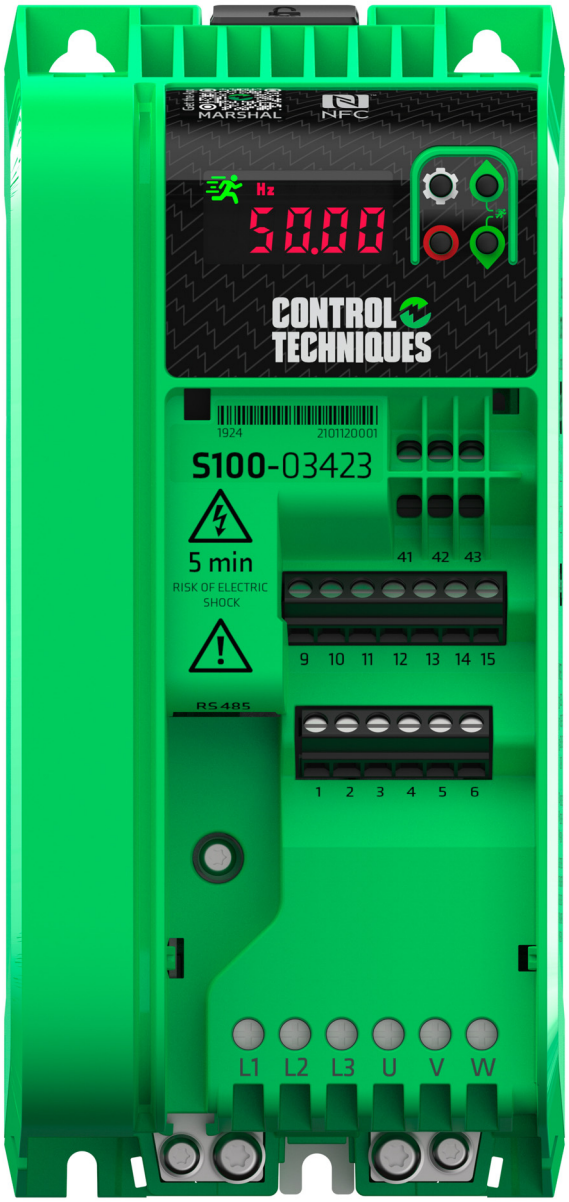
Nidec

All for dreams



Control User Guide

Commander S100

Variable Speed AC drive for induction motors

Part Number: 0478-0650-00
Issue: 0

MARSHAL

Available on the App Store

GET IT ON Google Play

Original Instructions

For the purposes of compliance with the EU Machinery Directive 2006/42/EC, the English version of this User Guide is the Original Instructions.

User Guides in other languages are Translations of the Original Instructions.

The information contained in this User Guide is believed to be correct at the time of printing and does not form part of any contract. The manufacturer reserves the right to change the specification of the product and its performance, and the contents of the User Guide, without notice.

Documentation & User Software Tools

User Guides, datasheets and software are available to download from: **http://www.drive-setup.com**

Marshal (Mobile App) is available to download from the Google Play store and the App Store.

Warranty and Liability

In no event and under no circumstances shall the manufacturer be liable for damages and failures due to misuse, abuse, improper installation, or abnormal conditions of temperature, dust, or corrosion, or failures due to operation outside the published ratings. The manufacturer is not liable for consequential and incidental damages. Contact the supplier of the drive for full details of the warranty terms.

Environmental policy

Control Techniques operates an Environmental Management System (EMS) that conforms to the International Standard ISO 14001. Further information on our Environmental Policy can be found at: **http://www.drive-setup.com/environment**

Restriction of Hazardous Substances (RoHS)

The products covered by this User Guide comply with European and International regulations on the Restriction of Hazardous Substances including EU directive 2011/65/EU and the Chinese Administrative Measures for Restriction of Hazardous Substances in Electrical and Electronic Products.

Disposal and Recycling (WEEE)

When electronic products reach the end of their useful life, they must not be disposed of along with domestic waste but should be recycled by a specialist recycler of electronic equipment. Control Techniques products are designed to be easily dismantled into their major component parts for efficient recycling. The majority of materials used in the product are suitable for recycling.

Product packaging is of good quality and can be re-used. Smaller products are packaged in strong cardboard cartons which have a high recycled fibre content. Cartons can be re-used and recycled. Polythene, used in protective film and bags for wrapping the product, can be recycled. When preparing to recycle or dispose of any product or packaging, please observe local legislation and best practice..

REACH legislation

EC Regulation 1907/2006 on the Registration, Evaluation, Authorisation and restriction of Chemicals (REACH) requires the supplier of an article to inform the recipient if it contains more than a specified proportion of any substance which is considered by the European Chemicals Agency (ECHA) to be a Substance of Very High Concern (SVHC) and is therefore listed by them as a candidate for compulsory authorisation.

Further information on our compliance with REACH can be found at: **http://www.drive-setup.com/reach**

Registered Office

Nidec Control Techniques Ltd
The Gro
Newtown
Powys
SY16 3BE
UK
Registered in England and Wales. Company Reg. No. 01236886.

Copyright

The contents of this publication 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.

All rights reserved. No parts of this User Guide may be reproduced or transmitted in any form or by any means, electrical or mechanical including photocopying, recording or by an information storage or retrieval system, without permission in writing from the publisher.

Copyright © February 2021 Nidec Control Techniques Ltd

Contents

1 Safety information 4
1.1 Important Safety Information 4
1.2 Responsibility 4
1.3 Compliance with regulations 4
1.4 Electrical hazards 4
1.5 Mechanical hazards 5
1.6 Access to equipment 5
1.7 Environmental limits 5
1.8 Hazardous environments 5
1.9 Motor 5
1.10 Adjusting parameters 5
1.11 Electromagnetic compatibility (EMC) 5
1.12 Repairs 5
1.13 Maintenance 5

2 Electrical installation 6
2.1 Control connections 6

3 Drive Parameters 9
3.1 Parameter Groups 9
3.2 Menu 0 - Quick Start 10
3.3 Full Parameter List 10
3.4 Menu 1 - Status & Monitoring 11
3.5 Menu 2 - Reference & Ramps 12
3.6 Menu 3 – Motor Setup 13
3.7 Menu 4 - General 13
3.8 Menu 5 - PID Controller 14
3.9 Menu 6 - IO Configuration 15
3.10 Parameter Descriptions 16

1 Safety information

1.1 Important Safety Information

Specific warnings are given at the relevant places in this User Guide as follows:

WARNING

A Warning contains information which is essential for avoiding a safety hazard.

CAUTION

A Caution contains information which is necessary for avoiding a risk of damage to the product or other equipment.

NOTE

A Note contains information which helps to ensure correct operation of the product.

1.1.1 Hazards

This User Guide applies to the Commander S100 and auxiliary equipment. In all cases the hazards associated with powerful electrical drives are present, and all safety information relating to drives and associated equipment must be observed.

1.1.2 Competence of Designers and Installers

Drives and controllers are intended as components for professional incorporation into complete systems. If installed incorrectly they may present a safety hazard. The drive uses high voltages and currents, carries a high level of stored electrical energy, and is used to control equipment which can cause injury. Close attention is required to the electrical installation and the system design to avoid hazards either in normal operation or in the event of equipment malfunction. System design, installation, commissioning and maintenance must be carried out by personnel who have the necessary training and competence. They must read all of the safety information and instructions in this User Guide carefully

1.2 Responsibility

It is the responsibility of the installer to ensure that the equipment is installed correctly with regard to all instructions given in this User Guide. They must give due consideration to the safety of the complete system, so as to avoid the risk of injury both in normal operation and in the event of a fault or of reasonably foreseeable misuse.

The manufacturer accepts no liability for any consequences resulting from inappropriate, negligent or incorrect installation of the equipment.

1.3 Compliance with regulations

The installer is responsible for complying with all relevant regulations, such as national wiring regulations, accident prevention regulations and electromagnetic compatibility (EMC) regulations. Particular attention must be given to the cross-sectional areas of conductors, the selection of fuses or other protection, and protective ground (earth) connections.

This guide contains instructions for achieving compliance with specific EMC standards.

All machinery to be supplied within the European Union in which this product is used must comply with the following directives:

2006/42/EC Safety of machinery.

2014/30/EU: Electromagnetic Compatibility.

1.4 Electrical hazards

The voltages used in the drive can cause severe electrical shock and/or burns, and could be lethal. Extreme care is necessary at all times when working with or adjacent to the drive. Hazardous voltage may be present in any of the following locations:

- AC and DC supply cables and connections
- Output cables and connections
- Control terminals and cables
- Many internal parts of the drive, and external option units

The drive must be installed in accordance with the instructions given in this User Guide. Failure to observe the instructions could result in a fire hazard

1.4.1 Isolating the Drive

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 by an approved electrical isolation at least five minutes before work may continue. Ensure the motor is not able to be driven by another part of the system as this could produce a regenerating current which could cause unsafe voltages on the drive terminals.

1.4.2 Stored Charge

Normally, the capacitors are discharged by an internal resistor. Under certain, unusual fault conditions, it is possible that the capacitors may fail to discharge or be prevented from being discharged by a voltage applied to the output terminals. If the drive has failed in a manner that causes the display to go blank immediately, it is possible the capacitors will not be discharged. In this case, contact the supplier of the drive.

1.4.3 Products Connected by Plug and Socket

A special hazard may exist where the drive is incorporated into a product which is connected to the supply by a plug and socket. When unplugged, the pins of the plug may be connected to the drive input, which is separated from the charge stored in the capacitor only by semiconductor devices. To avoid any possibility of electric shock from the pins, if they are accessible, a means must be provided for automatically isolating the plug from the drive - e.g. a latching contactor.

1.4.4 Grounding / Earthing

The drive must be grounded by a conductor sufficient to carry the prospective fault current in the event of a fault and in a zone of equipotential bonding. The ground loop impedance must conform to the requirements of local safety regulations. The ground connections must be inspected and tested at appropriate intervals.

Ground conductor size:- Either a single copper 10 mm² conductor or two conductors of the same cross-sectional area and material as the input conductors so long as the size of each conductor is 2.5 mm2. For location of ground connections refer to Figure 1-1 in the Step by Step guide.

Each ground connection requires an individual terminal or connection point. If using two conductors for the input and the cable management bracket, the motor ground should be connected to the grounding bracket.

1.4.5 Fuses and Circuit Breakers

The AC supply to the drive must be installed with suitable protection against overload. Failure to observe this requirement will cause risk of fire. Integral solid-state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code (NEC), The Canadian Electrical Code, and any additional local codes. Opening of the branch-circuit protective device may be an indication that a fault has been interrupted. To reduce the risk of fire or electric shock, the equipment should be examined and replaced if damaged. If burnout of the current element of an overload relay occurs, the complete overload relay must be replaced. If opting to use a residual current device, only type B should be used with the drive.

1.4.6 Over-Current Protection

The devices incorporate solid state overload protection for the motor load. The protection levels are expressed as a percentage of full-load current. For the motor protection to work properly, Motor Rated Current (P0.06) must be set correctly. The protection level may be adjusted below 150 % if required using Motor Output Current Limit (P3.17). All models are provided with thermal memory retention.

1.4.7 Isolation of control circuits

Unless otherwise indicated, control terminals and the EIA-485 Communications port are isolated from the power circuits in the drive by double/reinforced insulation. The installer must ensure that the external control circuits do not compromise this insulation barrier. If the control circuits are to be connected to circuits classified as Safety Extra Low Voltage (SELV) - for example, to a personal computer - an additional basic barrier must be included in order to maintain the SELV classification.

1.4.8 Terminal Connections and Torque Settings

Loose power connections are a fire risk. Always ensure that terminals are tightened to the specified torques. Refer to the tables in chapter 4 Electrical Installation.

1.5 Mechanical hazards

Careful consideration must be given to the functions of the drive or controller which might result in a hazard, either through their intended behaviour or through incorrect operation due to a fault. In any application where a malfunction of the drive or its control system could lead to or allow damage, loss or injury, a risk analysis must be carried out, and where necessary, further measures taken to reduce the risk - for example, an over-speed protection device in case of failure of the speed control, or a fail-safe mechanical brake in case of loss of motor braking.

None of the drive functions must be used to ensure safety of personnel. i.e. they must not be used for safety-related functions.

The system designer is responsible for ensuring that the complete system is safe and designed correctly according to the relevant safety standards.

The design of safety-related control systems must only be done by personnel with the required training and experience. The system must be subject to a risk assessment to confirm that the residual risk of an unsafe event is at an acceptable level for the application.

1.6 Access to equipment

Access must be restricted to authorized personnel only. Safety regulations which apply at the place of use must be complied with.

1.7 Environmental limits

Instructions in this guide regarding transport, storage, installation and use of the equipment must be complied with, including the specified environmental limits. This includes temperature, humidity, contamination, shock and vibration. Drives must not be subjected to excessive physical force.

1.8 Hazardous environments

The equipment must not be installed in a hazardous environment (i.e. a potentially explosive environment).

1.9 Motor

The safety of the motor under variable speed conditions must be ensured.

To avoid the risk of physical injury, do not exceed the maximum specified speed of the motor.

Low speeds may cause the motor to overheat because the cooling fan becomes less effective, causing a fire hazard. If possible, the motor should be installed with a protection thermistor. If necessary, an electric forced vent fan should be used.

The values of the motor parameters set in the drive affect the protection of the motor. The default values in the drive must not be relied upon. It is essential that the correct value is entered in the *Motor Rated Current* (P3.01).

1.9.1 Motor Sizing

The motor rated current should not exceed the maximum continuous output current of the drive. The maximum output voltage of the drive is not able to exceed the input voltage and the rated voltage of the motor should therefore be less than this value. Typical overloads are 150% for 60 s (from cold) or 150% for 8 s (from hot). The drive will initiate an error if the drive output current exceeds the over-current threshold which could occur in the event of a short circuit of the motor output cables. The over-current threshold is the maximum current the drive can measure.

1.10 Adjusting parameters

It is essential that changes to the drive parameters are given careful consideration. Depending on the application, a change could result in unexpected motor behaviour. Appropriate precautions must be taken against inadvertent changes or tampering. Some specific parameters which require particular care are: parameters in IO Configuration (Menu 6) (the drive may start unexpectedly if the logic or functions are changed); *Restore Factory Defaults* (P4.01) (depending on the application this may cause unpredictable or hazardous operation); parameters in *Motor Setup* (Menu 3) (overheating and possible fire risk could result from seriously incorrect settings).

1.11 Electromagnetic compatibility (EMC)

Installation instructions for a range of EMC environments are provided in section 4.5 Electromagnetic compatibility (EMC). If the installation is poorly designed or other equipment does not comply with suitable standards for EMC, the product might cause or suffer from disturbance due to electromagnetic interaction with other equipment. It is the responsibility of the installer to ensure that the equipment or system into which the product is incorporated complies with the relevant EMC legislation in the place of use.

1.12 Repairs

Users must not attempt to repair a drive if it is faulty. It must be returned to the supplier of the drive. Users must not make any attempt at removing drive plastics to inspect the internal parts of the drive.

1.13 Maintenance

Regular inspections and maintenance should be carried out to ensure drive's reliability is maximized. See detailed information in the in section 3.11 Routine Maintenance.

2 Electrical installation

2.1 Control connections

2.1.1 General Warnings

CAUTION

If any of the digital inputs are connected in parallel with an inductive load (i.e. contactor or motor brake) then suitable suppression (i.e. diode or varistor) should be used on the coil of the load. If no suppression is used, then over voltage spikes can cause damage to the digital inputs and outputs on the drive.

CAUTION

The control 0 V terminals are connected to earth but must not be used for protective purposes.

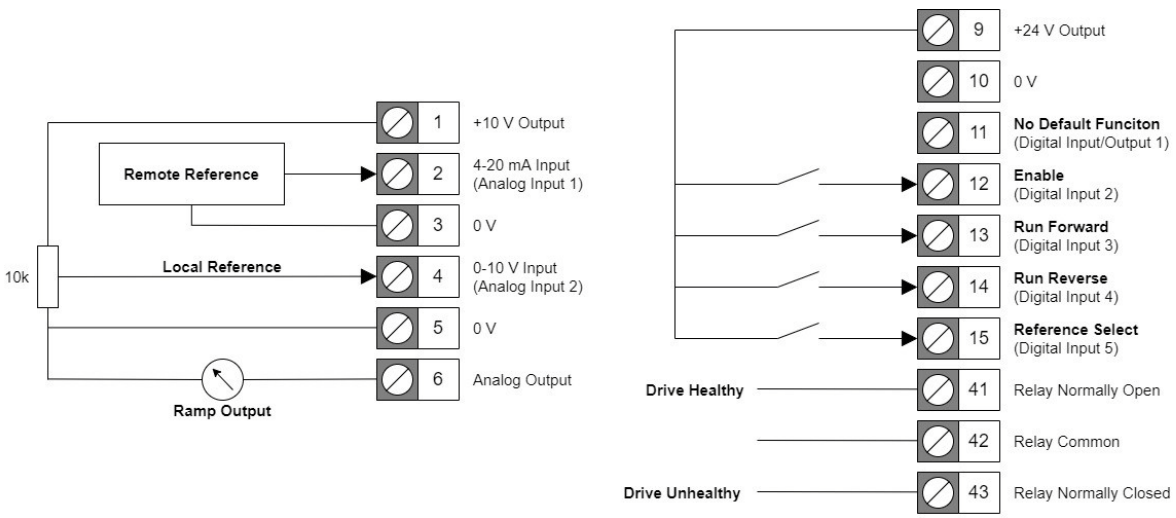
NOTE

Any signal cables which are carried inside the motor cable (i.e. motor thermistor, motor brake) will pick up large pulse currents via the cable capacitance. The shield of these signal cables must be connected to ground close to the point of exit of the motor cable, to avoid this noise current spreading through the control system.

2.1.2 Control Terminal Connections

The default connections are suitable for basic motor speed control using analog inputs to define a frequency reference.

