:

- (RUN)** Start the Drive running.

The **RUN** key is active only when the Drive is operating in Keypad mode (parameter **0.05 Reference select** set at **4**).

- (STOP-RESET)** The three functions of this key are as follows:

- Stop the Drive
- Reset the Drive after it has tripped
- Make new parameter-values take effect

The **STOP-RESET** key is active when the Drive is operating in Keypad mode. This key acts only as **RESET** when the Drive is operating in Terminal mode (parameter **0.05 Reference select** set at **0, 1, 2, 3 or 5**).

- (FWD/REV)** Change the direction of rotation of the motor. (This is not enabled by default, and is described later in this chapter in *Enabling reverse direction in Keypad mode*.)

Resetting the Drive

Terminal mode

When the Drive is stopped, press:



Alternatively, close the **RESET** contact (see Figure 2–5).

Keypad mode

When the Drive is stopped, press:



When the Drive is running, press and hold...



... then press:



Release both keys at the same time.

2.4 Working with software parameters

Parameters

The software parameters are contained in a menu named Menu 0. Each parameter has a number as well as a name. These are represented in this *User Guide* as (for example, parameter 03 in Menu 0):

0.03 Acceleration rate

When the value of a parameter is referred to, it is indicated as [0.03].

Types of parameter

Variable and bit parameters

There are two types of parameter, as follows:

- Bit parameters
- Variable parameters

Bit parameters can be set at 0 or 1 to carry out the following:

- Enable and disable functions
- Select from two options

Variable parameters can be set at any value within the specified range to carry out the following:

- Enter values
- Select from more than two options

No distinction is made in the parameter numbering system between variable and bit parameters. When a bit parameter is selected on the Drive display, the word **bit** appears.

Read–write and read-only

Both types of parameter can be as follows:

- Read–write (RW)
- Read-only (RO)

Read–write parameters are programmable by the user. Read-only parameters are for information purposes; they cannot be programmed.

The settings of read–write and read-only parameters can be read on the display or remotely using serial communications.

Adjusting parameter values

Instructions on adjusting parameter values are given in Appendix A *Programming Instructions*.

Making new values effective, and saving them

The new value of most parameters takes effect as soon as it is entered. Some parameters (such as the destination-selection parameters for the analog inputs) require the Drive to be reset before their new values take effect.

Unless a *save* procedure is carried out, the new value will be lost when the AC supply is disconnected from the Drive (described in *Saving new parameter-values* in Appendix A *Programming Instructions*).

Parameter 0.00

Parameter **0.00** is a special read–write parameter that is used for the following:

- Saving new values given to parameters
- Controlling security
- Enabling macro configurations

These functions are controlled by the user entering specific values, as shown below:

| Value | Function |
|---|--|
| Saving new parameter-values <i>The Drive can be running or stopped</i> (described in Appendix A <i>Operating Instructions</i>) | |
| 1000 | |
| Controlling security <i>The Drive can be running or stopped</i> (described in Appendix B <i>Security and Accessing the Advanced Parameters</i>) | |
| 0 ~ 255 | User security code |
| 2000 | Lock security |
| Restoring the Drive to a default configuration <i>The Drive must be stopped</i> (described later in this chapter) | |
| 1233 | Restore default values to all parameters for 50Hz AC supply frequency (Europe) |
| 1244 | Restore default values to all parameters for 60Hz AC supply frequency (USA) |
| Selecting Macros 0 to 7 <i>The Drive must be stopped</i> (described in Chapter 3 <i>Setting Up the Drive</i>) | |
| 2001 | Macro 1 <i>Easy mode</i> |
| 2002 | Macro 2 <i>Motorized potentiometer</i> |
| 2003 | Macro 3 <i>Preset speeds</i> |
| 2004 | Macro 4 <i>Torque control</i> |
| 2005 | Macro 5 <i>PID (set-point) control</i> |
| 2006 | Macro 6 <i>Axis-limit control</i> |
| 2007 | Macro 7 <i>Brake control</i> |
| 2009 | Macro 0 <i>General purpose</i> (USA default configuration) |
| 2010 | Macro 0 <i>General purpose</i> (EUR default configuration) |

The Drive must be reset to make a newly selected function or configuration take effect.

Instructions for using parameter **0.00** are given at the appropriate places in this User Guide

2.5 How macro configurations change the arrangement of the Menu 0 parameters

Note

Do not confuse the term *Macro* with the term *Menu*. Menu 0 contains parameters; macro configurations re-define some of these parameters to perform specific functions. Menu 0 always exists, but is affected by the macro configuration that is enabled.

Only one macro configuration can be enabled at a time.

Menu 0 contains 51 parameters which are arranged in four groups, as shown in Figure 2–8.

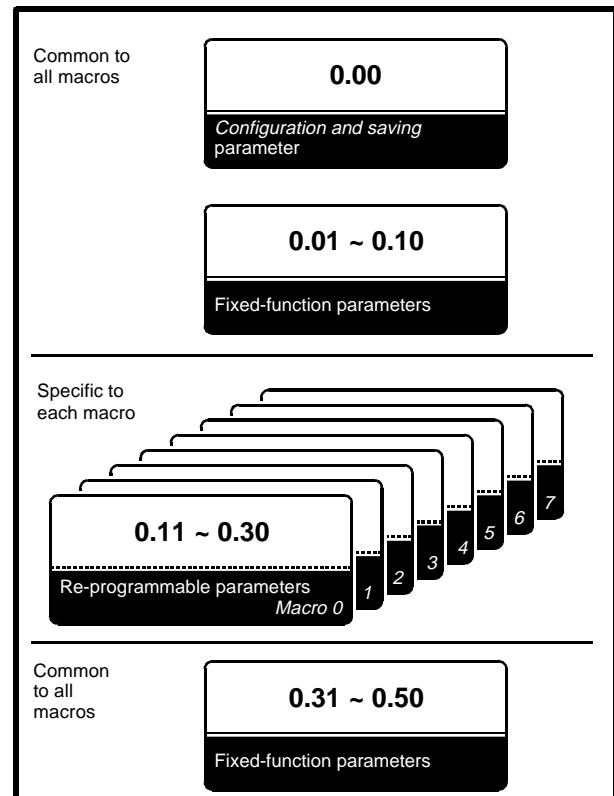


Figure 2–8 How the Menu 0 parameters are grouped and the relationship with the macro configurations

Macro 0

When Macro 0 is enabled, the re-programmable parameters have their default functions.

Macro 1

When Macro 1 *Easy Mode* is enabled, none of the re-programmable parameters are available.

Macros 2 to 7

When one of these macro configurations is enabled, the functions of some re-programmable parameters are specific to the macro configuration.

Other factors that affect the re-programmable parameters

In addition to the changes caused by the macro configurations, the functions of some re-programmable parameters are changed by the *default configuration* of the Drive (EUR or USA)

These are shown in Appendix D *Menu 0 Parameters*.

Where to find information on parameters

The functions of the parameters are listed for each macro configuration in Chapter 3 *Setting Up the Drive*.

The functions of the parameters for each macro configuration are described in detail in Appendix D *Menu 0 Parameters*.

2.6 Initial setting up

Noting the user values

A parameter table for each macro configuration in Chapter 3 *Setting Up the Drive* has a column for you to note the values entered in the parameters.

Restoring the Drive to a default configuration





Warning

Do not attempt to restore the Drive to a default configuration when the Drive is running.

Restoring the Drive to a default configuration enables Macro 0 and returns all parameters to their default values including the motor parameters. (If any one of the macros 1 to 7 has been enabled, the Drive still reverts to Macro 0.)

After restoring the Drive to a default configuration, it will be necessary for the required parameter values to be re-entered before the Drive is next run.

Restoring the Drive to a default configuration is not essential for initial setting up, but should be used for achieving the following:

- When one of the macros 2 to 7 is currently enabled, and a different macro configuration is required
 - Intentionally restoring all parameters to their default values (this includes the motor parameters)
 - Changing (or re-applying) the default configuration for the continent in which the Drive is to be used
1. Enter either of the following values in parameter **0.00**:
EUR> (Europe, 50Hz AC supply): **1233**
USA> (USA, 60Hz AC supply): **1244**
 2. Press  (RESET key).
 3. Set **0.00** at **1000**.
 4. Press  (RESET key).

The following conditions now apply:

- All the default values (including those of the motor parameters) take effect
- Macro 0 is enabled

If required, any other macro configuration can be enabled.

Enabling Macro 1



Warning

Do not attempt to enable any macro configuration when the Drive is running.

Note

If the Drive is to be operated in Macro 1 or 5 and a braking resistor is to be used, now set parameter 0.15 at FAS_t. Then follow the instructions below.

The setting of parameter 0.15 must be changed now because the function of this parameter is changed when one of these macro configurations is enabled.

1. Set parameter **0.00** at 2001.
2. Reset the Drive.

The configuration layers (see Chapter 1 *Introduction*) are now as follows:

1. Appropriate default configuration for the continent (EUR or USA)
2. Macro 1 *Easy mode*

Configuring the Drive for the motor



Warning

The values of the motor parameters affect the protection of the motor and the safety of the system.



Caution

When entering values, make sure they are relevant to the motor that is to be used. The default values in the Drive should not be relied upon.

The motor parameters should be set to within 10% of the required values for the motor. Failure to do this may result in poor response.

It is essential that the correct value is entered in parameter 0.46 *Motor – rated current*. This affects the thermal protection of the motor.

Keep a note of the values given to the motor parameters, since motor parameters are restored to their default values when the Drive is restored to a default configuration (this must be done if the Drive has been used with Macro 2 to 7 enabled and a different macro configuration is to be enabled)

Enter the motor ratings in the motor parameters of the Drive, as follows:

| | Default value | Range | Unit |
|--|--|------------------|-------|
| 0.41 PWM switching frequency | | | |
| | 3 | 3, 4.5, 6, 9, 12 | kHz |
| 0.42 Motor – number of poles | | | |
| | 4 | 2 ~ 32 | poles |
| 0.43 Motor – power factor | | | |
| | 0.92 | 0 ~ 1.0 | |
| (See Autotune later in this chapter) | | | |
| 0.44 Motor – rated voltage (Standard models) | | | |
| | 400 (EUR)460 (USA) | 0 ~ 480 | V |
| 0.44 Motor – rated voltage (LV models) | | | |
| | 220 | 0 ~ 240 | V |
| Enter the rated value. | | | |
| 0.45 Motor – rated speed | | | |
| | 0 | 0 ~ 6000 | RPM |
| When 0.45 is set at 0, no slip compensation is applied by the Drive. When a value greater than zero is entered, slip compensation is applied but instability can occur with motor loads that have predominant inertia. To avoid this instability, set 0.45 at 0. The value can be changed at a later time. | | | |
| 0.46 Motor – rated current | | | |
| | FLC (see the following Values of FLC table) | 0 ~ FLC | A |
| Ensure that the motor current-rating applies to the winding configuration used. | | | |
| 0.47 Motor – rated frequency | | | |
| | 50 (EUR) 60 (USA) | 0 ~ 1000.0 | Hz |
| Enter the rated value. | | | |

When the number of motor poles is not known

Calculate the number of poles from the following:

$$P = \frac{f \times 120}{N}$$

Where:

- f** AC supply frequency
- N** Rated full-load speed of the motor

The number of poles will be the whole number immediately below the value of **P**. Enter this whole number in **0.42**.

Example

Rated motor speed: 1450 RPM

AC supply frequency: 50Hz

$$P = \frac{50 \times 120}{1450} = 4.14$$

Therefore, the number of poles = 4


(The inaccuracy of the calculation is caused by slip, in this case 50 RPM.)

Values of FLC

| Model | FLC (A) | Model | FLC (A) |
|----------|---------|----------|---------|
| GPD 1201 | 2.1 | GPD 3201 | 34 |
| GPD 1401 | | GPD 3401 | |
| GPD 1202 | 2.8 | GPD 3402 | 40 |
| GPD 1402 | | | |
| GPD 1203 | 3.8 | GPD 3202 | 46 |
| GPD 1403 | | GPD 3403 | |
| GPD 1204 | 5.6 | GPD 3203 | 60 |
| GPD 1404 | | GPD 3404 | |
| GPD 1205 | 9.5 | GPD 3405 | 70 |
| GPD 1405 | | | |
| | | GPD 3204 | 74 |
| | | | |
| GPD 2201 | 12 | GPD 4401 | 96 |
| GPD 2401 | | | |
| GPD 2202 | 16 | GPD 4402 | 124 |
| GPD 2402 | | | |
| GPD 2203 | 25 | GPD 4403 | 156 |
| GPD 2403 | | | |
| | | GPD 4404 | 180 |
| | | | |
| | | GPD 4405 | 202 |

Saving the values

Use the following procedure:

- Set parameter **0.00** at **1000**.
- Press **M**. The display returns to Parameter mode. Do not press any keys within eight seconds; the display then enters Status mode.
- Momentarily press  to reset the Drive.

Autotune

Autotune is a sequence of tests performed by the Drive. The results of the tests are subsequently used by the Drive for controlling the motor.


Autotune should be used after the motor parameters have been entered, but before the Drive is used. Normally (and if the motor is not changed), Autotune needs performing only once.



Warning

During the following procedures, the Drive will power the motor and cause the shaft to rotate at up to $\frac{2}{3}$ full speed. Before starting, make sure it will be safe for the motor to be run.

Note

To stop the test at any time, press . The motor will then coast to a stand-still and the test will not be completed.

If the Drive trips

If the Drive trips during the test, note the trip code that appears on the upper display and refer to Appendix E *Diagnostics*. The test will not be completed.

Direction of rotation



Warning

Stored charge

The Drive contains capacitors that remain charged to a potentially lethal voltage after the AC supply has been disconnected. If the Drive has been energized, the AC supply must be isolated at least ten minutes before work may continue.

The motor shaft should rotate clockwise as viewed from the free end of the shaft during Autotune. If the shaft rotates in the reverse direction, stop the test, remove the AC supply and check the motor connections. If required, change the motor phase connections and repeat Autotune.

Procedure

Note



If the settings of parameters 0.41 to 0.47 are changed by a user after Autotune has been performed, it is essential that Autotune is repeated.

1. Ensure the motor is unloaded and at a stand-still.
2. Ensure the **EXTERNAL TRIP** contact is closed.
3. Follow this step only if the Drive has previously been set up and *both* of the following have occurred...
 - The setting of parameter **0.07 Voltage mode selector** has been changed to **Ur**
 - A different motor is now connected to the Drive

... change the setting of parameter **0.07** to **Ur_1**. (See *Open-loop voltage control modes* later in this chapter.)

4. Disconnect, then after at least 10 seconds, re-connect the AC supply (this causes the Drive to measure the stator resistance of the motor – it is essential for the Drive to be aware of the actual value of stator resistance for Autotune to be performed correctly).
5. Set parameter **0.40 Autotune enable** at 1. The following tests are performed:
 - The motor is accelerated up to two-thirds rated frequency in the forward direction while the magnetizing current is measured
 - The motor is decelerated to a stand-still
6. Parameter **0.43 Motor – power factor** is automatically updated.
7. Parameter **0.40** is automatically returned to zero.

Saving the values

1. Set parameter **0.00** at **1000**.
2. Press . The display returns to Parameter mode. Do not press any keys within eight seconds; the display then enters Status mode.
3. Momentarily press  to reset the Drive.

Changing the user-interface mode

Change the user-interface mode, as required. If jog is required, select Terminal mode (jog is available only in Macros 0, 1, 4).

| User-interface mode | Set parameter 0.05 at... |
|---------------------|--------------------------|
| Terminal | 0 |
| Keypad | 4 |

Note

The main function of parameter 0.05 is a reference selector which has other settings that operate the Drive in Terminal mode. At this stage, do not use any of these other settings.

Use of parameter 0.05 is described for Macros 0 and 1 in Chapter 3 *Setting Up the Drive*.

2.7 Operating instructions

Before completing the initial setting up of the Drive, you will need to learn how to operate it. Refer to the following instructions for Terminal mode or Keypad mode, as appropriate.

Terminal mode


Variable frequency

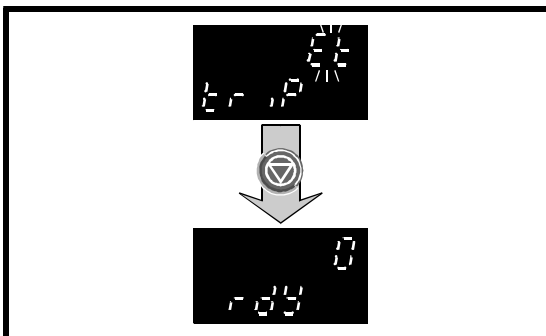
In Terminal mode (with Macro 1), the Drive can control the motor as follows:

- Run (forward and reverse)
- Jog/Preset frequency (forward and reverse)

1. Ensure the control signal connections shown in Figure 2–5 are made.
2. Check that the **FREQUENCY** potentiometer is set at minimum.
3. Ensure that the **EXTERNAL TRIP** contact is open.
4. Connect the Drive to the AC supply.
5. The display indicates as follows:



6. Close the **EXTERNAL TRIP** contact.
7. Press  or momentarily close the **RESET** contact.
8. The display indication changes as follows:



9. Ensure parameter **0.10 Motor speed** is displayed (default).
10. Close the **RUN FORWARD** contact. The display indicates as follows:



11. Advance the **FREQUENCY** potentiometer.
12. The value shown by the upper display increases accordingly, and the motor speed increases.
13. Open the **RUN FORWARD** contact. The following occur:
 - The value of the upper display reduces to zero
 - The lower display shows **dEC**, then **rdY**
 - The motor speed reduces to zero
14. If required, repeat steps 10 to 13 using the **RUN REVERSE** contact.

If you do not require the use of jog / preset frequency, go to Trip and Enable later in this chapter

Jog/Preset frequency

The jog function can be used alternatively as a preset frequency. The default value is 1.5Hz.

1. Close the **JOG/PRESET SELECT** contact. Then close the **RUN FORWARD** contact. It is essential that the contacts are closed in this order, otherwise the Drive will run forward (or reverse) normally at variable speed.


The display indicates a fixed low speed that cannot be changed by the **FREQUENCY** potentiometer. The motor runs at this low speed.

2. Open the **RUN FORWARD** contact to stop the Drive.
3. If required, repeat steps 1 and 2 using the **RUN REVERSE** contact.
4. If the **JOG/PRESET SELECT** contact is opened before the **RUN FORWARD** or **RUN REVERSE** contact, the motor speed will become controlled by the **FREQUENCY** potentiometer.

Go to Trip and Enable later in this chapter

Keypad mode


Motor direction in Keypad mode

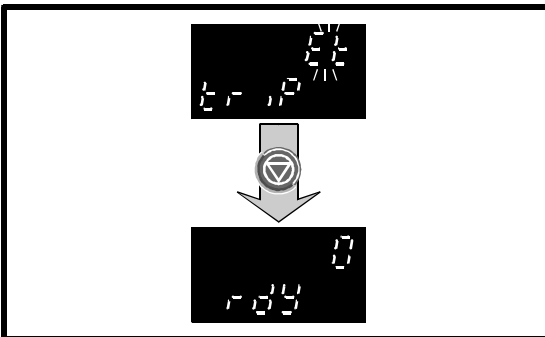
In Keypad mode (with Macro 1),  (FWD/REV) is disabled by default; the Drive can control the motor in the forward direction only. For reverse operation, see the *Commander Gp Advanced User Guide*.

Variable frequency

1. Ensure the control signal connections shown in Figure 2–6 are made.
2. Ensure that the **EXTERNAL TRIP** contact is open.
3. Connect the Drive to the AC supply.
4. The display indicates as follows:



5. Close the **EXTERNAL TRIP** contact.
6. Press .
7. The display indication changes as follows:




Ensure parameter **0.10** *Motor speed* is displayed (default).





Warning

If the Drive has been used previously in keypad mode, check that the value of parameter 0.35 is zero before proceeding with the next step. If it is not zero, use the speed control keys as appropriate to set parameter 0.35 at zero.


If parameter 0.35 is not zero, when the Drive is started it will immediately accelerate to the speed set in this parameter.


9. Press  to start the Drive running.
10. The upper display should indicate zero; the lower display will indicate as follows:



11. Press  to increase the speed. The value of the upper display increases and the motor speed increases.
12. Press  to decrease the speed. The value of the upper display decreases and the motor speed decreases.


When the Drive is configured to accept a bipolar speed reference, continuing to press this key after the motor has stopped will cause the speed to increase in the reverse direction. (For operation with a bipolar speed reference, see the *Commander Gp Advanced User Guide*.)

13. If  (FWD/REV) has been enabled, set the speed at a convenient value and then press this key. The speed reduces to zero then increases to the set value in the opposite direction.

14. Press  to stop the Drive. The following occur:
 - The value of the upper display reduces to zero
 - The lower display shows **dEC**, then **rdY**
 - The motor speed reduces to zero

Trip and enable

1. If the Drive trips, and a motor is connected, the motor will coast. See Appendix E *Diagnostics*.

To clear a trip, momentarily press  or, for Terminal mode only, momentarily close the **RESET** contact.

2. If the **EXTERNAL TRIP** contact is opened while the Drive is stopped or running, the Drive trips (and the motor will coast). The display will indicate as follows:



2.8 Setting up operating limits

Minimum and maximum frequencies



Warning

Do not set the maximum frequency at a value that is excessive for the motor. If the intended maximum frequency affects the safety of the machinery, additional independent over-speed protection must be used.

Set parameter **0.02** *Maximum frequency* at the required value. When initially setting up the Drive, leave **0.01** *Minimum frequency* at the default value of zero so that the motor shaft does not rotate as soon as a RUN command is received. When it is known to be safe to do so, set **0.01** at the required value.

Note the following:

- Slip compensation can cause the output frequency of the Drive to exceed [0.02].



Caution

For operation at motor speeds greater than twice base speed, contact the supplier of the motor.

Default values and range

| 0.01 | Default value | Range | Unit |
|------|---------------|------------|------|
| | 0 | 0 ~ [0.02] | Hz |

| 0.02 | Default value | Range | Unit |
|------|----------------------------|----------|------|
| | 50 Hz (EUR) 60 Hz (USA) | 0 ~ 1000 | Hz |

Acceleration rate

To adjust the acceleration rate, adjust parameter **0.03** *Acceleration rate*. Increase the value to increase the time taken for acceleration (ie. reduce the acceleration rate).

| Range | Default | Unit |
|----------|---------|---------|
| 0 ~ 3200 | 5 | s/100Hz |

If the required acceleration cannot be achieved, it may be necessary to increase the value of **0.06** *Current limit*.

Deceleration rate

To adjust the deceleration rate, adjust parameter **0.04** *Deceleration rate*. Increase the value to increase the time taken for deceleration (ie. reduce the deceleration rate).

| Range | Default | Unit |
|----------|---------|---------|
| 0 ~ 3200 | 10 | s/100Hz |

If the Drive trips when decelerating the motor and the display indicates **OU**, this indicates that the maximum permissible DC-bus voltage has been exceeded during braking. Increase the value of **0.04** *Deceleration rate* or, if a braking resistor is not currently connected, return to *Planning the installation* in Chapter 2 *Installing the Drive* in the Installation Guide for instructions on connecting a braking resistor.

Braking resistor



Warning

The Drive does not contain a braking resistor; when required, an external braking resistor must be used (see the Installation Guide).

Depending on the setting of parameter 0.15, failure to connect a braking resistor when one is required may result in deceleration times being extended or the Drive tripping during braking which would leave the motor free to coast.

If a braking resistor is being used, set the following parameter at **FAST** in order to prevent instability:

| Macro | Parameter |
|---------|---|
| 0 2 3 4 | 0.15 <i>Ramp mode selector</i> |
| 1 5 6 7 | See the <i>Commander Gp Advanced User Guide</i> |

For Macros 1 and 5, the *Note* at the beginning of *Enabling Macro 1* earlier in this chapter gave instructions for changing the setting of this parameter. When Macro 6 or 7 is enabled, the setting is made automatically. See **0.15** *Ramp mode selector* in Appendix D *Menu 0 Parameters*.

Torque-producing current limit

Set parameter **0.06** *Current limit* at the required percentage of rated motor torque (or rated active torque-producing current).

The current limit is used to protect the motor and Drive from excessive current and applies under motoring and regenerating conditions. When the Drive is operating in torque control, the current limit limits the value of torque demand.

The *total* motor current comprises a magnetizing current and an active (torque-producing) current. Since the maximum torque produced by the motor is proportional to the value of parameter **0.06** *Current limit*, this current limit is a *torque-producing current limit*.

When **0.06** is set at its maximum value, the maximum *total* motor current is as follows:

$$150\% \times \text{FLC}$$

Where **FLC** is the rated (full-load) current of the Drive.

The maximum value of **0.06** is given by the following (but cannot exceed 400 (%)):

$$[0.06]_{\text{MAX}} = \frac{\sqrt{(1.5)^2 - (1 - \cos^2 \phi)}}{\cos \phi} \times \frac{\text{FLC}}{[0.46]} \times 100(\%)$$

Where:

[0.46] = Value of *Motor – rated current*
 $\cos \phi$ is the power factor of the motor.

Note

The results from these equations may not correspond exactly with the maximum output current from the Drive, since the Drive may round up the calculated figure.

The value of FLC is given in the following table.

Values of FLC

| Model | FLC (A) | Model | FLC (A) |
|----------------------|---------|----------------------|---------|
| GPD 1201 GPD 1401 | 2.1 | GPD 3201 GPD 3401 | 34 |
| GPD 1202 GPD 1402 | 2.8 | GPD 3402 | 40 |
| GPD 1203 GPD 1403 | 3.8 | GPD 3202 GPD 3403 | 46 |
| GPD 1204 GPD 1404 | 5.6 | GPD 3203 GPD 3404 | 60 |
| GPD 1205 GPD 1405 | 9.5 | GPD 3405 | 70 |
| | | GPD 3204 | 74 |
| GPD 2201 GPD 2401 | 12 | GPD 4401 | 96 |
| GPD 2202 GPD 2402 | 16 | GPD 4402 | 124 |
| GPD 2203 GPD 2403 | 25 | GPD 4403 | 156 |
| | | GPD 4404 | 180 |
| | | GPD 4405 | 202 |

Voltage-control modes

The default setting is as follows:

Macro 1: **Fd**

Macros 0, 2, 3, 4, 5, 6, 7: **Ur_I**

To change the voltage control mode, select the required setting in parameter **0.07** *Voltage mode selector*, as follows:

| Setting | Function |
|-------------------------|---|
| Vector modes | |
| Ur_S 0 | Motor stator resistance is measured each time the Drive is started. |
| Ur_I 1 | Motor stator resistance is measured at power-up if the EXTERNAL TRIP contact is closed and no other trip condition exists. |
| Ur 2 | Motor stator resistance is not measured (use this mode only after having used Ur_S or Ur_I to measure the stator resistance). |
| Fixed boost mode | |
| Fd 3 | Fixed voltage boost that can be manually adjusted by parameter 0.08 <i>Boost voltage</i> . |

The Vector modes give better performance at low speed than the fixed-boost mode, but require the stator resistance to be accurately measured by the Drive.

Note

If parameter **0.39 Synchronize to a spinning motor** is to be set at **1**, for reliable operation of the Drive, set parameter **0.07** at **Fd**.



Warning

When **Ur_I** is selected, the motor might kick when the AC supply is connected to the Drive (with the **EXTERNAL TRIP** contact already closed).

Boost voltage

Use this procedure only when **0.07 Voltage mode selector** has been set at **Fd**.

Where actions apply to a particular control mode, the following key is used:

- K> Keypad mode
- T> Terminal mode

1. Connect the load to the motor.
2. Close the **EXTERNAL TRIP** contact.
3. Ensure the frequency reference is zero.

4. K> Press 
T> Close the **RUN FORWARD** or **RUN REVERSE** contact.

Increase the frequency reference to a value slightly above zero. If the motor shaft does not rotate, increase the value of parameter **0.08 Boost voltage** sufficiently to cause the shaft to rotate.

Default value: 3%

Range: 0 ~ 25%

5. If the motor is noisy and becomes unnecessarily heated, reduce the value of **0.08**.
6. Stop the Drive.

Save the new parameter-value.

Voltage/frequency characteristic

If the motor is to drive a pump or fan where the load can vary, set parameter **0.09 Dynamic V/f select** at **1**. This selects an automatic voltage/frequency characteristic which reduces power consumption and acoustic noise in the motor when lightly loaded.

For an explanation of the effects of the voltage/frequency characteristic, see parameter **0.09 Dynamic V/f select** in Appendix D *Menu 0 Parameters*.

3 Setting Up the Drive (Macro Configurations)



Warning

Do not change parameter values without careful consideration; wrong values may cause damage or a safety hazard.

Notes

Keep a note of changes

When changing the values of parameters, make a note of the new values in case they need to be entered again.

Saving the changes

For new parameter-values to apply after the AC supply to the Drive is interrupted, new values must be saved. Refer to *Saving new parameter-values in Appendix A Programming Instructions*.

3.1 How to use this chapter

When setting up the Drive for the first time, you must first have followed Chapter 2 *Getting Started*; Macro 1 *Easy mode* will then be enabled. Whether you keep Macro 1 or enable a different macro configuration, the settings you made in Chapter 2 will remain unchanged. During the course of setting up the Drive, you may need to change some of these settings. If so, refer again to Chapter 2.

It is recommended that you follow the instructions in this chapter in the order that they appear. You will be led through the following:

- **Enabling the required macro configuration (if a macro other than Macro 1 is required)**
- **Changing the signal connections accordingly**
- **Adjusting parameters that are specific to the macro configuration**
- **A list of subsidiary functions that can be set up**

3.2 Enabling a different macro configuration



Warning

Do not attempt to enable any macro configuration when the Drive is running.

Note

Only one macro configuration can be enabled at a time.

Enabling a different macro configuration after getting started with Macro 1

If Macro 1 is to remain enabled, ignore this section and go to *Macro 1* later in this chapter.

1. To enable a different macro configuration, set parameter **0.00** as follows:

| Macro | Function | Setting |
|-------|---|---------|
| 2 | Motorized potentiometer (frequency control by <i>up</i> and <i>down</i> contacts) | 2002 |
| 3 | Four preset frequencies (selected by digital control signals) | 2003 |
| 4 | Torque control | 2004 |
| 5 | PID (set-point) control | 2005 |
| 6 | Axis-limit control | 2006 |
| 7 | Brake control | 2007 |
| 0 | General purpose (USA default configuration) | 2009 |
| | General purpose (EUR default configuration) | 2010 |

Note

The values of the fixed parameters are not changed when any one of these macro configurations is enabled.



Caution

When Macro 0 is enabled, the functions of parameters **0.27** to **0.29** differ between the EUR and USA default configurations.

2. Reset the Drive.
3. Go to the relevant section in this chapter for the macro configuration that has been enabled.

Enabling a different macro configuration after using Macros 2 to 7

If any one of the macros from 2 to 7 has been enabled (after the instructions in this chapter have previously been followed), proceed as follows...

1. Go to *Initial setting up* in Chapter 2 *Getting Started*. Start proceeding through that section by referring to Restoring the Drive to a default configuration.
2. Follow the remainder of *Initial setting up*.
3. Return to this chapter and follow *Enabling a different macro configuration after getting started with Macro 1* earlier in this chapter.

3.3 Macro 0 General purpose (default configuration)

Features

Specific features

Macro 0 places the Drive in a default configuration for general-purpose use.

When a UD50 *small option module* is fitted in the Drive, the following additional functions become automatically available for Macro 0 only:

- Volt-free relay contact which closes when the Drive is AT OR BELOW MINIMUM SPEED
- Volt-free relay contact which closes when the Drive is AT SPEED
- DRIVE RUNNING digital output
- MOTOR CURRENT OVERLOAD ALARM digital output
- (EXCESSIVE) HEATSINK TEMPERATURE ALARM digital output
- MOTOR CURRENT MAGNITUDE analog output
- Frequency offset can be selected and applied
- Operation in torque mode can be selected
- A bipolar or unipolar frequency reference can be applied

To change the functions of the UD50 or to enable the UD50 to be used with other macro configurations, see the *Commander Gp Advanced User Guide*. With Drive software versions V03.01.05, a UD50 cannot be used with any of the other macro configurations.

Standard features

- Macro 0 operates in Terminal or Keypad mode
- In Terminal mode, digital control by **RUN FORWARD**, **RUN REVERSE** and **JOG SELECT** contacts
- Local and remote analog frequency inputs, or setting of frequency by use of the keypad
- Keypad control of speed can be uni-directional or bi-directional
- Selection of analog input modes
- Adjustable Jog/Preset frequency
- Adjustment of minimum and maximum frequencies
- Adjustment of acceleration and deceleration ramps
- S-ramp
- Skip frequencies
- Selection of stopping modes
- Selection of braking mode
- Motor thermistor input
- Negative logic for the digital inputs (EUR> positive logic can be selected)
- EUR> Adjustment of current-loop PI gains
- USA> Indication of frequency demand
- USA> Digital control by three-wire momentary contacts can be selected
- **SPEED** and **TORQUE** analog outputs
- **AT SPEED** digital output
- **External trip** digital input
- Drive **RESET** digital input

Signal connections for Macro 0

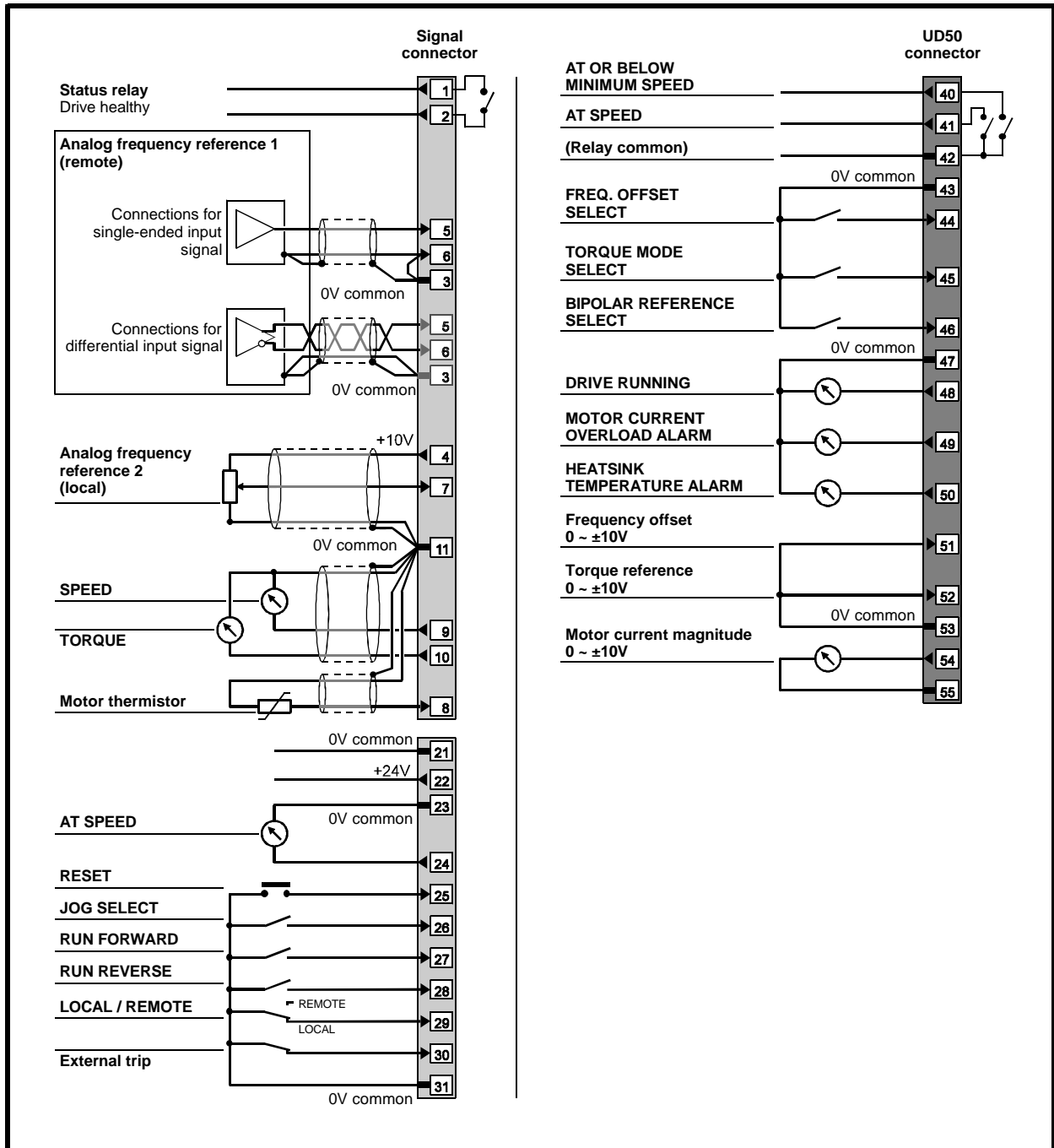


Figure 3-1 Control signal and thermistor connections for Macro 0 (showing optional connections to a UD50 small option module)

For electrical specifications, refer to Appendix C *Signal Connections*.

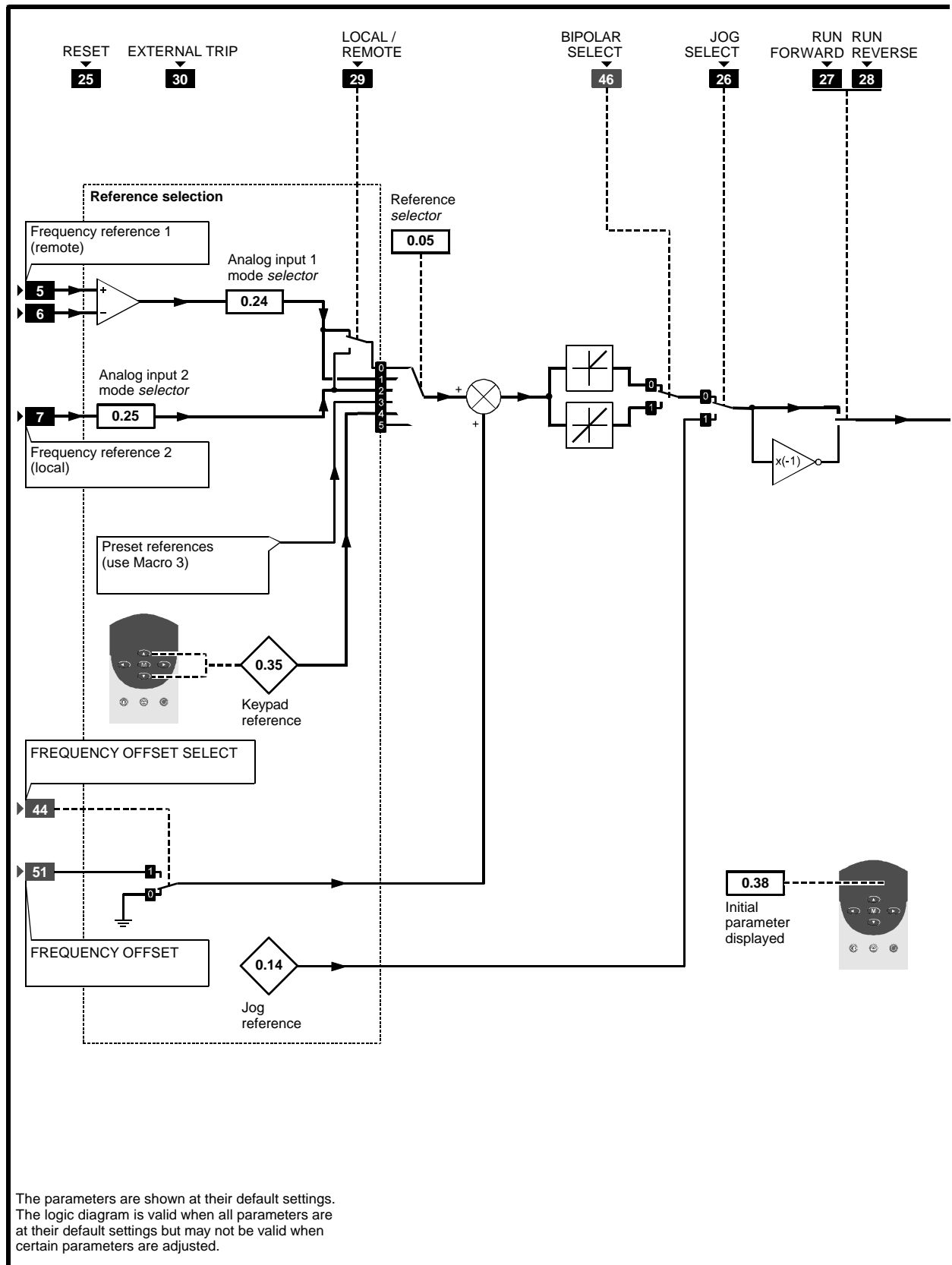
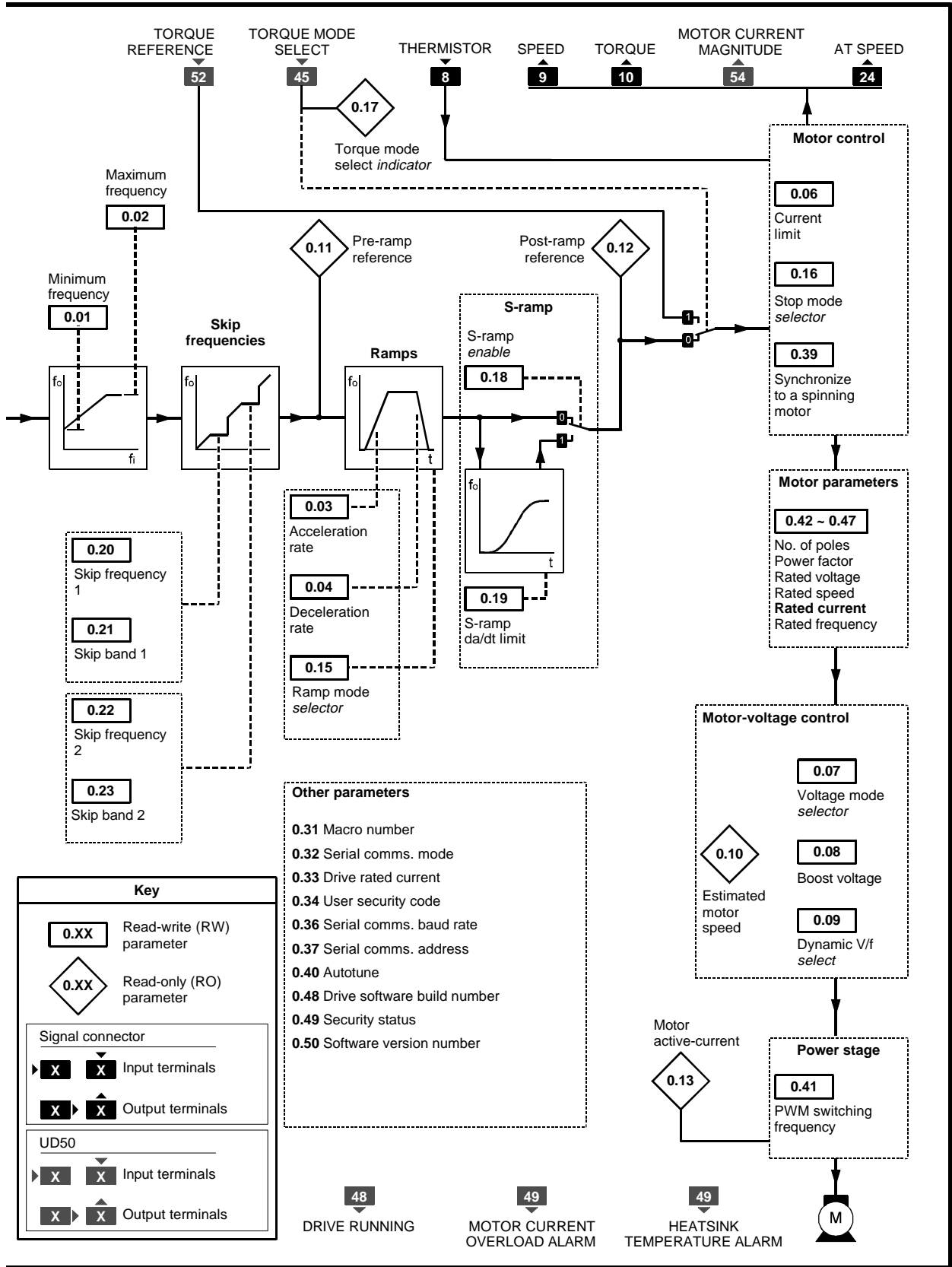


Figure 3-2 Programmable software for Macro 0



List of parameters specific to Macro 0

| Pr | Function | User value |
|------|------------------------------|------------|
| 0.00 | Configuration and saving | |
| 0.01 | Minimum frequency | |
| 0.02 | Maximum frequency | |
| 0.03 | Acceleration rate | |
| 0.04 | Deceleration rate | |
| 0.05 | Reference <i>selector</i> | |
| 0.06 | Current limit | |
| 0.07 | Voltage mode <i>selector</i> | |
| 0.08 | Boost voltage | |
| 0.09 | Dynamic V/f <i>select</i> | |
| 0.10 | Estimated motor speed | [M] |

[M] indicates the parameter is for monitoring only

For descriptions of these parameters, see Appendix D *Menu 0 Parameters*.

| Pr | Function | User value |
|------|---|------------|
| 0.31 | Macro number | [M] |
| 0.32 | Serial comms. mode | |
| 0.33 | Drive rated current (FLC) | [M] |
| 0.34 | User security code | [M] |
| 0.35 | Keypad reference | [M] |
| 0.36 | Serial comms. baud rate | |
| 0.37 | Serial comms. address | |
| 0.38 | Initial parameter displayed | |
| 0.39 | Synchronize to a spinning motor | |
| 0.40 | Autotune | |
| 0.41 | PWM switching frequency <i>selector</i> | |
| 0.42 | Motor – number of poles | |
| 0.43 | Motor – power factor | |
| 0.44 | Motor – rated voltage | |
| 0.45 | Motor – rated speed | |
| 0.46 | Motor – rated current | |
| 0.47 | Motor – rated frequency | |
| 0.48 | Drive software build number | [M] |
| 0.49 | Security status | [M] |
| 0.50 | Drive software version | [M] |

| Pr | Function | User value |
|------|---|------------|
| 0.11 | Pre-ramp reference | [M] |
| 0.12 | Post-ramp reference | [M] |
| 0.13 | Motor active-current | [M] |
| 0.14 | Jog reference | |
| 0.15 | Ramp mode <i>selector</i> | |
| 0.16 | Stop mode <i>selector</i> | |
| 0.17 | Torque mode <i>selector</i> | |
| 0.18 | S-ramp <i>enable</i> | |
| 0.19 | S-ramp da/dt limit | |
| 0.20 | Skip frequency 1 | |
| 0.21 | Skip band 1 | |
| 0.22 | Skip frequency 2 | |
| 0.23 | Skip band 2 | |
| 0.24 | Analog input 1 mode <i>selector</i> | |
| 0.25 | Analog input 2 mode <i>selector</i> | |
| 0.26 | Analog input 2 destination <i>selector</i> | |
| 0.27 | EUR> Positive logic <i>select</i> USA> Sequencing mode <i>selector</i> | |
| 0.28 | EUR> Current-loop proportional gain USA> Frequency demand | |
| 0.29 | EUR> Current-loop integral gain USA> Terminal-29 destination parameter | |
| 0.30 | FWD/REV key <i>enable</i> | |

Setting up and using Macro 0

The following may require attention in addition to the settings made in Chapter 2.

UD50 small option module

When any of the additional functions listed above in *Specific features* are required, refer to the *UD50 User Guide* for installing a UD50 module, as well as for the specifications of the terminals.

Reference selection

Use **0.05 Reference selector** to select the required frequency source, as follows:

| 0.05 | Source | Terminal(s) |
|------|--|---------------|
| 0 | Analog input 1 or 2 which can be selected using the LOCAL/REMOTE contact | 5 and 6, or 7 |
| 1 | Analog input 1 | 5, 6 |
| 2 | Analog input 2 | 7 |
| 3 | Preset frequencies (Do not use this setting, use Macro 3 instead) | |
| 4 | Keypad control | |
| 5 | (Do not use) | |

Analog input modes


The analog inputs can be configured for the following input signals:

0 ~ 20mA, 4 ~ 20mA or 0 ~ 10V

Refer to the following parameters in Appendix D *Menu 0 Parameters* for selecting the required mode:

| Analog input | Terminal(s) | Parameter |
|--------------|-------------|--|
| 1 | 5, 6 | 0.24 <i>Analog input 1 mode selector</i> |
| 2 | 7 | 0.25 <i>Analog input 2 mode selector</i> |

Forward and reverse direction in Keypad mode

The Drive is supplied with the  (FWD/REV) key disabled to ensure the Drive is run only in the forward direction. To enable this key, set **0.30 FWD/REV enable** at 1.

Jog/Preset frequency

The jog function can be used for low-speed jogging or as a preset frequency at any value up to the maximum.

If jog or a preset frequency is required, ensure the Drive is in Terminal mode and set **0.14 Jog reference** at the required value, as follows:

| Default value | Range | Unit |
|---------------|-----------|------|
| 1.5 | 0 ~ 400.0 | Hz |

To use jog or preset frequency, close the **JOG SELECT** contact (terminal 26) before closing the **RUN FORWARD** contact (terminal 27) or **RUN REVERSE** contact (terminal 28).

EUR> Selecting positive logic



Caution

Ensure the logic sense is correct for the control circuit to be used. Incorrect logic sense could cause the motor to be started unexpectedly.

By default, the digital inputs operate in negative logic. For operation in positive logic, set **0.27 Positive logic select** at 1.

USA> Digital control by three-wire momentary contacts

1. Set **0.05 Reference selector** at 0, 1 or 2.
2. Set **0.27 Sequencing mode selector** at 0.
3. Set **0.29 Terminal-29 destination selector** at **6.34** to change the function of terminal 29 to **RUN PERMIT / STOP**.

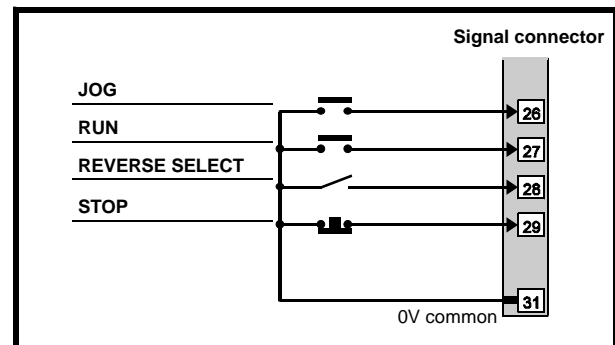


Figure 3-3 Connections for control by 3-wire momentary contacts (see Figure 3-1 for other connections)

Stopping and braking modes

Refer to the following parameters in Appendix D
Menu 0 Parameters:

| Parameter | Setting | Function |
|--|----------------|--|
| 0.15 <i>Ramp mode selector</i> | Std.Ct | (Standard controlled) Deceleration time is extended if the DC-bus voltage reaches its maximum permissible value during braking. |
| 0.16 <i>Stop mode selector</i> | rP | Ramp to stop then the Drive is disabled |

3.4 Macro 1 *Easy mode*

Features

Specific features

Easy mode gives the simplest operation of the Drive for basic applications.

Standard features

- Macro 1 operates in Terminal or Keypad mode
- In Terminal mode, digital control by **RUN FORWARD**, **RUN REVERSE** and **JOG SELECT** contacts
- Local and remote analog frequency inputs, or setting of frequency by use of the keypad
- Keypad control of frequency is uni-directional only
- Fixed analog input modes
- Fixed jog frequency
- Adjustment of minimum and maximum frequencies
- Adjustment of acceleration and deceleration ramps
- Negative logic for the digital inputs
- **SPEED** and **TORQUE** analog outputs
- **AT SPEED** digital output
- **External trip** digital input
- Drive **RESET** digital input

Signal connections for Macro 1

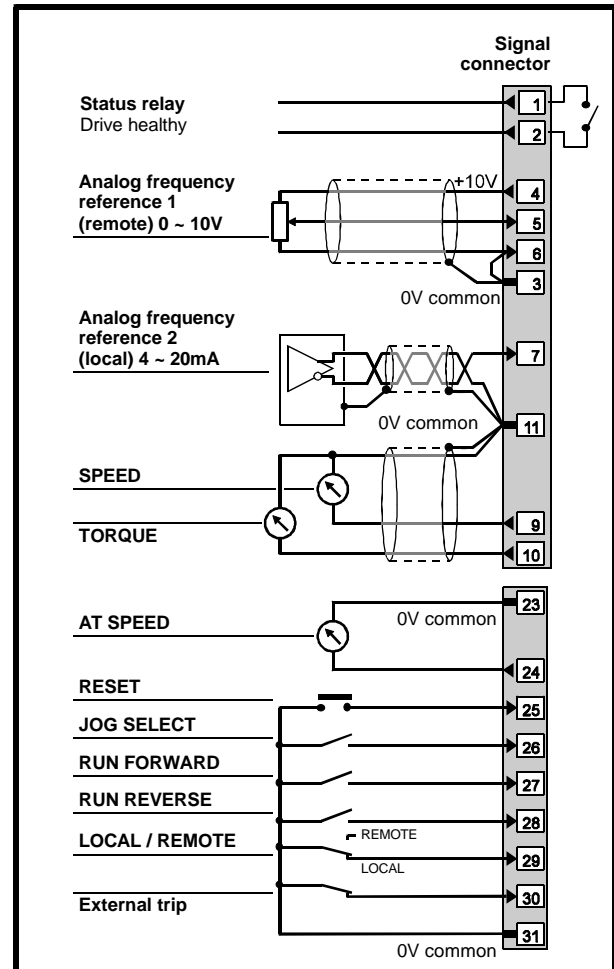


Figure 3–4 Control signal connections for Macro 1

For electrical specifications, refer to Appendix C *Signal Connections*.

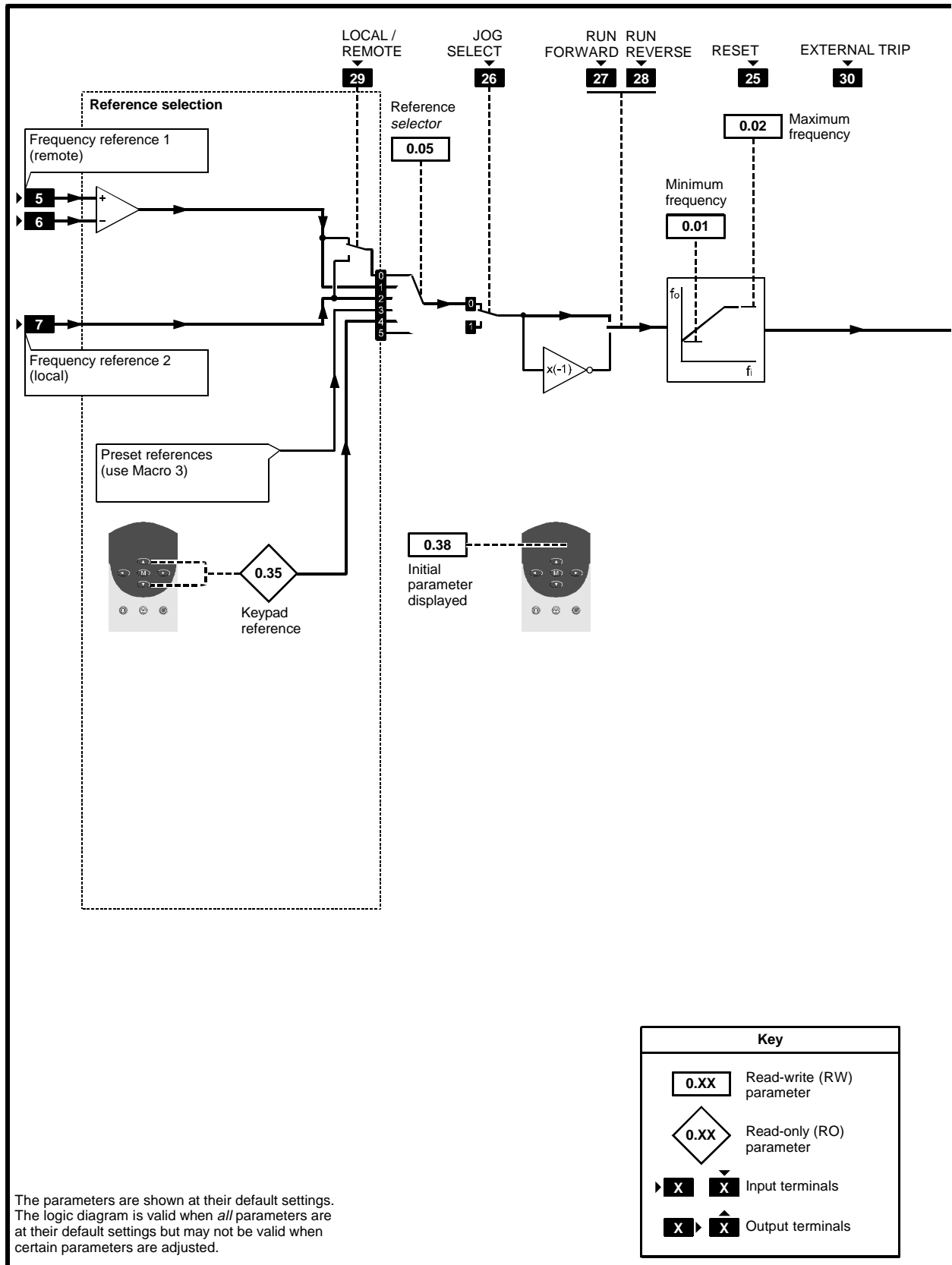
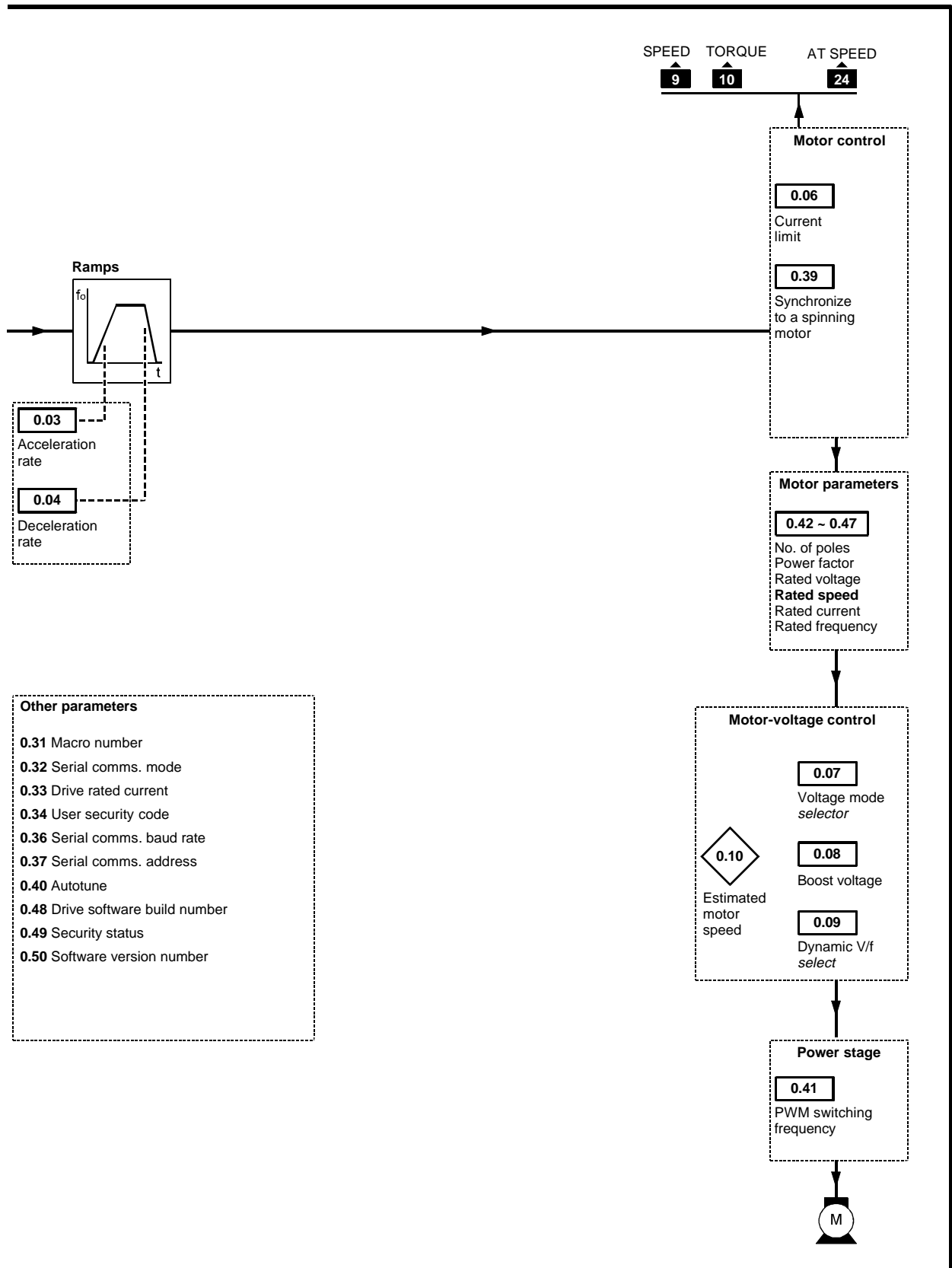


Figure 3–5 Programmable software for Macro 1



List of parameters specific to Macro 1

| Pr | Function | User value |
|------|---|------------|
| 0.00 | Configuration and saving | |
| 0.01 | Minimum frequency | |
| 0.02 | Maximum frequency | |
| 0.03 | Acceleration rate | |
| 0.04 | Deceleration rate | |
| 0.05 | Reference <i>selector</i> | |
| 0.06 | Current limit | |
| 0.07 | Voltage mode <i>selector</i> | |
| 0.08 | Boost voltage | |
| 0.09 | Dynamic V/f <i>select</i> | |
| 0.10 | Estimated motor speed | [M] |
| | | |
| 0.31 | Macro number | [M] |
| 0.32 | Serial comms. mode | |
| 0.33 | Drive rated current (FLC) | [M] |
| 0.34 | User security code | [M] |
| 0.35 | Keypad reference | [M] |
| 0.36 | Serial comms. baud rate | |
| 0.37 | Serial comms. address | |
| 0.38 | Initial parameter displayed | |
| 0.39 | Synchronize to a spinning motor | |
| 0.40 | Autotune | |
| 0.41 | PWM switching frequency <i>selector</i> | |
| 0.42 | Motor – number of poles | |
| 0.43 | Motor – power factor | |
| 0.44 | Motor – rated voltage | |
| 0.45 | Motor – rated speed | |
| 0.46 | Motor – rated current | |
| 0.47 | Motor – rated frequency | |
| 0.48 | Drive software build number | [M] |
| 0.49 | Security status | [M] |
| 0.50 | Drive software version | [M] |

[M] indicates the parameter is for monitoring only

For descriptions of these parameters, see Appendix D *Menu 0 Parameters*.

Setting up and using Macro 1

The following may require attention in addition to the settings made in Chapter 2.

Reference selection

Use **0.05** *Reference selector* to select the required frequency source, as follows:

| 0.05 | Source | Terminal(s) |
|-------------|--|--------------------|
| 0 | Analog input 1 or 2 which can be selected using the LOCAL/REMOTE contact | 5 and 6, or 7 |
| 1 | Analog input 1 | 5, 6 |
| 2 | Analog input 2 | 7 |
| 3 | (Do not use) | |
| 4 | Keypad control | |
| 5 | (Do not use) | |

Frequency references

Keypad mode

The value of the keypad reference can be read by displaying the value of **0.35** *Keypad reference*.

Terminal mode

Frequency reference 1 (terminals 5, 6) is configured for 0 to 10V signal.

Frequency reference 2 (terminal 7) is configured for 4 to 20mA signal. Loss of the current signal will be treated as zero reference.

Jog

To use jog, close the **JOG SELECT** contact (terminal 26) before closing the **RUN FORWARD** contact (terminal 27) or **RUN REVERSE** contact (terminal 28).

Jog will occur at 1.5Hz. This value cannot be altered.