Figure 2-1 Default Control Terminal Connections



2.1.3 Control Terminal Specification

Control and relay terminals maximum cable size is 1.5 mm^2

T1	+10 V User Output
Supply for external analog devices	
Nominal voltage	10.2 V
Voltage tolerance	±3 %

T2	Analog Input 1
Unipolar single-ended analog voltage or unipolar current input	
Default function	Remote Frequency Reference
Default Type	4 to 20 mA
Type Select Parameter	*T2 Analog Input 1 Type* (P6.01)
As a Voltage Input (Default)	
Full scale voltage range	0 V to +10 V ±3 %
Maximum offset	±30 mV
Absolute maximum voltage range	-18 V to +30 V relative to 0V
Input resistance	100k Ω
As a Current Input	
Current ranges	0 to 20 mA ±5 %, 4 to 20 mA ±5 %
Maximum offset	250 µA
Absolute maximum voltage (reverse bias)	-18 V to +30 V relative to 0V
Absolute maximum current	25 mA

T2	Analog Input 1 (Continued)
As a Digital Input	
Digital Function Select Parameter	*T2 Analog Input 1 Digital Function Select* (P6.14)
Switching Threshold as a Voltage Input	70 to 80 % *1
Switching Threshold as a Current Input	45 to 55 %
Common to all modes	
Resolution	11 bits
Sample rate	4 ms

T3,T5, T10	0 V Common
Unipolar single-ended analog voltage or unipolar current input	

T4	Analog Input 2
Unipolar single-ended analog voltage or unipolar current input	
Default function	Ramp Output
Default Type	0 to 10 V
Type Select Parameter	*T4 Analog Input 2 Type* (P6.02)
As a Voltage Input (Default)	
Full scale voltage range	0 V to +10 V ±3 %
Maximum offset	±30 mV
Absolute maximum voltage range	-18 V to +30 V relative to 0V
Input resistance	100k Ω
As a Current Input	
Current ranges	0 to 20 mA ±5 %, 4 to 20 mA ±5 %
Maximum offset	250 µA
Absolute maximum voltage (reverse bias)	-18 V to +30 V relative to 0V
Absolute maximum current	25 mA
As a Digital Input	
Digital Function Select Parameter	*T4 Analog Input 2 Digital Function Select* (P6.15)
Switching Threshold as a Voltage Input	70 to 80 % *1
Switching Threshold as a Current Input	45 to 55 %
Common to all modes	
Resolution	11 bits
Sample rate	4 ms

T6	Analog Output
Unipolar single-ended analog voltage or unipolar current output	
Default function	Ramp Output
Function Select Parameter	*T6 Analog Output Function Select* (P6.06)
Default type	0 to 10 V
Type Select Parameter	*T6 Analog Output Type* (P6.03)
Voltage Range	0 to 10 V
Current Range	0 to 20 mA or 4 to 20 mA
Maximum offset	15 mV
Load resistance	± 2k Ω
Protection	Short circuit relative to 0 V
Resolution	0.1 %
Sample rate	4 ms

T9	+24 V User Output
Supply for external analog devices	
Voltage tolerance	±20 %
Maximum output current	100 mA (Shared with T11 Digital Output)

T11	Digital Input/Output 1
Multi-functional digital input or output	
Default Function	None
Function Select Parameters	*T11 Digital Input 1 Function* (P6.16) *T11 Digital Output Function Select* (P6.09)
Default type	Digital Input (Positive Logic)
Type Select Parameter	*T11 Digital IO 1 Type* (P6.04)
As a digital input (default)	
Lower Threshold	< 5 V
Upper Threshold	> 11 V

T11	Digital Input/Output 1 (Continued)
Absolute maximum applied voltage range	-8 V to +30 V relative to 0V
Impedance	6.8 kΩ
Input threshold	10 V ±0.8 V (IEC 61131-2)
As a digital output	
Maximum Source Current	50 mA (100 mA total limit on T9 and T11)
As a Frequency or PWM Output	
Maximum Output	
PWM Output	
Resolution at Maximum Output	
Resolution at Minimum Input	
Common to all output types	
Voltage Range	0 V to +24 V
Sample rate	4 ms

T12	Digital Input 2
T13	Digital Input 3
T14	Digital Input 4
Programmable Digital Inputs	
T12 Default Function	Enable
T13 Default Function	Run Forward
T14 Default Function	Run Reverse
Function Select Parameters	*T12 Digital Input 2 Function (*P6.17) *T13 Digital Input 3 Function (*P6.18) *T14 Digital Input 4 Function (*P6.19)
Default Logic	Positive Logic
Lower Threshold	< 5 V
Upper Threshold	> 11 V
Absolute maximum applied voltage range	-8 V to +30 V relative to 0V
Impedance	6.8 kΩ
Input threshold	10 V ±0.8 V (IEC 61131-2)
Voltage Range	0 V to +24 V
Sample rate	4 ms

T15	Digital Input 5
Programmable Digital Input or Frequency Input	
T15 Default Function	Enable
Function Select Parameter	*T15 Digital Input 5 Function (*P6.20)
Default Logic	Positive Logic
Lower Threshold	< 5 V
Upper Threshold	> 11 V
Absolute maximum applied voltage range	-8 V to +30 V relative to 0V
Impedance	6.8 kΩ
Input threshold	10 V ±0.8 V (IEC 61131-2)
Voltage Range	0 V to +24 V
Sample rate	4 ms
As a Frequency Input	
Maximum Frequency	100 kHz

T41	**Relay Normally Open**
T42	**Relay Common**
T43	**Relay Normally Closed**

Programmable Relay	
Relay Default Function	Drive Healthy
Function Select Parameter	*T12 Digital Input 2 Function (*P6.17)
Default Logic	Positive Logic
Lower Threshold	< 5 V
Upper Threshold	> 11 V
Absolute maximum applied voltage range	-8 V to +30 V relative to 0V
Impedance	6.8 kΩ
Input threshold	10 V ±0.8 V (IEC 61131-2)
Voltage Range	0 V to +24 V
Sample rate	4 ms

3 Drive Parameters

Parameters are variables within the drive that can be used to monitor output levels and drive statuses or to control the settings within the drive. Parameters are divided into six menus based on their function which are:.

Menu 1 - Status & Monitoring (All read-only parameters)

Menu 2 - References and Ramps

Menu 3 - Motor Setup

Menu 4 - General

Menu 5 - PID Controller

Menu 6 - IO Configuration

There is also a quick start menu (Menu 0) that contains shortcuts to ten parameters used for basic drive setup. Because parameters in menu 0 are shortcuts, changing the value of the parameter in menu 0 will also change the value in its original menu and vice versa.

3.1 Parameter Groups

The parameter groups listed below are parameters that behave in the same way.

Configuration Parameters

Automatically adjust settings of multiple parameters to quickly setup a certain function.

- *Frequency Reference Configuration* (P0.05)
- *Enable/Run Configuration* (P0.10)

Selector Parameters

Select an analog value to be used as an input.

- *Reference Selector 1* (P2.21)
- *Reference Selector 2* (P2.22)
- *Reference Selector 3* (P2.23)
- *Reference Selector 4* (P2.24)
- *PID Reference Selector* (P5.02)
- *PID Feedback Selector* (P5.03)
- *PID Feedforward Selector* (P5.04)
- *PID Enable Selector* (P5.10)
- *Threshold Detector Selecto*r (P5.11)

Input Function Select Parameters

Define the function of an input

- *Keypad Run/Stop Key Function Select* (P4.07)
- *T2 Analog Input 1 Digital Function Select* (P6.14)
- *T4 Analog Input 2 Digital Function Select* (P6.15)
- *T11 Digital Input 1 Function Select* (P6.16)
- *T12 Digital Input 2 Function Select* (P6.17)
- *T13 Digital Input 3 Function Select* (P6.18)
- *T14 Digital Input 4 Function Select* (P6.19)
- *T15 Digital Input 5 Function Select* (P6.20)

Output Function Select Parameters

Define the function of an output

- *T6 Analog Output Function Select* (P6.06)
- *T11 Digital Output 1 Function Select* (P6.09)
- *T11 Frequency/PWM Output Function* Select (P6.10)

3.2 Menu 0 - Quick Start

For a description of a parameter in menu 0, refer to the alternative location of the parameter in the section 7.4 Parameter Descriptions.

Parameter		Range (Default)	Alternative Location
P0.01	Minimum Frequency Clamp	0.0 to 300.0 Hz **(50 Hz: -50.0 Hz, 60 Hz: -60.0 Hz)**	P2.01
P0.02	Maximum Frequency Clamp	0.0 to 300.0 Hz **(50 Hz: 50.0 Hz, 60 Hz: 60.0 Hz)**	P2.02
P0.03	Acceleration Rate 1	0.0 to 6000.0 s/Hz(max) **(5.0 s/Hz(max))**	P2.07
P0.04	Deceleration Rate 1	0.0 to 6000.0 s/Hz(max) **(10.0 s/Hz(max))**	P2.08
P0.05	Frequency Reference Configuration	Custom (0), **Local/Remote (1),** Voltage/Preset Input (2), Current/Preset Input (3), Presets (4), Keypad (5), Terminal Up/Down (6), Frequency Input (7), PID Voltage Ref. (8), PID + Feed Forward (9)	P2.03
P0.06	Motor Rated Current	0.00 to Drive Rated Current A **(Rating Dependent)**	P3.01
P0.07	Motor Rated Speed	0 to 18000 rpm **(50 Hz: 1500 rpm, 60 Hz: 1800 rpm)**	P3.02
P0.08	Motor Rated Voltage	0 to Drive Rated Voltage **(Rating Dependent)**	P3.03
P0.09	Motor Rated Power Factor	0.00 to 1.00 **(0.80)**	P3.04
P0.10	Run/Stop Configuration	Custom (0), **Enable + Run Forward + Run Reverse (1),** Run Forward + Run Reverse (3 Wire) (2), Enable + Run + Reverse (3), Run + Reverse (4), Run + Jog (5), Run Forward + Run Reverse (6), Run + Reverse (7), Keypad (8), Keypad With Enable (9), Keypad Jog (10)	P6.13

3.3 Full Parameter List

The list below contains all parameters within the drive and states the possible settings of the parameter with the default value outlined in bold where applicable. For further description of the parameters refer to section 7.4 *Parameter Descriptions* or the help within the Marshal App that contain useful graphics.

The lists in this table are for reference only and do not include sufficient information for adjusting these parameters. Incorrect adjustment can affect the safety of the system and damage the drive and or external equipment. Before attempting to adjust any of these parameters, refer to section 7.4 *Parameter Descriptions*.

3.4 Menu 1 - Status & Monitoring

Parameter		Range
P1.01	Output Frequency	- *Maximum Frequency Reference* (P2.02) to *Maximum Frequency Reference* (P2.02) Hz
P1.02	Output Voltage	0 to Maximum Output Voltage V (110 V, 200 V Drives = 240 V, 400 V Drives = 480 V)
P1.03	Output Power	Drive Rating Dependent kW
P1.04	Motor RPM	±18000 rpm
P1.05	Drive State	Inhibited (0), Ready (1), NA (2), NA (3), Running (4), Supply Loss (5), Deceleration (6), Injecting DC (7), NA (8), Error (9), NA (10), NA (11), NA (12), NA (13), NA (14), Under Voltage (15)
P1.06	Output Current	- Drive Rated Current to Drive Rated Current A
P1.07	Torque Producing Current	- Drive Rated Current to Drive Rated Current A
P1.08	Percentage Load	- Motor Output Current Limit (Max) to Motor Output Current Limit (Max) %
P1.09	Alarm Indicators	00000000 to 11111111
P1.10	Drive Status Indicators	00000000 to 11111111
P1.11	Sequencer Input and Output Indicators	00000000 to 11111111
P1.12	Run & Direction Indicators	00000000 to 11111111
P1.13	Ramp Input	± *Maximum Frequency Reference* (P2.02) Hz
P1.14	Ramp Output	± *Maximum Frequency Reference* (P2.02) Hz
P1.15	T2 Analog Input 1 Percentage	±100.00 %
P1.16	T4 Analog Input 2 Percentage	±100.00 %
P1.17	T15 Frequency Input Percentage	±100.00 %
P1.18	Up/Down Percentage	0.00 to 100.00 %
P1.19	PID Percentage	±100.00 %
P1.20	PID Status Indicators	00000000 to 11111111
P1.21	PID Error	±100.00 %
P1.22	Motor Thermal Percentage	0 to 100 %
P1.23	Drive Thermal Percentage	0 to 100 %
P1.24	DC Bus Voltage	0 to Maximum D.C. Link Voltage V (110 V, 200 V Drives = 415 V, 400 V Drives = 830 V)
P1.25	Digital IO Indicators	00000000 to 11111111
P1.26	Parameter 1 Saved Value on Error	-32768 to 32767
P1.27	Parameter 2 Saved Value on Error	-32768 to 32767
P1.28	Parameter 3 Saved Value on Error	-32768 to 32767
P1.29	Error	0 to 255
P1.30	Error History 1	0 to 255
P1.31	Error History 2	0 to 255
P1.32	Error History 3	0 to 255
P1.33	Drive Diagnostic	0 to 15

3.5 Menu 2 - Reference & Ramps

	Parameter	Range	Default
P2.01	Minimum Frequency Limit	0.0 to 300.0 Hz	0.0 Hz
P2.02	Maximum Frequency Limit	0.0 to 300.0 Hz	50Hz: 50.0 Hz 60Hz: 60.0 Hz
P2.03	Frequency Reference Configuration	Custom (0), Local/Remote (1), Voltage/Preset Input (2), Current/Preset Input (3), Presets (4), Keypad (5), Terminal Up/Down (6), Frequency Input (7), PID Voltage Ref. (8), PID + Feed Forward (9)	Local/Remote (1)
P2.04	Stopping Mode Selector	Coast (0), Ramp (1), Ramp & Brake (2), DC Brake, 0Hz detect (3), Timed DC Brake (4)	Ramp (1)
P2.05	S-Ramp Percentage	0.0 to 50.0	0.0
P2.06	Acceleration Rate 1	0.0 to 6000.0 s	5.0 s
P2.07	Deceleration Rate 1	0.0 to 6000.0 s	10.0 s
P2.08	Acceleration Rate 2	0.0 to 6000.0 s	5.0 s
P2.09	Deceleration Rate 2	0.0 to 6000.0 s	10.0 s
P2.10	Ramp Rate Selector	0 to 2	0
P2.11	Deceleration Ramp Type	Fast (0), Standard Ramp (1), Standard Ramp + Motor (2)	Standard Ramp (1)
P2.12	Standard Ramp Voltage	0 to DC Link Voltage (Max) V	400V drive 50Hz: 375 V 400V drive: 750 V 400V drive 60Hz: 775 V
P2.13	Jog Frequency	± Maximum Frequency Reference (P2.02) Hz	1.5 Hz
P2.14	Up/Down Percent Configuration	Reset (0), Last (1), Preset 1 (2), Keypad and Reset (3), Keypad and Last (4), Keypad and Preset 1 (5)	Reset (0)
P2.15	Up/Down Percentage Time to Max	0 to 250 s	20 s
P2.16	Preset Frequency 1	± Maximum Frequency Reference (P2.02) Hz	5.0 Hz
P2.17	Preset Frequency 2		10.0 Hz
P2.18	Preset Frequency 3		25.0 Hz
P2.19	Preset Frequency 4		50.0 Hz
P2.20	Frequency Reference 1 to 4 Selector	Binary (0), Freq. Reference 1 (1), Freq. Reference 2 (2), Freq. Reference 3 (3), Freq. Reference 4 (4)	Binary (0)
P2.21	Frequency Reference 1 Selector	None (0), Preset 1 (1), Preset 2 (2), Preset 3 (3), Preset 4 (4), Up/ Down Percent (5), Analog 1 Percent (6), Analog 2 Percent (7), Frequency Input % (8), PID Percent (9)	Analog 1 Percent (6)
P2.22	Frequency Reference 2 Selector		Analog 2 Percent (7)
P2.23	Frequency Reference 3 Selector		None (0)
P2.24	Frequency Reference 4 Selector		None (0)
P2.25	Skip Frequency	- Maximum Frequency Reference (P2.02) to Maximum Frequency Reference (P2.02) Hz	0.0 Hz
P2.26	Skip Frequency Band	0.0 to 25.0 Hz	0.0 Hz

3.6 Menu 3 – Motor Setup

	Parameter	Range	Default
P3.01	Motor Rated Current	VM_RATED_CURRENT[MIN] to VM_RATED_CURRENT[MAX] A	6.80 A
P3.02	Motor Rated Speed	0 to 18000 rpm	50 Hz: 1500 rpm 60 Hz: 1800 rpm
P3.03	Motor Rated Voltage	0 to Drive Rated Voltage V	400 V drive 50 Hz: 230 V 400 V drive: 400 V 400 V drive 60 Hz: 460 V
P3.04	Motor Rated Power Factor	0.00 to 1.00	0.80
P3.05	Motor Control Mode	Resistance Comp (0), Linear V to F (1), Square V to F (2)	Linear V to F (1)
P3.06	Motor Starting Boost	0.0 to 25.0	5.0
P3.07	Motor Starting Boost End Voltage	0.0 to 100.0	50.0
P3.08	Motor Starting Boost End Frequency	0.0 to 100.0	50.0
P3.09	Perform Auto-tune	Off (0) or On (1)	Off (0)
P3.10	Energy Optimiser	Off (0) or On (1)	Off (0)
P3.11	Catch An Already Spinning Motor	Disabled (0), Enabled (1), Forwards Only (2), Reverse Only (3)	Disabled (0)
P3.12	PWM Switching Frequency	Off (0) or On (1)	Off (0)
P3.13	DC Braking Current Level	0.0 to 150.0	100.0
P3.14	DC Braking Time	0.0 to 100.0 s	1.0 s
P3.15	Motor Rated Frequency	0.0 to 300.0 Hz	50 Hz: 50.0 Hz 60 Hz: 60.0 Hz
P3.16	Number Of Motor Poles	0 to 8	0
P3.17	Motor Output Current Limit	VM_MOTOR_CURRENT[MIN] to VM_MOTOR_CURRENT[MAX]	171.0
P3.18	Stator Resistance	0.00 to 199.99 Ω	2.00 Ω
P3.19	Motor Stability Optimiser	Off (0) or On (1)	Off (0)
P3.20	Reverse Motor Direction	Off (0) or On (1)	Off (0)
P3.21	Thermal Protection Action	Disabled (0), Error with Save (1), Error (2), Limit with Save (3), Limit (4)	Limit with Save (3)
P3.22	Low Frequency Thermal Protection	Off (0) or On (1)	On (1)
P3.23	Current Controller Gain	0 to 250	40

3.7 Menu 4 - General

	Parameter	Range	Default
P4.01	Restore Factory Defaults	None (0), 50Hz (1), 60Hz (2)	None (0)
P4.02	Security Pin	0 to 9999	0
P4.03	Serial Node Address	1 to 247	1
P4.04	Serial Mode	8.2NP (0), 8.1NP (1), 8.1EP (2), 8.1OP (3)	8.2NP (0)
P4.05	Serial Baud Rate	Disabled (0), 600 (1), 1200 (2), 2400 (3), 4800 (4), 9600 (5), 19200 (6), 38400 (7), 57600 (8), 76800 (9), 115200 (10)	115200 (10)
P4.06	Minimum Serial Comms Transmit Delay	0 to 250 ms	0 ms
P4.07	Keypad Run and Stop Function Select	0 to 2	0
P4.08	Supply Loss Action	Disable (0), Ramp Stop (1), Ride Through (2)	Disable (0)
P4.09	Parameter 1 Save on Error Selector	None (0), Output Frequency (1), Output Voltage (2), Output Power (3), Motor RPM (4), Drive State (5), Output Current (6), Torque Prod. Current (7), Percentage Load (8), Alarm Indicators (9), Drive Status Indica. (10), Sequ. In and Out (11), Run and Direction (12), Ramp Input (13), Ramp Output (14), T2 Analog 1 Percent (15), T4 Analog 2 Percent (16), T15 Freq. Input % (17), Up/Down Percentage (18), PID Percentage (19), PID Status Indica. (20), PID Error (21), Motor Therm. Percent (22), Drive Therm. Percent (23), DC Bus Voltage (24), Digital IO Indica. (25)	Output Power (3)
P4.10	Parameter 2 Save on Error Selector		Motor RPM (4)
P4.11	Parameter 3 Save on Error Selector		Drive State (5)
P4.12	Number of Auto Reset Attempts	None (0), One (1), Two (2), Three (3), Four (4), Five (5), Continuous (6)	None (0)
P4.13	Hold Drive Healthy on Auto Reset Attempts	Off (0) or On (1)	Off (0)
P4.14	Drive Reset When Enable or Run Applied	Off (0) or On (1)	On (1)
P4.15	Motor Phase Loss Detection	Off (0) or On (1)	Off (0)
P4.16	User Error	0 to 255	0
P4.17	Drive Enable	Off (0) or On (1)	On (1)
P4.18	Binary Control Word	0000000000000000 to 1111111111111111	0000000000000000
P4.19	Save Parameters	Off (0) or On (1)	Off (0)
P4.20	Near Field Communication (NFC)	Disabled (0), Read Only (1), Read & Write (2)	Read & Write (2)

3.8 Menu 5 - PID Controller

	Parameter	Range	Default
P5.01	PID Fixed Reference Set-Point 1	±100.00 %	0.00 %
P5.02	PID Fixed Reference Set-Point 2	±100.00 %	0.00 %
P5.03	PID Reference Selector	None (0), Analog 1 Percent (1), Analog 2 Percent (2), Frequency Input % (3), Up/Down Percent (4), Fixed Reference 1 (5), Fixed Reference 2 (6)	Fixed Reference 2 (6)
P5.04	PID Feedback Selector	None (0), Analog 1 Percent (1), Analog 2 Percent (2), Frequency Input % (3)	None (0)
P5.05	PID Feed Forward Selector	None (0), Analog 1 Percent (1), Analog 2 Percent (2), Frequency Input % (3), Up/Down Percent (4), Fixed Reference 1 (5), Fixed Reference 2 (6)	None (0)
P5.06	PID Reference Slew Rate Limit	0.0 to 3200.0 s	0.0 s
P5.07	PID Proportional Gain	0.000 to 4.000	1.000
P5.08	PID Integral Gain	0.000 to 4.000	0.500
P5.09	PID Output Lower Limit	±100.00 %	0.00 %
P5.10	PID Output Upper Limit	0.00 to 100.00 %	100.00 %
P5.11	PID Enable Selector	None (0), Drive Active Running (1), At Speed (2), At Zero (3), Under Voltage (4), External Error (5), Drive Ready (6), Drive Healthy (7), Current Limit Active (8), Reverse Selected (9), An In Current Loss (10), Threshold Detector (11)	None (0)
P5.12	Threshold Detector Selector	None (0), Ramp Input (1), Ramp Output (2), Output Frequency (3), Output Current (4), Torque Prod Current (5), Output Voltage (6), DC Bus Voltage (7), Analog 1 Percentage (8), Analog 2 Percentage (9), Freq. input Percent (10), Output Power (11), Motor RPM (12), Percentage Load (13), PID Percentage (14), PID Error (15)	None (0)
P5.13	Threshold Detector Level	0.00 to 100.00 %	0.00 %
P5.14	Threshold Detector Hysteresis	0.00 to 25.00 %	0.00 %
P5.15	Threshold Detector Delay	±25.0 s	0.0 s
P5.16	Threshold Detector Output Invert	Off (0) or On (1)	Off (0)
P5.17	Threshold Detector Function Select	None (0), Hardware Enable (1), Run Forward (2), Run Reverse (3), Run Permit (/Stop) (4), Forward Limit Switch (5), Reverse Limit Switch (6), Up/Down % Increase (7), Up/Down % Decrease (8), Up/Down % Reset (9), Ref Sel Bit 0 (10), Ref Sel Bit 1 (11), Ramp Select (12), PID Hardware Enable (13), External Error (14), Drive Reset (15), Run (16), Reverse (17), Jog Forward (18), Jog Reverse (19)	None (0)
P5.18	PID Lower Limit	Off (0) or On (1)	Off (0)