Use this free space for notes

3.5 Macro 2 Motorized potentiometer

Features

Special features

The digital inputs are configured to accept momentary **UP** and **DOWN** contacts.

Selection can be made between motorized potentiometer operation and normal frequency control. In both cases, analog input 1 remains configured for an analog frequency reference signal (0 to 10V).

Motorized potentiometer is used by first closing the **RUN FORWARD** or **RUN REVERSE** contact as required, then closing the **UP** or **DOWN** contact to increase or decrease the speed. When the **UP** and **DOWN** contacts are both open, the Drive maintains constant speed until the closed **RUN** contact is opened.

The output of the motorized potentiometer can be monitored by reading the value of **0.26 Motorized pot. output indicator**, and the frequency by reading the value of **0.11 Pre-ramp reference**.

The motorized potentiometer is reset when the **RESET** contact connected to terminal 25 is closed momentarily. (This also resets the Drive.)

Selection can be made for the motorized potentiometer to return to the previous set speed, or start at zero, after each power-up.

Standard features

- Macro 2 operates in Terminal mode only
- Digital control by **RUN FORWARD** and **RUN REVERSE** contacts
- Analog frequency input
- Adjustment of minimum and maximum frequencies
- Adjustment of acceleration and deceleration ramps
- S-ramp
- Skip frequencies
- Selection of stopping modes
- Selection of braking mode
- Motor thermistor input
- Negative logic for the digital inputs
- **SPEED** and **TORQUE** analog outputs
- **External trip** digital input
- Drive **RESET** digital input

Signal connections for Macro 2

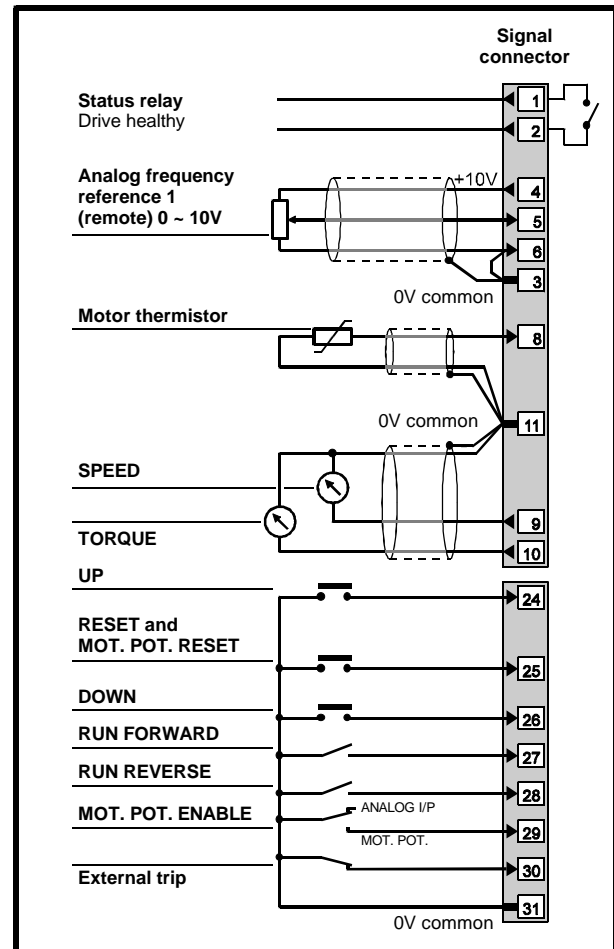


Figure 3-6 Control signal and thermistor connections for Macro 2

For electrical specifications, refer to Appendix C *Signal Connections*.

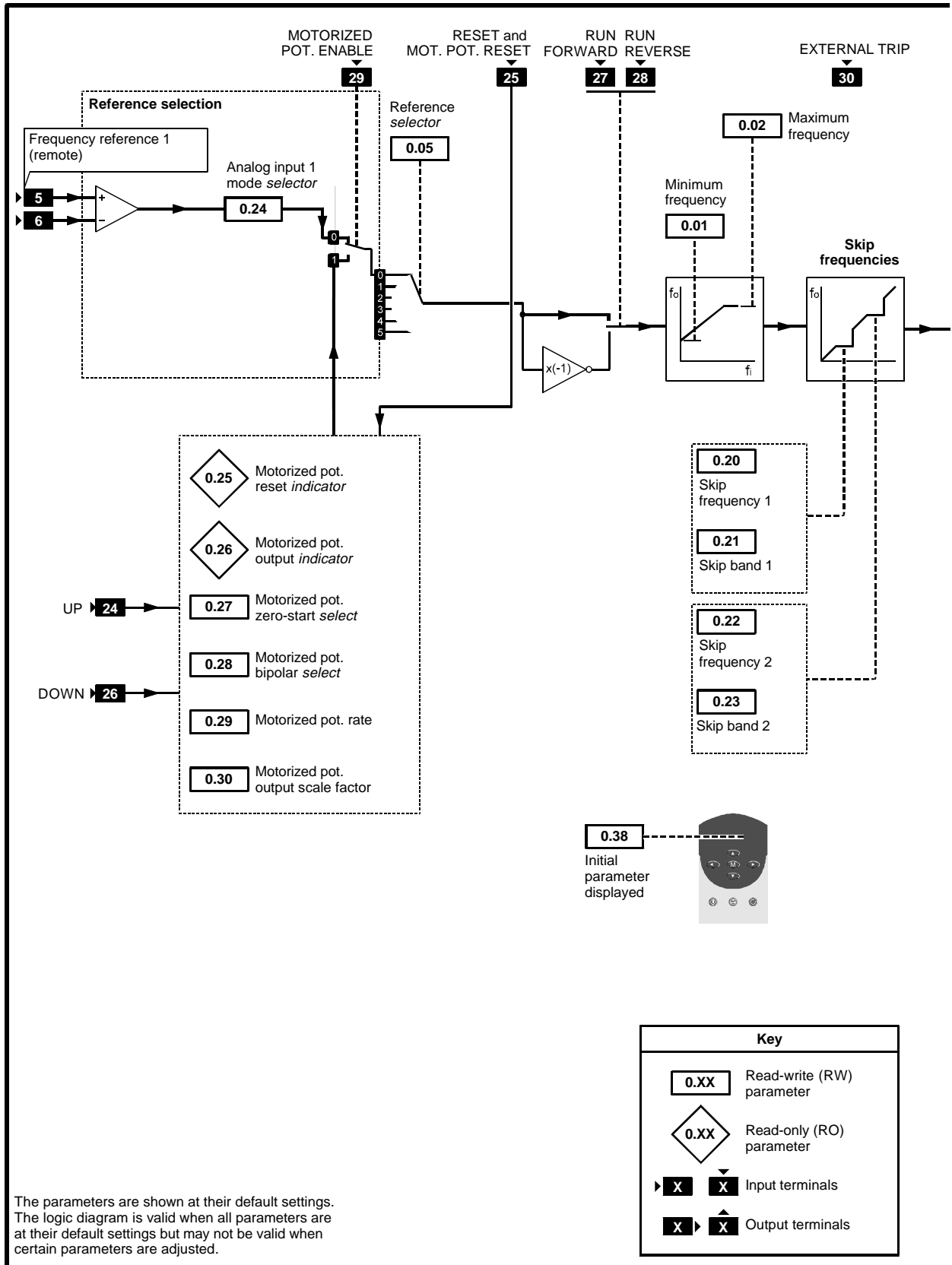
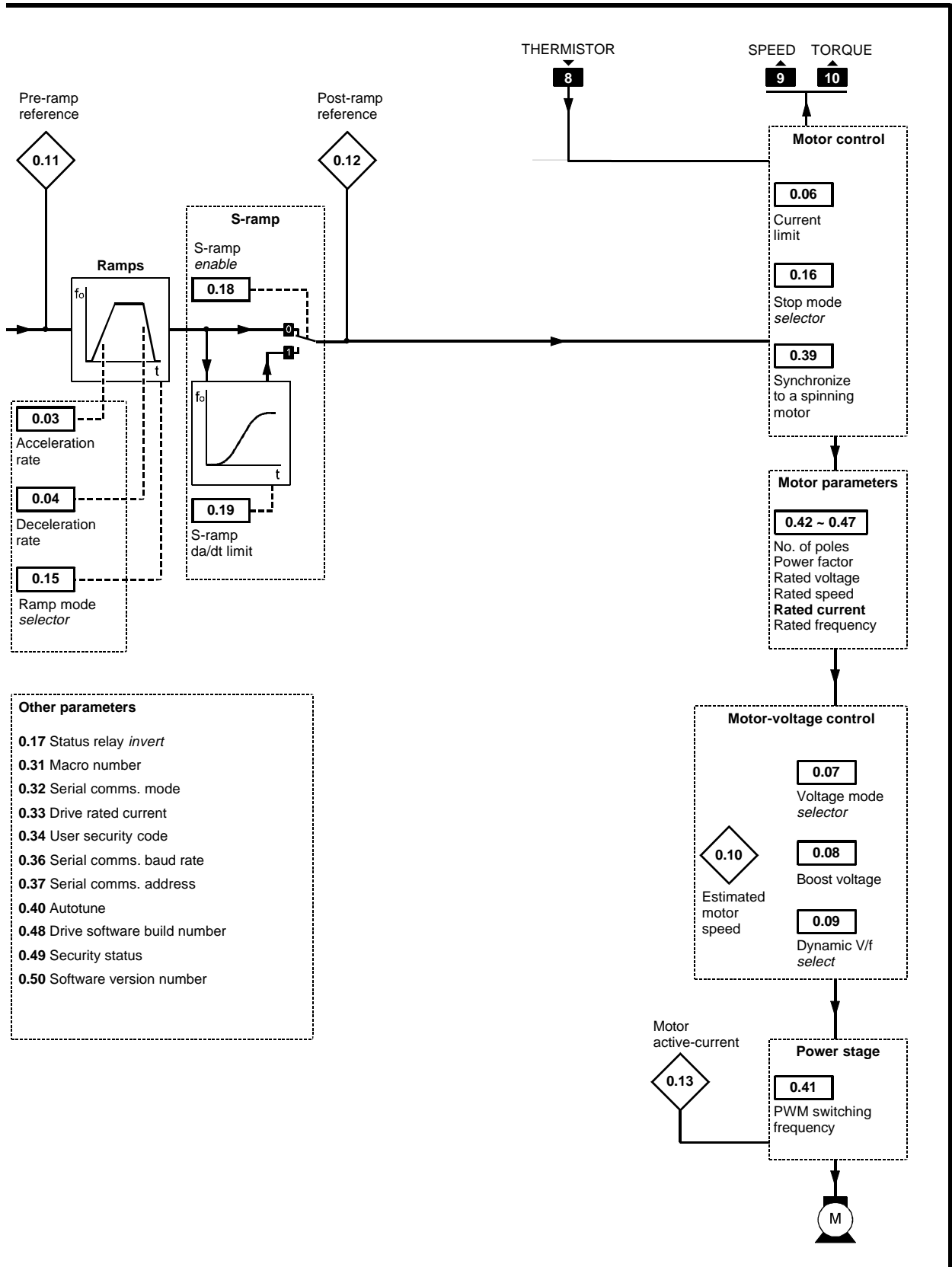


Figure 3-7 Programmable software for Macro 2



- Other parameters**
- 0.17 Status relay *invert*
 - 0.31 Macro number
 - 0.32 Serial comms. mode
 - 0.33 Drive rated current
 - 0.34 User security code
 - 0.36 Serial comms. baud rate
 - 0.37 Serial comms. address
 - 0.40 Autotune
 - 0.48 Drive software build number
 - 0.49 Security status
 - 0.50 Software version number

List of parameters specific to Macro 2

| Pr | Function | User value |
|------|---|------------|
| 0.00 | Configuration and saving | |
| 0.01 | Minimum frequency | |
| 0.02 | Maximum frequency | |
| 0.03 | Acceleration rate | |
| 0.04 | Deceleration rate | |
| 0.05 | Reference <i>selector</i> (do not adjust) | |
| 0.06 | Current limit | |
| 0.07 | Voltage mode <i>selector</i> | |
| 0.08 | Boost voltage | |
| 0.09 | Dynamic V/f <i>select</i> | |
| 0.10 | Estimated motor speed | [M] |

[M] indicates the parameter is for monitoring only

For descriptions of these parameters, see Appendix D *Menu 0 Parameters*.

| Pr | Function | User value |
|------|---|------------|
| 0.31 | Macro number | [M] |
| 0.32 | Serial comms. mode | |
| 0.33 | Drive rated current (FLC) | [M] |
| 0.34 | User security code | [M] |
| 0.35 | Keypad reference | [M] |
| 0.36 | Serial comms. baud rate | |
| 0.37 | Serial comms. address | |
| 0.38 | Initial parameter displayed | |
| 0.39 | Synchronize to a spinning motor | |
| 0.40 | Autotune | |
| 0.41 | PWM switching frequency <i>selector</i> | |
| 0.42 | Motor – number of poles | |
| 0.43 | Motor – power factor | |
| 0.44 | Motor – rated voltage | |
| 0.45 | Motor – rated speed | |
| 0.46 | Motor – rated current | |
| 0.47 | Motor – rated frequency | |
| 0.48 | Drive software build number | [M] |
| 0.49 | Security status | [M] |
| 0.50 | Drive software version | [M] |

| Pr | Function | User value |
|------|---|------------|
| 0.11 | Pre-ramp reference | [M] |
| 0.12 | Post-ramp reference | [M] |
| 0.13 | Motor active-current | [M] |
| 0.14 | Jog reference (not used) | |
| 0.15 | Ramp mode <i>selector</i> | |
| 0.16 | Stop mode <i>selector</i> | |
| 0.17 | Status relay <i>invert</i> | |
| 0.18 | S-ramp <i>enable</i> | |
| 0.19 | S-ramp da/dt | |
| 0.20 | Skip frequency 1 | |
| 0.21 | Skip band 1 | |
| 0.22 | Skip frequency 2 | |
| 0.23 | Skip band 2 | |
| 0.24 | Analog input 1 mode <i>selector</i> | |
| 0.25 | Motorized pot. reset <i>indicator</i> | [M] |
| 0.26 | Motorized pot. output <i>indicator</i> | |
| 0.27 | Motorized pot. zero-start <i>select</i> | |
| 0.28 | Motorized pot. bipolar <i>select</i> | |
| 0.29 | Motorized pot. rate | |
| 0.30 | Motorized pot. output scale factor | |

Setting up and using Macro 2

The following may require attention in addition to the settings made in Chapter 2.

Motorized potentiometer settings

1. By default, the Drive operates in frequency control. To disable this and enable the motorized potentiometer, close the **MOT. POT. ENABLE** contact (terminal 29).
2. If required, change the value of **0.29 Motorized pot. rate** to change the rate of increase and decrease. Increasing the value reduces the rate of change of frequency.
Default value: 20 s
Range: 0 ~ 250 s
3. If bipolar operation is required, set **0.28 Motorized pot. bipolar select** at 1.
4. By default, every time the Drive is powered-up and enabled, the frequency will return under ramp control to the last setting of the motorized potentiometer. If the Drive is required to start at zero, set **0.27 Motorized pot. zero-start select** at 1.
5. To reset the motorized potentiometer, momentarily close the **RESET** contact. (This also resets the Drive.)
6. If required, change the scaling of the motorized potentiometer output by adjusting **0.30 Motorized pot. output scale factor**.
7. If required, monitor the output value of the potentiometer by reading **0.26 Motorized pot. output indicator**.

Reference selection

For correct operation of this macro configuration, the setting of parameter of **0.05 Reference selection** should be at **0**.

Analog input modes

The analog input can be configured for the following input signals:

0 ~ 20mA, 4 ~ 20mA or 0 ~ 10V

Refer to the following parameter in Appendix D *Menu 0 Parameters* for selecting the required mode:

| Analog input | Terminal(s) | Parameter |
|--------------|-------------|--|
| 1 | 5, 6 | 0.24 <i>Analog input 1 mode selector</i> |

Jog frequency

There is no need to adjust **0.14 Jog reference** since the jog function cannot be used.

Stopping and braking modes

Refer to the following parameters in Appendix D *Menu 0 Parameters*:

| Parameter | Setting | Function |
|--|---------------|---|
| 0.15 <i>Ramp mode selector</i> | Std.Ct | (Standard controlled) Deceleration time is extended if the DC-bus voltage reaches its maximum permissible value during braking. |
| 0.16 <i>Stop mode selector</i> | rP | Ramp to stop then the Drive is disabled |

Use this page for notes

3.6 Macro 3 Preset frequencies

Features

Special features

Selection can be made between preset frequencies and analog frequency control. In both cases, analog input 1 remains configured for an analog frequency reference signal (0 to 10V).

Up to four preset frequencies can be used; their values must be programmed into individual parameters. Selection is made by external contacts operating in binary logic.

Standard features

- Macro 3 operates in Terminal mode only
- Digital control by **RUN FORWARD** and **RUN REVERSE** contacts
- Analog frequency input
- Adjustment of minimum and maximum frequencies
- Adjustment of acceleration and deceleration ramps
- Operation of the status relay can be inverted
- S-ramp
- Skip frequencies
- Selection of stopping modes
- Selection of braking mode
- Motor thermistor input
- Negative logic for the digital inputs
- **SPEED** and **TORQUE** analog outputs
- **External trip** digital input
- Drive **RESET** digital input

Signal connections for Macro 3

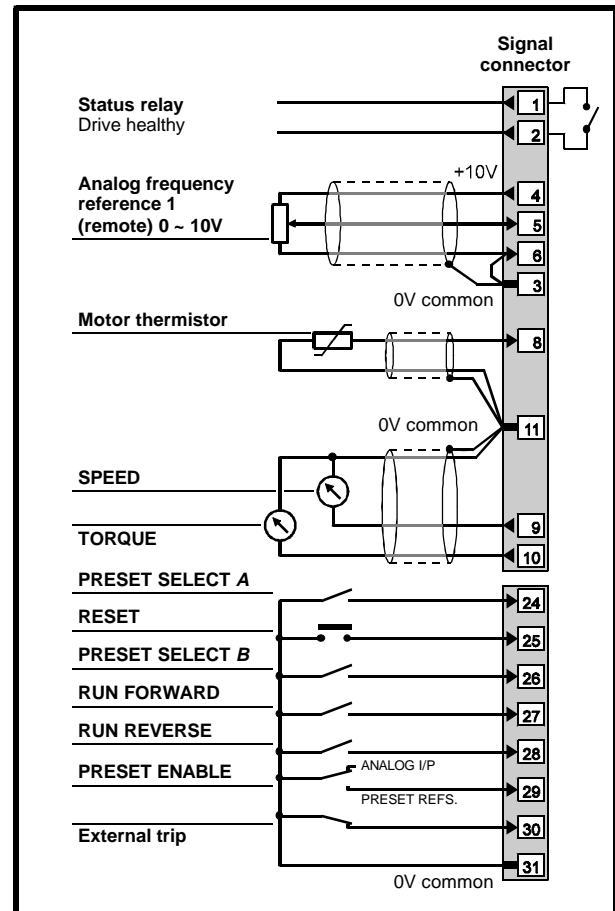


Figure 3–8 Control signal and thermistor connections for Macro 3

For electrical specifications, refer to Appendix C *Signal Connections*.

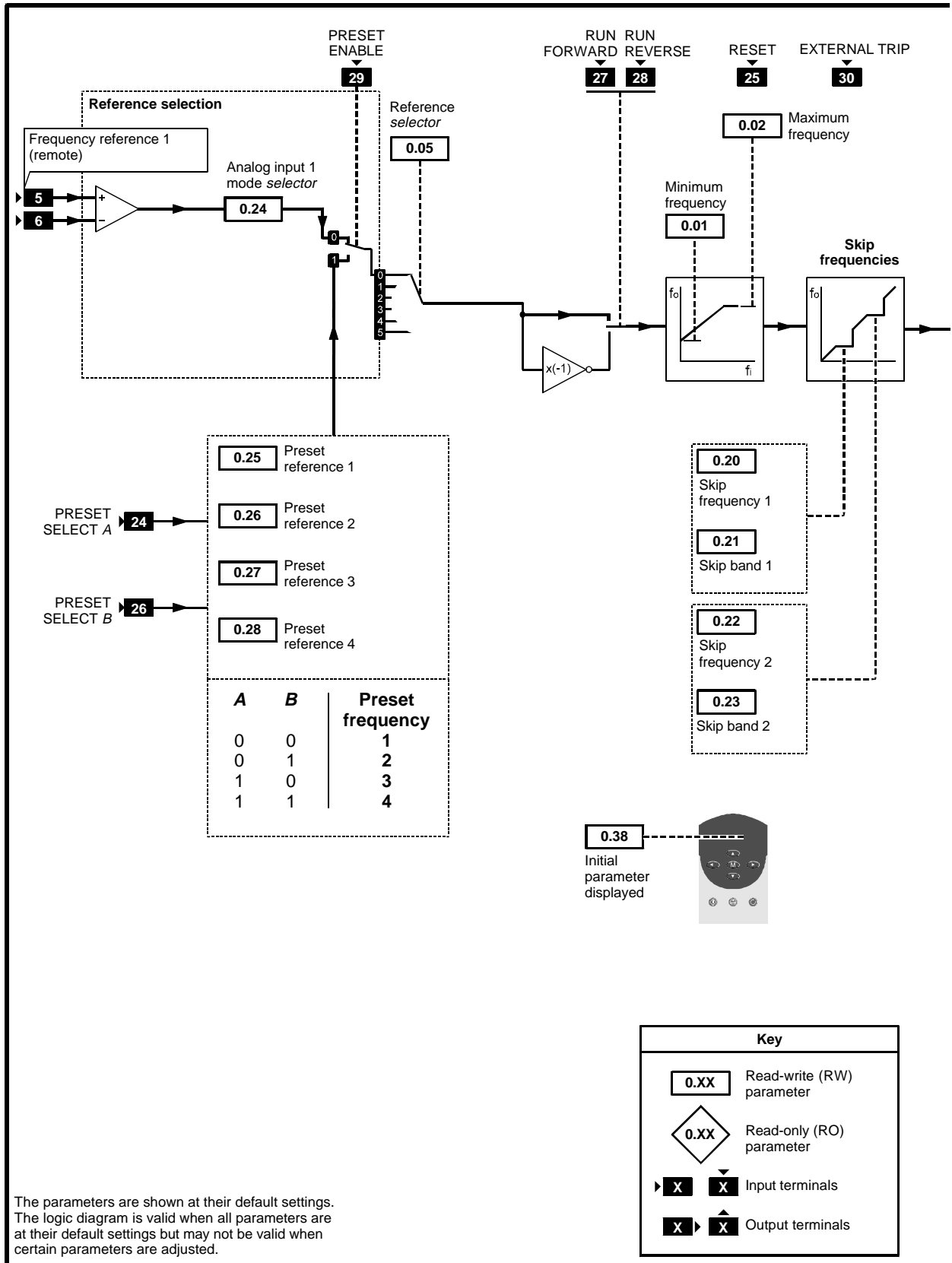
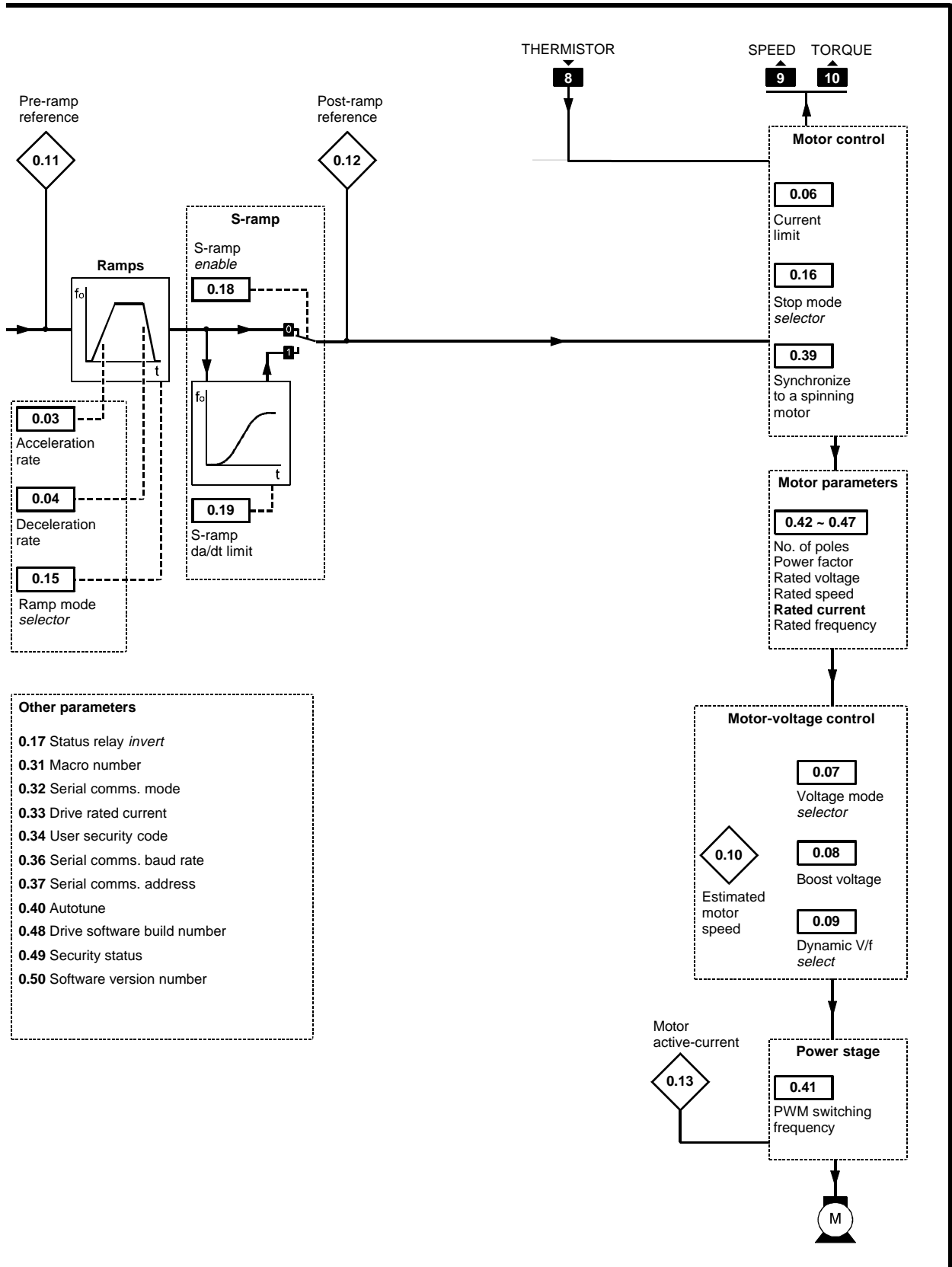


Figure 3–9 Programmable software for Macro 3



List of parameters specific to Macro 3

| Pr | Function | User value |
|------|---|------------|
| 0.00 | Configuration and saving | |
| 0.01 | Minimum frequency | |
| 0.02 | Maximum frequency | |
| 0.03 | Acceleration rate | |
| 0.04 | Deceleration rate | |
| 0.05 | Reference <i>selector</i> (do not adjust) | |
| 0.06 | Current limit | |
| 0.07 | Voltage mode <i>selector</i> | |
| 0.08 | Boost voltage | |
| 0.09 | Dynamic V/f <i>select</i> | |
| 0.10 | Estimated motor speed | [M] |

[M] indicates the parameter is for monitoring only

For descriptions of these parameters, see Appendix D *Menu 0 Parameters*.

| Pr | Function | User value |
|------|---|------------|
| 0.31 | Macro number | [M] |
| 0.32 | Serial comms. mode | |
| 0.33 | Drive rated current (FLC) | [M] |
| 0.34 | User security code | [M] |
| 0.35 | Keypad reference | [M] |
| 0.36 | Serial comms. baud rate | |
| 0.37 | Serial comms. address | |
| 0.38 | Initial parameter displayed | |
| 0.39 | Synchronize to a spinning motor | |
| 0.40 | Autotune | |
| 0.41 | PWM switching frequency <i>selector</i> | |
| 0.42 | Motor – number of poles | |
| 0.43 | Motor – power factor | |
| 0.44 | Motor – rated voltage | |
| 0.45 | Motor – rated speed | |
| 0.46 | Motor – rated current | |
| 0.47 | Motor – rated frequency | |
| 0.48 | Drive software build number | [M] |
| 0.49 | Security status | [M] |
| 0.50 | Drive software version | [M] |

| Pr | Function | User value |
|------|-------------------------------------|------------|
| 0.11 | Pre-ramp reference | [M] |
| 0.12 | Post-ramp reference | [M] |
| 0.13 | Motor active-current | [M] |
| 0.14 | Jog reference (not used) | |
| 0.15 | Ramp mode <i>selector</i> | |
| 0.16 | Stop mode <i>selector</i> | |
| 0.17 | Status relay <i>invert</i> | |
| 0.18 | S-ramp <i>enable</i> | |
| 0.19 | S-ramp da/dt | |
| 0.20 | Skip frequency 1 | |
| 0.21 | Skip band 1 | |
| 0.22 | Skip frequency 2 | |
| 0.23 | Skip band 2 | |
| 0.24 | Analog input 1 mode <i>selector</i> | |
| 0.25 | Preset reference 1 | |
| 0.26 | Preset reference 2 | |
| 0.27 | Preset reference 3 | |
| 0.28 | Preset reference 4 | |
| 0.29 | (Not used) | |
| 0.30 | (Not used) | |

Setting up and using Macro 3

The following may require attention in addition to the settings made in Chapter 2.

Preset references

1. By default, the Drive operates in frequency control. To disable this and enable the preset references, close the **PRESET ENABLE** contact (terminal 29).

2. Enter the required values in the following parameters:

0.25 Preset frequency 1

0.26 Preset frequency 2

0.27 Preset frequency 3

0.28 Preset frequency 4

Default value: 0

Range: ± 1000 Hz

3. Select the required preset reference as follows:

| Preset reference | PRESET SELECT A (terminal 24) | PRESET SELECT B (terminal 26) |
|------------------|-------------------------------|-------------------------------|
| 1 | Open | Open |
| 2 | Open | Closed |
| 3 | Closed | Open |
| 4 | Closed | Closed |

Reference selection

For correct operation of this macro configuration, the setting of parameter of **0.05** Reference selection should be at **0**.

Analog input modes

The analog input can be configured for the following input signals:

0 ~ 20mA, 4 ~ 20mA or 0 ~ 10V

Refer to the following parameter in Appendix D *Menu 0 Parameters* for selecting the required mode:

| Analog input | Terminal(s) | Parameter |
|--------------|-------------|---|
| 1 | 5, 6 | 0.24 Analog input 1 mode selector |

Jog frequency

There is no need to adjust **0.14** Jog reference since the jog function cannot be used.

Stopping and braking modes

Refer to the following parameters in Appendix D *Menu 0 Parameters*:

| Parameter | Setting | Function |
|-----------------------------------|---------------|---|
| 0.15 Ramp mode selector | Std.Ct | (Standard controlled) Deceleration time is extended if the DC-bus voltage reaches its maximum permissible value during braking. |
| 0.16 Stop mode selector | rP | Ramp to stop then the Drive is disabled |

Use this free space for notes

3.7 Macro 4 Torque control

Features

Specific features

Selection can be made between torque control and frequency control.

When frequency control is selected, the Drive will run at the frequency demand irrespective of load so long as the maximum permissible output current of the Drive is not reached. The frequency reference must be applied to analog input 2.

When torque control is selected, analog input 1 is configured for an analog torque reference. The maximum frequency is limited to the value of **0.02 Maximum frequency**. Analog input 2 is not used.

Both inputs accept 0 to 10V.

Torque slaving

Macro 4 can be used in applications where two or more motors are mechanically linked and must share the torque load in a controlled way.

Standard features

- Macro 4 operates in Terminal mode only
- Digital control by **RUN FORWARD** and **RUN REVERSE** contacts
- Analog torque and frequency inputs
- Adjustment of maximum frequencies
- Adjustment of acceleration and deceleration ramps
- Operation of the status relay can be inverted
- Selection of braking mode
- Motor thermistor input
- Negative logic for the digital inputs
- **SPEED** and **TORQUE** analog outputs
- **AT MINIMUM SPEED** digital output
- **AT SPEED** digital output
- **External trip** digital input
- Drive **RESET** digital input

Signal connections for Macro 4

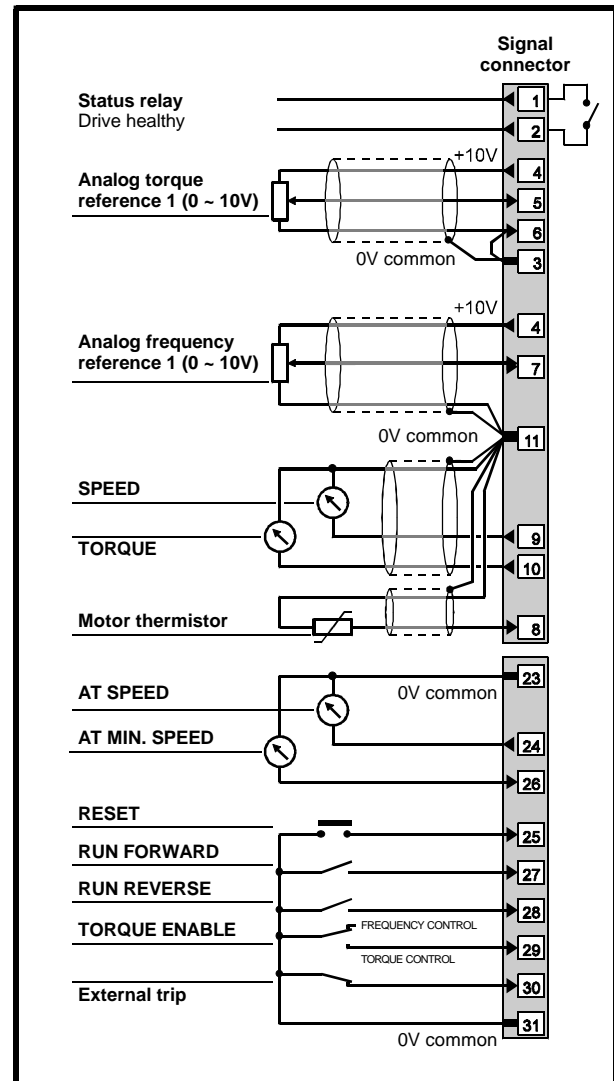


Figure 3-10 Control signal and thermistor connections for Macro 4

For electrical specifications, refer to Appendix C *Signal Connections*.

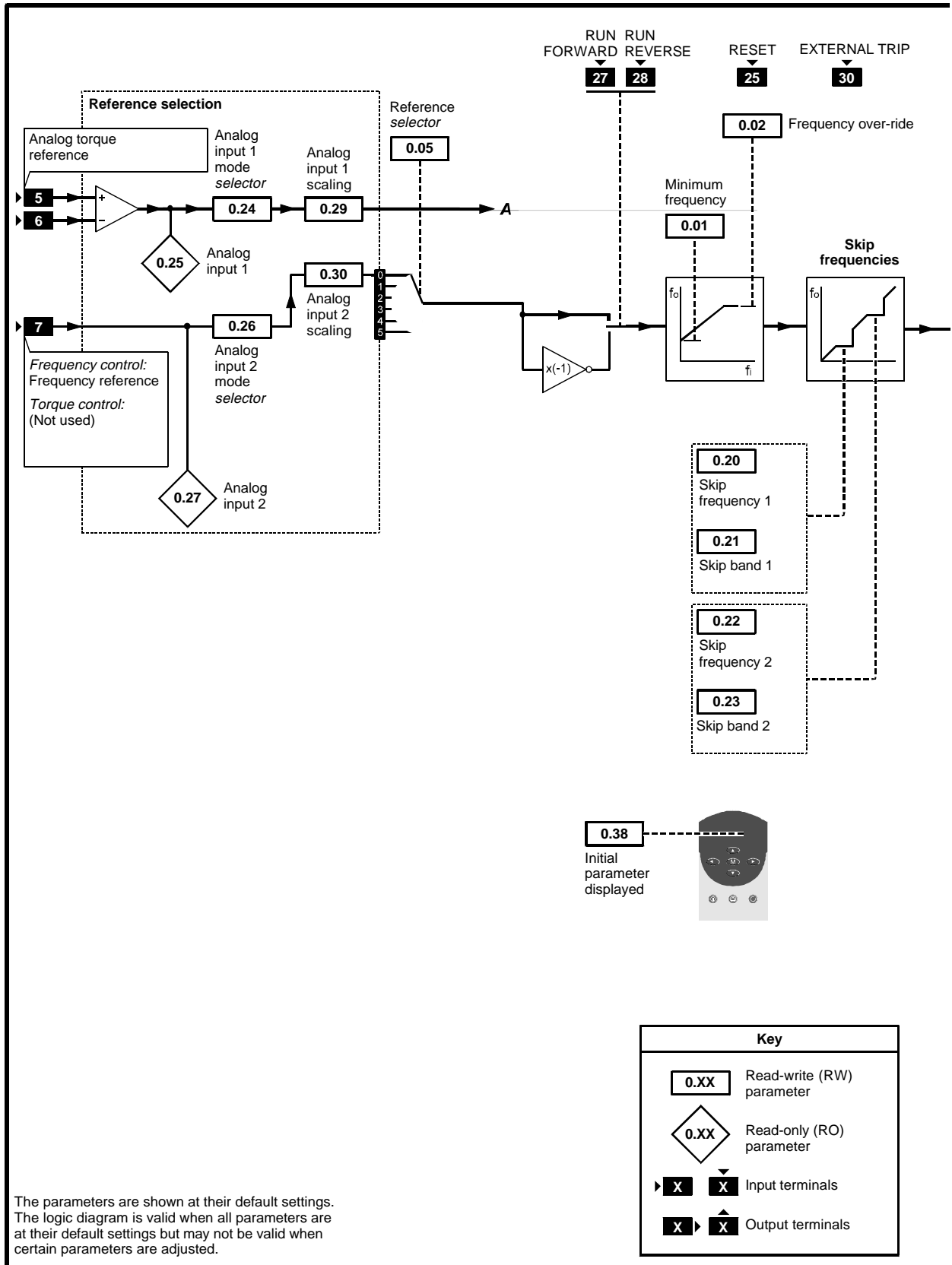
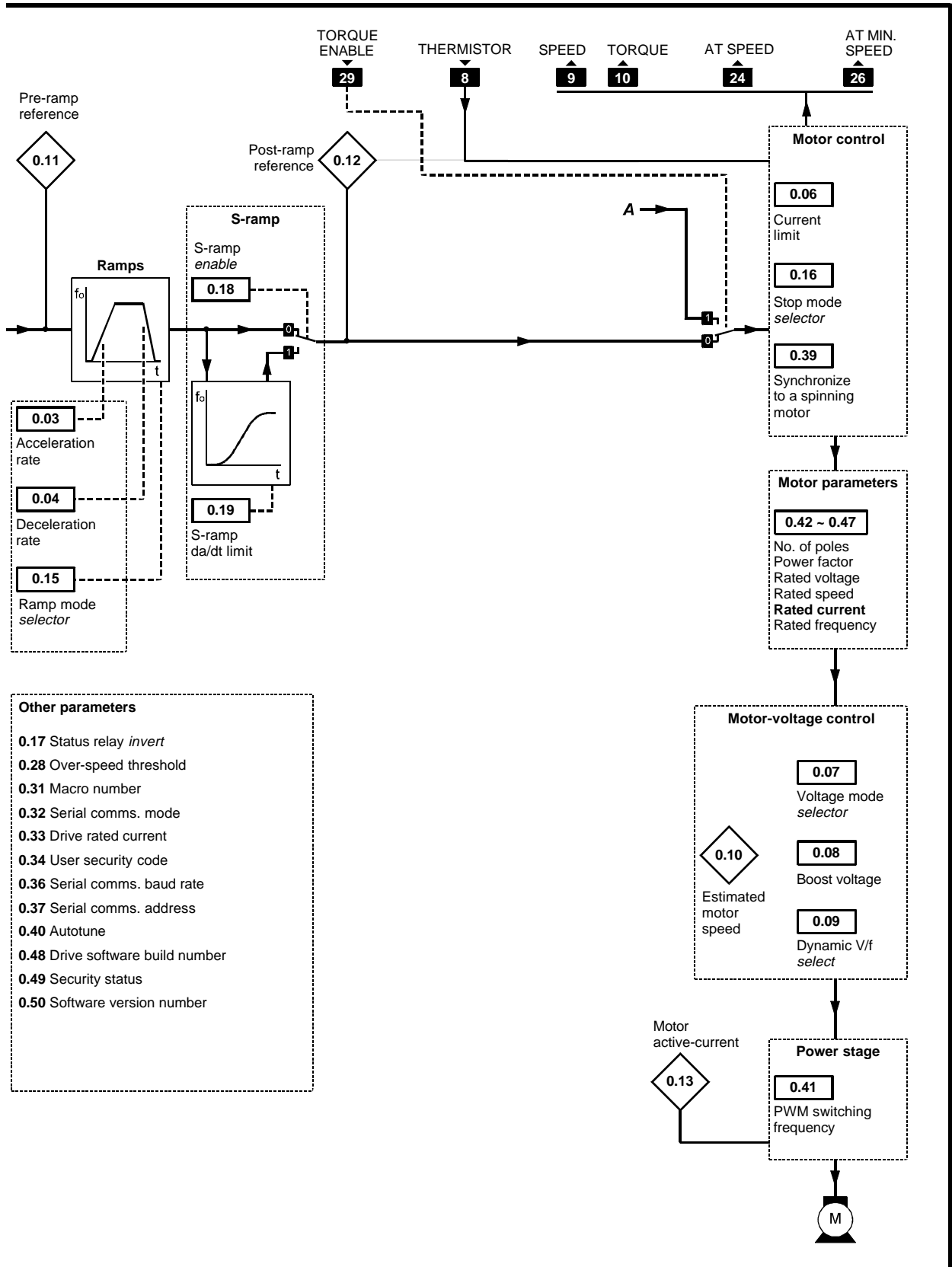


Figure 3–11 Programmable software for Macro 4



List of parameters specific to Macro 4

| Pr | Function | User value |
|------|---|------------|
| 0.00 | Configuration and saving | |
| 0.01 | Minimum frequency | |
| 0.02 | Maximum frequency | |
| 0.03 | Acceleration rate | |
| 0.04 | Deceleration rate | |
| 0.05 | Reference <i>selector</i> (do not adjust) | |
| 0.06 | Current limit | |
| 0.07 | Voltage mode <i>selector</i> | |
| 0.08 | Boost voltage | |
| 0.09 | Dynamic V/f <i>select</i> | |
| 0.10 | Estimated motor speed | [M] |

[M] indicates the parameter is for monitoring only

For descriptions of these parameters, see Appendix D *Menu 0 Parameters*.

| Pr | Function | User value |
|------|---|------------|
| 0.31 | Macro number | [M] |
| 0.32 | Serial comms. mode | |
| 0.33 | Drive rated current (FLC) | [M] |
| 0.34 | User security code | [M] |
| 0.35 | Keypad reference | [M] |
| 0.36 | Serial comms. baud rate | |
| 0.37 | Serial comms. address | |
| 0.38 | Initial parameter displayed | |
| 0.39 | Synchronize to a spinning motor | |
| 0.40 | Autotune | |
| 0.41 | PWM switching frequency <i>selector</i> | |
| 0.42 | Motor – number of poles | |
| 0.43 | Motor – power factor | |
| 0.44 | Motor – rated voltage | |
| 0.45 | Motor – rated speed | |
| 0.46 | Motor – rated current | |
| 0.47 | Motor – rated frequency | |
| 0.48 | Drive software build number | [M] |
| 0.49 | Security status | [M] |
| 0.50 | Drive software version | [M] |

| Pr | Function | User value |
|------|--------------------------------------|------------|
| 0.11 | Pre-ramp reference | [M] |
| 0.12 | Post-ramp reference | [M] |
| 0.13 | Motor active-current | [M] |
| 0.14 | Jog reference (not used) | |
| 0.15 | Braking mode <i>selector</i> | |
| 0.16 | Stop mode <i>selector</i> | |
| 0.17 | Status relay <i>invert</i> | |
| 0.18 | S-ramp <i>enable</i> | |
| 0.19 | S-ramp da/dt | |
| 0.20 | Skip frequency 1 | |
| 0.21 | Skip band 1 | |
| 0.22 | Skip frequency 2 | |
| 0.23 | Skip band 2 | |
| 0.24 | Analog input 1 mode <i>selector</i> | |
| 0.25 | Analog input 1 (torque reference) | |
| 0.26 | Analog input 2 mode <i>selector</i> | |
| 0.27 | Analog input 2 (frequency reference) | |
| 0.28 | Over-speed threshold | |
| 0.29 | Analog input 1 scaling | |
| 0.30 | Analog input 2 scaling | |

Setting up and using Macro 4

Torque control

- By default, the Drive operates in frequency control. To disable this and enable torque control, close the **TORQUE ENABLE** contact (terminal 29).
- Set **0.02** *Frequency over-ride* at the required value to limit the maximum speed of the motor.
- Set the analog torque reference at the required level.
- If required, adjust **0.29** *Analog input 1 scaling* to change the scaling of the torque reference input (see *Torque slaving* below).
- If required, adjust **0.30** *Analog input 2 scaling* to change the scaling of the frequency reference input.
- Set **0.28** *Over-speed threshold* at the frequency that the Drive is to trip for protecting the system.
Default value: $([0.02] \times 1.2)$ Hz
Range: $0 \sim ([1.06] \times 1.2)$ Hz
- Monitor the torque reference by displaying parameter **0.25** *Analog input 1*.

Reference selection

For correct operation of this macro configuration, the setting of parameter **0.05** *Reference selection* should be at **0**.

Jog frequency

There is no need to adjust **0.14** *Jog reference* since the jog function cannot be used.

Analog input modes

The analog inputs can be configured for the following input signals:

0 ~ 20mA, 4 ~ 20mA or 0 ~ 10V

Refer to the following parameters in Appendix D *Menu 0 Parameters* for selecting the required mode:

| Analog input | Terminal(s) | Parameter |
|--------------|-------------|--|
| 1 | 5, 6 | 0.24 <i>Analog input 1 mode selector</i> |
| 2 | 7 | 0.26 <i>Analog input 2 mode selector</i> |

Torque slaving

- Set up a master Drive in Macro 0 with frequency control.
- Set up slave Drive(s) in Macro 4.
- Make connections between the Drives as shown in Figure 3–12.

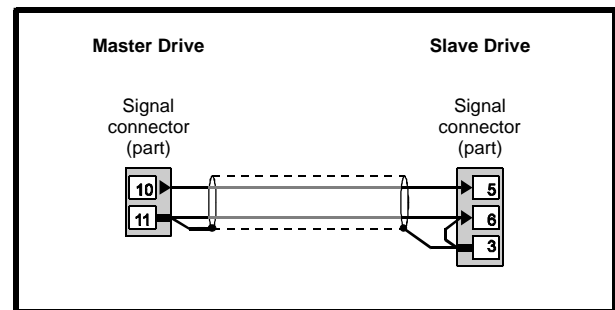


Figure 3–12 Torque slaving connections

- If the slave Drive(s) is to deliver a different torque from that of the master Drive, for (each) slave Drive, adjust **0.29** *Analog input 1 scaling* accordingly.

Stopping and braking modes

Refer to the following parameters in Appendix D *Menu 0 Parameters*:

| Parameter | Setting | Function |
|--|---------------|---|
| 0.15 <i>Ramp mode selector</i> | Std.Ct | (Standard controlled) Deceleration time is extended if the DC-bus voltage reaches its maximum permissible value during braking. |
| 0.16 <i>Stop mode selector</i> | rP | Ramp to stop then the Drive is disabled |

Use this free space for notes

3.8 Macro 5 PID (set-point control)

Features

Specific features

PID control is used for applications where a process is required to be maintained at a set-point. Typical applications are as follows:

- Closed-loop tension-control processes where a dancer-arm is used
- Closed-loop pressure-control systems

Selection can be made between PID and analog frequency control. When PID control is selected, the three analog inputs are configured as follows:

- *Frequency reference* to define the frequency demand
- *PID feedback* from the feedback device
- *PID reference* to define the set-point

The dynamic performance, scaling and range of the PID control can be adjusted.

Two preset references and an optional software PID-enable can be used.

Standard features

- Macro 5 operates in Terminal mode only
- Digital control by **RUN FORWARD** and **RUN REVERSE** contacts
- Analog frequency inputs
- Adjustment of acceleration and deceleration ramps
- Negative logic for the digital inputs
- **SPEED** and **TORQUE** analog outputs
- **AT SPEED** digital output
- **External trip** digital input
- Drive **RESET** digital input

Signal connections for Macro 5

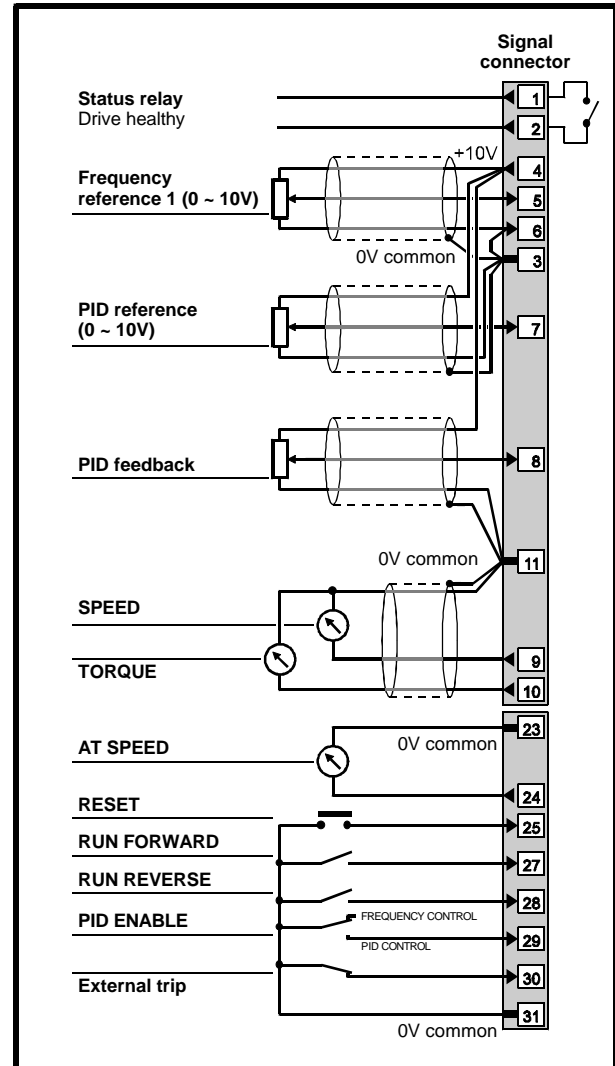


Figure 3–13 Control signal connections for Macro 5

For electrical specifications, refer to Appendix C *Signal Connections*.

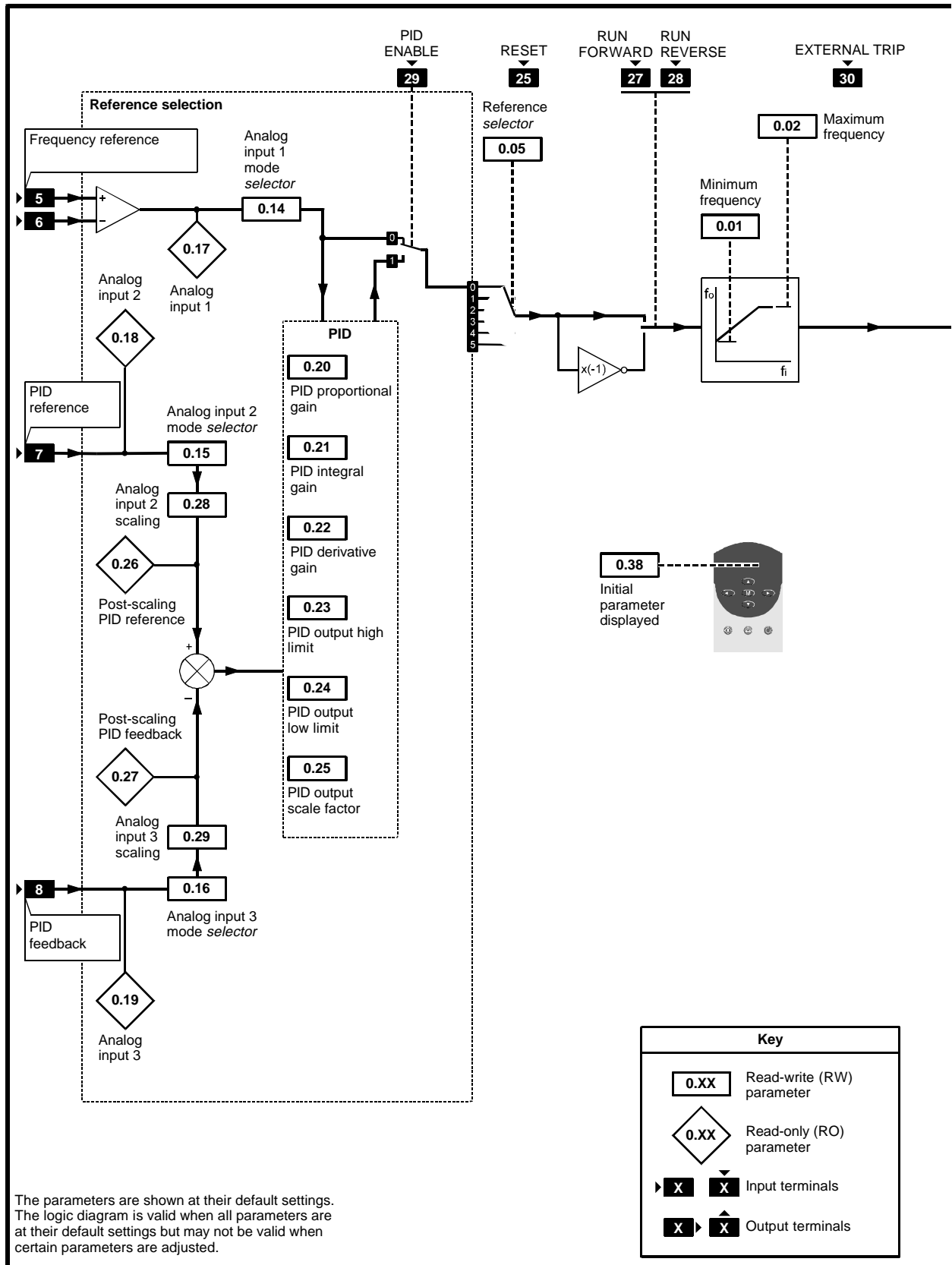
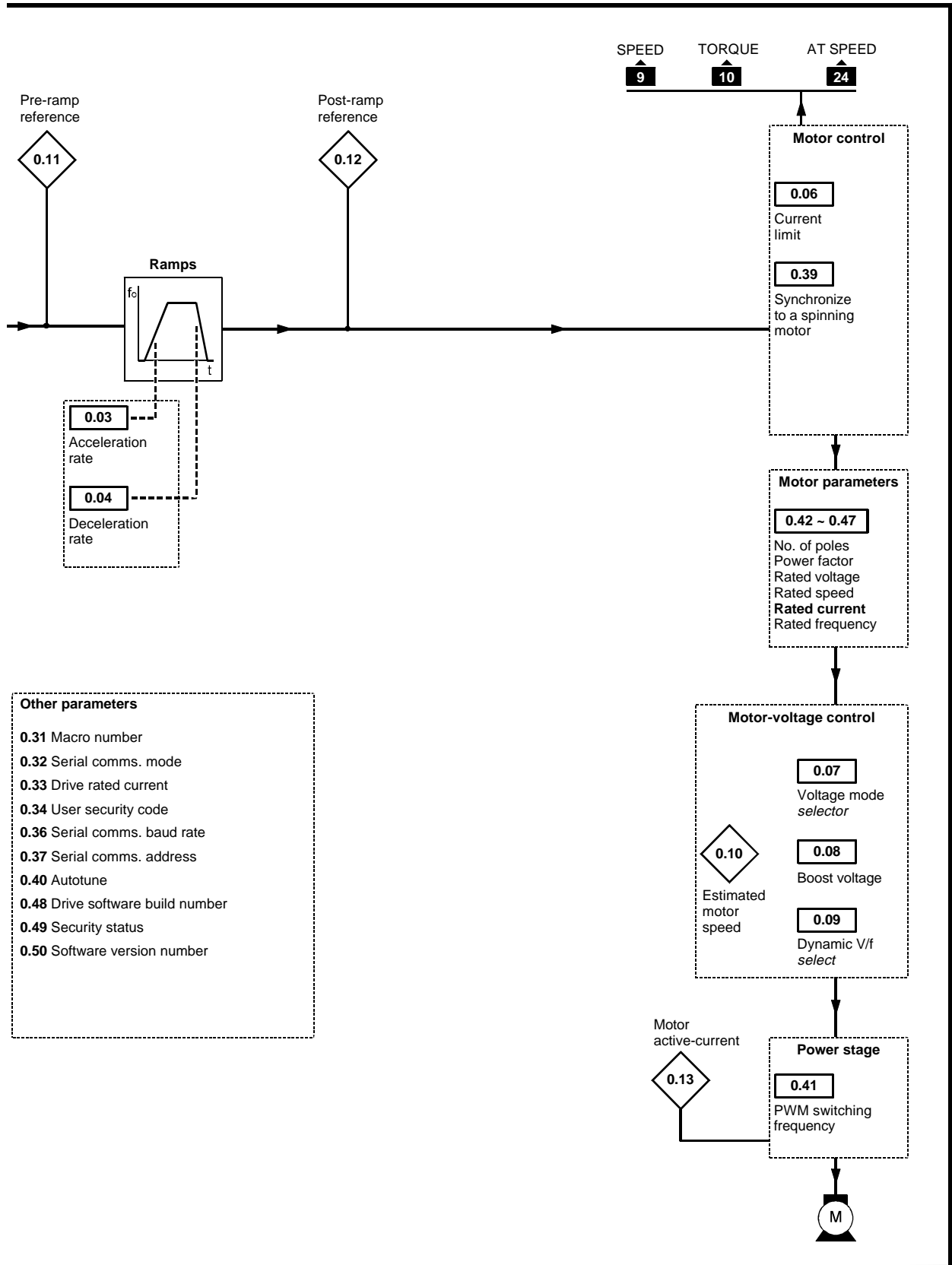


Figure 3-14 Programmable software for Macro 5



- Other parameters**
- 0.31 Macro number
 - 0.32 Serial comms. mode
 - 0.33 Drive rated current
 - 0.34 User security code
 - 0.36 Serial comms. baud rate
 - 0.37 Serial comms. address
 - 0.40 Autotune
 - 0.48 Drive software build number
 - 0.49 Security status
 - 0.50 Software version number

List of parameters specific to Macro 5

| Pr | Function | User value |
|------|---|------------|
| 0.00 | Configuration and saving | |
| 0.01 | Minimum frequency | |
| 0.02 | Maximum frequency | |
| 0.03 | Acceleration rate | |
| 0.04 | Deceleration rate | |
| 0.05 | Reference <i>selector</i> (do not adjust) | |
| 0.06 | Current limit | |
| 0.07 | Voltage mode <i>selector</i> | |
| 0.08 | Boost voltage | |
| 0.09 | Dynamic V/f <i>select</i> | |
| 0.10 | Estimated motor speed | [M] |

[M] indicates the parameter is for monitoring only

For descriptions of these parameters, see Appendix D *Menu 0 Parameters*.

| Pr | Function | User value |
|------|---|------------|
| 0.31 | Macro number | [M] |
| 0.32 | Serial comms. mode | |
| 0.33 | Drive rated current (FLC) | [M] |
| 0.34 | User security code | [M] |
| 0.35 | Keypad reference | [M] |
| 0.36 | Serial comms. baud rate | |
| 0.37 | Serial comms. address | |
| 0.38 | Initial parameter displayed | |
| 0.39 | Synchronize to a spinning motor | |
| 0.40 | Autotune | |
| 0.41 | PWM switching frequency <i>selector</i> | |
| 0.42 | Motor – number of poles | |
| 0.43 | Motor – power factor | |
| 0.44 | Motor – rated voltage | |
| 0.45 | Motor – rated speed | |
| 0.46 | Motor – rated current | |
| 0.47 | Motor – rated frequency | |
| 0.48 | Drive software build number | [M] |
| 0.49 | Security status | [M] |
| 0.50 | Drive software version | [M] |

| Pr | Function | User value |
|------|---|------------|
| 0.11 | Pre-ramp reference | [M] |
| 0.12 | Post-ramp reference | [M] |
| 0.13 | Motor active-current | [M] |
| 0.14 | Analog input 1 (frequency reference) mode <i>selector</i> | |
| 0.15 | Analog input 2 (PID reference) mode <i>selector</i> | |
| 0.16 | Analog input 3 (PID feedback) mode <i>selector</i> | |
| 0.17 | Analog input 1 (frequency reference) | |
| 0.18 | Analog input 2 (PID reference) | |
| 0.19 | Analog input 3 (PID feedback) | |
| 0.20 | PID proportional gain | |
| 0.21 | PID integral gain | |
| 0.22 | PID derivative gain | |
| 0.23 | PID output high limit | |
| 0.24 | PID output low limit | |
| 0.25 | PID output scale factor | |
| 0.26 | Post-scaling PID reference | |
| 0.27 | Post-scaling PID feedback | |
| 0.28 | Analog input 2 scaling | |
| 0.29 | Analog input 3 scaling | |
| 0.30 | (Not used) | |

Setting up and using Macro 5

Setting up PID control

1. By default, the Drive operates in frequency control. To disable this and enable PID control, close the **PID ENABLE** contact (terminal 29).
2. Set the **PID REFERENCE** potentiometer (terminal 7) at the required set-point.
3. Set the **FREQUENCY REFERENCE** (terminals 5, 6) for the required nominal motor (process) speed.
4. Connect the feedback device to terminal 8 (**PID FEEDBACK**).
5. The values of the analog signals can be monitored by displaying the following parameters:
 - 0.17** *Frequency reference*
 - 0.18** *PID reference*
 - 0.19** *PID feedback*
 - 0.26** *Post-scaling PID reference*
 - 0.27** *Post-scaling PID feedback*

Adjusting the PID control range

In PID control, the PID reference and PID feedback are each passed through a scaling stage, and the error resulting from differences between these references is passed through a limiter and then through a final scaling stage.

The limiter is used for applying minimum and maximum limits to the PID error. The minimum error can be a negative value.

The final scaling stage is used for adjusting the degree of change to the frequency reference.

After these two stages, the error is added to the frequency reference.

1. The default scaling for analog inputs 2 and 3 is 1. If required, adjust the following parameters to alter the scaling:
 - 0.28** *Analog input 2 scaling* (PID reference)
 - 0.29** *Analog input 3 scaling* (PID feedback)
2. To limit the maximum value of PID error, set **0.23** *PID high limit* at the required value.
Default value: 100 %
Range: 0 ~ 100 %

3. To define the minimum value of PID error, set **0.24** *PID low limit* at the required value.
Default value: -100 %
Range: ± 100 %
4. To define the degree of control on the frequency reference, set **0.25** *PID output scale factor* at the required value.
Default value: 1
Range: 0 ~ 4.000

Adjusting the PID gain settings

The following parameters are used:

- 0.20** *PID proportional gain*
Default value: 1
Range: 0 ~ 4.000
- 0.21** *PID integral gain*
Default value: 0.5
Range: 0 ~ 4.000
- 0.22** *PID derivative gain*
Default value: 0
Range: 0 ~ 4.000

Reference selection

For correct operation of this macro configuration, the setting of parameter of **0.05** *Reference selection* should be at 0.

Analog input modes

The analog inputs can be configured for the following input signals:

0 ~ 20mA, 4 ~ 20mA or 0 ~ 10V

Refer to the following parameters in Appendix D *Menu 0 Parameters* for selecting the required mode:

| Analog input | Terminal(s) | Parameter |
|--------------|-------------|--|
| 1 | 5, 6 | 0.14 <i>Analog input 1 mode selector</i> |
| 2 | 7 | 0.15 <i>Analog input 2 mode selector</i> |
| 3 | 8 | 0.16 <i>Analog input 3 mode selector</i> |

3.9 Macro 6

Axis-limit control

Features

Specific features

Axis-limit control is used for applications which require the process to be automatically stopped when a position limit has been reached.