3.9 Menu 6 - IO Configuration

	Parameter	Range	Default
P6.01	T2 Analog Input 1 Type	0-10V (0), 0-20mA (1), 4-20mA (2), 4-20mA Hold (3), 4-20mA Stop (4), 4-20mA Error (5)	4-20mA (2)
P6.02	T4 Analog Input 2 Type		0-10V (0)
P6.03	T6 Analog Output Type	0-10V (0), 0-20mA (1), 4-20mA (2)	0-10V (0)
P6.04	T11 Digital IO 1 Type	Digital Input (0), Digital Output (1), Frequency Output (2), PWM Output (3), Digital Out Inverted (4)	Digital Input (0)
P6.05	T15 Digital Input 5 Type	Digital Input (0), Frequency Input (1)	Digital Input (0)
P6.06	T6 Analog Output Function Select	None (0), Ramp Input (1), Ramp Output (2), Output Frequency (3), Output Current (4), Torque Prod Current (5), Output Voltage (6), DC Bus Voltage (7), Analog 1 Percentage (8), Analog 2 Percentage (9), Freq. input Percent (10), Output Power (11), Motor RPM (12), Percentage Load (13), PID Percentage (14), PID Error (15), Motor Thermal % (16), Drive Thermal % (17)	Ramp Output (2)
P6.07	T6 Analog Output Scaling	0.000 to 40.000	1.000
P6.08	T41-T43 Relay Function Select	None (0), Drive Active Running (1), At Speed (2), At Zero (3), Under Voltage (4), External Error (5), Drive Ready (6), Drive Healthy (7), Current Limit Active (8), Reverse Selected (9), An In Current Loss (10), Threshold Detector (11)	Drive Healthy (7)
P6.09	T11 Digital Output 1 Function Select		None (0)
P6.10	T11 Frequency/ PWM Output Function Select	None (0), Ramp Input (1), Ramp Output (2), Output Frequency (3), Output Current (4), Torque Prod Current (5), Output Voltage (6), DC Bus Voltage (7), Analog 1 Percentage (8), Analog 2 Percentage (9), Freq. input Percent (10), Output Power (11), Motor RPM (12), Percentage Load (13), PID Percentage (14), PID Error (15), Motor Thermal % (16), Drive Thermal % (17)	None (0)
P6.11	T11 Frequency/PWM Output Scaling	0.000 to 40.000	1.000
P6.12	Negative Logic (NPN Sensor) Select	Off (0) or On (1)	Off (0)
P6.13	Run/Stop Configuration	Custom (0), Enable + Run Forward + Run Reverse (1), Run Forward + Run Reverse (3 Wire) (2), Enable + Run + Reverse (3), Run + Reverse (4), Run + Jog (5), Run Forward + Run Reverse (6), Run + Reverse (7), Keypad (8), Keypad With Enable (9), Keypad Jog (10)	Enable + Run Forward + Run Reverse (1)
P6.14	T2 Analog Input 1 Digital Function Select	None (0), Hardware Enable (1), Run Forward (2), Run Reverse (3), Run Permit (/ Stop) (4), Forward Limit Switch (5), Reverse Limit Switch (6), Up/ Down % Increase (7), Up/Down % Decrease (8), Up/Down % Reset (9), Ref Sel Bit 0 (10), Ref Sel Bit 1 (11), Ramp Select (12), PID Hardware Enable (13), External Error (14), Drive Reset (15), Run (16), Reverse (17), Jog Forward (18), Jog Reverse (19)	None (0)
P6.15	T4 Analog Input 2 Digital Function Select		None (0)
P6.16	T11 Digital Input 1 Function Select		None (0)
P6.17	T12 Digital Input 2 Function Select		Hardware Enable (1)
P6.18	T13 Digital Input 3 Function Select		Run Forward (2)
P6.19	T14 Digital Input 4 Function Select		Run Reverse (3)
P6.20	T15 Digital Input 5 Function Select		Ref Sel Bit 0 (10)
P6.21	T2 Analog Input 1 Minimum Input	0.00 to 100.00 %	0.00 %
P6.22	T2 Analog Input 1 Percentage at Minimum Input	±100.00 %	0.00 %
P6.23	T2 Analog Input 1 Maximum Input	0.00 to 100.00 %	100.00 %
P6.24	T2 Analog Input 1 Percentage at Maximum Input	±100.00 %	100.00 %
P6.25	T4 Analog Input 2 Minimum Input	0.00 to 100.00 %	0.00 %
P6.26	T4 Analog Input 2 Percentage at Minimum Input	±100.00 %	0.00 %
P6.27	T4 Analog Input 2 Maximum Input	0.00 to 100.00 %	100.00 %
P6.28	T4 Analog Input 2 Percentage at Maximum Input	±100.00 %	100.00 %
P6.29	T15 Frequency Input Minimum Input	0.00 to 100.00 %	0.00 %
P6.30	T15 Frequency Input Percentage at Minimum Input	±100.00 %	0.00 %
P6.31	T15 Frequency Input Maximum Input	0.00 to 100.00 %	100.00 %
P6.32	T15 Frequency Input Percentage at Maximum Input	±100.00 %	100.00 %

3.10 Parameter Descriptions

This section provides detailed descriptions on the functions of all parameters within the drive. Not all parameters of the parameters listed can be accessed via the keypad as they are intended for use via Modbus RTU and are therefore marked Communication. The table below shows a list of additional attributes a parameter may have.

Table 3-1

Coding	Attribute
RW	Read/Write: can be written by the user
RO	Read only: can only be read by the user
Bit	1 bit parameter. 'On' or 'Off' on the display
Num	Number: can be uni-polar or bi-polar
Txt	Text: the parameter uses text strings instead of numbers.
Bin	Binary parameter
IP	IP Address parameter
Mac	Mac Address parameter
Date	Date parameter
Time	Time parameter
Chr	Character parameter
FI	Filtered: Some parameters which can have rapidly changing values are filtered when displayed on the drive keypad for easy viewing
DE	Destination: This parameter selects the destination of an input or logic function
RA	Rating dependent: this parameter is likely to have different values and ranges with drives of different voltage and current ratings. Parameters with this attribute will be transferred to the destination drive by non-volatile storage media when the rating of the destination drive is different from the source drive and the file is a parameter file. However, the values will be transferred if only the current rating is different and the file is a difference from default type file.
ND	No default: The parameter is not modified when defaults are loaded
NC	Not copied: not transferred to or from non-volatile media during copying.
PT	Protected: Cannot be used as a destination

3.10.1 Menu 1 – Status & Monitoring

This menu contains all parameters that show an output variable of the drive for status and monitoring purposes. All parameters are read-only.

Parameter	**P1.01 *Output Frequency***		
Short description	The output frequency of the drive		
Minimum	−*Maximum Frequency Limit* (P2.02)	**Maximum**	*Maximum Frequency Limit* (P2.02)
Default		**Units**	Hz
Type	16 Bit Volatile	**Update Rate**	
Display Format	Standard	**Decimal Places**	1
Coding	RO, FI, VM, ND, NC		

Displays the drive output frequency in Hz. This can be higher than motor rotation frequency and *Ramp Output* (P1.13) due to motor slip compensation. A positive value is used for forward rotation, a negative value is used for reverse rotation.

Parameter	**P1.02 *Output Voltage***		
Short description	The r.m.s. line to line voltage at the output of the drive		
Minimum	-Drive Rated Voltage	**Maximum**	Drive Rated Voltage
Default		**Units**	V
Type	16 Bit Volatile	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RO, FI, VM, ND, NC		

Displays the r.m.s. line to line voltage at the output terminals of the drive.
(U to V; V to W; W to U.)

Parameter	P1.03 *Output Power*		
Short description	Displays the power flowing through the output terminals of the drive		
Minimum	−VM_POWER	**Maximum**	VM_POWER
Default		**Units**	kW
Type	16 Bit Volatile	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RO, FI, VM, ND, NC		

Displays the power flowing through the output terminals of the drive. This parameter should be used for indication purposes only. A positive value indicates power flowing from the drive to the motor.

Parameter	P1.04 *Motor RPM*		
Short description	The drive output in terms of motor rpm		
Minimum	-18000	**Maximum**	18000
Default		**Units**	rpm
Type	16 Bit Volatile	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RO, FI, ND, NC		

The drive output frequency is converted to the equivalent RPM using the number of motor poles. The actual motor RPM could be lower due to the load and slip frequency if motor rated speed is not set correctly.

Parameter	P1.05 *Drive State*		
Short description	Displays the current state of the drive		
Minimum	0	**Maximum**	DriveState
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RO, VM, ND, NC, BU		

This parameter shows the present state of the drive as described below.

Value	*Text*	*Description*
0	Inhibited	The drive is not enabled
1	Ready	The drive is enabled but has not received a run command
2	NA	
3	NA	
4	Running	The drive is running
5	Supply Loss	Supply loss has been detected
6	Deceleration	The drive is stopping the motor with a decelerating ramp
7	Injecting DC	The drive is injecting DC braking current into the motor
8	NA	
9	Error	The drive in an error state, check the error log for more information
10	NA	
11	NA	
12	NA	
13	NA	
14	NA	
15	Under Voltage	The drive is in the under-voltage state

Parameter	P1.06 *Output Current*		
Short description	The total output current to the motor		
Minimum	−Drive Rated Current	**Maximum**	Drive Rated Current
Default		**Units**	A
Type	16 Bit Volatile	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RO, FI, VM, ND, NC		

Displays the total r.m.s phase current being delivered to the motor. This is made up of two components, motor magnetising current and motor *Torque Producing Current* (P1.07).

NOTE

This is an equivalent r.m.s. current at 0 Hz or low output frequency.

Parameter	P1.07 *Torque Producing Current*		
Short description	The output current that produces torque in the motor		
Minimum	−Drive Rated Current	**Maximum**	Drive Rated Current
Default		**Units**	A
Type	16 Bit Volatile	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RO, FI, VM, ND, NC		

This parameter displays the component of the *Output Current* (P1.06) that is in phase with the voltage and does not include the magnetising current of the motor. The value is proportional to the torque produced by the motor provided the frequency applied to the motor is at or below the motor rated frequency.
This torque includes the load torque and acceleration torque.

If the Output Frequency is positive (forward), a positive value of Torque Producing Current would hold the motor load or cause the motor to accelerate, a negative value would decelerate the motor.

If the Output Frequency is negative (reverse), a negative value of torque producing current would hold the motor load or cause the motor to accelerate, a positive value would decelerate the motor.

Parameter	P1.08 *Percentage Load*		
Short description	The load as a percentage of motor rated torque		
Minimum	−Motor Output Current Limit (Max)	**Maximum**	Motor Output Current Limit (Max)
Default		**Units**	%
Type	16 Bit Volatile	**Update Rate**	
Display Format	Standard	**Decimal Places**	1
Coding	RO, FI, VM, ND, NC		

Percentage Load (P1.08) indicates the load on the motor as a percentage of the rated load of the motor.
For forward rotation, this value is positive for a motoring load and negative for a regenerating load. For reverse rotation this value is negative for a motoring load and positive for a regenerating load.
Percentage Load (P1.08) = *Torque Producing Current* (P1.07) / I_{Trated} x 100

I_{Trated} = Rated Torque Current = *Motor Rated Current (P3.01) x Motor Rated Power Factor (P3.04)*
See *Motor Output Current Limit* (P3.17)

Parameter	P1.09 *Alarm Indicators*		
Short description	A set of indicators that represent the drive alarms		
Minimum	0 (Display: 00000000)	**Maximum**	255 (Display: 11111111)
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	
Display Format	Binary	**Decimal Places**	0
Coding	RO, ND, NC, BU		

Bit	Alarm	How to remove the alarm
Bit 0	Motor Overload	Reduce the load on the motor
Bit 1	Drive Overload	Reduce the load on the motor or ambient temperature of the drive
Bit 2	Auto-tune Active	Will be reset when Autotune complete
Bit 3	Limit Switch Active	Rotate the motor away from the limit switch
Bit 4	Input Phase Loss or Imbalance	Check input fuses to the drive
Bit 5	Analog Input Current Loop Loss	Check current loop master is powered and the integrity of the wiring is good
Bit 6	Current Limit Active	Reduce the load on the motor
Bit 7	I/O Overload	Check 24 V output and digital output for an overload condition

An alarm is used by the drive to give an early warning of a problem which could lead to a drive error. In some alarm conditions, the drive may take action to prevent an error for example reducing the motor current or speed.

Parameter	P1.10 *Drive Status Indicators*		
Short description	A set of indicators that represent the drive status		
Minimum	0 (Display: 00000000)	**Maximum**	255 (Display: 11111111)
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	
Display Format	Binary	**Decimal Places**	0
Coding	RO, ND, NC, BU		

Bit	Alarm	How to remove the alarm
Bit 0	Supply Loss	Indicates supply loss has been detected. The behaviour in this situation is controlled by *Supply Loss Action* (P4.08).
Bit 1	Limit Switch Active	Indicates at least one limit switch is active.
Bit 2	Thermal Limit Active	Indicates the output current is being limited further than that defined by *Motor Output Current Limit* (P3.17) for thermal protection.
Bit 3	Current Limit Active	Indicates the output current is being limited by the current limit defined by *Motor Output Current Limit* (P3.17) or Bit 2 above.
Bit 4	Drive Active	Indicates the drive is applying voltage to the motor.
Bit 5	Healthy	Indicates the drive is healthy and there are no errors.
Bit 6	At Speed ± 1 Hz	Indicates the output frequency of the drive is within 1 Hz of the demand.
Bit 7	At Zero ± 2 Hz	Indicates the output frequency of the drive is within 2 Hz of 0 Hz

Parameter	P1.11 *Sequencer Input and Output Indicators*		
Short description	A set of indicators that represent the enable inputs, the Limit Switch inputs, and the sequencer outputs		
Minimum	0 (Display: 00000000)	**Maximum**	255 (Display: 11111111)
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	
Display Format	Binary	**Decimal Places**	0
Coding	RO, ND, NC, BU		

Displays a set of indicators that represent the enable inputs, the Limit Switch inputs, and the sequencer outputs.

Bit 0	Hardware Enable	Set to 1 if an active digital input has been configured as the Hardware Enable function (1), or if no digital input has been configured as a Hardware Enable
Bit 1	Software Enable	If the *Binary Control Word* (P4.18) is enabled this is set to 1 when the enable bit of the control word is set otherwise this is set to 1 if *Drive Enable* (P4.17) is set to true
Bit 2	Limit Switch Forwards	Set to 1 if an active digital input has been configured as the Forward Limit Switch function (5). The drive will stop if there is with a positive reference
Bit 3	Limit Switch Reverse	Set to 1 if an active digital input has been configured as the Forward Limit Switch function (6). The drive will stop if there is a negative reference
Bit 4	Reference On	Set to 1 by the sequencer to switch the selected reference through to the Ramps when a start command is detected. See *References & Ramps*
Bit 5	Reverse	Set to 1 by the sequencer to reverse the selected reference when a Reverse command is detected. See *References & Ramps*
Bit 6	Jog	Set to 1 by the sequencer to select the Jog reference when a Jog command is detected. See *References & Ramps*
Bit 7	Under Voltage	Set to 1 by the sequencer if the drive is in an under voltage state

Bits 0, 2 & 3 shown here can be set by any of the digital inputs using their function selector parameters such as *T11 Digital Input 1 Function Select* (P6.16) or by selecting an appropriate *Run/Stop Configuration* (P6.13).

Before the drive can run the motor, it must check that certain conditions are met. These are handled by the drive sequencer. The drive sequencer monitors all drive inputs and compares them to the drive's configuration, set by the user, to ensure the motor only runs when it should.

For example:

1. If a drive input is configured as a Hardware Enabled (1), the drive will not be able to run the motor, even if a Run Forward (2) signal is provided, until the enable signal is given on that input.
2. If Limit Switch Forward is active, only a Run Reverse signal would allow the motor to run.
3. If a drive input is configured as a Run Permit (4), the drive will not be able to run the motor while a Run Permit (4) signal is not provided.

Parameter	**P1.12 *Run & Direction Indicators***		
Short description	A set of indicators that represent the sequencer run and direction inputs		
Minimum	0 (Display: 00000000)	**Maximum**	255 (Display: 11111111)
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	
Display Format	Binary	**Decimal Places**	0
Coding	RO, ND, NC, BU		

Bit 0	Run Forward	Set to 1 if a digital input has been configured as the Run Forward function (2) and is active.
Bit 1	Run Reverse	Set to 1 if a digital input has been configured as the Run Reverse function (3) and is active.
Bit 2	Run	Set to 1 if a digital input has been configured as the Run function (16) and is active.
Bit 3	Reverse	Set to 1 if a digital input has been configured as the Reverse function (17) and is active.
Bit 4	Jog Forward	Set to 1 if a digital input has been configured as the Jog Forward function (18) and is active.
Bit 5	Jog Reverse	Set to 1 if a digital input has been configured as the Jog Reverse function (19) and is active.
Bit 6	Run Permit (Not Stop)	Set to 1 if a digital input has been configured as the Run Permit (Not Stop) function (4) and is active.

The Indicators that are shown here can be set by any of the digital inputs using their function selector parameters such as *T11 Digital Input 1 Function Select* (P6.16) or by selecting an appropriate Run / Stop Config in *Run/Stop Configuration* (P6.13) .

Before the drive can run the motor, it must check that certain conditions are met. These are handled by the drive sequencer. The drive sequencer monitors all drive inputs and compares them to the drive's configuration, set by the user, to ensure the motor only runs when it should.

For example:

4. If a drive input is configured as a Hardware Enabled (1), the drive will not be able to run the motor, even if a Run Forward (2) signal is provided, until the enable signal is given on that input.
5. If Limit Switch Forward is active, only a Run Reverse signal would allow the motor to run.
6. If a drive input is configured as a Run Permit (4), the drive will not be able to run the motor if a Run Permit (4) signal is not provided.

Parameter	**P1.13 *Ramp Input***		
Short description	The selected reference fed into the Ramp System		
Minimum	−*MAXIMUM FREQUENCY LIMIT* (P2.02)	**Maximum**	*MAXIMUM FREQUENCY LIMIT* (P2.02)
Default		**Units**	Hz
Type	8 Bit Volatile	**Update Rate**	1 ms
Display Format	Standard	**Decimal Places**	1
Coding	RO, VM, ND, NC		

Displays the reference frequency after the skip band and frequency limits have been applied but before it is fed into the ramp system. See *References & Ramps* .

Parameter	**P1.14 *Ramp Output***		
Short description	The frequency output from the Ramp System		
Minimum	−*MAXIMUM FREQUENCY LIMIT* (P2.02	**Maximum**	*MAXIMUM FREQUENCY LIMIT* (P2.02)
Default		**Units**	Hz
Type	8 Bit Volatile	**Update Rate**	
Display Format	Standard	**Decimal Places**	1
Coding	RO, VM, ND, NC		

Displays the reference frequency after the skip band and frequency limits have been applied but before it is fed into the ramp system. See References & Ramps .