Speed can be controlled in both directions in either of two ways, as follows:

- Bipolar frequency reference signal and use of a **RUN FORWARD** contact (bipolar control)
- Unipolar frequency reference signal and use of **RUN FORWARD** and **RUN REVERSE** contacts (unipolar control)

Selection can be made between the following frequency reference inputs:

Local unipolar input (0 ~ 10V)

Remote differential input which can be used as follows:

- Single-ended unipolar input (0 ~ 10V)
- Single-ended bipolar input ($\pm 10V$)
- Bipolar or unipolar differential input ($\pm 10V$ on each line)

Travel in each direction is halted by use of a **LIMIT** digital input. By default, these inputs require normally-open contacts but can be configured for normally-closed contacts.

To run the Drive, the appropriate **RUN** contact must be closed. When the related **LIMIT** contact changes state to mark the axis limit, the Drive decelerates to zero speed at a rate set by the user. In order to change direction, it is necessary to perform either of the following, as appropriate:

- Bipolar control: Reverse the polarity of the frequency reference
- Unipolar control: Open the **RUN** switch, and then close the **RUN** switch for the opposite direction

The Drive is operated under frequency control.

Selection can be made to apply torque to the motor at zero speed, or to allow the motor to rotate freely.

Standard features

- Macro 6 operates in Terminal mode only
- Adjustment of minimum and maximum frequencies
- Adjustment of acceleration and deceleration ramps
- Selection of stopping modes
- Motor thermistor input
- **SPEED** and **TORQUE** analog outputs
- **AT SPEED** digital output
- **External trip** digital input
- Drive **RESET** digital input

Signal connections for Macro 6

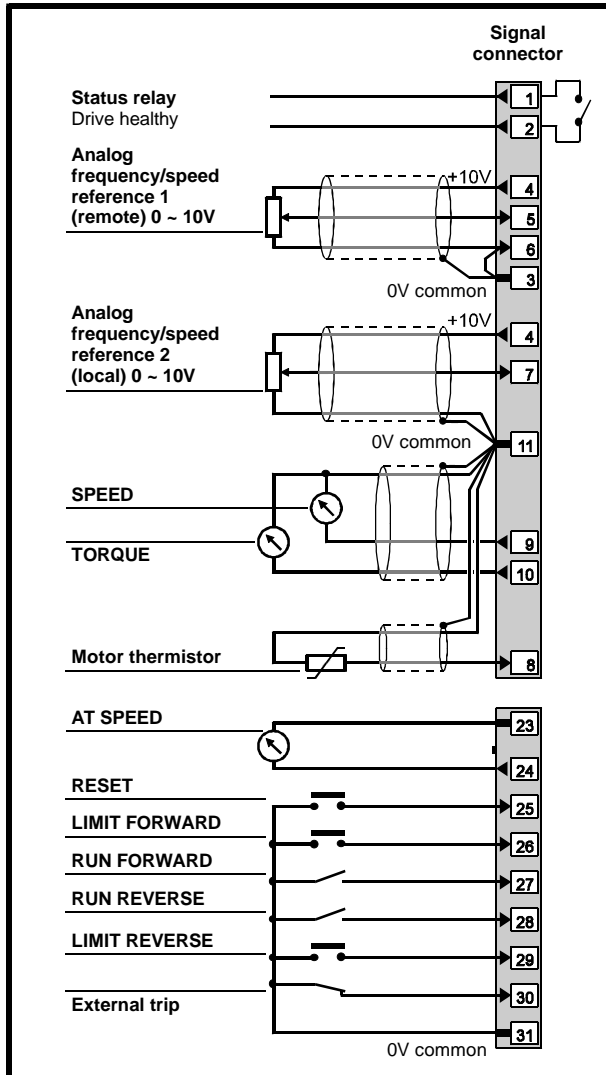


Figure 3-14 Control signal and thermistor connections for Macro 6 when used in unipolar control

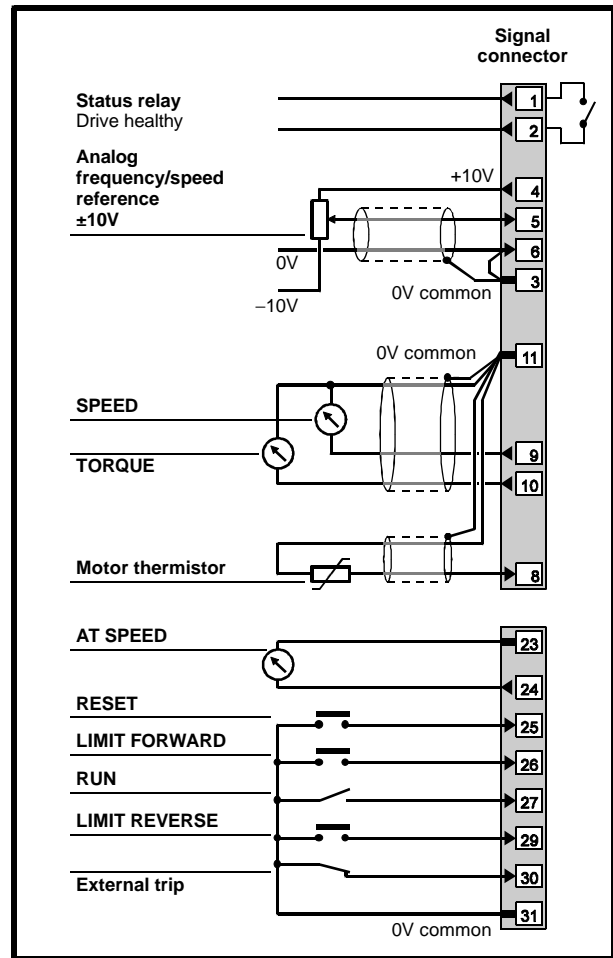


Figure 3-15 Control signal and thermistor connections for Macro 6 when used in bipolar control (typical frequency reference connections)

For electrical specifications, refer to Appendix C Signal Connections.

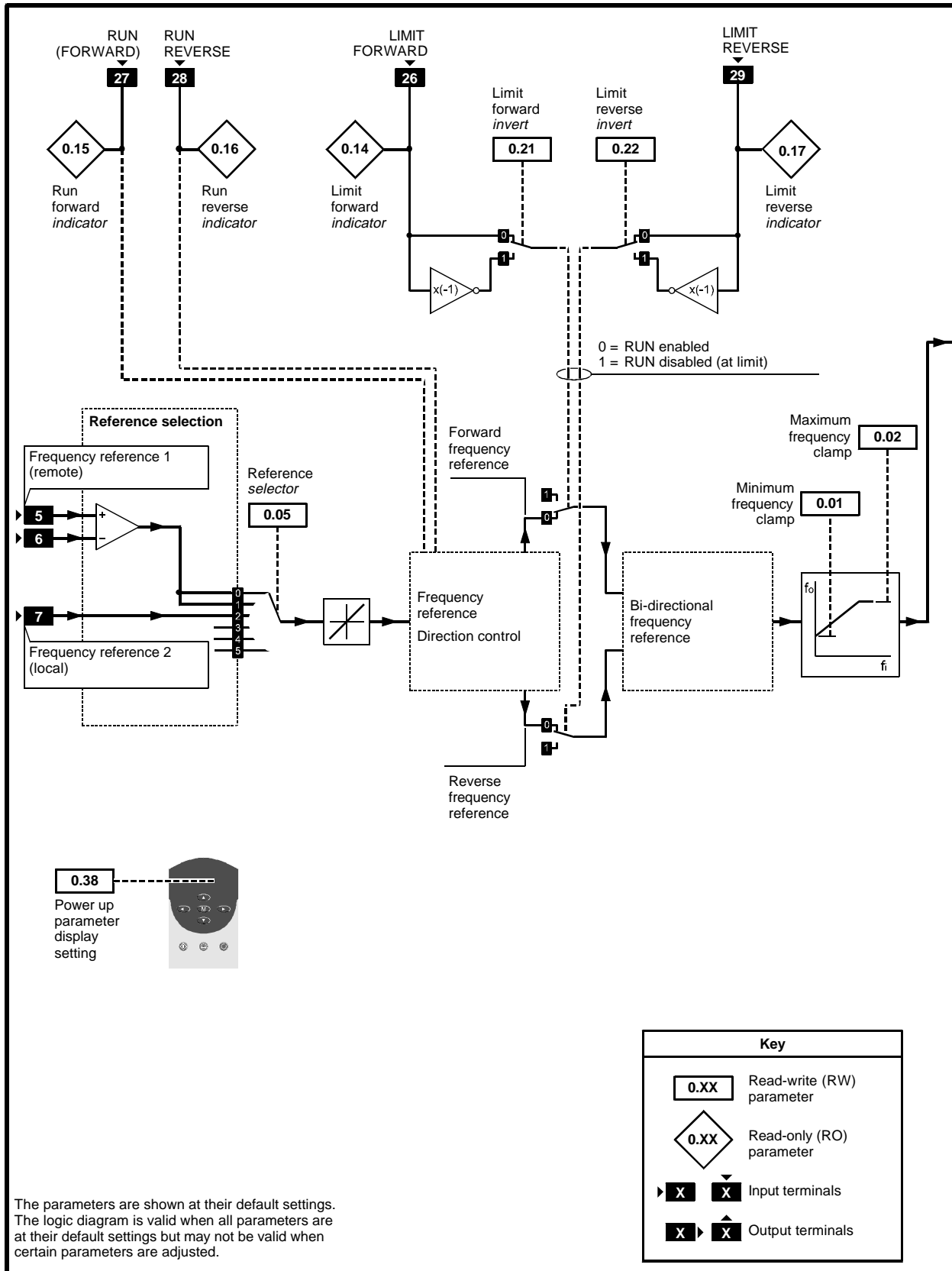
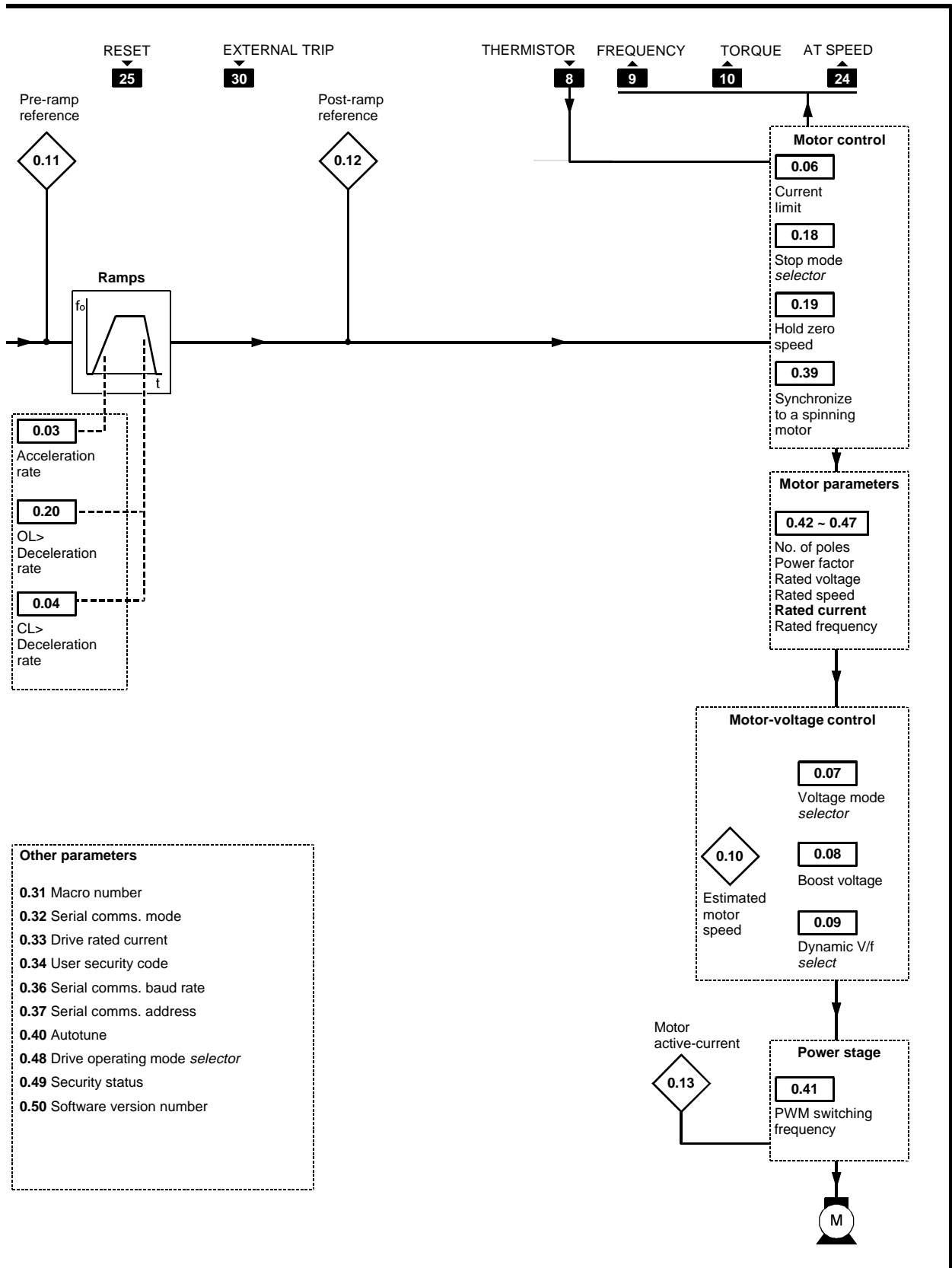


Figure 3-16 Programmable software for Macro 6



List of parameters specific to Macro 6

| Pr | Function | User value |
|------|--|------------|
| 0.00 | Configuration and saving | |
| 0.01 | Minimum frequency clamp | |
| 0.02 | Maximum frequency clamp | |
| 0.03 | Acceleration rate | |
| 0.04 | Deceleration rate | |
| 0.05 | Reference <i>selector</i> (limited settings) | |
| 0.06 | Current limit | |
| 0.07 | Voltage mode <i>selector</i> | |
| 0.08 | Boost voltage | |
| 0.09 | Dynamic V/f <i>select</i> | |
| 0.10 | Estimated motor speed | [M] |

[M] indicates the parameter is for monitoring only

For descriptions of these parameters, see Appendix D *Menu 0 Parameters*.

| Pr | Function | User value |
|------|--|------------|
| 0.31 | Macro number | [M] |
| 0.32 | Serial comms. mode | |
| 0.33 | Drive rated current (FLC) | [M] |
| 0.34 | User security code | [M] |
| 0.35 | Keypad reference | [M] |
| 0.36 | Serial comms. baud rate | |
| 0.37 | Serial comms. address | |
| 0.38 | Power up parameter display <i>select</i> | |
| 0.39 | Synchronize to a spinning motor | |
| 0.40 | Autotune | |
| 0.41 | PWM switching frequency <i>selector</i> | |
| 0.42 | Motor – number of poles | |
| 0.43 | Motor – power factor | |
| 0.44 | Motor – rated voltage | |
| 0.45 | Motor – rated full load RPM | |
| 0.46 | Motor – rated current | |
| 0.47 | Motor – rated frequency | |
| 0.48 | Drive operating mode <i>selector</i> | |
| 0.49 | Security status | [M] |
| 0.50 | Drive software version | [M] |

| Pr | Function | User value |
|------|--------------------------------|------------|
| 0.11 | Pre-ramp reference | [M] |
| 0.12 | Post-ramp reference | [M] |
| 0.13 | Motor active-current | [M] |
| 0.14 | Limit forward <i>indicator</i> | [M] |
| 0.15 | Run forward <i>indicator</i> | [M] |
| 0.16 | Run reverse <i>indicator</i> | [M] |
| 0.17 | Limit reverse <i>indicator</i> | [M] |
| 0.18 | Stop mode <i>selector</i> | |
| 0.19 | Hold zero speed <i>enable</i> | |
| 0.20 | Limit deceleration rate | |
| 0.21 | Limit forward <i>invert</i> | |
| 0.22 | Limit reverse <i>invert</i> | |
| 0.23 | (Not used) | |
| 0.24 | (Not used) | |
| 0.25 | (Not used) | |
| 0.26 | (Not used) | |
| 0.27 | (Not used) | |
| 0.28 | (Not used) | |
| 0.29 | (Not used) | |
| 0.30 | (Not used) | |

Setting up and using Macro 6

The following may require attention in addition to the settings made in Chapter 2.

Frequency control

When Macro 6 is selected, the Drive *always* operates in axis-limit control; unlike Macros 2 to 5, no digital input exists to allow switching to and from normal frequency control.

Operation in bipolar or unipolar frequency control is dependent only on the signal connections made. When bipolar control is required, to prevent confusion do not connect a RUN REVERSE contact. No jog function exists.

Reference selection

Use **0.05** *Reference selector* to select the required frequency reference source, as follows:

| 0.05 | Source | Terminal(s) |
|------|--------------------------------------|-------------|
| 0 | Analog input 1 (bipolar or unipolar) | 5, 6 |
| 1 | Analog input 1 (bipolar or unipolar) | 5, 6 |
| 2 | Analog input 2 (unipolar only) | 7 |
| 3 | (Do not use) | |
| 4 | (Do not use) | |
| 5 | (Do not use) | |

Analog input mode

The analog inputs are configured for 0 ~ 10V.

See the *Commander Gp Advanced User Guide* for selecting other modes.

Limit switch types

By default, the Drive requires normally-open limit switches. When either or both limit switches are to be normally-closed, set the following parameters at 1, as appropriate:

LIMIT FORWARD **0.21**
LIMIT REVERSE **0.22**

Deceleration rates



Caution

Position the limit switches to allow for the distance that will be travelled during deceleration. This distance will be increased if the deceleration time is extended (see *Braking mode*).

The rate of deceleration to be applied when the motor is being stopped at the limit of travel can be adjusted separately from the normal deceleration rate, as follows:

Use **0.04** *Deceleration rate* for adjusting the maximum deceleration rate that is to apply when any of the following occurs:

- The motor is stopped by removal of a **RUN** command
- The motor is stopped or slowed by reduction of the frequency reference

For setting the deceleration rate at the limit of travel, use parameter **0.20** *Limit deceleration rate*.

Braking mode

The **FASt** ramp mode is applied. This gives continuous deceleration under maximum braking conditions (the ramp mode should not be changed). A braking resistor is normally required in order to prevent the DC-bus voltage from reaching the trip level.

Stopping modes

Refer to parameter **0.18** *Stop mode selector* in Appendix D *Menu 0 Parameters*.

Hold zero speed

Refer to parameter **0.19** *Hold zero speed enable* in Appendix D *Menu 0 Parameters*.

The default setting is 0 (Free to rotate).

Use this free space for notes

3.10 Macro 7 Brake control

Features

Specific features

Brake control is used for controlling the application and release of a mechanical brake in hoist or crane applications. The Drive issues a *brake release* signal when all of the following conditions are met:

- The Drive has not tripped (ie. *healthy*)
- The output frequency of the Drive is above 1Hz
- Current above a user-defined threshold is being supplied to the motor in order to hold or move the load

The *brake release* signal can be delayed by an amount that is adjusted by the user. This delay is used to ensure that only genuine conditions will cause the brake to be released.

The Drive applies the brake, by removing the *brake release* signal, as the motor is stopping and motor current falls below the threshold level.

The Drive is operated under frequency control; selection can be made between local and remote sources, as well as keypad control.

Standard features

- Macro 7 can be operated in Terminal mode (default) or Keypad mode
- Digital control by **RUN FORWARD**, and **RUN REVERSE** contacts
- Analog frequency inputs
- Adjustment of minimum and maximum frequencies
- Adjustment of acceleration and deceleration ramps
- Motor thermistor input
- **SPEED** and **TORQUE** analog outputs
- **External trip** digital input
- Drive **RESET** digital input

Signal connections for Macro 7

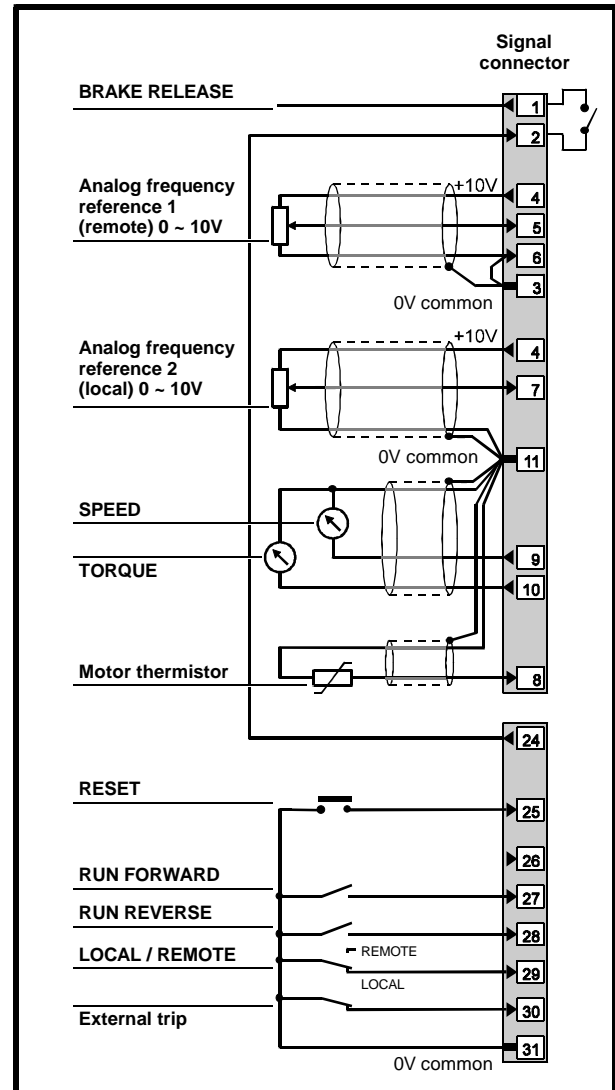


Figure 3-17 Control signal and thermistor connections for Macro 7

The **BRAKE RELEASE** output must be connected as shown in Figure 3-17. Note that the actual **BRAKE RELEASE** output appears on terminal 24 which operates as shown in the following table.

| Terminal 24 | BRAKE RELEASE logic state | Effect |
|-------------|---------------------------|---------------|
| Low | 1 | Release brake |
| High | 0 | Apply brake |

For electrical specifications, refer to Appendix C *Signal Connections*.

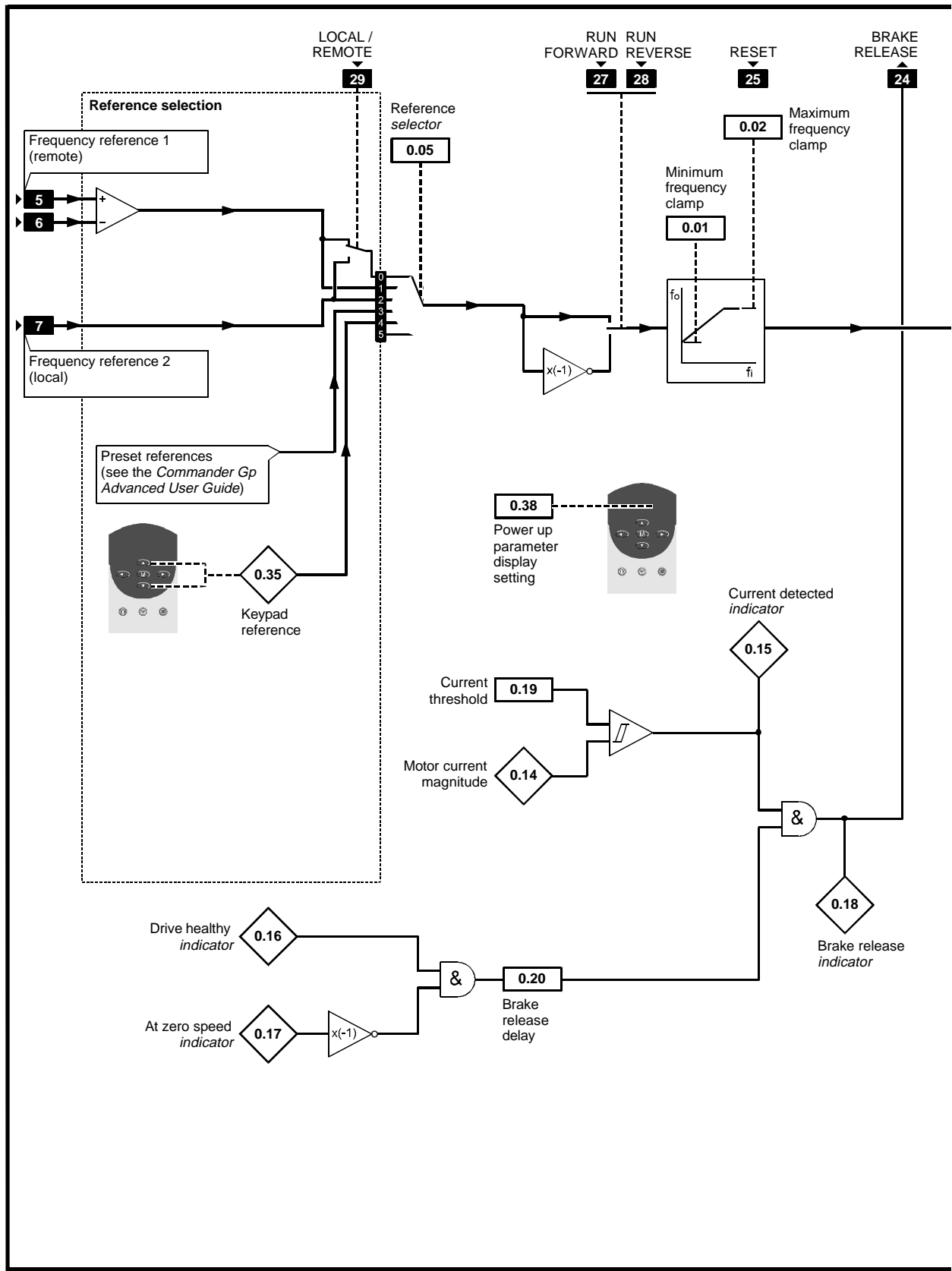
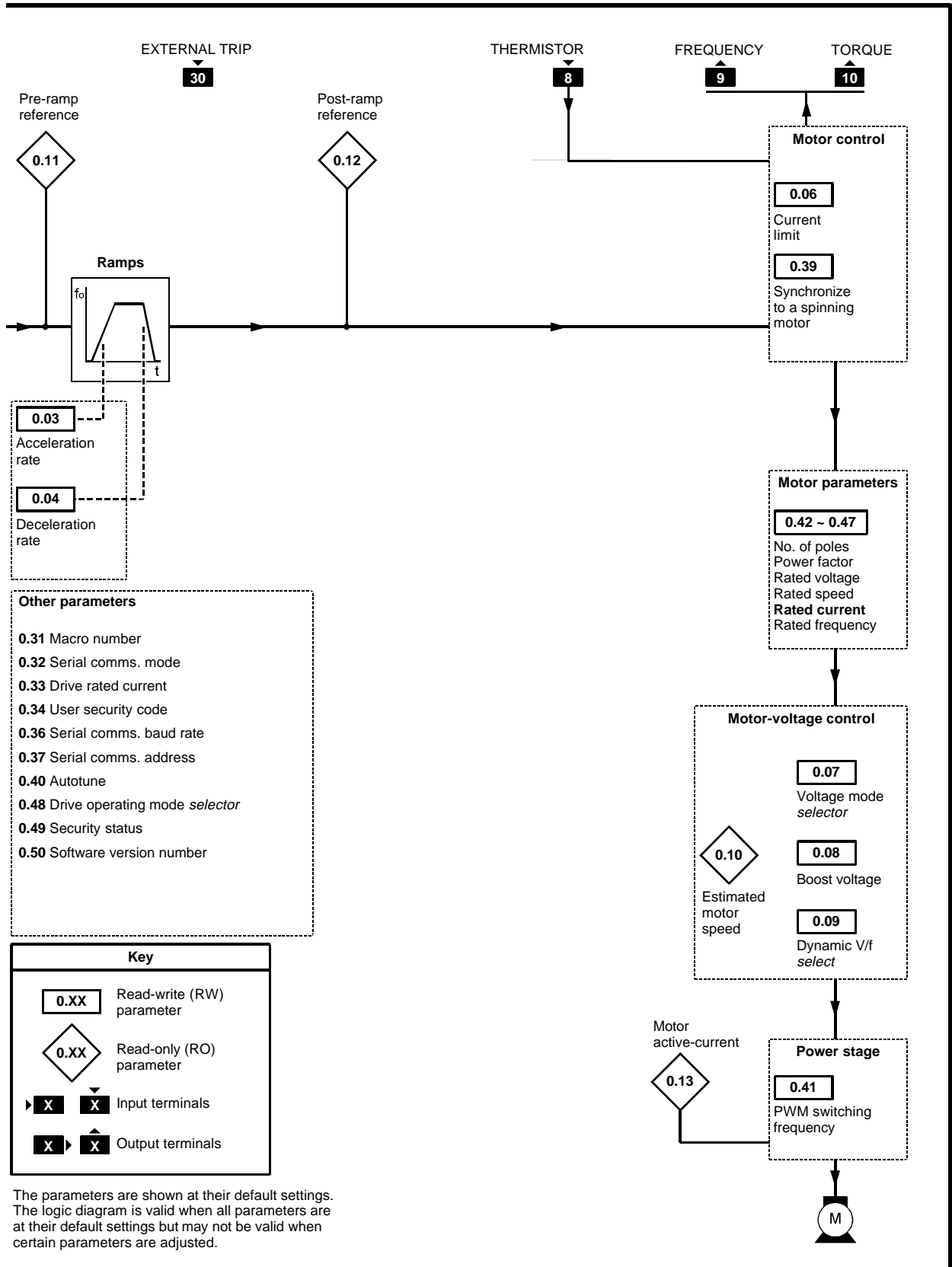


Figure 3-18 Programmable software for Macro 7



List of parameters specific to Macro 7

| Pr | Function | User value |
|------|--|------------|
| 0.00 | Configuration and saving | |
| 0.01 | Minimum frequency clamp | |
| 0.02 | Maximum frequency clamp | |
| 0.03 | Acceleration rate | |
| 0.04 | Deceleration rate | |
| 0.05 | Reference <i>selector</i> (limited settings) | |
| 0.06 | Current limit | |
| 0.07 | Voltage mode <i>selector</i> | |
| 0.08 | Boost voltage | |
| 0.09 | Dynamic V/f <i>select</i> | |
| 0.10 | Estimated motor speed | [M] |

[M] indicates the parameter is for monitoring only

For descriptions of these parameters, see Appendix D *Menu 0 Parameters*.

| Pr | Function | User value |
|------|--|------------|
| 0.31 | Macro number | [M] |
| 0.32 | Serial comms. mode | |
| 0.33 | Drive rated current (FLC) | [M] |
| 0.34 | User security code | [M] |
| 0.35 | Keypad reference | [M] |
| 0.36 | Serial comms. baud rate | |
| 0.37 | Serial comms. address | |
| 0.38 | Power up parameter display <i>select</i> | |
| 0.39 | Synchronize to a spinning motor | |
| 0.40 | Autotune | |
| 0.41 | PWM switching frequency <i>selector</i> | |
| 0.42 | Motor – number of poles | |
| 0.43 | Motor – power factor | |
| 0.44 | Motor – rated voltage | |
| 0.45 | Motor – rated full load RPM | |
| 0.46 | Motor – rated current | |
| 0.47 | Motor – rated frequency | |
| 0.48 | Drive operating mode <i>selector</i> | |
| 0.49 | Security status | [M] |
| 0.50 | Drive software version | [M] |

| Pr | Function | User value |
|------|-----------------------------------|------------|
| 0.11 | Pre-ramp reference | [M] |
| 0.12 | Post-ramp reference | [M] |
| 0.13 | Motor active-current | [M] |
| 0.14 | Motor current magnitude | [M] |
| 0.15 | Current detected <i>indicator</i> | [M] |
| 0.16 | Drive healthy <i>indicator</i> | [M] |
| 0.17 | At zero speed <i>indicator</i> | [M] |
| 0.18 | Brake release <i>indicator</i> | [M] |
| 0.19 | Current threshold | |
| 0.20 | Brake release delay | |
| 0.21 | (Not used) | |
| 0.22 | (Not used) | |
| 0.23 | (Not used) | |
| 0.24 | (Not used) | |
| 0.25 | (Not used) | |
| 0.26 | (Not used) | |
| 0.27 | (Not used) | |
| 0.28 | (Not used) | |
| 0.29 | (Not used) | |
| 0.30 | (Not used) | |

Setting up and using Macro 7

The following may require attention in addition to the settings made in Chapter 2.

Frequency control

When Macro 7 is selected, the Drive *always* operates in brake control; unlike Macros 2 to 5, no digital input exists to allow switching to and from normal frequency control.

The frequency of the motor is controlled in the same way as in normal frequency control.

Reference selection

Use **0.05** *Reference selector* to select the required frequency reference source, as follows:

| 0.05 | Source | Terminal(s) |
|------|--|---------------|
| 0 | Analog input 1 or 2 which can be selected using the LOCAL/REMOTE contact | 5 and 6, or 7 |
| 1 | Analog input 1 | 5, 6 |
| 2 | Analog input 2 | 7 |
| 3 | Preset frequencies | |
| 4 | Keypad control | |
| 5 | (Do not use) | |

Analog input mode

The analog inputs are configured for 0 ~ 10V.

See the *Commander Gp Advanced User Guide* for selecting other modes.

Brake-control settings

1. The default setting of 10% for parameter **0.19** *Current threshold* is suitable for the majority of applications. If required, change the value to the required percentage of I_{max} (see below). This value must ensure that adequate current will flow through the motor to control the load when the brake is released.

$$I_{MAX} = FLC \times 150\%$$

2. If required, change the setting of **0.20** *Brake release delay* to a suitable value (between 0 and 25 seconds) that will ensure a brake release signal is not issued if the following occur simultaneously under transient conditions:
 - **0.16** *Drive healthy indicator* changes state to 1
 - **0.17** *At zero speed* changes state to 0

Braking mode

The **FASt** ramp mode is applied. This gives continuous deceleration under maximum braking conditions (the ramp mode should not be changed). A braking resistor is normally required in order to prevent the DC-bus voltage from reaching the trip level.

Stopping mode

The stopping mode is *Ramp to a stop*.

Use this free space for notes

A Programming Instructions

The instructions in this appendix take you step-by-step through learning how to use the display and keypad, and alert you to avoid actions that could cause confusion. It is in your interests to follow these instructions carefully.

The instructions can be used when the Drive is operating in Keypad or Terminal mode. They cover the basic procedure for accessing a numerical variable parameter. Instructions for accessing other types of parameter, as well as for more advanced operations, are given later in this appendix.

A.1 Electrical connections

Before following the instructions in this chapter ensure the Drive has been connected in accordance with the instructions in Chapter 2 *Installing the Drive*, in the Installation Guide or Chapter 2 *Getting Started* in this User Guide.

When following the instructions in this appendix, It is your responsibility to connect and disconnect the AC supply as required.



Warning

The terminal cover must be fitted to the Drive before the AC supply is connected. If the cover needs to be removed, the AC supply must first be disconnected for ten minutes.



Warning

The AC supply must be connected to the Drive with appropriate fuses or protection, as described in the Installation Guide.



Warning

Adjustment of parameter values must be performed only by suitably trained or experienced personnel. Incorrect values could be hazardous.


A.2 Preparation

1. Ensure that terminal 30 is connected to terminal 31 or that a contact connected to these terminals is closed.
2. If these instructions are being followed when a macro other than Macro 1 is enabled, ensure terminal 8 is connected to terminal 11 or a motor thermistor is connected to these terminals. These connections will allow the Drive to be operated.
3. Ensure that terminals 27 and 28 are open-circuit, or that contacts connected to these terminals are open. This will prevent a motor (if connected) from being driven.
4. Ensure that if a **FREQUENCY** potentiometer is connected, it is set at minimum (wiper at 0V common).
5. Connect the AC supply to the Drive.
6. The display is in *Status mode* and should indicate as follows:



If the lower display shows **triP** and the upper display shows one of the following, check the cause and attend to the remedy:

| Display | Cause and remedy |
|-----------|---|
| th | Motor thermistor not connected, or terminal 8 not connected to terminal 11. Make the necessary connections. |
| Et | External trip signal received, or terminal 30 not connected to terminal 31. Make the necessary connections. |
| rS | Motor is not connected, one phase is not connected or the motor is open-circuit. |

Press  to reset the Drive. The display should now show **rdY**

If the lower display still shows **triP** and another code is shown on the upper display, see Appendix E *Diagnostics*.

A.3 Status mode



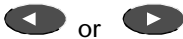
The lower display shows **rdY** to indicate that the Drive is ready to drive a motor, as follows:

The upper display indicates the output frequency of the Drive or the motor speed. This is the value of parameter **0.10**. (The value of a different parameter could be shown if the Drive has been used previously.)

A.4 Displaying the parameter number in Status mode

When the display is in Status mode, the upper display shows the value of parameter **0.10** (or of the last parameter to be selected). The number of this parameter can be shown on the lower display instead of the Drive status.

1. To show the parameter number, press:

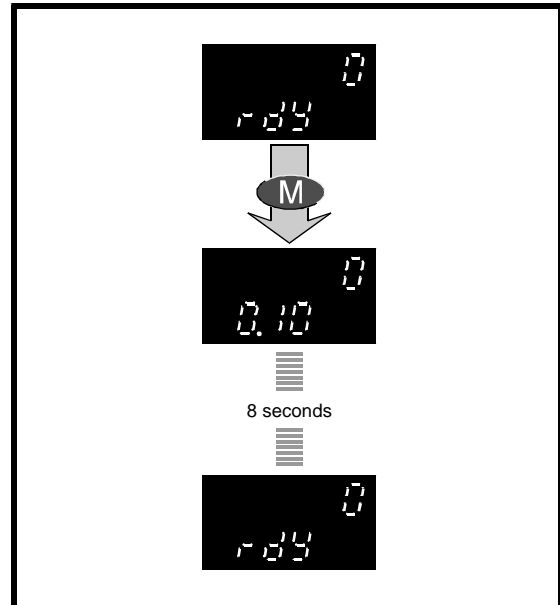


2. To show the status, press: **M**. The status is shown immediately.

A.5 Entering Parameter mode and returning to Status mode

1. Momentarily press **M**. The display enters *Parameter mode*.

The lower display shows parameter number **0.10**. (A different parameter number could be shown if the Drive has been used previously.) The display appears as follows:



2. Do not press any keys. After eight seconds, the display returns to Status mode. This shows that the display always returns from Parameter mode to Status mode when no keys are pressed within eight seconds.

You may repeat these two steps as many times as required to obtain an understanding of the operation.

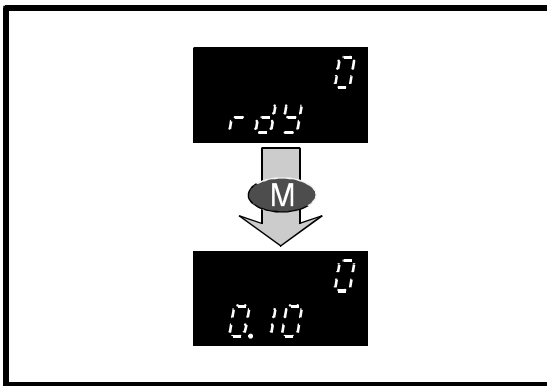
A.6 Selecting a parameter to access

If the display returns to Status mode during the course of selecting parameters (because no keys have been pressed for eight seconds), to re-enter Parameter mode, press:

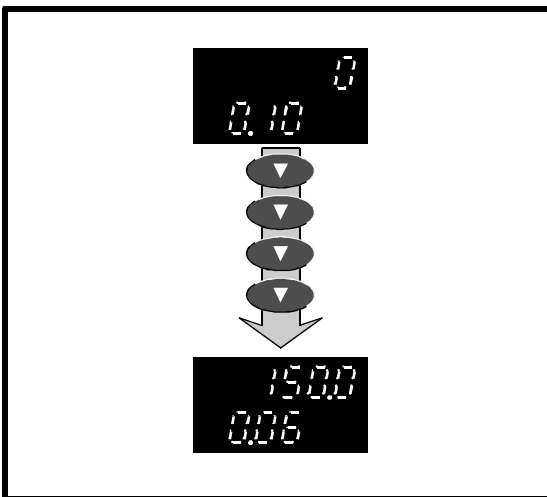


1. Momentarily press . The display enters Parameter mode.

Parameter number **0.10**, or the number of the last selected parameter, appears on the lower display. The value shown on the upper display remains the same.



2. Within eight seconds, press . The parameter number decreases by one. Repeat this step until **0.06** is displayed.



Notice that the upper display changes to show the value of the parameter that is selected.

Scrolling

1. Within eight seconds, press and hold down:



The parameter number continuously increases (scrolls upward) until the highest numbered parameter in the menu is reached.

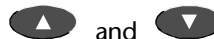
2. To start scrolling upward again from parameter number **0.00**, release then re-press:



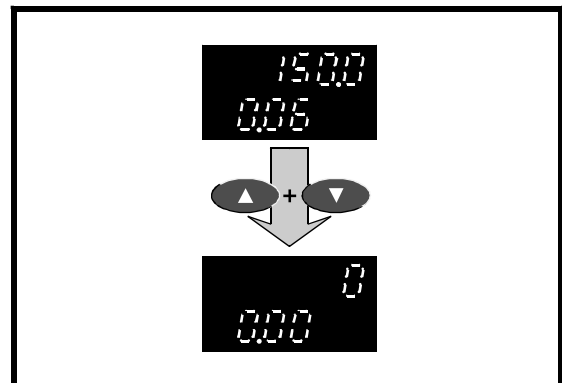
3. Repeat steps 1 and 2 using . The parameter numbers will now decrease. In step 2, when parameter **0.00** is reached, releasing and re-pressing the key will re-start downward scrolling from the highest numbered parameter in the menu.

Quick selection of parameter 0.00

1. While the display is in Parameter mode, press at the same time:



Parameter **0.00** is displayed.



2. Now select parameter number **0.06**.

A.7 Changing the value of a parameter

1. Within eight seconds of selecting parameter **0.06**, press:

M

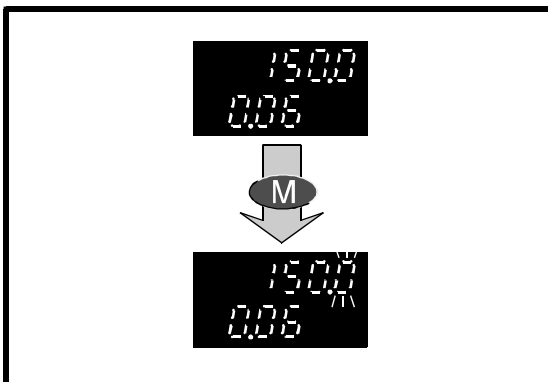
The display enters *Edit mode*.

(If more than eight seconds have elapsed, the display will have returned to Status mode. In this case, twice press:

M

On the first press, the display will re-enter Parameter mode where parameter **0.06** will again be displayed; on the second press, the display will enter Edit mode.)

The upper display still shows the value of the parameter, but the least-significant digit flashes. (The value shown is the default value for **0.06**; the value displayed may be different if the Drive has been used previously.)

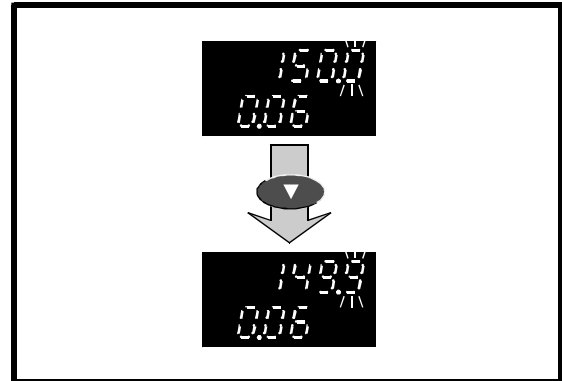


Note that when the display is in Edit mode, it will not return to Status mode after eight seconds. You can spend as much time as required changing the value of a parameter.

2. To decrease the value, momentarily press:

▼

The value of the flashing digit decreases by one. You can repeat this step as many times as required. The new value takes effect immediately.



3. Press and hold down **▼**
The value scrolls downward. Release the key when the required value is reached.
To increase the value, press **▲**
4. When the required value is displayed, press:
M
5. The display returns to Parameter mode. If no keys are pressed within eight seconds, the display enters Status mode.

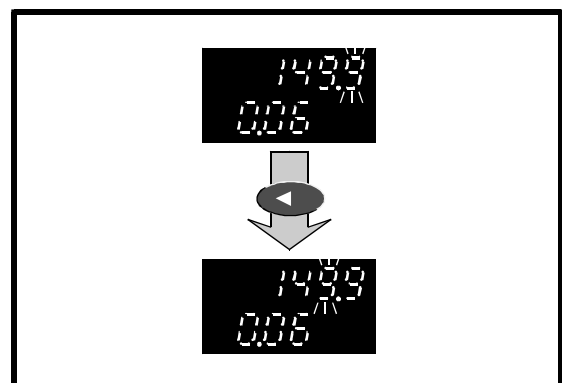
Making large changes in value quickly

So far, you have changed the value by incrementing or decrementing the least significant digit. The speed of change can be increased by selecting, then scrolling either of the more significant digits, as follows:

1. When the display is in Edit mode, momentarily press:

◀

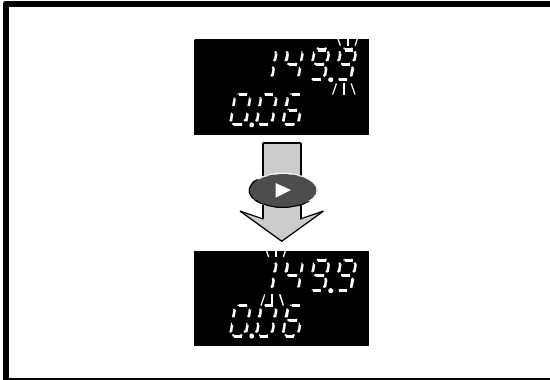
When the key is released, the digit at the left of the least significant digit flashes. This operation can be repeated to select the most significant digit of the display. If this digit is not currently displayed, it can still be selected. When selected, a bar appears in its place.



You can then change the value of the newly selected digit.

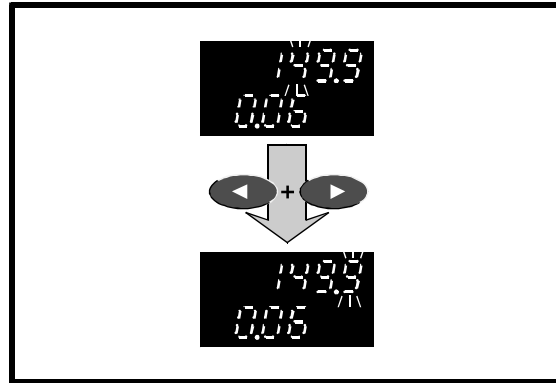
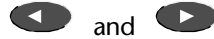
Quick selection from least to most significant digit

To select the most significant digit when the least significant digit is flashing, momentarily press:



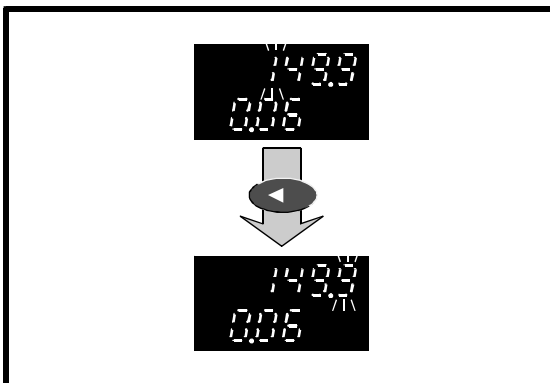
Quick selection of the least significant digit

Irrespective of the digit that is selected, to select the least significant digit, press at the same time:



Quick selection from most to least significant digit

If the most significant digit of the display (not just the displayed value) is flashing, to select the least significant digit, momentarily press:



Reaching the maximum or minimum value



A special condition arises when both the following occur:

- A digit other than the least significant digit (LSD) is being increased, and the maximum value is approached.
- The displayed LSD is not the same value as the LSD of the maximum value. For example: if the displayed value is **126.4**, and the maximum value is **217.9**, the displayed LSD of **4** differs from **9**.

The special condition allows the value to be set at either of the following:

- The highest permissible value that contains the displayed LSD (eg. **4**)
- The maximum value for the parameter

Use the following procedure to see how the operation works:

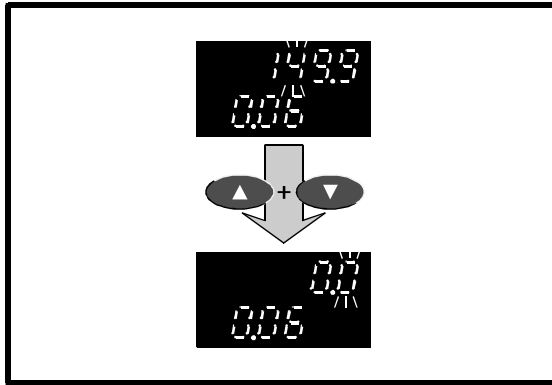
1. Ensure the selected digit is not the LSD.
2. Press and hold down . When the maximum value is reached, the entire display flashes the maximum value (eg. **217.9**). Release the key within three flashes of the display. The display now shows the highest permissible value (eg. **216.4**) that contains the displayed LSD.
3. Again press and hold down . When the maximum value is reached, the entire display again flashes the maximum value (eg. **217.9**). Release the key after four flashes of the display. The display now shows the maximum value.

When setting the value at maximum in normal operation, it is not necessary to follow step 2.

The same principles apply when reaching the minimum value.

Setting the value at zero

1. Momentarily press at the same time:



Bench-testing? Return to default value

If you have followed this procedure while bench-testing the Drive, return the value to **150** before returning the display to Parameter mode.

A.8 Saving new parameter-values

Use the following procedure to save new parameter-values. The new values will then apply each time the AC supply is subsequently applied to the Drive. If new parameter-values are not saved, the previously saved (or default) values will apply each time the AC supply is applied to the Drive.

1. Set parameter **0.00** at **1000**.
2. Press **M**. The display returns to Parameter mode. Do not press any keys within eight seconds; the display then enters Status mode.
3. To reset the Drive when it is stopped, press:



To reset the Drive when it is running, press and hold...



...then press:



Release both keys at the same time.

The new parameter-value(s) are now saved.

A.9 Flashing and non-flashing digits

When the display is in Edit mode, the flashing of a digit indicates that the value of the digit can be changed. If no digits flash, the parameter cannot be edited because it is read-only (or *protected*).

A.10 Negative values

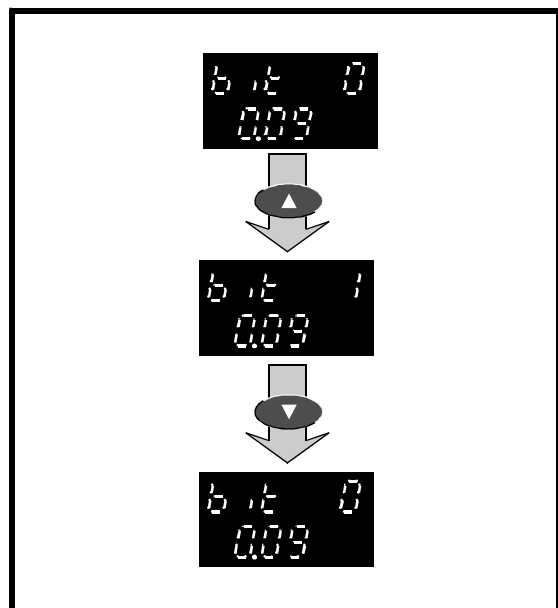
When the value of a bipolar variable parameter is negative, a minus sign appears at the left of the displayed value.

A.11 Changing the setting of a bit parameter

When a bit parameter is selected and Edit mode entered, the display appears as shown below. **bit** appears at the left of the upper display. **0** or **1** is displayed at the right.

When **0** is displayed, press to select **1**.


When **1** is displayed, press to select **0**.




A.12 Selecting a different option

Some variable parameters are used for selecting among a number of options. These options can be shown as numbers (as 1 to 5 in parameter **0.05 Reference selector**) or as character strings (as **Ur_S**, etc, in parameter **0.07 Voltage mode selector**).

- To select a different option, press:

 to ascend through the range of options

 to descend through the range of options

When the first option is displayed, it is necessary to ascend through the range in order to select another option. When the last option is displayed, it is necessary to descend through the range.

A.13 Restoring the Drive to a default configuration



Warning

Do not attempt to restore the Drive to a default configuration when the Drive is running.

Restoring the Drive to a default configuration enables Macro 0 and returns all parameters to their default values including the motor parameters. (If any one of the macros 1 to 7 has been enabled, the Drive still reverts to Macro 0.)


After restoring the Drive to a default configuration, it will be necessary for the required parameter values to be re-entered before the Drive is next run.

When the Drive is despatched from the factory, the parameters have default values, some of which depend on the AC supply frequency (European 50Hz or USA 60Hz). Consequently, the Drive has a default configuration for each of these supply frequencies.

Use the following procedure:

- Enter either of the following values in parameter **0.00**:
1233 (Europe, 50Hz AC supply frequency)
1244 (USA, 60Hz AC supply frequency)



- Press 
The default values now take effect.

(The Drive is automatically restored to a default state when the operating mode is changed.)







Saving the default values

If new parameter-values had previously been saved, these (not the default) values will apply when the AC supply is next connected to the Drive. If the default values are required instead, they must be saved in the same way as new values. Refer to *Saving new parameter-values* earlier in this chapter to save the default values.









A.14 Summary of key operation

| | |
|--|-------------------------|
|  | Change the display mode |
|--|-------------------------|

Parameter mode

| | |
|---|-----------------------|
|  or  | Select a parameter |
|  and  | Select parameter 0.00 |
|  and  | Select Menu 0 |

Edit mode

| | |
|---|---|
|  or  | Change the value of a digit Change the setting of a bit parameter Select a different option |
|  and  | Select the value at 0 |
|  or  | Select a different digit |
|  and  | Select the least significant digit |

B Security

Note

Software versions V03.01.07 onward allow the advanced parameters to be read and edited via. serial communications irrespective of the security state.

B.1 User-defined Security

The Drive is supplied without User Security having been set-up. All parameters can be read and all read–write parameters can be edited.

User-defined Security operates only when it has been set-up by the user. When locked, it prevents editing of all parameters except for parameter **0.00**.

The code number used to unlock User-defined Security is defined by the user. This gives protection against unauthorized editing of parameters. The code number can be read and edited only when User Security has been unlocked.

B.2 Setting-up User Security

Set-up User Security as follows:

1. Select parameter **0.34** *User security code*. The default value **149** is displayed.
2. Change the value to the required User Security number which must be within the range **0** to **255**. Do not use the default value **149**.
3. When the display is returned to Parameter mode, the displayed value reverts to **149**. This hides the new User Security number.
4. Follow the procedure in *Saving new parameter-values* in Appendix A *Programming Instructions*.

User Security is now set-up.

B.3 Unlocking User Security

When User Security has been set-up and AC power is applied to the Drive, User Security is automatically locked. No parameters can be edited except for parameter **.00** in any menu.

Unlock User Security as follows:

1. Select parameter **0.00**.
2. Set the value at the User Security code number.

All read–write parameters can now be edited.

B.4 Locking User Security

When User security has been set up, and the AC supply is removed and subsequently re-applied, User security becomes locked.

To lock User security without removing the AC supply, set parameter **0.00** at **2000**.

B.5 Summary

| Condition | User Security |
|--------------------------------------|--|
| Locked | Only parameter 0.00 can be edited; all other parameters can be read |
| Drive as despatched from the factory | None |
| Setting up security | Set 0.34 at 0 ~ 255 (but not 149); the display reverts to 149 hiding the true value |
| Saving the code number | Occurs automatically at power-down |
| Locking | Occurs automatically at power-down or when parameter 0.00 is set at 2000 |
| Unlocking | Set parameter 0.00 at the user security code; the display reverts to 0, hiding the true value |
| Changing the code | Set 0.34 at the required value |
| Disabling security | Set 0.34 at 149 (this value is always displayed; just enter Edit mode and return to Parameter mode) |
| Restoring a default configuration | No change |

C Signal Connections



Warning

The control circuits are isolated from the power circuits in the Drive by basic insulation only. The installer must ensure that the external control circuits are insulated from human contact by at least one layer of insulation rated for use at the AC supply voltage.



Warning

If the control circuits are to be connected to other circuits classified as Safety Extra Low Voltage (SELV) (eg. to a personal computer), an additional isolating barrier must be included in order to maintain the SELV classification.

Logic levels of the digital inputs

| Logic sense | Logic state | Voltage | Action |
|-------------|-------------|------------|-------------------|
| Negative | 0 | $\geq 15V$ | Open-circuit |
| | 1 | $\leq 5V$ | Connected to 0V |
| Positive | 0 | $\leq 5V$ | Open-circuit |
| | 1 | $\geq 15V$ | Connected to +24V |

For positive logic, the supply can be obtained from terminal 22 +24V output.

Signal modes of the analog inputs

| Signal | Condition | Parameter setting |
|-----------|--|-------------------|
| 0 ~ 10V | | VOLt |
| 0 ~ 20 mA | | 0-20 |
| 20 ~ 0 mA | | 20-0 |
| 4 ~ 20 mA | Trip on loss of signal current | 4-20.tr |
| 20 ~ 4 mA | Trip on loss of signal current | 20-4.tr |
| 4 ~ 20 mA | Minimum or low speed on loss of signal current | 4-20.Lo |
| 20 ~ 4 mA | Minimum or low speed on loss of signal current | 20-4.Lo |
| 4 ~ 20 mA | Previous speed on loss of signal current | 4-20.Pr |
| 20 ~ 4 mA | Previous speed on loss of signal current | 20-4.Pr |

Descriptions of the control signal connections

The function and possibly the specification of some terminals change according to the macro configuration that is enabled. In these cases, the number of the associated macro configuration(s) is stated in italics before the function of the terminal. Where no indication is given, the function and specification apply to all the macro configurations.

1 Status relay contact

| Function | Drive healthy |
|--------------------------------|-----------------------------------|
| Contact voltage rating | 240VAC Installation category 1 |
| Contact current rating | 5A resistive |
| Contact minimum current rating | 10mA |
| Contact condition | Normally open |
| Isolation | 1.5kV |
| Update period | 8ms |

3 0V common (analog)

Common connection for external analog devices.

4 +10V reference voltage

| | |
|------------------------|---|
| Function | Supply for external analog signal devices |
| Voltage tolerance | $\pm 1\%$ |
| Maximum output current | 10mA |
| Protection | Current limit |

| Analog input 1 | |
|----------------------------------|---|
| 5 | Non-inverting input |
| 6 | Inverting input |
| Macro | Function |
| 0 1 2 3 5 6 7 | Frequency reference 1 (remote) |
| 4 | Analog torque reference |
| Type of input | Bipolar differential analog (For single-ended use, connect terminal 6 to terminal 3) |
| Operating in voltage mode | |
| Voltage range | -10V ~ +10V |
| Absolute maximum voltage range | -24V ~ +24V relative to 0V ±24V differential |
| Input resistance | 100kΩ |
| Operating in current mode | |
| Current ranges | 0 ~ 20mA 20mA ~ 0 4 ~ 20mA 20 ~ 4mA |
| Absolute maximum current | 50mA |
| Equivalent input resistance | ≤200Ω at 20mA |
| Resolution | 12-bit plus sign |
| Sampling period | ≤2ms |

| Analog input 2 | |
|----------------------------------|--|
| Macro | Function |
| 0 1 6 7 | Frequency reference 2 (local) |
| 5 | PID reference |
| Type of input | Bipolar single-ended analog |
| Operating in voltage mode | |
| Voltage range | -10V ~ +10V |
| Absolute maximum voltage range | ±24V relative to 0V |
| Input resistance | 100kΩ |
| Operating in current mode | |
| Current ranges | 0 ~ 20mA 20mA ~ 0 4 ~ 20mA 20 ~ 4mA |
| Absolute maximum current | 50mA |
| Equivalent input resistance | ≤200Ω at 20mA |

When the Drive is used in torque control (Macro 4), terminal 7 is used for the analog torque reference.

| Analog input 3 | |
|----------------------------------|--|
| Macro | Function |
| 0 2 3 4 6 7 | Motor thermistor input* |
| 1 | No function |
| Internal pull-up voltage | <5V |
| Trip threshold resistance | 3 kΩ ±15% |
| Reset resistance | 1.9 kΩ ±15% |
| Short-circuit detection R | 51 Ω ±12% |
| Macro | Function |
| 5 | PID feedback |
| Type of input | Bipolar single-ended analog |
| Operating in voltage mode | |
| Voltage range | -10V ~ +10V |
| Absolute maximum voltage range | ±24V relative to 0V |
| Input resistance | 100kΩ |
| Operating in current mode | |
| Current ranges | 0 ~ 20mA 20mA ~ 0 4 ~ 20mA 20 ~ 4mA |
| Absolute maximum current | 50mA |
| Equivalent input resistance | ≤200Ω at 20mA |

* When the Drive is used with Macro 0, 2, 3, 4, 6 or 7 and a motor thermistor is not connected to terminal 8 (or terminal 15 on the 15-way D type connector), terminal 8 must be connected to 0V (terminal 3 or 11).

| FREQUENCY output signal | |
|--------------------------------|--|
| 10 TORQUE output signal | |
| Type of output | Single-ended analog voltage Bipolar |
| Maximum output voltage | -10V ~ +10V |
| Maximum output current | 10mA peak |
| Load resistance | 1kΩ minimum |
| Protection | Short-circuit proof |
| Resolution | 10-bit plus sign |
| Update period | 8ms |

11 0V common (analog)

Common connection for external analog devices.

21 0V common

| 22 +24V digital supply | |
|-------------------------------|-------------------------------------|
| Voltage tolerance | ±10% |
| Nominal output current | 200mA (total including terminal 24) |
| Overload output current | 240mA (total including terminal 24) |
| Protection | Current foldback above 240mA |

Supply for external digital signal devices.

| 23 0V common (digital) |
|-------------------------------|
|-------------------------------|

Common connection for external digital devices.

| 24 | Macro | Function |
|-----------|------------------|-------------------------------|
| | 0 1 4 5 6 | AT-SPEED output |
| | 2 | UP input |
| | 3 | PRESET SELECT A input |
| | 7 | BRAKE RELEASE output |
| 25 | | RESET input |
| 26 | Macro | Function |
| | 0 1 | JOG SELECT input |
| | 2 | DOWN input |
| | 3 | PRESET SELECT B input |
| | 4 | AT MIN. SPEED output |
| | 6 | LIMIT FORWARD input |
| 27 | | RUN FORWARD input |
| 28 | | RUN REVERSE input |
| 29 | Macro | Function |
| | 0 1 7 | LOCAL/REMOTE input |
| | 2 | MOT. POT. ENABLE input |
| | 3 | PRESET ENABLE input |
| | 4 | TORQUE ENABLE input |
| | 5 | PID ENABLE input |
| | 6 | LIMIT REVERSE input |

| 30 | EXTERNAL TRIP input |
|--------------------------------|--|
| Inputs | |
| Input | Negative-logic digital |
| Voltage range | 0V ~ +24V |
| Absolute maximum voltage range | -3V ~ +30V |
| Input current when 0V applied | ≥3.2mA |
| Negative-logic levels | Inactive state (input open-circuit): > +15V Active state: < +5V |
| Positive-logic levels | Inactive state (input open-circuit): < +5V Active state: > +15V |
| Outputs | |
| Type of output | Negative-logic digital (push-pull) |
| Voltage range | 0V ~ +24V |
| Maximum output current | 200mA (total including terminal 22) |
| Overload output current | 240mA (total including terminal 22) |

| 31 0V common (digital) |
|-------------------------------|
|-------------------------------|

Common connection for external digital devices.