Parameter	P1.15 T2 *Analog Input 1 Percentage*		
Short description	The input level of analog input 1 as a percentage after it has been scaled		
Minimum	-100	**Maximum**	100
Default		**Units**	%
Type	16 Bit Volatile	**Update Rate**	
Display Format	Binary	**Decimal Places**	0
Coding	RO, ND, NC, BU		

Displays the input level of analog input 1 as a percentage after it has been scaled according to the terminal's scaling parameters. See *T2 Analog Input 1 Minimum Inpu*t (P6.21).

This can be configured to set the motor frequency by selecting it as one of the 4 references (P2.21 - P2.24). See *Frequency Reference 1 Selector* (P2.21). This value can then be used as a frequency reference, where 0% is the *Minimum Frequency Limit* (P2.01) and 100% is the *Maximum Frequency Limit* (P2.02).

Parameter	P1.16 *T4 Analog Input 2 Percentage*		
Short description	The input level of analog input 2 as a percentage after it has been scaled		
Minimum	-100.00	**Maximum**	100.00
Default		**Units**	%
Type	16 Bit Volatile	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RO, FI, ND, NC		

Displays the input level of analog input 2 as a percentage after it has been scaled according to the terminal's scaling parameters. See *T4 Analog Input 2 Minimum Input* (P6.25).

This can be configured to set the motor frequency by selecting it as one of the 4 references (P2.21 - P2.24). See *Frequency Reference 1 Selector* (P2.21). This value can then be used as a frequency reference, where 0% is the *Minimum Frequency Limit* (P2.01) and 100% is the *Maximum Frequency Limit* (P2.02).

Parameter	P1.17 *T15 Frequency Input Percentage*		
Short description	The input level of T15 Frequency Input as a percentage after it has been scaled		
Minimum	-100.00	**Maximum**	100.00
Default		**Units**	%
Type	16 Bit Volatile	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RO, FI, ND, NC		

Displays the input level of T15 Frequency Input as a percentage after it has been scaled according to the frequency input's scaling parameters. See *T15 Frequency Input Minimum Input* (P6.29).

This can be configured to set the motor frequency by selecting it as one of the 4 references (P2.21 - P2.24). See *Frequency Reference 1 Selector* (P2.21). This value can then be used as a frequency reference, where 0% is the *Minimum Frequency Limit* (P2.01) and 100% is the *Maximum Frequency Limit* (P2.02).

Parameter	P1.18 *Up/Down Percentage*		
Short description	The value of the Up/Down reference as a percentage which can be increased or decreased by the keypad or drive control terminals		
Minimum	0.00	**Maximum**	100.00
Default		**Units**	%
Type	16 Bit Power Down Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RO, ND, NC, BU		

This can be configured to set the motor frequency by selecting it as one of the 4 references (P2.21 - P2.24). See *Frequency Reference 1 Selector* (P2.21). This value can then be used as a frequency reference, where 0% is the *Minimum Frequency Limit* (P2.01) and 100% is the *Maximum Frequency Limit* (P2.02). The value can be increased or decreased using the UP and DOWN keys on the keypad (when in Status View) or, if selected, by the drive control terminals.

See *Up/Down Percent Configuration* (P2.14) and *Up/Down Percentage Time to Max* (P2.15) for information on Up/Down control configuration.

This parameter is unidirectional with motor direction set by run forward / run reverse.

This feature is sometimes referred to as a Motorised Pot.

Parameter	P1.19 *PID Percentage*		
Short description	The percentage output for the PID controller including the Feed Forward		
Minimum	-100.00	**Maximum**	100.00
Default		**Units**	%
Type	16 Bit Volatile	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RO, ND, NC		

This is derived from the output of the PID controller plus the Feed Forward term selected by *PID Feed Forward Selector* (P5.05).

The derivative term in the PID controller is fixed to 0.

This can be configured to set the motor frequency by selecting it as one of the 4 references (P2.21 - P2.24). See *Frequency Reference 1 Selector* (P2.21). This value can then be used as a frequency reference, where 0% is the *Minimum Frequency Limit* (P2.01) and 100% is the *Maximum Frequency Limit* (P2.02).

Parameter	P1.20 *PID Status Indicators*		
Short description	A set of indicators that represent the status of the PID and Threshold Detector		
Minimum	0 (Display: 00000000)	**Maximum**	255 (Display: 11111111)
Default		**Units**	%
Type	8 Bit Volatile	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, BU		

If a source has been set at *PID Enable Selector* (P5.11) or *Threshold Detector Selector* (P5.12) they must be true to enable the PID controller. If an input has been routed to *PID Hardware Enable* (13) this must also be true to enable the PID controller.

Bit 0	PID Enabled	Indicates that the PID is enabled and active
Bit 1	PID limit applied	Indicates that the PID output is being limited by PID Output Lower Limit (P5.09) or PID Output Upper Limit (P5.10), or a limit following the addition of the Feed Forward is being applied
Bit 2	Threshold Detector Output	Indicates that the Threshold Detector output is active

Parameter	P1.21 *PID Error*		
Short description	The error the PID controller is operating on		
Minimum	-100.00	**Maximum**	100.00
Default		**Units**	%
Type	16 Bit Volatile	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RO, ND, NC		

The PID Error is the difference between the PID reference and PID feedback which are selected by *PID Reference Selector* (P5.03) and *PID Feedback Selector* (P5.04).

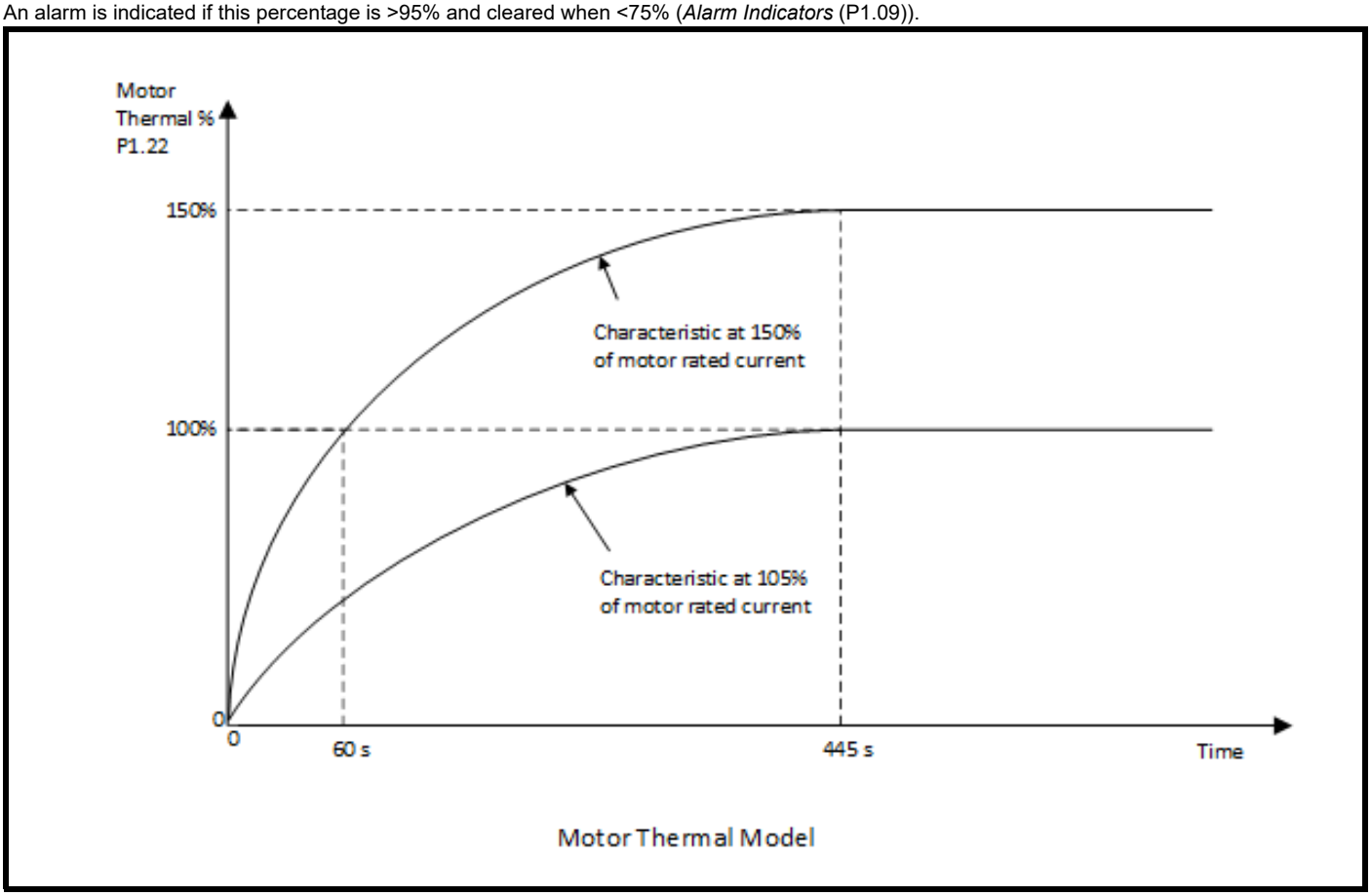
Parameter	P1.22 *Motor Thermal Percentage*		
Short description	The percentage of the maximum allowed temperature for the motor		
Minimum	0	**Maximum**	100
Default		**Units**	%
Type	8 Bit Power Down Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, BU		

The drive estimates the percentage of the motor maximum temperature from the output current and uses this to limit the overload period to protect the motor. This function allows a longer overload period when the motor is cool and reduces the allowable overload period as the motor heats.

The overload period depends on the percentage overload current and motor starting temperature.

The action taken by the drive can be set in *Thermal Protection Actio*n (P3.21).
If *Thermal Protection Action* (P3.21) is set to Limit, the output current will be limited if this parameter > 90%.
If *Thermal Protection Action* (P3.21) is set to Error, the error will occur when this parameter = 100%.

An alarm is indicated if this percentage is >95% and cleared when <75% (*Alarm Indicators* (P1.09)).



Motor Thermal Model

Parameter	P1.23 *Drive Thermal Percentage*		
Short description	The percentage of the maximum allowed temperature in the drive		
Minimum	0	**Maximum**	100
Default		**Units**	%
Type	8 Bit Volatile	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, BU		

The drive measures its internal temperature which changes depending on the output current. This is displayed as a percentage of the maximum allowed drive temperature.

The action taken by the drive can be set in *Thermal Protection Action* (P3.21).
If *Thermal Protection Action* (P3.21) is set to Limit, the output current will be limited if this parameter > 90%.
If *Thermal Protection Action* (P3.21) is set to Error, the error will occur when this parameter = 100%.

An alarm is indicated if this percentage is >95% and cleared when <75% (*Alarm Indicators* (P1.09)).

Parameter	P1.24 *DC Bus Voltage*		
Short description	The voltage on the DC Bus of the drive		
Minimum	0	**Maximum**	Maximum D.C. Link Voltage (110 V, 200 V Drives = 415 V, 400 V Drives = 830 V)
Default		**Units**	V
Type	16 Bit Volatile	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RO, FI, VM, ND, NC		

Displays the voltage on the DC Bus of the drive. This is the *Supply Voltage* x √2.
This voltage must exceed the under-voltage (UV) level for the drive to run.
100 V and 200 V drives (UV) = 175 V
400 V UV = 330 V

Parameter	P1.25 *Digital IO Indicators*		
Short description	A set of indicators that represent the status of the digital I/O		
Minimum	0 (Display: 00000000)	**Maximum**	255 (Display: 11111111)
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	
Display Format	Binary	**Decimal Places**	0
Coding	RO, ND, NC, BU		

Bit 0	T11 Digital IO 1	Set to 1 if the input or output is active
Bit 1	T12 Digital Input 2	Set to 1 if the input is active
Bit 2	T13 Digital Input 3	Set to 1 if the input is active
Bit 3	T14 Digital Input 4	Set to 1 if the input is active
Bit 4	T15 Digital Input 5	Set to 1 if the input is active when a digital input, otherwise 0
Bit 5	T2 Analog Input 1	Set to 1 if the input is active
Bit 6	T4 Analog Input 2	Set to 1 if the input is active
Bit 7	T41 Relay	Set to 1 if the relay is active

Parameter	P1.26 *Parameter 1 Saved Value on Error*		
Short description	The value of a designated parameter when the latest error occurred		
Minimum	-32768	**Maximum**	32767
Default		**Units**	
Type	16 Bit Power Down Save	**Update Rate**	Write on Error
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC		

If an error occurs the drive will save the value of the parameter selected by *Parameter 1 Save on Error Selector* (P4.09). There are two other saved parameters that behave in the same way, *Parameter 2 Saved Value on Error* (P1.27) & *Parameter 3 Saved Value on Error* (P1.28) . All of these parameters are saved at the point when an **Error** (P1.29) occurs.

Parameter	P1.27 *Parameter 2 Saved Value on Error*		
Short description	The value of a designated parameter when the latest error occurred		
Minimum	-32768	**Maximum**	32767
Default		**Units**	
Type	16 Bit Power Down Save	**Update Rate**	Write on Error
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC		

See *Parameter 1 Saved Value on Error* (P1.26).

Parameter	P1.28 *Parameter 3 Saved Value on Error*		
Short description	The value of a designated parameter when the latest error occurred		
Minimum	-32768	**Maximum**	32767
Default		**Units**	
Type	16 Bit Power Down Save	**Update Rate**	Write on Error
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC		

See *Parameter 1 Saved Value on Error* (P1.26).

Parameter	P1.29 *Error*		
Short description	The active or last error to have occurred		
Minimum	0	**Maximum**	255
Default		**Units**	
Type	8 Bit Power Down Save	**Update Rate**	Write on Error
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, BU		

Displays the active error, or if there is no error currently active this is the last error to have occurred.

Parameter	P1.30 *Error History 1*		
Short description	The previous error to P1.29		
Minimum	0	**Maximum**	255
Default		**Units**	
Type	8 Bit Power Down Save	**Update Rate**	Write on Error
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, BU		

Displays the second from last error to have occurred.

Parameter	P1.31 *Error History 2*		
Short description	The previous error to P1.30		
Minimum	0	**Maximum**	255
Default		**Units**	
Type	8 Bit Power Down Save	**Update Rate**	Write on Error
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, BU		

Displays the third from last error to have occurred.

Parameter	P1.32 *Error History 3*		
Short description	The previous error to P1.31		
Minimum	0	**Maximum**	255
Default		**Units**	
Type	8 Bit Power Down Save	**Update Rate**	Write on Error
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, BU		

Displays the fourth from last error to have occurred.

Parameter	P1.33 *Drive Diagnostic*		
Short description	Provides an indication of why the drive is not running		
Minimum	0	**Maximum**	15
Default		**Units**	
Type	8 Bit Volatile	**Update Rate**	Write on Error
Display Format	Standard	**Decimal Places**	0
Coding	RO, ND, NC, BU		

This parameter is a diagnostic parameter that helps identify what needs to happen in order for the drive to run.

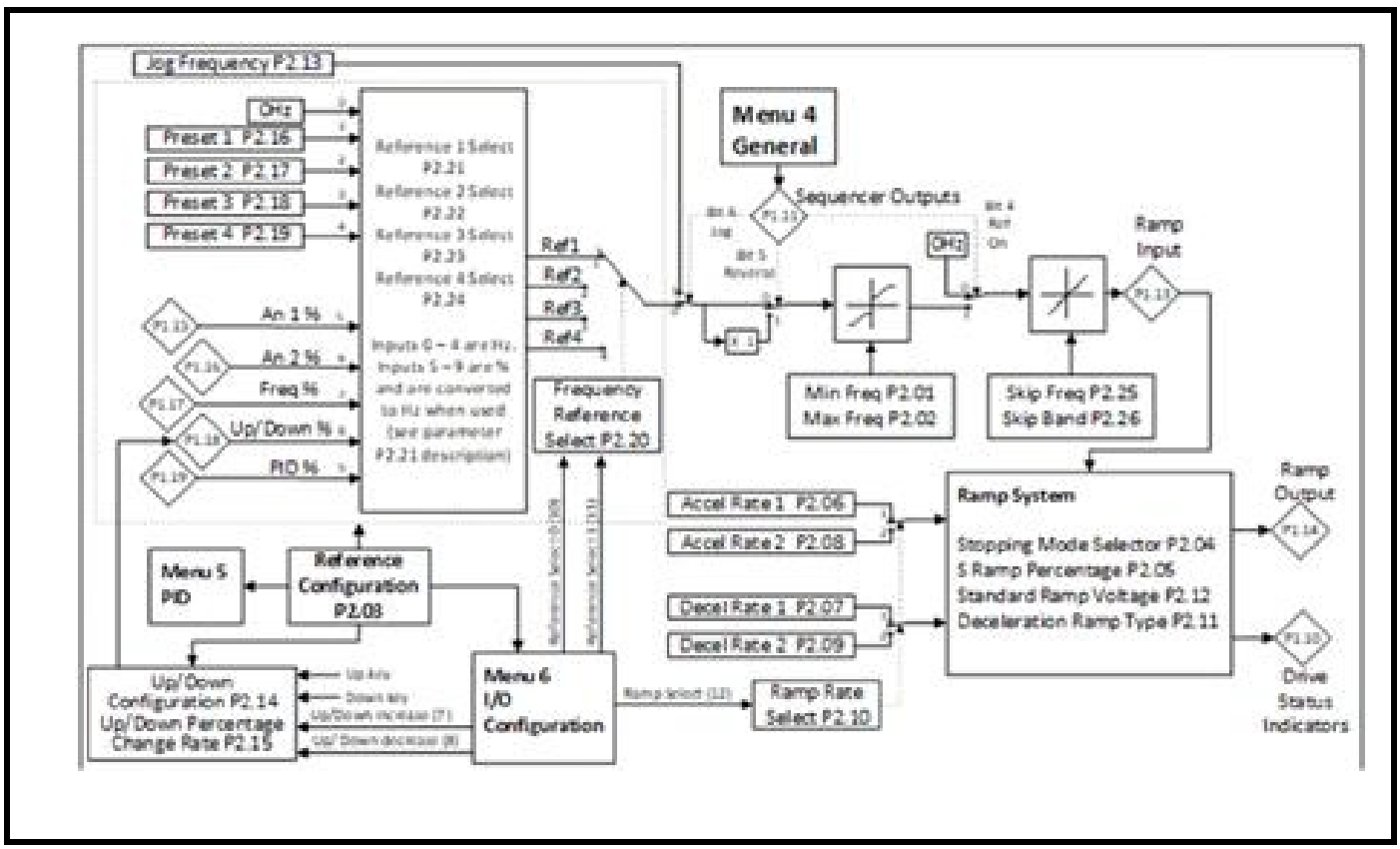
Value	Name	Description
0	Running	Drive is running i.e. No Diagnostic information
1	Inhibited	Drive is not enabled. See *IO Configuration* (Menu 6) and *Drive Enable* (P4.17).
2	Ready	Drive is enabled but has not received a Run command. See *IO Configuration* (Menu 6).
3	Locked Inhibit	Drive has stopped and is waiting for the run command to be removed before it can be made to run again (such as after an Auto-tune has finished)
4	Ref 1 Setup	Ref 1 has been selected but is set to 0 Hz. See *Frequency Reference 1 Selector* (P2.21)
5	Ref 2 Setup	Ref 2 has been selected but is set to 0 Hz. See *Frequency Reference 1 Selector* (P2.21)
6	Ref 3 Setup	Ref 3 has been selected but is set to 0 Hz. See *Frequency Reference 1 Selector* (P2.21)
7	Ref 4 Setup	Ref 4 has been selected but is set to 0 Hz. See *Frequency Reference 1 Selector* (P2.21)
8	Up/Down Ref	The Up/Down Reference has been selected, but not configured. See *Up/Down Percent Configuration* (P2.14)
9	Freq Ref	The Frequency Reference has been selected, but has not been configured See *T15 Digital Input 5 Type* (P6.05)
10	PID Enable	PID Percent has been selected, but the PID has not been enabled. See *PID Controller* (Menu 5).
11	PID Ref	PID Percent has been selected, but the PID Reference has not been configured See *PID Reference Selector* (P5.03)
12	PID Fbk	PID Percent has been selected, but the PID Feedback has not been configured See *PID Feedback Selector* (P5.04)
13	PID Up/Down Ref	PID Percent has been selected and the PID Reference is set to Up/Down, but the Up/Down Reference has not been configured. See *Up/Down Percent Configuration* (P2.14)
14	PID Freq Ref	PID Percent has been selected and the PID Reference is set to Frequency input, but the Frequency input has not been configured. See *T15 Digital Input 5 Type* (P6.05)
15	PID Freq Fbk	PID Percent has been selected and the PID feedback is set to Frequency input, but the Frequency input has not been configured. See *T15 Digital Input 5 Type* (P6.05)

3.10.2 Menu 2 - Reference & Ramps

This menu groups together parameters used to define the reference input to the drive (the speed demand) and the ramp system (how the drive accelerates and decelerates to the chosen reference). Multiple references can be configured so that the drive can be switched from one reference input to another using a digital input or communications.

Associated Parameters

- *Ramp Input* (P1.13)
- *Ramp Output* (P1.14)
- *T2 Analog Input 1 Percentage* (P1.15)
- *T4 Analog Input 2 Percentage* (P1.16)
- *T15 Frequency Input Percentage* (P1.17)
- *Up/Down Percentage* (P1.18)
- *PID Percentage* (P1.19)
- *Enable/Run Configuration* (P6.13)



Parameter	P2.01 *Minimum Frequency Limit*		
Short description	Defines the minimum frequency the drive can be commanded to run at		
Minimum	0.0	**Maximum**	300.0
Default	0.0	**Units**	Hz
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	1
Coding	RW, BU		

This parameter is the minimum limit applied to the selected reference. If the value set is higher than the *Maximum Frequency Limit* (P2.02) the reference will be limited to the maximum. This is a symmetrical limit for both directions of rotation.

This is used for scaling the range of percentage inputs.

Parameter	P2.02 *Maximum Frequency Limit*		
Short description	Defines the maximum frequency the drive can be commanded to run at		
Minimum	0.0	**Maximum**	300.0
Default	See exceptions below	**Units**	Hz
Type	16 Bit User Save	**Update Rate**	Background read
Display Format	Standard	**Decimal Places**	1
Coding	RW, BU		

Region	*Default Value*
50Hz	50.0
60Hz	60.0

This parameter is applied to the selected reference. If the *Minimum Frequency Limit* (P2.01) is higher than this parameter the reference will be limited to the maximum. This is a symmetrical limit for both directions of rotation.

This is used for scaling the range of percentage inputs.

NOTE

Output Frequency (P1.01) can be higher than the limit due to motor slip compensation

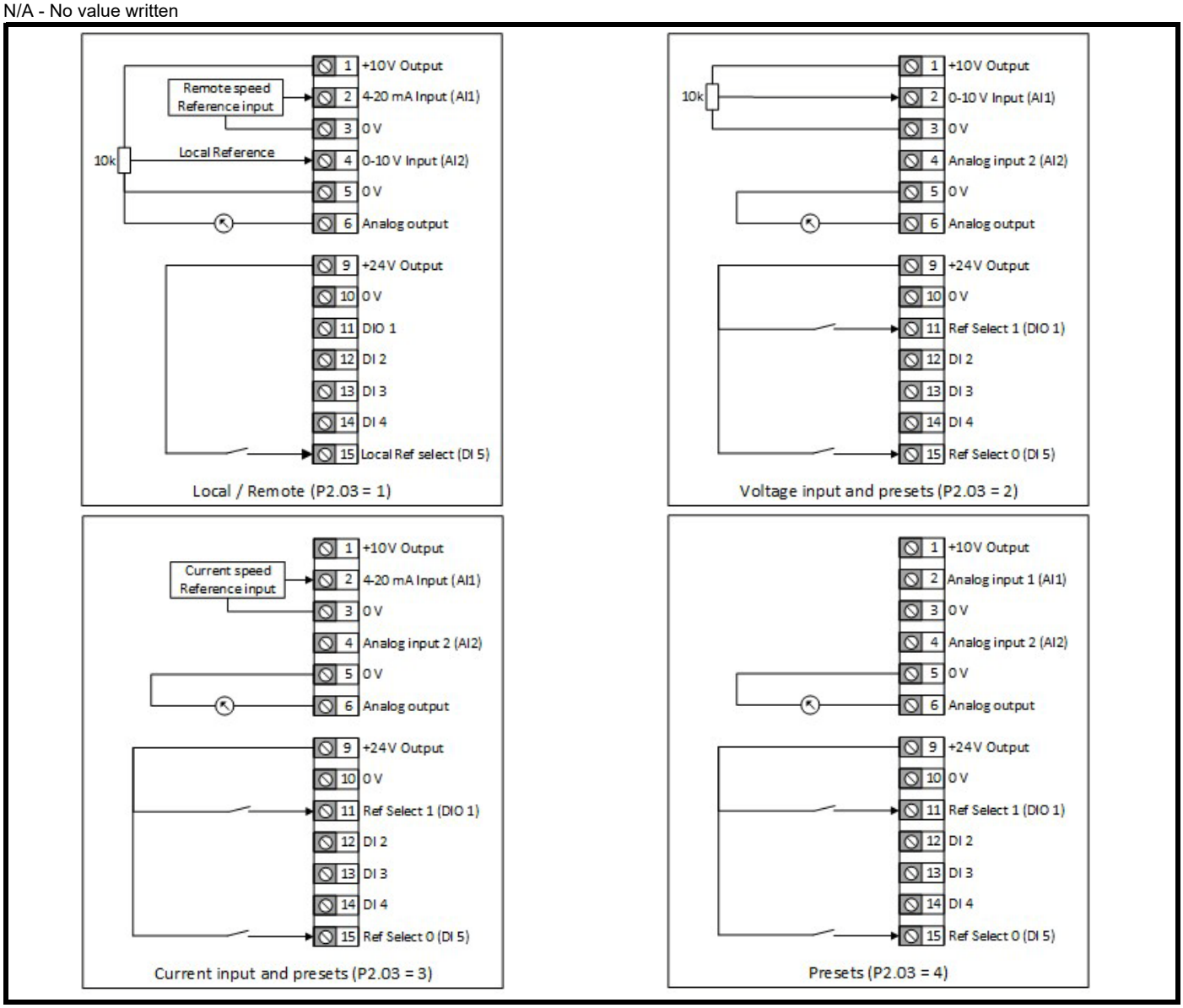
Parameter	P2.03 *Frequency Reference Configuration*		
Short description	Common configurations for speed references used by the drive		
Minimum	0	**Maximum**	9
Default	1	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

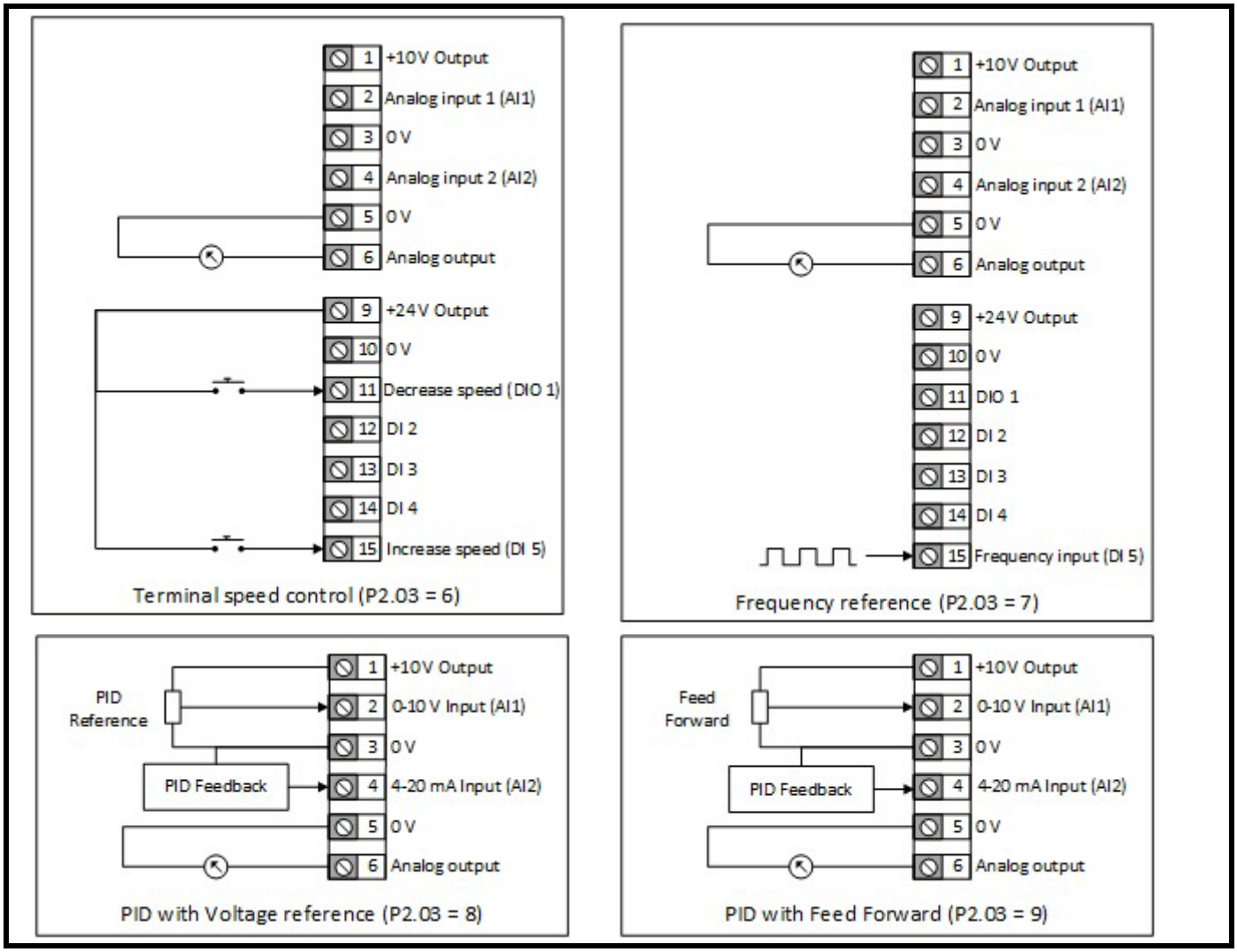
Value	*Text*	*Description*
0	Custom	The reference system can be entirely customised
1	Local/Remote	A current input on Analog input 1 and a voltage input on Analog input 2. Digital input 5 is used to select between them.
2	Voltage/Preset Input	A voltage input on Analog input 1. Digital input 5 and digital input 1 are used as binary selectors to choose between it and three preset frequency references
3	Current/Preset Input	A current input on Analog input 1. Digital input 5 and digital input 1 are used as binary selectors to choose between it and three preset frequency references
4	Presets	Digital input 5 and digital input 1 are used as the binary selectors to choose between the four preset frequency references
5	Keypad	The keypad keys are used to control the frequency Up/Down percentage (P1.18)
6	Terminal Up/Down	Digital input 5 and digital input 1 are used to control the Up/Down percentage (P1.18)
7	Frequency Input	A frequency input on digital input 5
8	PID Voltage Ref.	A Voltage input on Analog input 1 as the reference, and a current input on Analog input 2 as the feedback. The PID output is used as the drive reference
9	PID + Feed Forward	A Voltage input on Analog input 1 as the Feed Forward, and a current input on Analog input 2 as the feedback, the reference is fixed. The PID output is used as the drive reference

The table above shows the options to quickly set up the reference system for a specific application. The assignments are made on exit of the parameter (Press settings key or Back in Marshal). The table below indicates the parameters that are set up and the values written.

Value	P2.14	P2.20	P2.21	P2.22	P2.23	P2.24	P5.03	P5.04	P5.05	P5.11	P6.01	P6.02	P6.04	P6.05	P6.16	P6.20
0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1	N/A	0	6	7	N/A	N/A	N/A	N/A	N/A	N/A	2	0	N/A	0	N/A	10
2	N/A	0	6	2	3	4	N/A	N/A	N/A	N/A	0	N/A	0	0	11	10
3	N/A	0	6	2	3	4	N/A	N/A	N/A	N/A	2	N/A	0	0	11	10
4	N/A	0	1	2	3	4	N/A	N/A	N/A	N/A	N/A	N/A	0	0	11	10
5	3	1	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6	0	1	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	8	7
7	N/A	1	8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	N/A	N/A
8	N/A	1	9	N/A	N/A	N/A	1	2	0	1	0	5	N/A	N/A	N/A	N/A
9	N/A	1	9	N/A	N/A	N/A	5	2	1	1	0	5	N/A	N/A	N/A	N/A

N/A - No value written





Parameter	P2.04 *Stopping Mode Selector*		
Short description	Defines how the motor is controlled when the run signal is removed from the drive		
Minimum	0	**Maximum**	4
Default	1	**Units**	
Type	8 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

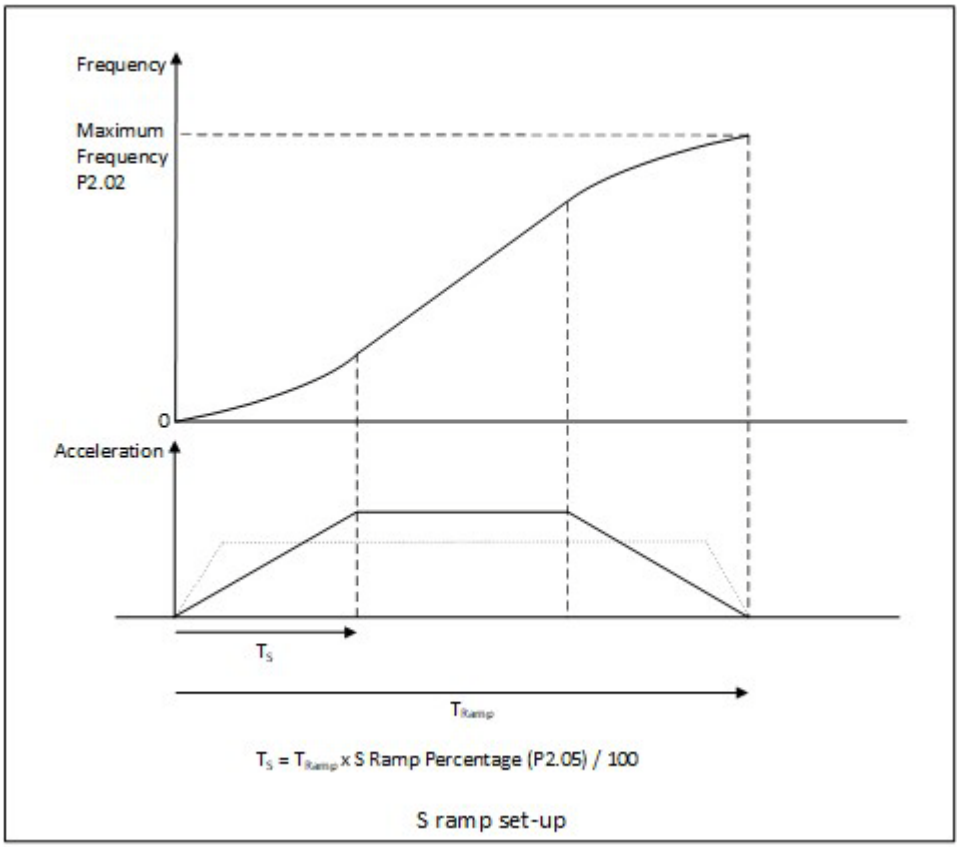
Value	*Text*	*Description*
0	Coast	Remove power from the motor and allow to spin under control of the load
1	Ramp	Motor slows down to 0 Hz under control of the drive. The drive waits for 1 second before it can be restarted
2	Ramp & Brake	Ramp stop and then DC injection at a level defined by DC Braking Current Level (P3.13) for a time defined by DC Braking Time (P3.14). Can prevent motor from moving after the deceleration
3	DC Brake, 0Hz detect	Low frequency current injection with detection of low speed and then DC injection at a level defined by DC Braking Current Level (P3.13) for a time defined by DC Braking Time (P3.14)
4	Timed DC Brake	DC injected at a level defined by DC Braking Current Level (P3.13) for a time defined by DC Braking Time (P3.14)

Parameter	P2.05 *S-Ramp Percentage*		
Short description	Defines the profile of the S ramp system as a percentage		
Minimum	0.0	**Maximum**	51.0
Default	0.0	**Units**	
Type	16 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	1
Coding	RW, BU		

As default this parameter is set to 0 which means that the S-Ramp profile is not active. To enable an S-Ramp profile a percentage must be set.

The parameter specifies the percentage of the ramp to maximum frequency that includes the S ramp profile. The maximum frequency is defined by *Maximum Frequency Limit* (P2.02).

It should be noted that as this parameter is increased, the time to ramp to maximum frequency does not change, instead the maximum acceleration rate in the centre of the profile increases which causes a steeper linear portion at the centre of the profile.



Parameter	P2.06 *Acceleration Rate 1*		
Short description	Defines the acceleration time from 0 Hz to the maximum frequency limit		
Minimum	0.0	**Maximum**	6000.0
Default	5.0	**Units**	s
Type	16 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	1
Coding	RW, BU		

Specified in seconds from 0 Hz to *Maximum Frequency Limit* (P2.02) for a linear ramp. An acceleration rate applies when the frequency is changing away from 0 Hz.

Parameter	P2.07 *Deceleration Rate 1*		
Short description	Defines the deceleration time from the maximum frequency limit to 0 Hz		
Minimum	0.0	**Maximum**	6000.0
Default	10.0	**Units**	s
Type	16 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	1
Coding	RW, BU		

Specified in seconds from *Maximum Frequency Limit* (P2.02) to 0 Hz for a linear ramp. A deceleration rate applies when the frequency is changing towards 0 Hz.

The drive may increase the ramp time due to the DC bus voltage controller, see *Deceleration Ramp Type* (P2.11)

Parameter	P2.08 *Acceleration Rate 2*		
Short description	Defines the acceleration time from 0 Hz to the maximum frequency limit		
Minimum	0.0	**Maximum**	6000.0
Default	5.0	**Units**	s
Type	16 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	1
Coding	RW, BU		

Specified in seconds from 0 Hz to *Maximum Frequency Limit* (P2.02) for a linear ramp. An acceleration rate applies when the frequency is changing away from 0 Hz.

To select between *Acceleration Rate 1* (P2.06) and *Acceleration Rate 2* (P2.08) use *Ramp Rate Selector* (P2.10).

Parameter	P2.09 *Deceleration Rate 2*		
Short description	Defines the deceleration time from the maximum frequency limit to 0 Hz		
Minimum	0.0	**Maximum**	6000.0
Default	10.0	**Units**	s
Type	16 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	1
Coding	RW, BU		

Specified in seconds from *Maximum Frequency Limit* (P2.02) to 0 Hz for a linear ramp. A deceleration rate applies when the frequency is changing towards 0 Hz.

The drive may increase the ramp time due to the DC bus voltage controller, see *Deceleration Ramp Type* (P2.11) .

To select between *Deceleration Rate 1* (P2.07) and Deceleration Rate 2 (P2.09) use *Ramp Rate Selector* (P2.10).

Parameter	P2.10 *Ramp Rate Selector*		
Short description	Selects between ramp rate 1 or 2		
Minimum	0	**Maximum**	2
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

Used to define the selection of the required ramp rates.