D Menu 0 Parameters

D.1 Introduction

Key

Type of parameter

| | |
|--------------|--|
| RO | Read-only |
| RW | Read–write |
| ...selector | Select from a number of settings |
| ...select | Select from two settings |
| ...enable | Make or allow a function to operate |
| ...disable | Stop or disallow a function from operating |
| ...indicator | The value can only be read |

Limitations of use

| | |
|---|--|
| R | The Drive must be reset for a new value to take effect. |
| S | The new parameter-value is saved when the AC supply is disconnected from the Drive. |
| P | Protected parameter; the parameter cannot be used as the destination parameter for a programmable input. |

Range

| | |
|-----|--|
| Bi | Variable parameter having bipolar value range. |
| Uni | Variable parameter having unipolar value range. |
| Txt | Variable parameter having text displayed. A number is stated alongside the setting; this is displayed on the system controller when the Drive is accessed by serial communications |
| Bit | Bit parameter |
| FLC | Full-load current (maximum continuous output current) (see Appendix C <i>Data</i> in the Installation Guide) |

Symbols

| | |
|-------|---|
| ⇒ | Default value |
| ⇄ | Range of values |
| [...] | Indicates the value of the parameter |
| ~ | Indicates a range of values (in the case of bit parameters, ~ indicates <i>or</i>) |

Categories of the fixed-function parameters

The parameters are arranged in the following categories:

| | |
|--------------------|--|
| 0.00 | Configuration and saving |
| 0.01 ~ 0.02 | Frequency limits |
| 0.03 ~ 0.06 | Ramps Frequency reference selection Current limit |
| 0.07 ~ 0.09 | Voltage boost |
| 0.10 | Speed indication |
| 0.31 | Macro-number indication |
| 0.32 ~ 0.34 | Miscellaneous |
| 0.35 | Keypad-reference monitoring |
| 0.36 ~ 0.38 | Serial communications Parameter displayed at power-up |
| 0.39 ~ 0.41 | Spinning motor Autotune PWM switching frequency |
| 0.42 ~ 0.47 | Motor parameters |
| 0.48 | Drive software build number |
| 0.49 ~ 0.50 | Security and software information |


D.2 Fixed-function parameters common to all macro configurations

Configuration

0.00 Macro selection, Configuration, Saving

| | | | | |
|---|----------|-----|---|---|
| | RW | Uni | | R |
| ⇅ | 0 ~ 2010 | ⇄ | 0 | |

| Value | Function |
|-------|--|
| 1000 | Save new parameter-values |
| 1233 | Restore parameters to their default values for 50Hz AC supply frequency (Europe) |
| 1244 | Restore parameters to their default values for 60Hz AC supply frequency (USA) |
| 2001 | Macro 1 <i>Easy mode</i> |
| 2002 | Macro 2 <i>Motorized potentiometer</i> |
| 2003 | Macro 3 <i>Preset speeds</i> |
| 2004 | Macro 4 <i>Torque control</i> |
| 2005 | Macro 5 <i>PID control</i> |
| 2006 | Macro 6 <i>Axis-limit control</i> |
| 2007 | Macro 7 <i>Brake control</i> |
| 2009 | Macro 0 <i>General purpose (USA default configuration)</i> |
| 2010 | Macro 0 <i>General purpose (EUR default configuration)</i> |

Press  after setting parameter **0.00** at the required value.

Frequency limits

0.01 Minimum frequency

| | | | | |
|---|------------|-----|---|----|
| | RW | Uni | | |
| ⇅ | 0 ~ [0.02] | ⇄ | 0 | Hz |

Set **0.01** at the required minimum output frequency of the Drive for both directions of rotation. The Drive runs at the minimum frequency when the frequency reference is zero.

[0.01] is a nominal value; slip compensation may cause the actual frequency to be higher.

(When the Drive is jogging, [0.01] has no effect.)

0.02 Maximum frequency

| | | | | |
|---|------------|-----|-----------------------|----|
| | RW | Uni | | |
| ⇅ | 0 ~ 1000.0 | ⇄ | 50 (EURO) 60 (USA) | Hz |

Set **0.02** at the required maximum output frequency for both directions of rotation. The frequency reference cannot cause the Drive to run at a frequency higher than [0.02].

[0.02] is a nominal value; slip compensation may cause the actual frequency to be higher.

(The Drive has additional over-speed protection.)



Caution

For operation at motor speeds greater than twice base speed, contact the supplier of the motor.

Ramps, Frequency reference selection, Current limit

0.03 Acceleration rate

| | | | | |
|---|------------|-----|---|---------|
| | RW | Uni | | |
| ⇅ | 0 ~ 3200.0 | ⇄ | 5 | s/100Hz |

Set **0.03** at the required rate of acceleration. Note that larger values produce lower acceleration. The rate applies in both directions of rotation.

0.03 does not apply to jog speed. See Menu 2 in the *Commander Gp Advanced User Guide* for jog acceleration and deceleration rates.

0.04 Deceleration rate

| | | | | |
|---|------------|-----|----|---------|
| | RW | Uni | | |
| ⇅ | 0 ~ 3200.0 | ⇄ | 10 | s/100Hz |

Set **0.04** at the required rate of deceleration. Note that larger values produce lower deceleration. The rate applies in both directions of rotation.

0.04 does not apply to jog speed. See Menu 2 in the *Commander Gp Advanced User Guide* for jog acceleration and deceleration rates.

0.05 Reference selector

| | | | | |
|---|-------|-----|-------------|--|
| | RW | Uni | | |
| ⇅ | 0 ~ 5 | ⇄ | (See below) | |

The default setting of **0.05** depends on the default configuration of the Drive, as follows:

| | | |
|-----|---|---------------|
| EUR | 0 | Terminal mode |
| USA | 4 | Keypad mode |

Note

Macros 2 to 5: Do not change the setting of parameter 0.05.

Macro 6: Only settings 0, 1, 2 can be used.

Macro 7: Only settings 0, 1, 2, 4 can be used. For using setting 3, see the *Commander Gp Advanced User Guide*.

Use **0.05** to select the required frequency reference, as follows:

| Setting | User-interface mode | Function |
|---------|---------------------|---|
| 0 | Terminal | Analog frequency reference selected by LOCAL/REMOTE contact |
| 1 | Terminal | Analog frequency reference 1 selected |
| 2 | Terminal | Analog frequency reference 2 selected |
| 3 | Terminal | Preset frequency references selected (used with Macro 3) |
| 4 | Keypad | Frequency controlled by the keypad |
| 5 | | (Not used) |

0.06 Current limit

| | | | | |
|---|----------|-----|-----|----------------------|
| | RW | Uni | | |
| ⇅ | 0 ~ ≥150 | ⇄ | 150 | % I _{RATIO} |

$$I_{RATIO} = \frac{FLC}{[0.06]}$$

0.06 limits the maximum output current of the Drive (and hence maximum motor torque) to protect the Drive and motor from overload.

Set **0.06** at the required maximum torque as a percentage of the rated torque of the motor, as follows:

$$[0.06] = \frac{T_R}{T_{RATED}} \times 100(\%)$$

Where:

T_R Required maximum torque
 T_{RATED} Motor rated torque

Alternatively, set **0.06** at the required maximum active (torque-producing) current as a percentage of the rated active current of the motor, as follows:

$$[0.06] = \frac{I_R}{I_{RATED}} \times 100(\%)$$

Where:

I_R Required maximum active current
 I_{RATED} Motor rated active current

Refer to *Setting the torque-producing current limit* in Chapter 3 *Setting up the Drive*.

Voltage boost

0.07 Voltage mode selector

| | | | | | |
|------------------------------|-------------|-----|------|--|--|
| Voltage mode selector | RW | Uni | | | |
| ⇅ | (See below) | ⇒ | Ur_I | | |

| Setting | Function |
|-------------------------|---|
| Vector modes | |
| Ur_S 0 | Motor stator resistance is measured each time the Drive is started. |
| Ur_I 1 | Motor stator resistance is measured at power-up if the EXTERNAL TRIP contact is closed and no other trip condition exists. |
| Ur 2 | Motor stator resistance is not measured (use this mode only after having used Ur_S or Ur_I to measure the stator resistance). |
| Fixed boost mode | |
| Fd 3 | Fixed voltage boost that can be manually adjusted by parameter 0.08 Boost voltage . |

Use **0.07** to select fixed voltage boost, or Vector control of voltage boost. Fixed boost requires a value to be set in **0.08 Boost voltage** by the user. See Figure D-1. Fixed boost should be used when **0.39 Synchronize to a spinning motor** is set at 1.

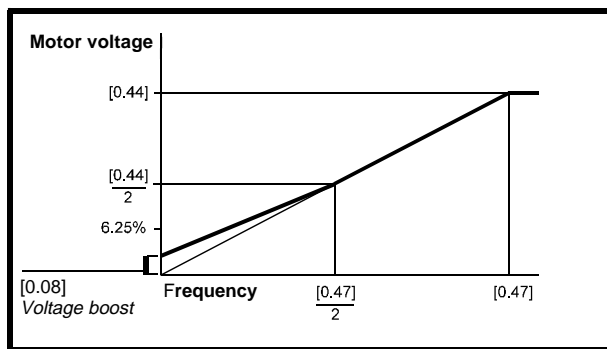


Figure D-1 Effect of fixed voltage boost on the voltage-to-frequency characteristic

Vector control causes the voltage boost to be automatically regulated according to the load on the motor.

Vector control requires the value of stator winding resistance to be stored in a parameter in the Drive. The three Vector modes allow the resistance to be measured under different circumstances.

0.08 Boost voltage

| | | | | | |
|----------------------|----------|-----|-----|------------|--|
| Boost voltage | RW | Uni | | | |
| ⇅ | 0 ~ 25.0 | ⇒ | 3.0 | % x [0.44] | |

When **0.07 Voltage mode selector** is set at **Fd**, set **0.08** at the required value for the motor to run reliably at low speeds. See Figure D-1.

Excessive values of **0.08** can cause the motor to be overheated.

0.09 Dynamic V/f select

| | | | | | |
|---------------------------|-------|-----|---|--|--|
| Dynamic V/f select | RW | Bit | | | |
| ⇅ | 0 ~ 1 | ⇒ | 0 | | |

Set **0.09** at 0 when the V/f characteristic applied to the motor is to be fixed. It is then based on the rated voltage and frequency of the motor.

Set **0.09** at 1 when reduced power dissipation is required in the motor when it is lightly loaded. The V/f characteristic is then variable resulting in the motor voltage being proportionally reduced for lower motor currents. Figure D-2 shows the change in V/f slope when the motor current is reduced.

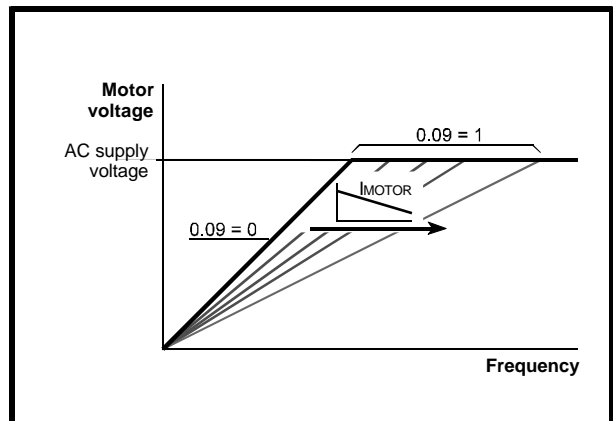


Figure D-2 Fixed and variable V/f characteristics

Speed indication

0.10 Estimated motor speed

| Estimated motor speed | RO | Bi | | | |
|-----------------------|----|----|--|--|-----|
| ±6000 | | | | | RPM |

0.10 indicates the value of motor speed that is estimated from the following:

0.12 Post-ramp frequency reference

0.42 Motor – no. of poles

The value of **0.10** is applied to the analog output on terminal 9 to indicate estimated speed.

Macro-number indication

0.31 Macro number

| | RO | Uni | | | |
|-------|----|-----|--|--|--|
| 0 ~ 7 | | | | | |

0.31 indicates the number of the macro configuration that is currently in operation.

Miscellaneous

0.32 Serial comms. mode

| | RW | Txt | | R | P |
|-------------------------------------|----|--------|--|---|---|
| ANSI 2 ANSI 4 OUtPUT INPUT | | ANSI 4 | | | |

Use **0.32** to select the required serial communications mode as follows:

| | |
|--------|--------------------------|
| ANSI 2 | ANSI protocol, two-wire |
| ANSI 4 | ANSI protocol, four-wire |

0.33 Drive rated current (FLC)

| | RO | Uni | | | P |
|------------|----|-----|--|--|---|
| 2.10 ~ 202 | | | | | A |

0.34 User security code

| | RW | Uni | S | | P |
|---------|----|-----|-----|--|---|
| 0 ~ 255 | | | 149 | | |

Use **0.34** to set up a User Security code. Irrespective of the code number entered in **0.34**, it always indicates the default value **149**. When **0.34** is actually set at **149**, no User Security is applied.

See *Setting-up User Security* in Appendix B *Security*.

Keypad-reference monitoring

0.35 Keypad reference

| | RO | Bi | S | | P |
|----------|----|----|---|--|----|
| ± [0.02] | | | | | Hz |

0.35 indicates the value of the frequency reference when the Drive is operating in Keypad mode. The reference is then controlled by the following control keys (when the display is in Status mode):



The value is automatically saved when the Drive is powered-down. At the next power-up, the Drive ramps up to the frequency that applied before the power-down.

Serial communications, Parameter displayed after power-up

0.36 Serial comms. baud rate

| | RW | Txt | | | P |
|---|----|-------------|--|--|------|
| 4800 (0) 9600 (1) 19200 (2) 2400 (3) | | 4800 (0) | | | baud |

Use **0.36** to select the required baud rate for serial communications when a *Basic serial communications* large option module is fitted in the Drive.

0.37 Serial comms. address

| | RW | Uni | | | P |
|-----------|----|-----|--|--|------------|
| 0.0 ~ 9.9 | | 1.1 | | | Group.Unit |

Use **0.37** to select the required address for serial communications when a *Basic serial communications* large option module is fitted in the Drive.

Do not enter an address that contains a zero, since this is used when addressing a group of Drives.

0.38 Initial parameter displayed

| | RW | Uni | | P |
|---|-------------|-----|------|---|
| ⇅ | 0.00 ~ 0.50 | ⇄ | 0.10 | |

At the time the AC supply is connected to the Drive, parameter **0.10** *Estimated motor speed* is automatically pre-selected as the initial parameter to be displayed. This results in the following:

1. After the AC supply is connected to the Drive, and before any other parameter is selected, the value of parameter **0.10** is shown on the upper display. This allows the motor speed to be monitored without the need to select the parameter.
2. If the keypad is subsequently used to select another parameter, the value of the newly selected parameter is displayed in place of the initial parameter.

To select a different parameter to be displayed initially, enter the required parameter number in **0.38** (eg. to display **0.12** *Post-ramp reference*, enter **0.12**).

Spinning motor, Autotune, PWM switching frequency

0.39 Synchronize to a spinning motor

| | RW | Bit | | |
|---|-------|-----|---|--|
| ⇅ | 0 ~ 1 | ⇄ | 0 | |

Set **0.39** at 1 for the Drive always to automatically synchronize itself to the motor if the motor is already rotating when the Drive is started.

If the Drive is started when the motor is already spinning and **0.39** is set at 0, the Drive cannot detect the speed of the motor; the normal operation of the Drive will cause the motor to be braked to a stand-still in the same way as DC injection braking. The Drive will then accelerate the motor to the value of the frequency reference.

Notes

The Drive can be synchronized to a single motor only. If more than one motor is connected to the Drive, this function should not be used.

For the Drive to operate correctly during and after synchronization, parameter **0.07 *Voltage mode selector* must be set at **Fd**.**

The Drive starts a sequence of operations at one quarter of the rated motor voltage in order to detect the frequency associated with the speed of

the motor. The sequence is stopped when the motor frequency is detected. The stages in the sequence are as follows:

1. The frequency of the Drive is set at maximum (the value of **0.02**) in the direction that the motor was last driven. (If the AC supply to the Drive was interrupted before an attempt is made to synchronize to a spinning motor, the Drive always starts in the forward direction.)
2. The frequency is reduced to zero. If the motor frequency is detected during the reduction in Drive frequency, the test is stopped. The Drive frequency is set at the detected motor frequency and the Drive takes control of the motor.
3. If the motor frequency is not detected, the Drive is set at maximum frequency in the opposite direction, and the test is repeated.
4. If the motor frequency is still not detected, the Drive frequency is set at 0Hz, and the Drive takes control of the motor.

0.40 Autotune

| | RW | Bit | | P |
|---|-------|-----|---|---|
| ⇅ | 0 ~ 1 | ⇄ | 0 | |

Set **0.40** at 1 to start the Autotune sequence. See *Autotune* in Chapter 2 *Getting Started*.

0.41 PWM switching frequency

| | RW | Txt | | P |
|---|------------------|-----|---|-----|
| ⇅ | 3, 4.5, 6, 9, 12 | ⇄ | 3 | kHz |

See *PWM switching frequency* in *Planning the installation* in Chapter 2 *Installing the Drive* in the Installation Guide.

Thermal protection

Intelligent thermal modelling in the Drive effectively monitors the junction temperature of the IGBTs in the power stage. When the junction temperature is calculated to reach the maximum permissible value, two levels of protection occur, as follows:

1. When a PWM switching frequency of 6kHz, 9kHz or 12kHz is selected, the PWM switching frequency is automatically halved. This reduces switching losses in the IGBTs. (The value of parameter **0.41** *PWM switching frequency* remains at the value set by the user.)

Then at one-second intervals, the Drive will attempt to return the PWM switching frequency to the original value. This will be successful when the thermal modelling has calculated that the temperature has reduced sufficiently.

2. If the junction temperature continues to rise (due to the output current) after the PWM switching frequency has been halved, and the temperature reaches the maximum permissible value, the Drive will trip. The display will indicate trip code **Oh1**.

Motor parameters

0.42 Motor – number of poles

| | RW | Txt | | P |
|---|----|--------|---|---------|
| ⇅ | | 2 ~ 32 | ⇄ | 4 poles |

Enter the number of motor poles (not pole pairs). (See *Configuring the Drive for the motor* in Chapter 2 *Getting Started*.)

0.43 Motor – power factor

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

When Autotune is used, the power factor of the motor is measured by the Drive and stored in **0.43**. The value can be seen when **0.43** is accessed. The value may be higher than the value stated on the motor rating plate.

If Autotune is not used, enter the value in **0.43**.

0.44 Motor – rated voltage

| | RW | Uni | | |
|------------------------|----|-----|---------|---------------|
| Commander GP | | | | |
| ⇅ | | EUR | 0 ~ 400 | ⇄ 400 (EUR) V |
| ⇅ | | USA | 0 ~ 480 | ⇄ 460 (USA) V |
| Commander GP LV | | | | |
| ⇅ | | EUR | 0 ~ 240 | ⇄ 220 V |
| ⇅ | | USA | 0 ~ 240 | ⇄ 220 V |

Enter the value from the rating plate of the motor. (See *Configuring the Drive for the motor* in Chapter 2 *Getting Started*.)

0.45 Motor – rated speed

| | RW | Uni | | |
|---|----|----------|---|-------|
| ⇅ | | 0 ~ 6000 | ⇄ | 0 RPM |

Enter the value from the rating plate of the motor. (See *Configuring the Drive for the motor* in Chapter 3 *Setting up the Drive*.)

0.46 Motor – rated current

| | RW | Uni | | |
|---|----|---------|---|-------|
| ⇅ | | 0 ~ FLC | ⇄ | FLC A |

FLC is the maximum permissible continuous output current of the Drive up to 40°C ambient temperature and 3kHz PWM switching frequency.

Enter the value from the rating plate of the motor. (See *Configuring the Drive for the motor* in Chapter 2 *Getting Started*.)

0.47 Motor – rated frequency

| | RW | Uni | | |
|---|----|------------|---|-------------------------|
| ⇅ | | 0 ~ 1000.0 | ⇄ | 50 (EUR) Hz 60 (USA) |

Enter the value from the rating plate of the motor. (See *Configuring the Drive for the motor* in Chapter 2 *Getting Started*.)

Drive software build number

0.48 Drive software build number

| | RO | Uni | | |
|---|----|--------|---|--|
| ⇅ | | 0 ~ 99 | ⇄ | |

Status information

0.49 Security status

| | RO | Uni | | |
|---|----|-------|---|---|
| ⇅ | | 0 ~ 1 | ⇄ | 1 |

0.49 normally indicates 1. This shows that access to the advanced parameters is not possible.

0.50 Software version number

| | RO | Uni | | P |
|---|----|--------------|---|---|
| ⇅ | | 1.00 ~ 99.99 | ⇄ | |

D.3 Parameters specific to the macro configurations

Since parameters **0.11** to **0.30** are specific to individual macros, most parameter numbers appear more than once in this section, but with different names; these are *variants* on the parameter number. For guidance, a table headed *Applicable to Macros...* appears for each parameter variant. (In places, the listing is not able to be in strict numerical order.)

A table at the end of this appendix shows the variants for all the macros (except Macro 1 which does not use these parameters).

| | |
|-------------|----------------------------|
| 0.11 | Pre-ramp reference |
| 0.12 | Post-ramp reference |

| | | | | | |
|---|---------|----|--|--|----|
| | RO | Bi | | | |
| ⇅ | ±1000.0 | ⇄ | | | Hz |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ✓ | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

When the frequency is constant, [0.12] = [0.11]. During acceleration and deceleration, the two values may differ.

[0.12] differs from [0.11] also under either of the following conditions:

- When the Drive is in current limit
- During braking in a standard ramp (**Std.Hd** or **Std.Ct**) mode.

| | |
|-------------|-----------------------------|
| 0.13 | Motor active-current |
|-------------|-----------------------------|

| | | | | | |
|---|------|----|--|--|---|
| | RO | Bi | | | |
| ⇅ | ±FLC | ⇄ | | | A |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ✓ | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

When the motor is being driven below its rated speed, the torque is proportional to [0.13].

| | |
|-------------|----------------------|
| 0.14 | Jog reference |
|-------------|----------------------|

| | | | | | |
|---|-----------|-----|-----|--|----|
| | RW | Uni | | | |
| ⇅ | 0 ~ 400.0 | ⇄ | 1.5 | | Hz |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ✓ | × | × | × | × | × | × | × |

Enter the required value of jog frequency. The frequency limits affect the Drive when jogging as follows:

| Frequency-limit parameter | Limit applies |
|-------------------------------|---------------|
| 0.01 Minimum frequency | No |
| 0.02 Maximum frequency | Yes |

Note

So that jog can be selected, the Drive must be operated in either Macro 0 or Macro 1 and in Terminal mode.

| | |
|-------------|--------------------------------|
| 0.14 | Limit forward indicator |
|-------------|--------------------------------|

| | | | | | |
|---|-------|-----|--|--|---|
| | RO | Bit | | | P |
| ⇅ | 0 ~ 1 | ⇄ | | | |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| × | × | × | × | × | × | ✓ | × |

0.14 indicates the state of the **LIMIT FORWARD** contact, as follows:

| 0.21 | LIMIT FORWARD contact | 0.14 | Condition |
|------|-----------------------|------|-------------------|
| 0 | Open | 0 | Limit not reached |
| 0 | Closed | 1 | Limit reached |
| 1 | Closed | 1 | Limit not reached |
| 1 | Open | 0 | Limit reached |

0.14 Motor current magnitude

| | | | | | | |
|---|----------------------|----|-----|--|--|---|
| | | RO | Uni | | | P |
| ⇅ | 0 ~ I _{max} | ⇄ | | | | A |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | x | x | x | x | x | ✓ |

0.14 indicates the measured value of phase current in the motor; this is the vector sum of the active and magnetizing currents.

$$I_{MAX} = FLC \times 150\%$$

0.14 Analog input 1 mode selector

0.15 Analog input 2 mode selector

0.16 Analog input 3 mode selector

| | | | | | | |
|---|-------------|----|------|--|--|---|
| | | RW | Txt | | | P |
| ⇅ | (See below) | ⇄ | VOLt | | | |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | x | x | x | ✓ | x | x |

Set the required mode as follows:

| Setting | Input signal | When current signal ≤3mA... |
|-----------|----------------------------------|---------------------------------------|
| VOLt 0 | 0V to 10V | |
| 0-20 1 | 0 to 20mA | Signal treated as zero |
| 20-0 2 | 20mA to 0 | Signal treated as zero |
| 4-20.tr 3 | 4mA to 20mA | Drive trips |
| 20-4.tr 4 | 20mA to 4mA | Drive trips |
| 4-20.Lo 5 | 4mA to 20mA | Drive runs at minimum or low speed |
| 20-4.Lo 6 | 20mA to 4mA | Drive runs at minimum or low speed |
| 4-20.Pr 7 | 4mA to 20mA | Drive runs at previous speed |
| 20-4.Pr 8 | 20mA to 4mA | Drive runs at previous speed |
| th.SC 9 | Thermistor (analog input 3 only) | Drive trips if short-circuit detected |
| th 10 | Thermistor (analog input 3 only) | (No short-circuit detection) |

0.15 Ramp mode selector

| | | | | | | |
|---|-------------|----|--------|--|--|--|
| | | RW | Txt | | | |
| ⇅ | (See below) | ⇄ | Std.Ct | | | |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ✓ | x | ✓ | ✓ | ✓ | x | x | x |

Select the required ramp mode as follows:

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

Set **0.15 Ramp mode selector** for the required means of controlling regenerated energy. Regeneration arises when the Drive is braking the motor. This occurs when the Drive decelerates the motor, or prevents the speed of the motor from being increased as a result of mechanical influences.

Regeneration causes the DC-bus voltage to be increased. The settings for **0.15** determine the braking action in relation to a DC-bus threshold level known as the *standard ramp voltage* which is fixed at 750V.

0.15 set at Std.Hd (0) Standard hold

If motor regeneration causes the DC-bus voltage to reach the standard ramp voltage, the braking is interrupted until the DC-bus voltage reduces sufficiently. Braking then continues until the next time the DC-bus voltage reaches its limit, resulting in maximum braking occurring in steps.

0.15 set at FASt (1) Fast ramp

This setting gives continuous deceleration under maximum braking conditions. This can give faster deceleration than the **Std.Hd** setting with the result that the regenerated power is greater. A braking resistor is normally required in order to prevent the DC-bus voltage from reaching the trip level.

0.15 set at Std.Ct (2) Standard controlled (default setting)

Deceleration is smoother than with the **Std.Hd** setting. The deceleration is controlled by a current controller in the Drive in order to maintain the DC bus at or below the standard ramp voltage (750V). When necessary, this extends the deceleration time. Do not use this setting when a braking resistor is connected to the Drive.

0.15 Run forward indicator

| | | | | | | | | | |
|---|-------|--|--|--|----|-----|--|--|---|
| | | | | | RO | Bit | | | P |
| ⇅ | 0 ~ 1 | | | | ⇒ | | | | |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | x | x | x | x | ✓ | x |

0.15 indicates the state of the **RUN FORWARD** contact, as follows:

| 0.15 | RUN FORWARD contact |
|------|---------------------|
| 0 | Open |
| 1 | Closed |

0.16 Run reverse indicator

| | | | | | | | | | |
|---|-------|--|--|--|----|-----|--|--|---|
| | | | | | RO | Bit | | | P |
| ⇅ | 0 ~ 1 | | | | ⇒ | | | | |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | x | x | x | x | ✓ | x |

0.16 indicates the state of the **RUN REVERSE** contact, as follows:

| 0.16 | RUN REVERSE contact |
|------|---------------------|
| 0 | Open |
| 1 | Closed |

0.15 Current detected indicator

| | | | | | | | | | |
|---|-------|--|--|--|----|-----|--|--|---|
| | | | | | RO | Bit | | | P |
| ⇅ | 0 ~ 1 | | | | ⇒ | | | | |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | x | x | x | x | x | ✓ |

0.15 indicates as follows:

| 0.15 | Motor current magnitude... |
|------|--|
| 0 | Lower than the value set in 0.19 |
| 1 | Higher than the value set in 0.19 |

0.16 Drive healthy indicator

| | | | | | | | | | |
|---|-------|--|--|--|----|-----|--|--|---|
| | | | | | RO | Bit | | | P |
| ⇅ | 0 ~ 1 | | | | ⇒ | | | | |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | x | x | x | x | x | ✓ |

0.16 indicates as follows:

| 0.16 | Drive... |
|------|--------------------|
| 1 | Operating normally |
| 0 | Tripped |

0.16 Stop mode selector

| | | | | | | | | | |
|---|-------------|--|--|--|----|-----|--|--|--|
| | | | | | RW | Txt | | | |
| ⇅ | (See below) | | | | ⇒ | rP | | | |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ✓ | x | ✓ | ✓ | ✓ | x | x | x |

Select the required stop mode as follows:

| COAST | 0 | The motor is allowed to coast |
|--------|---|--|
| rP | 1 | Ramp to a stop |
| rP-dcl | 2 | Ramp followed by 1 second DC injection |
| dcl | 3 | AC injection braking followed by 1 second DC injection braking |

See *Stopping and braking modes* for the appropriate macro configurations in Chapter 3 *Setting up the Drive*.

0.17 Torque mode selector

| | | | | | | | | | |
|---|-------|--|--|--|----|-----|--|--|--|
| | | | | | RW | Uni | | | |
| ⇅ | 0 ~ 1 | | | | ⇒ | 0 | | | |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ✓ | x | x | x | x | x | x | x |

Set **0.17** as follows:

| Setting | Open-loop |
|---------|-------------------|
| 0 | Frequency control |
| 1 | Torque control |

For operation in setting 1 *Torque control*, see Macro 4 in Chapter 3 *Setting Up the Drive*.

| | |
|-------------|----------------------------|
| 0.17 | Status relay invert |
| | RW Bit |
| ⇅ | 0 ~ 1 ⇨ 0 |

| | | | | | | | |
|--------------------------------|----------|----------|----------|----------|----------|----------|----------|
| Applicable to Macros... | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | ✓ | ✓ | ✓ | x | x | x |

When **0.17** is set at 0 and the Drive trips, the status relay contacts open.

If required, set **0.17** at 1 for the contacts to close when the Drive trips.

| | |
|-------------|--------------------------------|
| 0.17 | Limit reverse indicator |
| | RO Bit P |
| ⇅ | 0 ~ 1 ⇨ |

| | | | | | | | |
|--------------------------------|----------|----------|----------|----------|----------|----------|----------|
| Applicable to Macros... | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | x | x | x | x | ✓ | x |

0.17 indicates the state of the LIMIT REVERSE contact, as follows:

| 0.22 | LIMIT REVERSE contact | 0.17 | Condition |
|-------------|------------------------------|-------------|-------------------|
| 0 | Open | 0 | Limit not reached |
| 0 | Closed | 1 | Limit reached |
| 1 | Closed | 1 | Limit not reached |
| 1 | Open | 0 | Limit reached |

| | |
|-------------|--------------------------------|
| 0.17 | At zero speed indicator |
| | RO Bit P |
| ⇅ | 0 ~ 1 ⇨ |

| | | | | | | | |
|--------------------------------|----------|----------|----------|----------|----------|----------|----------|
| Applicable to Macros... | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | x | x | x | x | x | ✓ |

0.17 indicates as follows:

| 0.17 | 0.12 |
|-------------|-------------|
| 0 | Above 2Hz |
| 1 | Below 2Hz |

The value of **0.12** is the output frequency of the Drive when it is not in current limiting. To change the frequency at which parameter **0.17** changes state, see the *Commander Gp Advanced User Guide*.

| | |
|-------------|-----------------------|
| 0.17 | Analog input 1 |
| 0.18 | Analog input 2 |
| 0.19 | Analog input 3 |

| | | | |
|---|------|----|---|
| | RO | Bi | P |
| ⇅ | ±100 | ⇨ | % |

| | | | | | | | |
|--------------------------------|----------|----------|----------|----------|----------|----------|----------|
| Applicable to Macros... | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | x | x | x | ✓ | x | x |

These parameters indicate the values of the following inputs as percentages of the full-scale values:

- 0.17** Frequency reference
- 0.18** PID reference
- 0.19** PID feedback

| | |
|-------------|----------------------|
| 0.18 | S-ramp enable |
| | RW Bit |
| ⇅ | 0 ~ 1 ⇨ 0 |

| | | | | | | | |
|--------------------------------|----------|----------|----------|----------|----------|----------|----------|
| Applicable to Macros... | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ✓ | x | ✓ | ✓ | ✓ | x | x | x |

Set at 1 to enable S-ramp. See **0.19** *S-ramp da/dt limit*.

| | |
|-------------|---------------------------|
| 0.18 | Stop mode selector |
| | RW Txt |
| ⇅ | (See below) ⇨ rP |

| | | | | | | | |
|--------------------------------|----------|----------|----------|----------|----------|----------|----------|
| Applicable to Macros... | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | x | x | x | x | ✓ | x |

Select the required stop mode as follows:

| | | |
|---------------|---|---|
| COAST | 0 | The motor is allowed to coast |
| rP | 1 | Ramp to a stop |
| rP-dcl | 2 | Ramp followed by 1 second DC injection |
| dcl | 3 | AC injection braking followed by 1 second DC injection braking |
| td-dcl | 4 | DC injection braking for an adjustable time (see the <i>Unidrive Advanced User Guide</i>). |

See also **0.19** *Hold zero speed enable*.