Value	Description
0	The Digital Input Function Ramp Select (12) is used to select between acceleration / deceleration rates 1 and 2 (see *IO Configuration* (06)). This function can be selected for any of the digital inputs. If the Digital Input Function has not been configured, *Acceleration Rate 1* (P2.06) and *Deceleration Rate 1* (P2.07) are used by the ramp system
1	*Acceleration Rate 1* (P2.06) and *Deceleration Rate 1* (P2.07) are used by the ramp system
2	*Acceleration Rate 2* (P2.08) and *Deceleration Rate 2* (P2.09) are used by the ramp system

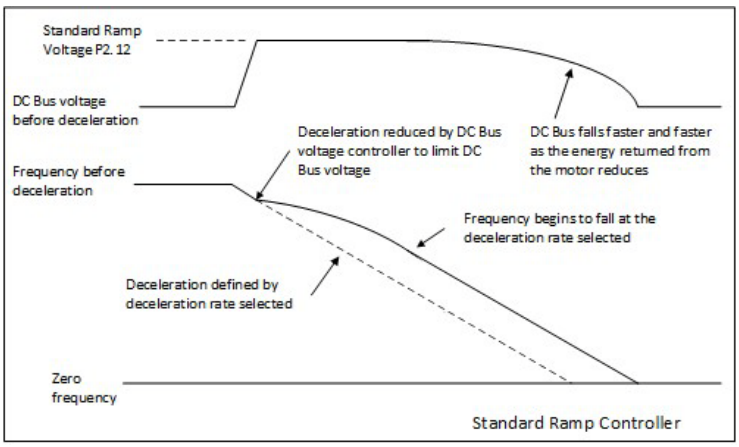
Parameter	P2.11 *Deceleration Ramp Type*		
Short description	Defines the type of deceleration required when stopping		
Minimum	0	**Maximum**	2
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	Fast	Based on the deceleration rate selected
1	Standard Ramp	Deceleration is controlled to prevent a DC Bus over voltage
2	Standard Ramp + Motor	Deceleration is controlled to prevent a DC Bus over voltage, with increased losses in the motor

Defines the ramp type used for decelerating, three types are available. Fast ramp decelerates at the selected deceleration rate, and if the energy returned from the motor is too great the drive will generate an Over Voltage error due to the DC Bus voltage rising above its permitted level.

In Standard Ramp modes the drive limits the deceleration rate to maintain the DC Bus voltage at the value set in *Standard Ramp Voltage* (P2.12).

The Standard Ramp Plus Motor also increases the voltage applied to the motor by 20% above the normal level to increase the losses in the motor and thus reduce the deceleration time that can be achieved. Note that with applications requiring a lot of deceleration cycles this could overheat the motor.



Parameter	P2.12 *Standard Ramp Voltage*		
Short description	DC bus voltage controller will attempt to hold this voltage during deceleration		
Minimum	0	**Maximum**	Maximum D.C. Link Voltage (110 V, 200 V Drives = 415 V, 400 V Drives = 830 V)
Default	See exceptions below	**Units**	V
Type	16 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW, VM, RA, BU		

Voltage	*Region*	*Default Value*
400V	50Hz	375
400V	All	750
400V	60Hz	775

During deceleration power is fed into the DC bus of the drive which causes the voltage to rise. When the voltage reaches the level defined by this parameter the DC bus voltage controller becomes active and limits the deceleration rate to maintain this voltage until the energy returning no longer causes the DC Bus voltage to rise, see *Deceleration Ramp Type* (P2.11) . Increasing *Current Controller Gain* (P3.23) improves the controller action, but this parameter may also need to be reduced to prevent over voltage errors when decelerating high inertia loads.

NOTE

This parameter should not be set lower than the maximum expected peak mains voltage of the incoming supply.

Parameter	P2.13 *Jog Frequency*		
Short description	Frequency when jog is enabled		
Minimum	-MAXIMUM FREQUENCY LIMIT (P2.02)	**Maximum**	MAXIMUM FREQUENCY LIMIT (P2.02)
Default	1.5	**Units**	Hz
Type	16 Bit User Save	**Update Rate**	20 ms
Display Format	Standard	**Decimal Places**	1
Coding	RW, VM		

Defines the frequency when jog is active, the currently selected acceleration and deceleration rates are used.

Parameter	P2.14 *Up/Down Percent Configuration*		
Short description	Defines the behaviour of the Up/Down Percentage at power-up		
Minimum	0	**Maximum**	5
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	Reset	Up/Down Percentage set to 0 at power up
1	Last	Up/Down Percentage saved and restored at power up
2	Preset 1	Up/Down Percentage set to Preset Reference 1 (P2.16) at power up
3	Keypad and Reset	Keypad Up/Down control enabled and Up/Down Percentage set to 0 at power up
4	Keypad and Last	Keypad Up/Down control enabled and Up/Down Percentage saved and restored at power up
5	Keypad and Preset 1	Keypad Up/Down control enabled and Up/Down Percentage set to Preset Reference 1 (P2.16) at power up

The first three values are used to define the Up/Down Percentage value at power up only, and the last 3 values define the UP/Down Percentage value at power up and enable Keypad speed control. If *Preset Frequency 1* (P2.16) is selected as the power up reference, the value set in *Up/Down Percentage* (P1.18) at power up is *Preset Frequency 1* (P2.16) / *Maximum Frequency Limit* (P2.02).

Parameter	P2.15 *Up/Down Percentage Time to Max*		
Short description	Defines the rate at which the Up/Down reference changes		
Minimum	0	**Maximum**	250
Default	20	**Units**	s
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

The rate of change of *Up/Down Percentage* (P1.18) is defined by *Up/Down Percentage Time to Max* (P2.15) which gives the number of seconds to change from 0 % to 100%.

If the keypad reference mode is active, then this rate is applied when holding the Up or Down while selecting the reference. Single presses of Up or Down will change the value by 0.1%.

Parameter	P2.16 *Preset Frequency 1*		
Short description	Defines the frequency for preset reference 1		
Minimum	-MAXIMUM FREQUENCY LIMIT (P2.02	**Maximum**	MAXIMUM FREQUENCY LIMIT (P2.02)
Default	5.0	**Units**	Hz
Type	16 Bit User Save	**Update Rate**	20 ms
Display Format	Standard	**Decimal Places**	1
Coding	RW, VM		

A frequency that can be used as a fixed reference by the reference select system.

NOTE

To use a preset speed as a drive frequency reference, it should be selected in a *Frequency Reference Selector parameter* (P2.21 to P2.24).

Parameter	P2.17 *Preset Frequency 2*		
Short description	Defines the frequency for preset reference 2		
Minimum	-MAXIMUM FREQUENCY LIMIT (P2.02)	**Maximum**	MAXIMUM FREQUENCY LIMIT (P2.02)
Default	10.0	**Units**	Hz
Type	16 Bit User Save	**Update Rate**	20 ms
Display Format	Standard	**Decimal Places**	1
Coding	RW, VM		

A frequency that can be used as a fixed reference by the reference select system.

Parameter	P2.18 *Preset Frequency 3*		
Short description	Defines the frequency for preset reference 3		
Minimum	-MAXIMUM FREQUENCY LIMIT (P2.02)	**Maximum**	MAXIMUM FREQUENCY LIMIT (P2.02)
Default	25.0	**Units**	Hz
Type	16 Bit User Save	**Update Rate**	20 ms
Display Format	Standard	**Decimal Places**	1
Coding	RW, VM		

A frequency that can be used as a fixed reference by the reference select system.

Parameter	P2.19 *Preset Frequency 4*		
Short description	Defines the frequency for preset reference 4		
Minimum	-MAXIMUM FREQUENCY LIMIT (P2.02)	**Maximum**	MAXIMUM FREQUENCY LIMIT (P2.02)
Default	50.0	**Units**	Hz
Type	16 Bit User Save	**Update Rate**	20 ms
Display Format	Standard	**Decimal Places**	1
Coding	RW, VM		

A frequency that can be used as a fixed reference by the reference select system.

Parameter	P2.20 *Frequency Reference 1 to 4 Selector*		
Short description	Defines which reference is used by the reference system		
Minimum	0	**Maximum**	4
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	20 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	Binary	Digital input functions can be configured to select reference 1, 2, 3 or 4 using Digital inputs
1	Freq. Reference 1	The reference selected by Reference 1 Select (2.21) will be used
2	Freq. Reference 2	The reference selected by Reference 2 Select (2.22) will be used
3	Freq. Reference 3	The reference selected by Reference 3 Select (2.23) will be used
4	Freq. Reference 4	The reference selected by Reference 4 Select (2.24) will be used

One of the 4 frequency references to be used by the reference system is selected by this parameter. If this parameter is set to 0, any digital input can be configured to select a reference by setting their input function to Reference Selector 0 or Reference Selector 1, as per the following table:

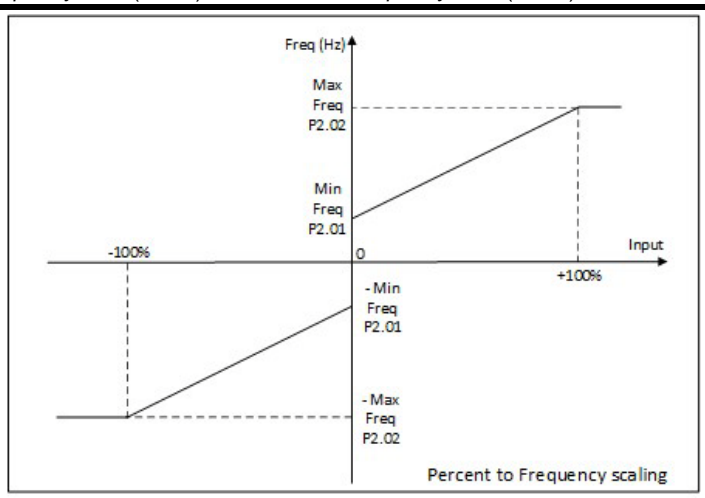
Reference Selector Bit 1	Reference Selector Bit 0	Reference selected
0	0	Reference 1
0	1	Reference 2
1	0	Reference 3
1	1	Reference 4

If no digital inputs are configured as a reference selector bit, the reference selector values are 0 and therefore Reference 1 will be used.

Parameter	P2.21 *Frequency Reference 1 Selector*		
Short description	Defines which Frequency reference or Percentage reference is selected as reference 1		
Minimum	0	**Maximum**	9
Default	6	**Units**	
Type	8 Bit User Save	**Update Rate**	20 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	None	A fixed reference of 0Hz
1	Preset 1	The frequency reference is defined by Preset Frequency 1 (P2.16)
2	Preset 2	The frequency reference is defined by Preset Frequency 2 (P2.17)
3	Preset 3	The frequency reference is defined by Preset Frequency 3 (P2.18)
4	Preset 4	The frequency reference is defined by Preset Frequency 4 (P2.19)
5	Up/Down Percent	The frequency reference is derived from the Up/Down Percentage (P1.18)
6	Analog 1 Percent	The frequency reference is derived from Analog Percentage 1 (P1.15)
7	Analog 2 Percent	The frequency reference is derived from Analog Percentage 2 (P1.16)
8	Frequency Input %	The frequency reference is derived from the frequency input Percentage (P1.17)
9	PID Percent	The frequency reference is derived from the PID output Percentage (P1.19)

For inputs 0 - 4, the frequency references are transferred directly into the reference system. For inputs 5 - 9, the percentages selected are converted to Hz using parameters *Minimum Frequency Limit* (P2.01) and *Maximum Frequency Limit* (P2.02).



NOTE

If Frequency Reference 1 Selector (P2.21) is set to 0 Hz, the drive will run at the minimum frequency limit.
The value of this parameter can be set by Frequency Reference Configuration (P2.03).
This parameter cannot have the same setting as another frequency reference selector parameter.

Parameter	P2.22 *Frequency Reference 2 Selector*		
Short description	Defines which Frequency reference or Percentage reference is selected as reference 2		
Minimum	0	**Maximum**	9
Default	7	**Units**	
Type	8 Bit User Save	**Update Rate**	20 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

See *Frequency Reference 1 Selector* (P2.21).

NOTE

The value of this parameter can be set by *Frequency Reference Configuration* (P2.03).

Parameter	P2.23 *Frequency Reference 3 Selector*		
Short description	Defines which Frequency reference or Percentage reference is selected as reference 3		
Minimum	0	**Maximum**	9
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	20 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

See *Frequency Reference 1 Selector* (P2.21).

NOTE

The value of this parameter can be set by *Frequency Reference Configuration* (P2.03).

Parameter	P2.24 *Frequency Reference 4 Selector*		
Short description	Defines which Frequency reference or Percentage reference is selected as reference 4		
Minimum	0	**Maximum**	9
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	20 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

See *Frequency Reference 1 Selector* (P2.21).

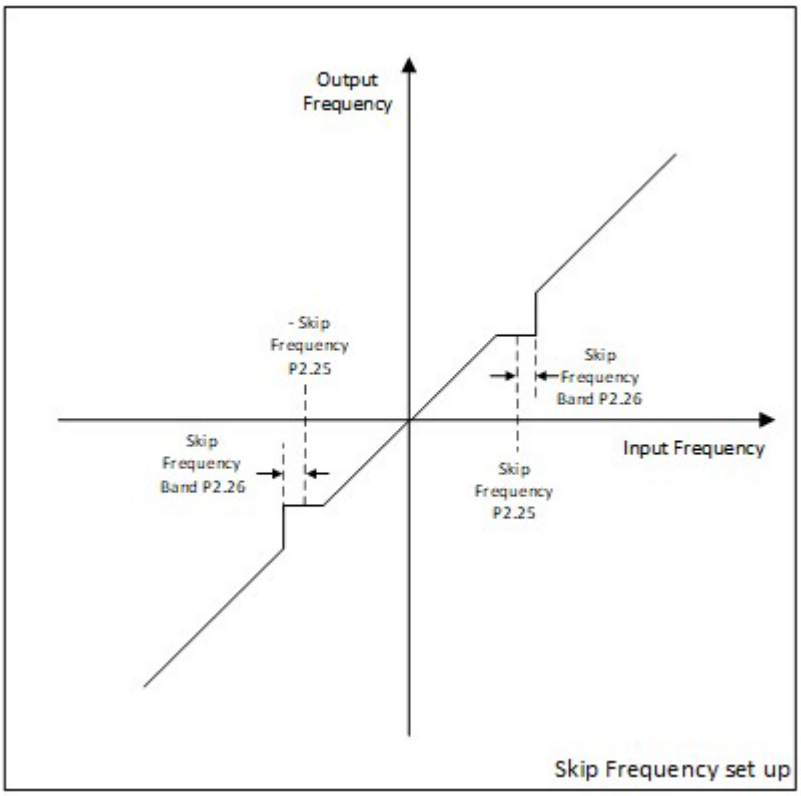
NOTE

The value of this parameter can be set by *Frequency Reference Configuration* (P2.03).

Parameter	P2.25 *Skip Frequency*		
Short description	Defines the reference frequency to skip		
Minimum	0.0	**Maximum**	MAXIMUM FREQUENCY LIMIT (P2.02)
Default	0.0	**Units**	Hz
Type	16 Bit User Save	**Update Rate**	20 ms
Display Format	Standard	**Decimal Places**	1
Coding	RW, VM, BU		

By default, this parameter is set to 0 which means that the skip frequency function is not active. To enable the skip frequency function a value must be specified in this parameter.

The skip reference function is available to prevent continuous operation within a specified frequency range (i.e. where mechanical resonance may occur). Skip *Frequency Band* (P2.26) defines the range either side of the value set here over which references are rejected in either direction. The actual rejection band is therefore twice that defined by *Skip Frequency Band* (P2.26) with this parameter at the centre of the band. When the selected reference is within the rejection band the lower limit of the band is passed through the filter so that reference is always less in magnitude than demanded.

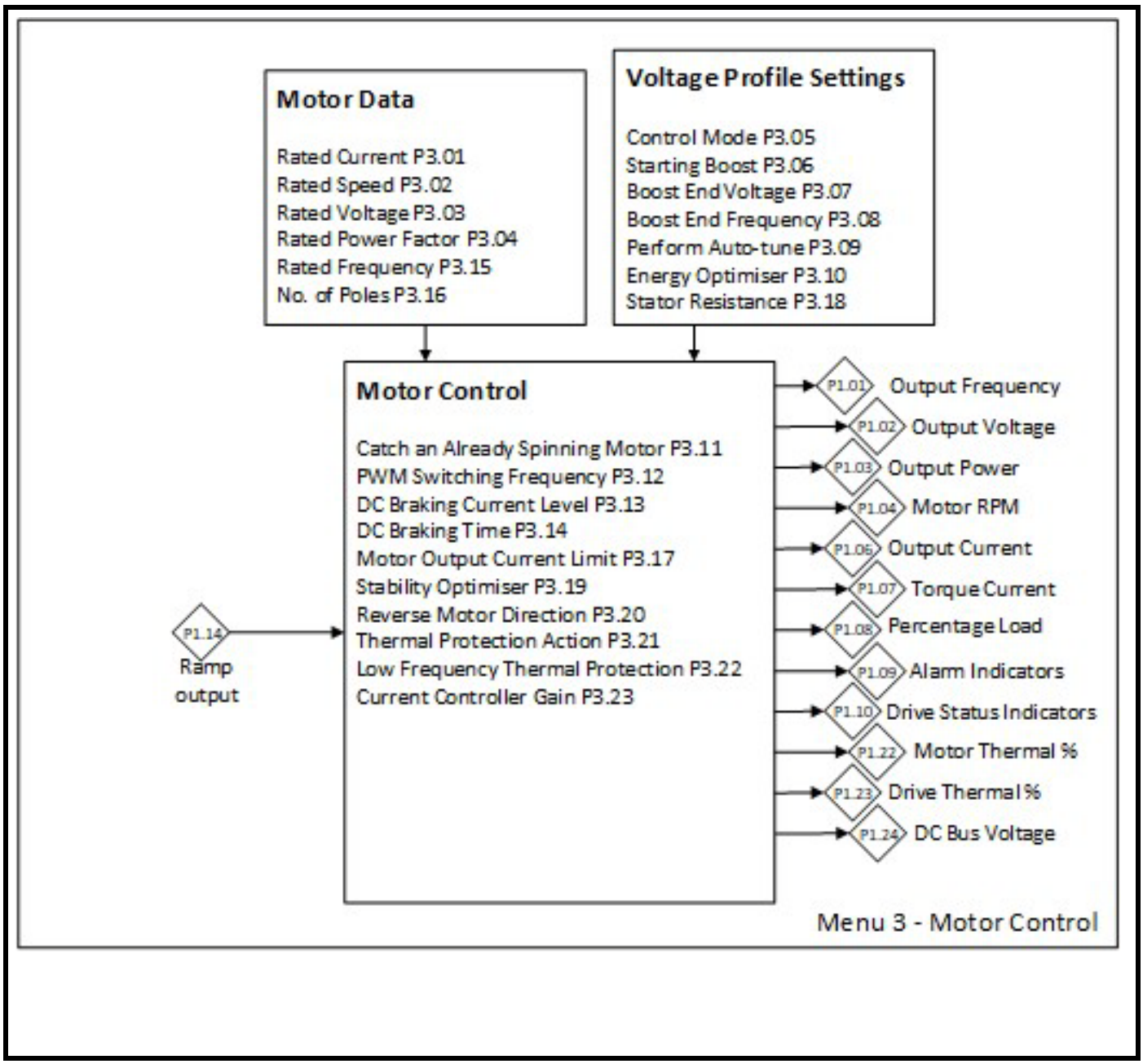


3.10.3 Menu 3 - Motor Setup

This menu contains parameters relating to motor setup and control.

Associated Parameters

- *Output Frequency* (P1.01)
- *Output Voltage* (P1.02)
- *Output Power* (P1.03)
- *Motor RPM* (P1.04)
- *Output Current* (P1.06)
- *Torque Producing Current* (P1.07)
- *Percentage Load* (P1.08)
- *Motor Thermal Percentage* (P1.22)
- *Motor Thermal Percentage* (P1.23)



Parameter	P3.01 *Motor Rated Current*		
Short description	Set to the rated current of the motor from the motor nameplate		
Minimum	0.00	**Maximum**	Drive Rated Current
Default	6.80	**Units**	A
Type	16 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	2
Coding	RW, VM, RA, BU		

Motor Rated Current must be set to the maximum continuous current of the motor (taken from the motor name plate). It is used as follows:

1. In the motor control algorithms
2. To define the range of the current limits - the current limits can be set higher than default if the motor rated current is less than the drive rating. See *Motor Output Current Limit* (P3.17))
3. In determining *Percentage Load* (P1.08)
4. To define the rated operating conditions for motor thermal protection. See *Motor Thermal Percentage* (P1.22)

Parameter	P3.02 *Motor Rated Speed*		
Short description	Set to the rated current of the motor from the motor nameplate		
Minimum	0	**Maximum**	18000
Default	See exceptions below	**Units**	rpm
Type	16 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW		

Region	*Default Value*
50Hz	1500
60Hz	1800

Motor rated Speed is used together with *Motor Rated Frequency* (P3.15) to calculate the slip of the machine and *Number Of Motor Poles* (P3.16).

Rated Slip (Hz) = *Motor Rated Frequency* (P3.15) - (Pole Pairs x *Motor Rated Speed* (P3.02) / 60)
Pole Pairs = Motor Poles / 2 either calculated automatically, or read from *Number Of Motor Poles* (P3.16)

Slip compensation adjusts the output frequency to compensate for the change in slip with the load in the motor.
Slip Compensation (Hz) = Rated Slip x Torque Producing Current (P1.07) / I^{Trated}

I^{Trated} = Torque Rated Current. See *Motor Output Current Limit* (P3.17)

Slip compensation is disabled by setting *Motor Rated Speed* (P3.02) ≥ 0

If spinning start is required (i.e. *Catch An Already Spinning Motor* (P3.11) 1) then Motor Rated Speed should be set correctly for the motor.

NOTE

If motor rated Speed is set to 0, *Number Of Motor Poles* (P3.16) must be set up *Manually for Motor RPM* (P1.04) to indicate the correct speed.

Parameter	P3.03 *Motor Rated Voltage*		
Short description	Set to the rated current of the motor		
Minimum	0	**Maximum**	Drive Rated Voltage
Default	See exceptions below	**Units**	V
Type	16 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW, VM, RA, BU		

Voltage	*Region*	*Default Value*
400 V	50 Hz	230
400 V	All	400
400 V	60 Hz	460

Motor Rated Voltage must be set to the voltage rating of the motor (taken from the motor name plate).

Motor Rated Voltage and *Motor Rated Frequency* (P3.15) define the frequency to voltage characteristic applied to the motor. See *Motor Control Mode* (P3.05) for more details.

Parameter	P3.04 *Motor Rated Power Factor*		
Short description	Set to the rated power factor of the motor (cosΦ)		
Minimum	0.00	**Maximum**	1.00
Default	0.80	**Units**	
Type	8 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	2
Coding	RW, RA, BU		

Motor Rated Power Factor is the rated power factor of the machine, cos φ (taken from the motor name plate). Motor Rated Power Factor is used to calculate the rated torque producing current, I_{Trated}. See *Motor Output Current Limit* (P3.17).

Parameter	P3.05 *Motor Control Mode*		
Short description	Defines the mode used to set the output voltage		
Minimum	0	**Maximum**	2
Default	1	**Units**	
Type	8 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	Resistance Comp	A linear frequency to voltage characteristic with vector based stator resistance compensation
1	Linear V to F	A fixed linear frequency to voltage characteristic
2	Square V to F	A fixed square frequency to voltage characteristic

This parameter defines the voltage characteristic applied to the motor. Three control modes are available, Resistance Compensation (0), linear V to F with boost (1), and Square V to F with boost (2).

The default mode of linear V to F is suitable for most applications. For fan and pump applications the Square V to F mode can be selected which matches the characteristic of the load. For applications that require good torque performance the Resistance Compensation mode should be used. For this mode of operation an auto-tune should be carried out to measure the stator resistance of the motor, or the resistance should be set up Manually. An auto-tune can be carried out with *Perform Auto-tune* (P3.09).

For Linear V to F, the V-F characteristic can be adjusted at two points, 0Hz where the starting boost voltage is set in *Motor Starting Boost* (P3.06), and *Motor Starting Boost End Frequency* (P3.08), *Motor Starting Boost End Voltage* (P3.07) which is the frequency and voltage point at which the boost level is tapered too.

From the second adjustable point the voltage rises linearly towards the *Motor Rated Voltage* (P3.03) at *Motor Rated Frequency* (P3.15). Above *Motor Rated Frequency* (P3.15) the voltage on the motor is constant and the field strength in the motor reduces as the frequency is increased.

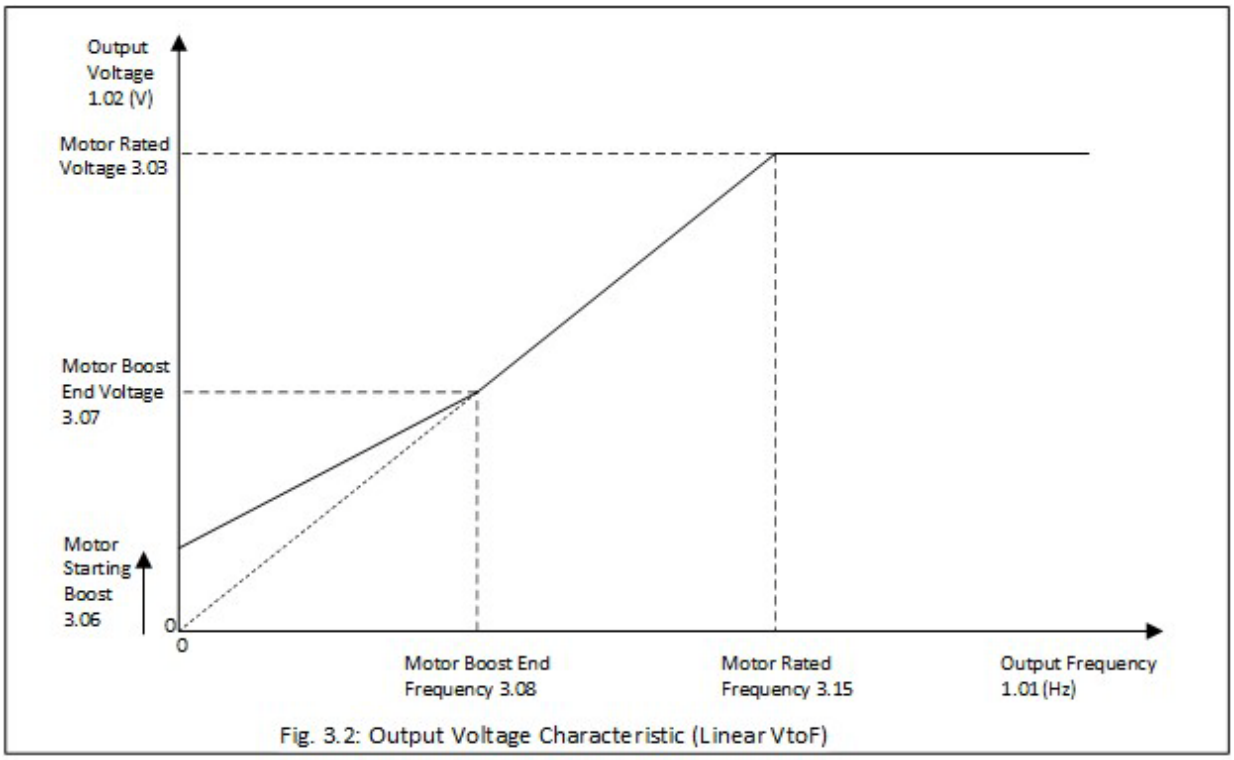
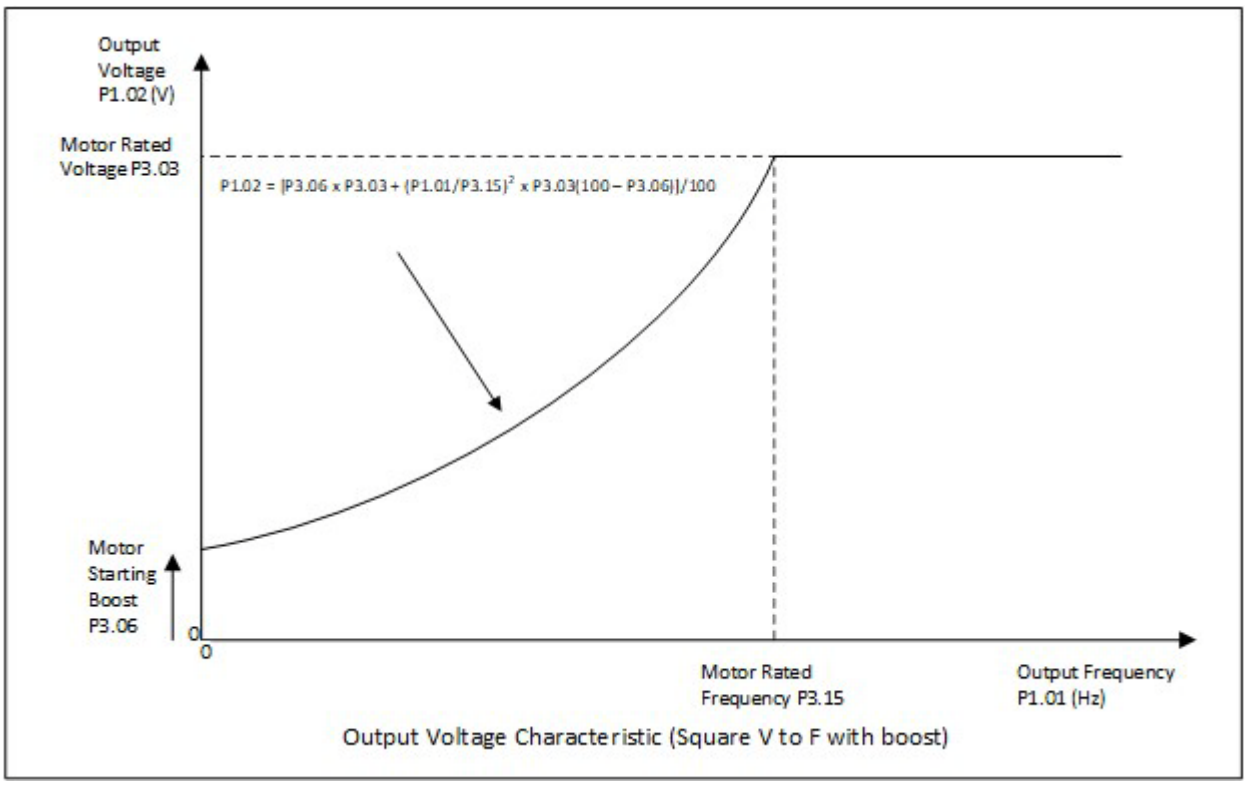


Fig. 3.2: Output Voltage Characteristic (Linear VtoF)

For Square V to F, only the starting boost is adjustable and the voltage output follows a square law from this point until the voltage reaches *Motor Rated Voltage* (P3.03) at *Motor Rated Frequency* (P3.15). At frequencies above this the motor voltage is constant.



Output Voltage Characteristic (Square V to F with boost)

Parameter	P3.06 *Motor Starting Boost*		
Short description	Defines the level of voltage boost at 0 Hz when using Linear V to F		
Minimum	0.0	**Maximum**	25.0
Default	5.0	**Units**	%
Type	8 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	1
Coding	RW, BU		

Defines the level of voltage boost at 0Hz as a percentage of the *Motor Rated Voltage* (P3.03) when *Motor Control Mode* (P3.05) is set to Linear V to F (1) or Square V to F (2). It can be used to increase low frequency torque performance, but if set too high will cause excessive motor current which would result in a Motor Overload error.

Parameter	P3.07 *Motor Starting Boost End Voltage*		
Short description	Defines the boost end voltage as a percentage of the motor rated voltage		
Minimum	0.0	**Maximum**	100.0
Default	50.0	**Units**	%
Type	16 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	1
Coding	RW, BU		

Defines the level of voltage as a percentage of the *Motor Rated Voltage* (P3.03) at the *Motor Starting Boost End Frequency* (P3.08) when *Motor Control Mode* (P3.05) is in Linear mode (1). See *Motor Control Mode* (P3.05).

Parameter	P3.08 *Motor Starting Boost End Frequency*		
Short description	Defines the boost end frequency as a percentage of the motor rated frequency		
Minimum	0.0	**Maximum**	100.0
Default	50.0	**Units**	%
Type	16 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	1
Coding	RW, BU		

Defines the frequency as a percentage of the *Motor Rated Frequency* (P3.15) at which *Motor Starting Boost* (P3.06) has been faded out when *Motor Control Mode* (P3.05) is in Linear (1) mode. See *Motor Control Mode* (P3.05).

Parameter	P3.09 *Perform Auto-tune*		
Short description	Auto-tune test to obtain some of the motor characteristics		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit Volatile	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW		

A stationary test to measure Stator Resistance (P3.18).
This is only used if P3.05 = Resistance Compensation (0). Or if Catch an Already Spinning Motor (P3.11) ≥ 1.

To perform an auto-tune:
Set this parameter to 1 and run the drive

When the auto-tune sequence is completed successfully the drive is stopped. This parameter is set to 0.

The drive can be restarted by removing the run commands and activating them again.

NOTE

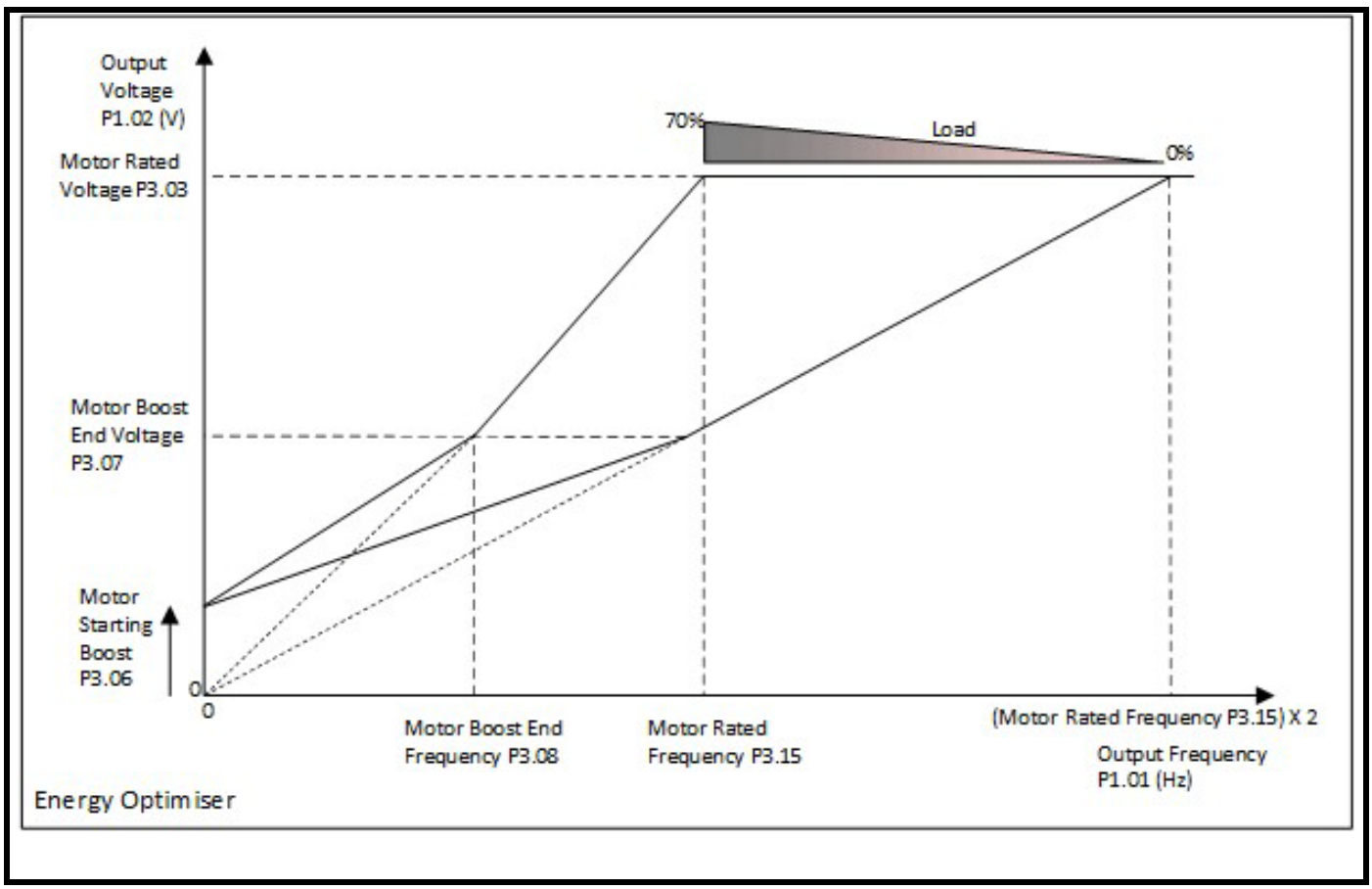
An auto-tune test cannot be initiated if the drive is in error or the drive inverter is active, i.e. Drive Healthy = 0 or Drive Active = 1 in Drive State (P1.05).

The auto-tune test relies on the motor being stationary when it is initiated to give accurate results. The motor should also remain stationary during the test.

Parameter	P3.10 *Energy Optimiser*		
Short description	Enables low energy mode		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW		

Energy efficient motor control (sometimes referred to as Dynamic V to F) is intended for applications where power loss should be kept to a minimum under low load conditions, but dynamic (rapid acceleration) performance is not important. The reduction in power loss under low load conditions is achieved by increasing the rated frequency (internal to the drive) used to derive the frequency to voltage characteristic. When the function is enabled, the rated frequency used to derive the output voltage is given by:

Motor Rated Frequency (P3.15) x (2 - |*Percentage Load* (P1.08)| / 70.0%) ,see diagram below.



Parameter	P3.11 *Catch an Already Spinning Motor*		
Short description	Defines the behaviour of the drive when the drive is enabled whilst the motor is rotating		
Minimum	0	**Maximum**	3
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	Disabled	No attempt to detect the motor speed
1	Enabled	Detects the motor speed before starting
2	Forwards Only	Detects forward motor speed only, starts at 0Hz if motor rotating backwards
3	Reverse Only	Detects reverse motor speed only, starts at 0Hz if motor rotating forwards

If it is possible that the motor is spinning when the run command is given then this parameter should be set for the required action. If this parameter is > 0, a test is carried out to measure the frequency that the motor is running at when the drive enters the run state. The measured frequency is used to preset *Ramp Output* (P1.14) and give a smooth start at the motor speed detected. For the test to be successful it is important that the motor parameters, especially *Stator Resistance* (P3.18) and *Motor Rated Speed* (P3.02), are set up correctly.

Parameter	P3.12 *PWM Switching Frequency*		
Short description	Increases the maximum frequency the drive is allowed to switch the inverter at to 12 kHz		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This parameter defines the required switching frequency.

Value	Name	Description
0	Off	The switching frequency used by the inverter will be 4 kHz (default)
1	On	The maximum switching frequency used by the inverter will be 12 kHz

Parameter	P3.13 *DC Braking Current Level*		
Short description	Defines the level of current used for injection braking		
Minimum	0.0	**Maximum**	150.0
Default	100.0	**Units**	
Type	16 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	1
Coding	RW, BU		

Defines the level of current used for injection braking as a percentage of *Motor Rated Current* (P3.01). Excessive current can cause the motor to overheat.

Parameter	P3.14 *DC Braking Time*		
Short description	Defines the time during which DC current is injected into the motor during timed injection stopping modes		
Minimum	0.0	**Maximum**	100.0
Default	1.0	**Units**	s
Type	16 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	1
Coding	RW, BU		

Defines the time during which DC current is injected into the motor during timed injection stopping modes. See *Stopping Mode Selector* (P2.04). Excessive time when the motor speed is low can cause the motor to overheat due to reduced motor self-ventilation.

Parameter	P3.15 *Motor Rated Frequency*		
Short description	Set to the rated frequency of the motor		
Minimum	0.0	**Maximum**	300.0
Default	See exception below	**Units**	Hz
Type	16 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	1
Coding	RW, BU		

Region	*Default Value*
50Hz	50.0
60Hz	60.0

Motor Rated Frequency must be set to the rated frequency of the motor (taken from the motor name plate). The Motor rated frequency is used with *Motor Rated Voltage* (P3.03) to define the end point of the voltage characteristic. See *Motor Control Mode* (P3.05). It is also used together with *Motor Rated Speed* (P3.02) to calculate the No. of motor poles if *Number Of Motor Poles* (P3.16) is set to *0* = Automatic which is the default setting.