0.18 Brake release indicator

| | | | | | | |
|---|-------|----|-----|--|--|---|
| | | RO | Bit | | | P |
| ⇅ | 0 ~ 1 | ⇒ | | | | |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | x | x | x | x | x | ✓ |

0.18 indicates as follows:

| 0.18 | Brake... |
|------|----------|
| 0 | Applied |
| 1 | Released |

0.19 S-ramp da/dt limit

| | | | | | | |
|---|------------|----|-----|-----------------------|--|--|
| | | RW | Uni | | | |
| ⇅ | 0 ~ 3000.0 | ⇒ | 3.1 | s ² /100Hz | | |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ✓ | x | ✓ | ✓ | ✓ | x | x | x |

Use S-ramp to limit the rate of change of acceleration and deceleration at the start and end of ramps.

If a different rate of change of acceleration and deceleration is required, set **0.19 S-ramp da/dt limit** at the required rate. (The acceleration and deceleration rates are set in parameters **0.03** and **0.04**.)

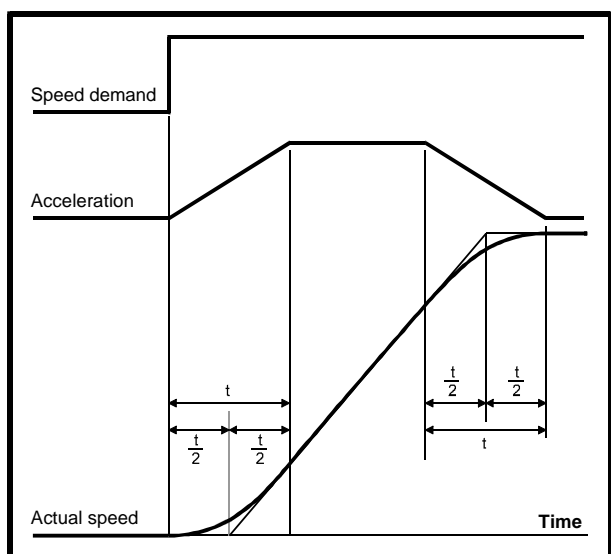


Figure D-3 S-ramp time durations

Refer to Figure D-3. The time duration **t** of the curved sections can be calculated as follows:

For acceleration:

$$t = \frac{[0.19]}{[0.03]}$$

For deceleration:

$$t = \frac{[0.19]}{[0.04]}$$

In comparison with a normal ramp, S-ramp increases the total ramp time by the value of **t**, since an additional $\frac{1}{2}t$ is added at the beginning and end of the ramp.

0.19 Hold zero speed enable

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

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | x | x | x | x | ✓ | x |

Set at 0 to cause the IGBT bridge to become disabled when no **RUN** signal is applied. The motor shaft will then be free to rotate.

Set at 1 to keep the IGBT bridge enabled when no **RUN** signal is applied. The Drive will apply torque to hold the motor shaft stationary.

0.19 Current threshold

| | | | | | | |
|---|-------------|----|-----|--------------------|--|---|
| | | RW | Uni | | | P |
| ⇅ | 0.0 ~ 100.0 | ⇒ | 0 | % I _{max} | | |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | x | x | x | x | x | ✓ |

Set **0.19** at the required percentage of I_{max} (see below). This value must ensure that adequate current will flow through the motor to control the load when the brake is released.

$$I_{MAX} = FLC \times 150\%$$

0.20 Skip frequency 1
0.22 Skip frequency 2

| | | | | |
|---|------------|-----|---|----|
| | RW | Uni | | |
| ⇅ | 0 ~ 1000.0 | ⇄ | 0 | Hz |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ✓ | × | ✓ | ✓ | ✓ | × | × | × |

See **0.21** and **0.23** Skip bands.

0.20 PID proportional gain

| | | | | |
|---|-------|-----|---|--|
| | RW | Uni | | |
| ⇅ | 0 ~ 4 | ⇄ | 1 | |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| × | × | × | × | × | ✓ | × | × |

Refer to the setting up instructions for Macro 5 in Chapter 3 *Setting Up the Drive*.

0.20 Limit deceleration rate

| | | | | |
|---|------------|-----|-----|---------|
| | RW | Uni | | |
| ⇅ | 0 ~ 3200.0 | ⇄ | 0.2 | s/100Hz |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| × | × | × | × | × | × | ✓ | × |

Set **0.20** at the required rate of deceleration at the limit of travel (ie. when the relevant limit switch has been activated). Note that larger values produce lower deceleration. The rate is applied in both directions of rotation.

Refer to the setting up instructions for Macro 6 in Chapter 3 *Setting Up the Drive*.

0.20 Brake release delay

| | | | | |
|---|------------|-----|-----|---|
| | RW | Uni | | |
| ⇅ | 0.0 ~ 25.0 | ⇄ | 0.2 | s |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| × | × | × | × | × | × | × | ✓ |

If required, change the setting of **0.20** *Brake release delay* to a suitable value (between 0 and 25 seconds) that will ensure a brake release signal is not issued if the following occur simultaneously under transient conditions:

0.16 *Drive healthy indicator* changes state to 1

0.17 *At zero speed* changes state to 0

0.21 Skip band 1
0.23 Skip band 2

| | | | | |
|---|---------|-----|-----|----|
| | RW | Uni | | |
| ⇅ | 0 ~ 5.0 | ⇄ | 0.5 | Hz |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ✓ | × | ✓ | ✓ | ✓ | × | × | × |

Use skip frequencies and skip bands to prevent the motor from running at speeds that cause mechanical resonances in the machine. During acceleration and deceleration, the Drive passes through the skip bands, but it does not stabilize in a skip band.

Up to two skip frequencies can be programmed.

Enter the centre frequency of the band in **0.20** (or **0.22**) *Skip frequency*, then enter the width of each sideband in **0.21** (or **0.23**) *Skip band*.

When the value of a skip frequency is zero, the related skip band is disabled.

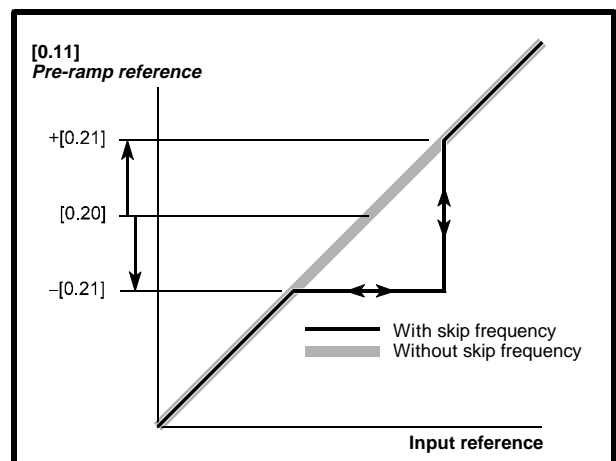


Figure D-4 Action of skip frequency 1 and skip band 1

When the frequency (input) reference ascends into a skip band, the resulting (output) reference remains at the lower edge of the band until the input reference has reached the upper edge of the band. The output reference then jumps to the value of the input reference.

When the frequency (input) reference descends into a skip band, the resulting (output) reference jumps immediately to the lower edge of the band.

Example

- Skip frequency 1 = 20Hz
- Enter 20 in parameter **0.20**
- Required skip band = 4Hz
- Enter 2 in parameter **0.21**

(Skip band = 2 × Value of skip-band parameter.)

0.21 PID integral gain

| | | | | | | |
|-------|----|-----|--|--|--|--|
| | RW | Uni | | | | |
| 0 ~ 4 | | 0.5 | | | | |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | x | x | x | ✓ | x | x |

Refer to the setting up instructions for Macro 5 in Chapter 3 *Setting Up the Drive*.

0.21 Limit forward invert

| | | | | | | |
|-------|----|-----|--|--|--|--|
| | RW | Bit | | | | |
| 0 ~ 1 | | 0 | | | | |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | x | x | x | x | ✓ | x |

Set **0.21** at 1 when the **LIMIT FORWARD** contact is normally closed.

0.22 PID derivative gain

| | | | | | | |
|-------|----|-----|--|--|--|--|
| | RW | Uni | | | | |
| 0 ~ 4 | | 0 | | | | |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | x | x | x | ✓ | x | x |

Refer to the setting up instructions for Macro 5 in Chapter 3 *Setting Up the Drive*.

0.22 Limit reverse invert

| | | | | | | |
|-------|----|-----|--|--|--|--|
| | RW | Bit | | | | |
| 0 ~ 1 | | 0 | | | | |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | x | x | x | x | ✓ | x |

Set **0.22** at 1 when the **LIMIT REVERSE** contact is normally closed.

0.23 PID output high limit

| | | | | | | |
|---------|----|-----|--|--|--|---|
| | RW | Uni | | | | |
| 0 ~ 100 | | 100 | | | | % |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | x | x | x | ✓ | x | x |

Refer to the setting up instructions for Macro 5 in Chapter 3 *Setting Up the Drive*.

0.24 PID output low limit

| | | | | | | |
|------|----|------|--|--|--|---|
| | RW | Bi | | | | |
| ±100 | | -100 | | | | % |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | x | x | x | ✓ | x | x |

Refer to the setting up instructions for Macro 5 in Chapter 3 *Setting Up the Drive*.

0.25 PID output scale factor

| | | | | | | |
|-------|----|-----|--|--|--|--|
| | RW | Uni | | | | |
| 0 ~ 4 | | 1 | | | | |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | x | x | x | ✓ | x | x |

Refer to the setting up instructions for Macro 5 in Chapter 3 *Setting Up the Drive*.

0.24 Analog input 1 mode selector

0.25 Analog input 2 mode selector

| | | | | | |
|---|-------------|-----|------|--|---|
| | RW | Txt | | | P |
| ⌄ | (See below) | ⇒ | VOLt | | |

0.24 - Applicable to Macros...

| | | | | | | | |
|----------|----------|----------|----------|----------|----------|----------|----------|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ✓ | × | ✓ | ✓ | ✓ | × | × | × |

0.25 - Applicable to Macros...

| | | | | | | | |
|----------|----------|----------|----------|----------|----------|----------|----------|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ✓ | × | × | × | × | × | × | × |

Set the required mode as follows:

| Setting | Input signal | When current signal ≤3mA... |
|---------|--------------|-----------------------------|
| VOLt | 0 | 0V to 10V |
| 0-20 | 1 | 0 to 20mA |
| 20-0 | 2 | 20mA to 0 |
| 4-20.tr | 3 | 4mA to 20mA |
| 20-4.tr | 4 | 20mA to 4mA |
| 4-20.Lo | 5 | 4mA to 20mA |
| 20-4.Lo | 6 | 20mA to 4mA |
| 4-20.Pr | 7 | 4mA to 20mA |
| 20-4.Pr | 8 | 20mA to 4mA |

0.25 Motorized potentiometer reset indicator

| | | | | | |
|---|-------|-----|--|--|--|
| | RO | Bit | | | |
| ⌄ | 0 ~ 1 | ⇒ | | | |

Applicable to Macros...

| | | | | | | | |
|----------|----------|----------|----------|----------|----------|----------|----------|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| × | × | ✓ | × | × | × | × | × |

When **0.25** is set at 1, this indicates that the motorized potentiometer output is reset to 0%. The motorized potentiometer is reset when the **RESET** contact is closed (terminal 25) (only when Macro 2 is enabled).

0.25 Preset reference 1

0.26 Preset reference 2

0.27 Preset reference 3

0.28 Preset reference 4

| | | | | | |
|---|-------|----|---|--|----|
| | RW | Bi | | | |
| ⌄ | ±1000 | ⇒ | 0 | | Hz |

Applicable to Macros...

| | | | | | | | |
|----------|----------|----------|----------|----------|----------|----------|----------|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| × | × | × | ✓ | × | × | × | × |

Enter the required values.

0.25 Analog reference 1

| | | | | | |
|---|-------|----|--|--|----|
| | RO | Bi | | | |
| ⌄ | ±1000 | ⇒ | | | Hz |

Applicable to Macros...

| | | | | | | | |
|----------|----------|----------|----------|----------|----------|----------|----------|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| × | × | × | × | ✓ | × | × | × |

0.25 indicates the value of the torque reference applied to terminals 5 and 6 of the signal connector.

0.26 Motorized potentiometer output indicator

| | | | | | |
|---|------|----|---|--|---|
| | RO | Bi | S | | |
| ⌄ | ±100 | ⇒ | | | % |

Applicable to Macros...

| | | | | | | | |
|----------|----------|----------|----------|----------|----------|----------|----------|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| × | × | ✓ | × | × | × | × | × |

0.26 indicates the value of the output of the motorized potentiometer as a percentage of the maximum value.

0.26 Analog input 2 mode selector

| | | | | | |
|---|-------------|-----|------|--|---|
| | RW | Txt | | | P |
| ⇅ | (See below) | ⇒ | VOLt | | |

Applicable to Macros...

| | | | | | | | |
|----------|----------|----------|----------|----------|----------|----------|----------|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ✓ | x | x | x | x | ✓ | x | x |
| x | x | x | x | ✓ | x | x | x |

Set the required mode as follows:

| Setting | Input signal | When current signal ≤3mA... | |
|---------|--------------|-----------------------------|------------------------------------|
| VOLt | 0 | 0V to 10V | |
| 0-20 | 1 | 0 to 20mA | Signal treated as zero |
| 20-0 | 2 | 20mA to 0 | Signal treated as zero |
| 4-20.tr | 3 | 4mA to 20mA | Drive trips |
| 20-4.tr | 4 | 20mA to 4mA | Drive trips |
| 4-20.Lo | 5 | 4mA to 20mA | Drive runs at minimum or low speed |
| 20-4.Lo | 6 | 20mA to 4mA | Drive runs at minimum or low speed |
| 4-20.Pr | 7 | 4mA to 20mA | Drive runs at previous speed |
| 20-4.Pr | 8 | 20mA to 4mA | Drive runs at previous speed |

0.26 Post-scaling PID reference

0.27 Post-scaling PID feedback

| | | | | | |
|---|-------|----|--|--|----|
| | RO | Bi | | | |
| ⇅ | ±1000 | ⇒ | | | Hz |

Applicable to Macros...

| | | | | | | | |
|----------|----------|----------|----------|----------|----------|----------|----------|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | x | x | x | ✓ | x | x |

These parameters are used for monitoring the PID reference and PID feedback. Refer to Macro 5 in Chapter 3 *Setting Up the Drive*.

**0.27 EUR> Positive logic select
USA> Sequencing mode selector**

Applicable to Macros...

| | | | | | | | |
|----------|----------|----------|----------|----------|----------|----------|----------|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ✓ | x | x | x | x | x | x | x |

European configuration

| | | | | | |
|------------------------------|-------|-----|---|---|---|
| Positive logic select | RW | Bit | | R | P |
| ⇅ | 0 ~ 1 | ⇒ | 0 | | |

Use **0.27** to select the logic polarity of the digital inputs, as follows:

| | |
|---|----------------|
| 0 | Negative logic |
| 1 | Positive logic |

USA configuration

| | | | | | |
|---------------------------------|-------|-----|---|--|---|
| Sequencing mode selector | RW | Uni | | | P |
| ⇅ | 0 ~ 4 | ⇒ | 4 | | |

Use **0.27** to change the functions of the digital inputs; these functions determine the *digital control mode*.

The default setting (4) gives the functions shown in the signal connection diagrams in Chapter 3 *Setting up the Drive*.

Set **0.27** at 0 for digital control by momentary contacts. See Macro 0 in Chapter 3 *Setting up the Drive*.

It is essential that you see **0.29 USA> Terminal-29 destination selector** in order to set up a **RUN PERMIT / STOP** input.

For other settings of **0.27**, see the *Commander Gp Advanced User Guide*.

0.27 Motorized potentiometer zero-start select

| | | | | | | | |
|---|-------|----|-----|---|--|--|--|
| | | RW | Bit | | | | |
| ⇅ | 0 ~ 1 | | ⇄ | 0 | | | |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | ✓ | x | x | x | x | x |

Set **0.27** for the way the motorized potentiometer is to behave at power-up of the Drive as follows:

| | |
|---|--|
| 0 | The motorized-potentiometer output returns to the value it held when the Drive was previously powered-down |
| 1 | The motorized-potentiometer output starts at zero |

0.27 Analog reference 2

| | | | | | | | |
|---|------|----|----|--|--|--|---|
| | | RO | Bi | | | | |
| ⇅ | ±100 | | ⇄ | | | | % |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | x | x | ✓ | x | x | x |

0.27 indicates the value of analog input 2 as a percentage of the full-scale value.

Analog input 2 is used for the frequency reference when Macro 4 is being used in frequency control. In this case, analog input 2 is not used for torque control.

0.28 EUR> Current-loop proportional gain

| | | | | | | | |
|---|------------|----|-----|----|--|--|--|
| | | RW | Uni | | | | |
| ⇅ | 0 ~ 30 000 | | ⇄ | 20 | | | |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ✓ | x | x | x | x | x | x | x |

Do not adjust this parameter.

0.28 Motorized potentiometer bipolar select

| | | | | | | | |
|---|-------|----|-----|---|--|--|--|
| | | RW | Bit | | | | |
| ⇅ | 0 ~ 1 | | ⇄ | 0 | | | |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | ✓ | x | x | x | x | x |

Set **0.28** as follows:

| | |
|---|----------------------------|
| 0 | Unipolar output (0 ~ 100%) |
| 1 | Bipolar output (±100%) |

0.28 USA> Frequency demand

| | | | | | | | |
|---|-------|----|----|--|--|--|----|
| | | RO | Bi | | | | P |
| ⇅ | ±1000 | | ⇄ | | | | Hz |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ✓ | x | x | x | x | x | x | x |

USA configuration

0.28 differs from **0.11 Pre-ramp reference** in that it indicates the demanded reference before frequency limiting and skip bands.

0.29 EUR> Current-loop integral gain
USA> Terminal-29 destination selector

Applicable to Macros...

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| ✓ | x | x | x | x | x | x | x |

European configuration

| RW | Uni | | | |
|----|-----|------------|---|----|
| ⇅ | | 0 ~ 30 000 | ⇨ | 40 |

Do not adjust this parameter.

USA configuration

| RW | Uni | R | P | | |
|----|-----|--------------|---|------|-----------------|
| ⇅ | | 0.00 ~ 20.50 | ⇨ | 1.41 | Menu. parameter |

Use **0.29** to change the function of the digital input on terminal 29.

The default setting (1.41) gives **LOCAL/REMOTE** switching.

When **0.27** Sequencing mode selector is set at 0, it is essential that you set **0.29** at **6.34**. This makes terminal 29 function as a stop input (**RUN PERMIT / STOP**).

0.29 Motorized potentiometer rate

| RW | Uni | | | | |
|----|-----|---------|---|----|---|
| ⇅ | | 0 ~ 250 | ⇨ | 20 | s |

Applicable to Macros...

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| x | x | ✓ | x | x | x | x | x |

Enter the required time for the motorized-potentiometer output to change by 100%.

0.28 Analog input 2 (PID reference) scaling

0.29 Analog input 3 (PID feedback) scaling

| RW | Uni | | | |
|----|-----|-------|---|---|
| ⇅ | | 0 ~ 4 | ⇨ | 1 |

Applicable to Macros...

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| x | x | x | x | x | ✓ | x | x |

If required, change the scaling of the PID reference and feedback inputs by entering appropriate values in these parameters.

0.29 Analog input 1 (Torque reference) scaling

0.30 Analog input 2 (Frequency reference) scaling

| RW | Uni | | | |
|----|-----|-------|---|---|
| ⇅ | | 0 ~ 4 | ⇨ | 1 |

Applicable to Macros...

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| x | x | x | x | ✓ | x | x | x |


If required, change the scaling of the torque reference and frequency reference inputs by entering appropriate values in these parameters.

0.30 FWD/REV key enable

| RW | Bit | | | |
|----|-----|-------|---|---|
| ⇅ | | 0 ~ 1 | ⇨ | 0 |

Applicable to Macros...

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| ✓ | x | x | x | x | x | x | x |

The Drive is supplied with the  key disabled. To enable this key, set **0.30** FWD/REV enable at 1.

| | |
|-------------|--|
| 0.30 | Motorized potentiometer output scale factor |
|-------------|--|

| | | | | | |
|---|-------|-----|---|--|--|
| | RW | Uni | | | |
| ↕ | 0 ~ 4 | ⇄ | 1 | | |

| Applicable to Macros... | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| x | x | ✓ | x | x | x | x | x |

By default, when the motorized potentiometer output is 100%, the frequency is set at 100%. If necessary, enter the required value to reduce the frequency range.

| Pr | Macro 0 | Macro 2 | Macro 3 | Macro 4 |
|-----------|---|---|-------------------------------------|---|
| 0.11 | Pre-ramp reference | Pre-ramp reference | Pre-ramp reference | Pre-ramp reference |
| 0.12 | Post-ramp reference | Post-ramp reference | Post-ramp reference | Post-ramp reference |
| 0.13 | Motor active-current | Motor active-current | Motor active-current | Motor active-current |
| 0.14 | Jog reference | Jog reference | Jog reference | Jog reference |
| 0.15 | Ramp mode <i>selector</i> | Ramp mode <i>selector</i> | Ramp mode <i>selector</i> | Ramp mode <i>selector</i> |
| 0.16 | Stop mode <i>selector</i> | Stop mode <i>selector</i> | Stop mode <i>selector</i> | Stop mode <i>selector</i> |
| 0.17 | Torque mode <i>selector</i> | Status relay <i>invert</i> | Status relay <i>invert</i> | Status relay <i>invert</i> |
| 0.18 | S-ramp <i>enable</i> | S-ramp <i>enable</i> | S-ramp <i>enable</i> | S-ramp <i>enable</i> |
| 0.19 | S-ramp da/dt limit | S-ramp da/dt limit | S-ramp da/dt limit | S-ramp da/dt limit |
| 0.20 | Skip frequency 1 | Skip frequency 1 | Skip frequency 1 | Skip frequency 1 |
| 0.21 | Skip band 1 | Skip band 1 | Skip band 1 | Skip band 1 |
| 0.22 | Skip frequency 2 | Skip frequency 2 | Skip frequency 2 | Skip frequency 2 |
| 0.23 | Skip band 2 | Skip band 2 | Skip band 2 | Skip band 2 |
| 0.24 | Analog input 1 mode <i>selector</i> | Analog input 1 mode <i>selector</i> | Analog input 1 mode <i>selector</i> | Analog input 1 (torque reference) mode <i>selector</i> |
| 0.25 | Analog input 2 mode <i>selector</i> | Motorized pot. reset | Preset reference 1 | Analog input 1 (torque reference) |
| 0.26 | | Motorized pot. output indicator | Preset reference 2 | Analog input 2 (frequency reference) mode <i>selector</i> |
| 0.27 | EUR> Positive logic <i>select</i> USA> Sequencing mode <i>selector</i> | Motorized pot. zero-start <i>select</i> | Preset reference 3 | Analog input 2 (speed reference) |
| 0.28 | EUR> Current-loop proportional gain USA> Frequency demand | Motorized pot. bipolar <i>select</i> | Preset reference 4 | Over-speed threshold |
| 0.29 | EUR> Current-loop integral gain USA> Terminal-29 destination <i>selector</i> | Motorized pot. rate | | Analog input 1 scaling |
| 0.30 | FWD/REV key <i>enable</i> | Motorized pot. output scale factor | | Analog input 2 scaling |

| Pr | Macro 5 | Macro 6 | Macro 7 |
|-----------|--|--------------------------------|-----------------------------------|
| 0.11 | Pre-ramp reference | Pre-ramp reference | Pre-ramp reference |
| 0.12 | Post-ramp reference | Post-ramp reference | Post-ramp reference |
| 0.13 | Motor active-current | Motor active-current | Motor active-current |
| 0.14 | Analog input 1 (frequency reference) mode selector | Limit forward <i>indicator</i> | Motor current magnitude |
| 0.15 | Analog input 2 (PID reference) mode selector | Run forward <i>indicator</i> | Current detected <i>indicator</i> |
| 0.16 | Analog input 3 (PID feedback) mode selector | Run reverse <i>indicator</i> | Drive healthy <i>indicator</i> |
| 0.17 | Analog input 1 (frequency reference) | Limit reverse <i>indicator</i> | At zero speed <i>indicator</i> |
| 0.18 | Analog input 2 (PID reference) | Stop mode <i>selector</i> | Brake release <i>indicator</i> |
| 0.19 | Analog input 3 (PID feedback) | Hold zero speed <i>enable</i> | Current threshold |
| 0.20 | PID proportional gain | Limit deceleration rate | Brake release delay |
| 0.21 | PID integral gain | Limit forward <i>invert</i> | |
| 0.22 | PID derivative gain | Limit reverse <i>invert</i> | |
| 0.23 | PID output high limit | | |
| 0.24 | PID output low limit | | |
| 0.25 | PID output scale factor | | |
| 0.26 | Post-scaling PID reference | | |
| 0.27 | Post-scaling PID feedback | | |
| 0.28 | Analog input 2 scaling | | |
| 0.29 | Analog input 3 scaling | | |
| 0.30 | | | |

E Diagnostics



Warning

Users must not attempt to repair a Drive if it is faulty, nor carry out fault diagnosis other than through the use of the diagnostic features described in this appendix.

Under no circumstances must the casing of the Drive be opened when the AC supply is connected.

If a Drive is faulty, it must be returned to an authorized Control Techniques distributor for repair.

When the Drive display is in Status mode, it is used for displaying coded messages. These are categorized as follows:

Status indications

When the Drive is in normal operation, the lower display shows a code which indicates the status of the Drive.

Alarm indications

If a critical condition is detected, the Drive continues operating and the lower display shows an alarm code in place of the status code. If the condition is not rectified, the Drive could trip.

The alarm message flashes alternately with the normal display indication.

Trip codes

If the Drive trips, the output is disabled so that the Drive stops controlling the motor. The lower display indicates that a trip has occurred and the upper display shows a trip code.

E.1 Status indications

| Lower display | Conditions | Drive output |
|---------------|---|--------------|
| rdY | The Drive is ready to be run. | Enabled |
| run | The Drive is running. | Enabled |
| inh | The Drive cannot be run and is waiting to enter the ready (rdY) state | Disabled |
| StoP | The Drive is holding the motor at zero speed. | Enabled |
| dEC | The Drive is decelerating the motor. | Enabled |
| SCAn | The Drive is searching for the motor frequency when synchronizing to a spinning motor. | Enabled |
| dc | The Drive is applying DC injection braking. | Enabled |
| triP | The Drive has tripped and is no longer controlling the motor. The trip code appears on the upper display. | Enabled |

E.2 Alarm indications

| Lower display | Conditions |
|---------------|--|
| br.rS | The braking-resistor [I x t] accumulator in the Drive has reached 75% of the value at which the Drive will be tripped. |
| OVLd | The motor [I x t] accumulator in the Drive has reached 75% of the value at which the Drive will be tripped. |
| hot | The Drive heatsink has reached 95°C (203°F) and the output current has not been reduced (sufficiently). |
| Air | The temperature of the air around the control circuits is near the maximum permissible. |

E.3 Trip codes

| Lower display | No. | Conditions |
|----------------|-----|--|
| UU | 1 | Insufficient DC-bus voltage. This occurs when the AC supply is removed. |
| OU | 2 | Excessive DC-bus voltage. Excessive regenerated power caused by the following: 0.04 Deceleration rate value too low Braking resistor not being used |
| OI.AC | 3 | Excessive output current caused by: 0.03 Acceleration rate value too low 0.04 Deceleration rate value too low Excessive motor-cable capacitance Short-circuit at the output of the Drive |
| OI.br | 4 | Excessive current in the braking resistor. A short-circuit exists across the braking resistor. |
| PS | 5 | Internal power supply fault. Remove and re-connect the AC supply. If the trip persists, contact the supplier of the Drive. |
| Et | 6 | External trip signal applied to terminal 30. Remove the trip signal, then reset the Drive. |
| OV.SPd | 7 | The motor has exceeded the over-speed threshold. This can be caused by the following: Sudden removal of a large mechanical load 0.04 Deceleration rate too low Inappropriate 0.16 Stop mode setting 0.19 S-ramp da/dt too high (not used in Macro 5) |
| SEP | 9 | Trip in UD50 small option module. For more information, see the User Guide. |
| ENC.PH8 | 18 | Autotune fail (limit-switch operated, trip, etc). |
| It.br | 19 | Excessive braking-resistor [I x t] |
| It.AC | 20 | The [I x t] thermal overload accumulator has reached 100% (see the OVLd alarm). |

| | | |
|----------------|----|--|
| Oh1 | 21 | Excessive heatsink temperature due to excessive [I x t] (see the hot alarm). |
| Oh2 | 22 | Excessive heatsink temperature detected by thermistor. |
| OA | 23 | The temperature of the air around the control circuits is excessive (see the Air alarm). |
| th | 24 | The motor thermistor has detected excessive motor temperature (or the thermistor or wiring is open-circuit). |
| thS | 25 | The motor thermistor or wiring is short-circuit. |
| OP.OVLd | 26 | The total current drawn from terminals 22 and 24 exceeds 200mA. |
| cL1 | 27 | When configured for current signal, loss of signal current at terminals 5 and 6 (Analog input 1). |
| cL2 | 28 | When configured for current signal, loss of signal current at terminal 7 (Analog input 2). |
| cL3 | 29 | When configured for current signal, loss of signal current at terminal 8 (Analog input 3). |
| SCL | 30 | Loss of serial communications with the Universal Remote Keypad |
| EEF | 31 | Fault in the internal EEPROM causing loss of parameter values. Follow the procedure <i>Restoring all parameters to the default values</i> in Appendix A, then re-enter the values for the application. |
| Ph | 32 | Loss of an AC supply phase. |
| rS | 33 | Incorrect measurement of stator resistance due to the following: Motor cable disconnected when the measurement was being made Motor too small for the Drive See <i>Autotune</i> in Chapter 2 <i>Getting Started</i> . |

| Lower display | No. | Conditions |
|----------------|-----|---|
| SEP.diS | 180 | <p>The UD55 small option module has been removed or is not fitted correctly.</p> <p>Perform either of the following:</p> <p>Ensure a UD55 small option module is correctly fitted</p> <p>To operate the Drive without a UD55, set parameter .00 at 1000 and press the STOP/RESET key.</p> |
| FSH.Err | 182 | <p>The memory of the UD55 small option module has been found to be corrupt. If the trip has occurred at power-up, the memory is automatically re-formatted and all the parameter-sets are erased. If the trip occurs after power-up, the memory and parameter-sets are unaffected. See the <i>UD55 User Guide</i>.</p> |
| FSH.Dat | 183 | <p>No values have been found in the selected parameter-set in the UD55 small option module. Consequently, no values have been copied to the destination Drive.</p> |
| FSH.TyP | 184 | <p>The operating mode of the destination Drive is different from that related to the selected parameter-set in the UD55 small option module. Consequently, no values have been copied to the destination Drive. Select an appropriate parameter-set.</p> |
| FSH.ACC | 185 | <p>Write-access to the UD55 small option module has not been enabled. Consequently, no values have been copied to the destination Drive. To enable write-access, connect together terminals 40 and 41 on the UD55.</p> |
| FSH.rn9 | 188 | <p>The current rating or voltage rating of the destination Drive is different from that relating to the selected parameter-set in the UD55 small option module. Consequently, all parameter values have been copied to the destination Drive except for those listed in <i>Transferring parameter-sets between Drives of different ratings</i> in the <i>UD55 User Guide</i>.</p> |