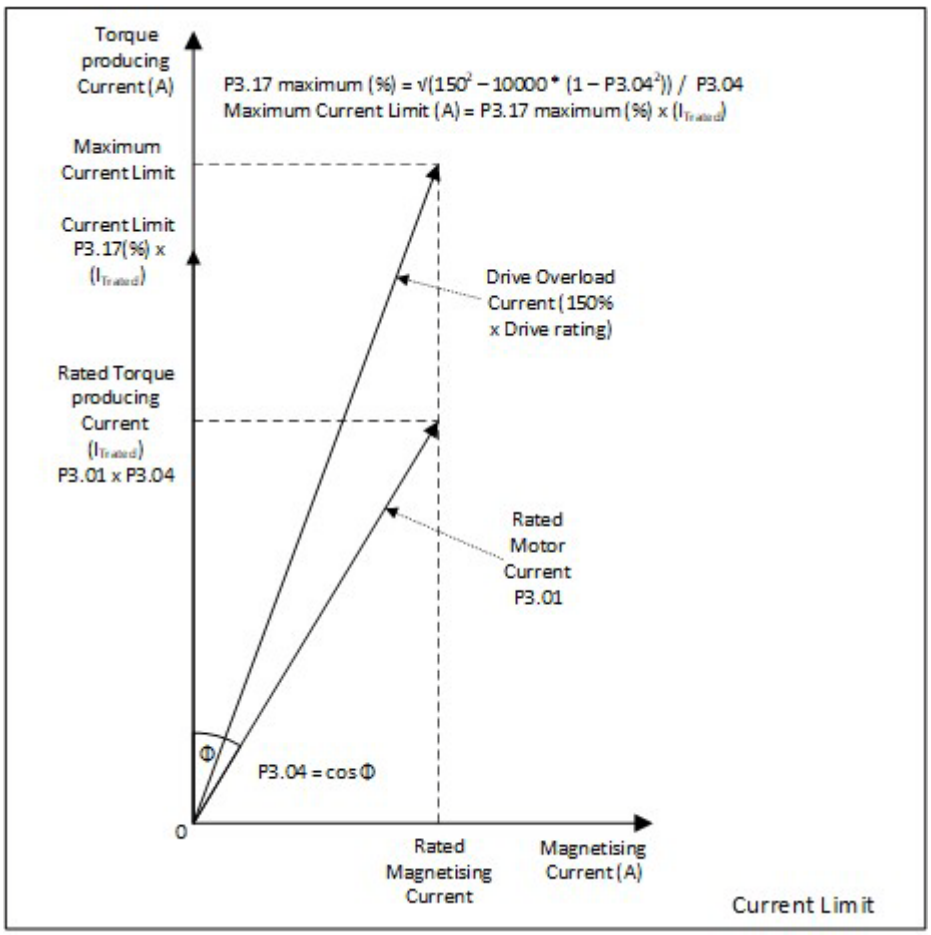
Parameter	P3.16 *Number of Motor Poles*		
Short description	Defaulted to calculate automatically, but if required set from motor manufactures datasheet		
Minimum	0	**Maximum**	8
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

If Number of Motor Poles = 0 (default), the number of motor poles are calculated automatically as shown below:

Number of Poles = 2 x 60 x *Motor Rated Frequency* (P3.15) / *Motor Rated Speed* (P3.02) rounded down to the nearest integer.
If Number of Motor Poles > 0, the value is taken as the number of poles. If an odd number is entered, then the even number one less than the odd value entered is used as the number of Poles.

Parameter	P3.17 *Motor Output Current Limit*		
Short description	Defines the maximum torque producing current the drive will deliver to the motor		
Minimum	0.0	**Maximum**	Motor Current Variable
Default	171.0	**Units**	
Type	16 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	1
Coding	RW, VM, RA, BU		

Defines the maximum torque producing current that can be supplied to the motor. It is a symmetrical limit which means that it is applied when the motor is motoring or regenerating.
The maximum setting for this parameter is defined by the setting of *Motor Rated Current* (P3.01) and *Motor Rated Power Factor* (P3.04). The maximum setting can be calculated from the diagram as below:



$$Motor\ Output\ Current\ Limit\ (Max) = \frac{Torque\ Producing\ Current\ (Max)}{Motor\ Rated\ Torque\ Producing\ Current}$$

$$\text{Torque Producing Current (Max)} = \sqrt{(Drive\ Rated\ Current \times 150\%)^2 - (Motor\ Rated\ Magnetising\ Current)^2}$$

$$\text{Motor Rated Torque Producing Current} = P3.01 \times P3.04$$

$$\text{Motor Rated Magnetising Current} = \sqrt{(P3.01)^2 - (P3.01 \times P3.04)^2}$$

The default value (165%) is the maximum setting when the *Motor Rated Current* (P3.01) is equal to the *Drive Rated Current*, and the *Motor Rated Power Factor* (P3.04) is 0.85.

If the *Motor Rated Current* (P3.01) is lower than the *Drive Rated Current*, or if *Motor Rated Power Factor* (P3.04) is lower than 0.85; then *Motor Output Current Limit* (P3.17) could be increased to provide more torque producing current. This increase is an overload, and as such the drive will only allow increased current for a short duration to prevent the motor overheating.

If the maximum motor torque should be limited in an application, this parameter should be reduced accordingly.
This value is populated when *Perform Auto-tune* (P3.09) has been performed and can also be adjusted manually.

Parameter	P3.18 *Stator Resistance*		
Short description	Defines the resistance of the motor stator		
Minimum	0.00	**Maximum**	199.99
Default	2.00	**Units**	Ω
Type	16 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	2
Coding	RW		

This parameter stores the stator resistance of the motor and is used when *Motor Control Mode* (P3.05) is set to resistance compensation, and also when *Catch An Already Spinning Motor* (P3.11) is enabled. This value is populated when *Perform Auto-tune* (P3.09) has been performed and can also be adjusted Manually.

Parameter	P3.19 *Motor Stability Optimiser*		
Short description	This can reduce vibration/oscillation under some load conditions.		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW		

When this parameter is enabled it alters the motor control algorithm to help reduce stability problems. The disadvantages of setting this parameter are increased acoustic noise from the motor and a reduction in the thermal capability of the drive at low output frequencies.

This is typically required when lightly loaded motors exhibit stability issues below half rated speed, or when fully loaded motors exhibit instability at maximum output voltage.

Parameter	P3.20 *Reverse Motor Direction*		
Short description	Makes the motor run in the opposite direction		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW		

If the motor direction does not match the required forward and reverse control commands, this parameter will change the motor direction without the need to swap output cables. Changes to this parameter will only take effect when the drive is not running.

NOTE

This reverses the output phase sequence for the selected forward and reverse directions which is non-standard.

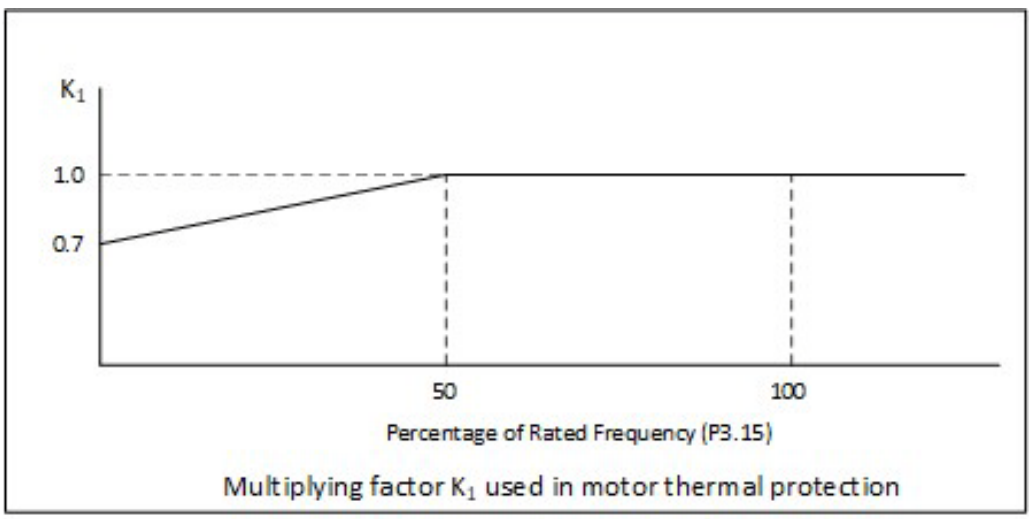
Parameter	P3.21 *Thermal Protection Action*		
Short description	Set to the required thermal protection operation		
Minimum	0	**Maximum**	4
Default	3	**Units**	
Type	8 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	Disabled	No motor thermal protection but drive thermal protection is still active
1	Error with Save	Drive generates an Error when Limit reached. Motor and Drive thermal protection percentages are stored at power down
2	Error	Drive generates an Error when Limit reached. Motor and Drive thermal protection percentages start at 0% at power up
3	Limit with Save	Current is limited if drive or motor thermal percentage approaches 100%. Motor and Drive percentages are stored at power down (default)
4	Limit	Current is limited if drive or motor thermal percentage approaches 100%. Motor and Drive percentages start at 0% at power up

If the drive or motor is getting too hot the default setting will limit the output current. Change this parameter to configure a different action as detailed above.
If any of the current limiting modes are selected, the larger of *Motor Thermal Percentage* (P1.22) and *Drive Thermal Percentage* (P1.23) is used to reduce the current limit. If the larger percentage is > 90% the current limit set in *Motor Output Current Limit* (P3.17) is progressively reduced to 0 as the percentage increases from 90% to 100%. If thermal limiting is active, bit 2 is set in *Drive State* (P1.05).

Parameter	P3.22 *Low Frequency Thermal Protection*		
Short description	Should be set if naturally cooled motor is required to run at high load currents at low frequency		
Minimum	0	**Maximum**	1
Default	1	**Units**	
Type	1 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

If a naturally cooled motor is required to run at high loads at low frequencies then this parameter should be set to On to protect the motor thermally. *Motor Rated Current* (P3.01) is multiplied by a factor K_1 to determine the level above which the motor is considered to be in an overload condition. When this parameter is set to Off (0), $K_1 = 1$, and when this parameter is set to On (1), K_1 is as the diagram below.



Multiplying factor K_1 used in motor thermal protection

Parameter	P3.23 *Current Controller Gain*		
Short description	Defines the current loop controller gain		
Minimum	0	**Maximum**	250
Default	40	**Units**	
Type	8 Bit User Save	**Update Rate**	400 ms
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

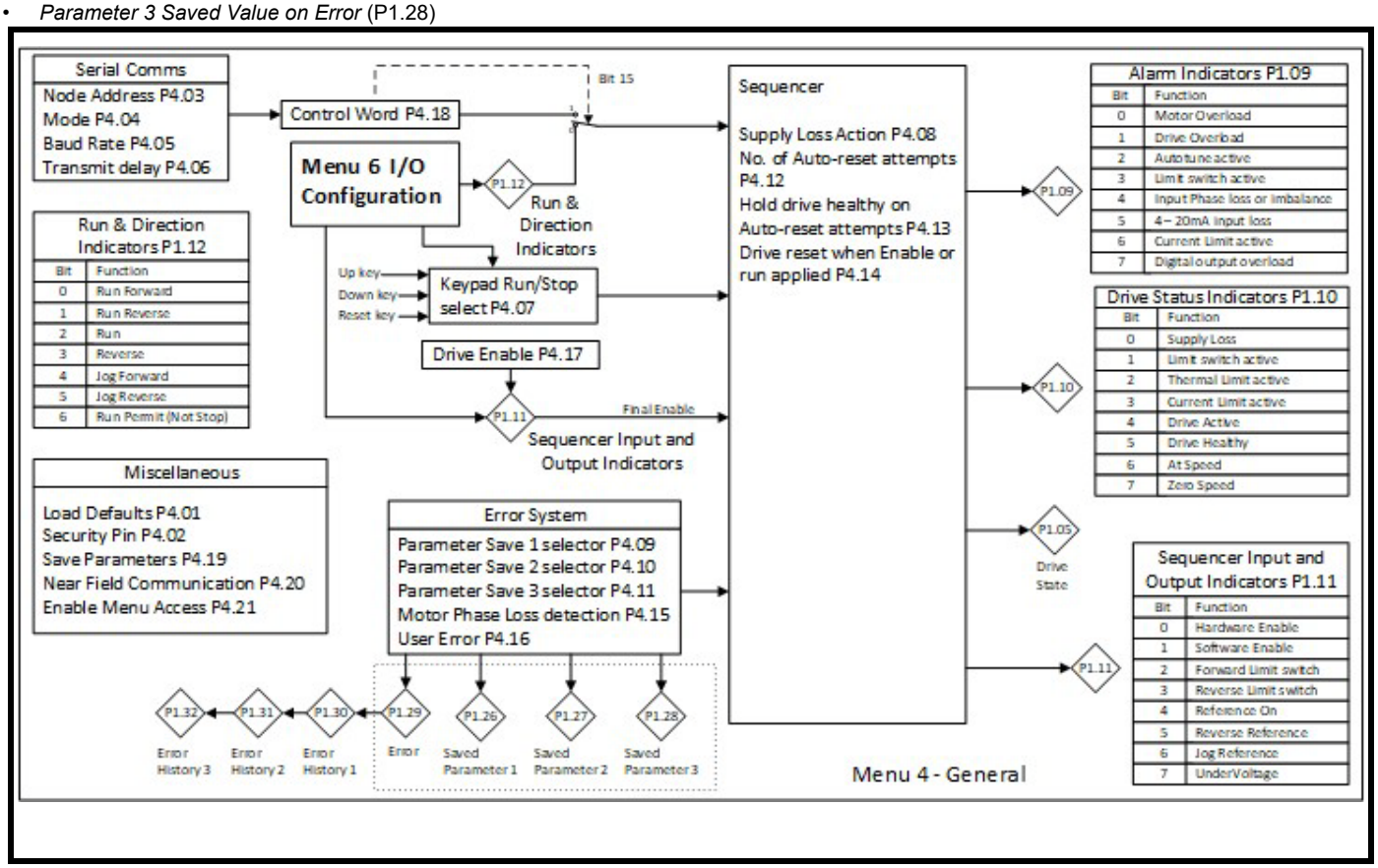
Used to adjust the gain of the current limit controller. This does not normally need to be adjusted, but can be reduced if there is evidence of motor noise during current limiting. Increasing the value may be required if *Standard Ramp* (1) or *Standard Ramp Plus Motor* (2) are being used in *Deceleration Ramp Type* (P2.11) with a high inertia load, or if *Supply Loss Action* (P4.08) > 0, as the increased gain will help the control of the DC link voltage during these operations.

3.10.4 Menu 4 – General

This menu contains parameters related to the general drive settings, communication setup parameters and miscellaneous functions such as defining parameter values to store when an error occurs.

Associated Parameters

- *Parameter 1 Saved Value on Error* (P1.26)
- *Parameter 2 Saved Value on Error* (P1.27)
- *Parameter 3 Saved Value on Error* (P1.28)



Parameter	P4.01 *Restore Factory Defaults*		
Short description	Restore the drive's default parameter settings		
Minimum	0	**Maximum**	2
Default	0	**Units**	
Type	8 Bit Volatile	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	None	No action
1	50Hz	Restore Factory Defaults for 50 Hz region
2	60Hz	Restore Factory Defaults for 60 Hz region

If this parameter is set to something other than 0 then the drive will load the appropriate defaults and save parameters. This parameter will be reset to 0 after the action is completed. If editing on the keypad the action will be performed when the edit is finished.

After this has been set, it cannot be undone.

Parameter	P4.02 *Security Pin*		
Short description	Defines the user security pin of the drive		
Minimum	0	**Maximum**	9999
Default	0	**Units**	
Type	16 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

Defines the 4-digit security pin of the drive. This parameter should be set to a value other than 0 to prevent unauthorised write access to the drive. When a value greater than 0 has been set, it will not be displayed on the keypad or Marshal app to maintain security. If a value has been set, the security pin must be entered before any parameter can be adjusted via the keypad.

Parameter	P4.03 *Serial Node Address*		
Short description	Defines the serial address of the drive		
Minimum	1	**Maximum**	247
Default	1	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

Defines the node address for the serial communications interface in the range of 1 to 247.

Parameter	P4.04 *Serial Mode*		
Short description	Defines the serial mode of the drive		
Minimum	0	**Maximum**	3
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	8.2NP	8 data bits, 2 stop bits, no parity bit
1	8.1NP	8 data bits, 1 stop bit, no parity bit
2	8.1EP	8 data bits, 1 stop bit, even parity bit
3	8.1OP	8 data bits, 1 stop bit, odd parity bit

The drive always uses the Modbus RTU protocol and is always a slave.

Parameter	P4.05 *Serial Baud Rate*		
Short description	Defines the serial baud rate of the drive		
Minimum	0	**Maximum**	10
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	*Text*
0	Disabled
1	600
2	1200
3	2400
4	4800
5	9600
6	19200
7	38400
8	57600
9	76800
10	115200

Parameter	P4.06 *Minimum Serial Comms Transmit Delay*		
Short description	Defines the minimum delay between the host message being received and the drive response		
Minimum	0	**Maximum**	250
Default	0	**Units**	ms
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

Defines the delay in the drive responding to a message from the host. This may need to be extended if the host is not ready to receive data within 1 ms of the drive receiving a message. This delay is added to the base delay of 1 ms.

Parameter	P4.07 *Keypad Run and Stop Function Select*		
Short description	Selects the digital function of the Reset and Up/Down keys on the keypad		
Minimum	0	**Maximum**	2
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

Selects the function of the Reset and Up/Down keys for starting and stopping the drive.

Value	Description
0	The keypad cannot be used to run and stop the drive
1	Pressing the Up and Down keys together will run the drive and pressing the Stop/Reset key will stop the drive.
2	Continuously pressing the Up and Down keys together will cause the drive to run in the forward direction at the programmed Jog speed.

NOTE

The value of this parameter can be set by *Run/Stop Configuration* (P6.13).

Parameter	P4.08 *Supply Loss Action*		
Short description	Defines the behaviour of the drive when the supply voltage is removed		
Minimum	0	**Maximum**	2
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	Disable	Operate normally unless the under-voltage condition is detected
1	Ramp Stop	Stops with selected deceleration while attempting to control the DC link voltage to take energy from the motor
2	Ride Through	Attempts to control the DC link voltage to take energy from the motor and continues normally if the supply returns

If the supply voltage returns during a Ramp stop or before the drives supply rails have collapsed, the run command needs to be removed and re-applied before the drive will run again.

Parameter	P4.09 *Parameter 1 Save on Error Selector*		
Short description	Defines which monitoring parameter is saved on an error		
Minimum	0	**Maximum**	25
Default	3	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	*Text*
0	None
1	Output Frequency
2	Output Voltage
3	Output Power
4	Motor RPM
5	Drive State
6	Output Current
7	Torque Producing Current
8	Percentage Load
9	Alarm Indicators
10	Drive Status Indicators
11	Sequencer Indicators
12	Run and Direction
13	Ramp Input
14	Ramp Output
15	T2 Analog 1 Percentage
16	T4 Analog 2 Percentage
17	T15 Freq. Input %
18	Up/Down Percentage
19	PID Percentage
20	PID Status Indicators
21	PID Error
22	Motor Thermal Percentage
23	Drive Thermal Percentage
24	DC Bus Voltage
25	Digital IO Indicators

If the drive enters an Error state, it is possible to save several parameter values at the instant of the error. This can be useful to locate the source of the error. This defines the first of three parameters that can be saved.

The value is saved in *Parameter 1 Saved Value on Error* (P1.26).
The saved values and error code are maintained after the error has been reset.

Parameter	**P4.10 *Parameter 2 Save on Error Selector***		
Short description	Defines which monitoring parameter is saved on an error		
Minimum	0	**Maximum**	25
Default	4	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

See *Parameter 1 Save on Error Selector* (P4.09).

Parameter	**P4.11 *Parameter 3 Save on Error Selector***		
Short description	Defines which monitoring parameter is saved on an error		
Minimum	0	**Maximum**	25
Default	5	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

See *Parameter 1 Save on Error Selector* (P4.09).

Parameter	**P4.12 *Number of Auto Reset Attempts***		
Short description	Set to the number of required auto-reset attempts		
Minimum	0	**Maximum**	6
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	***Text***
0	None
1	One
2	Two
3	Three
4	Four
5	Five
6	Continuous

If the drive enters an Error state, it can automatically attempt to reset.

If this parameter is set to 0 then no auto-reset attempts are made. Any other value will cause the drive to automatically reset following an error for the number of times programmed after a delay of one second. Some errors have extended delays such as *motor over current* which will reset after ten seconds. The auto-reset count is only incremented when the error is the same as the previous error otherwise it is reset to zero. When the auto-reset count reaches the programmed value, any further error of the same value will require a manual reset from the keypad or via serial comms.
If there has been no error for five minutes, then the auto-reset count is cleared. Some errors cannot be automatically reset such as stored HF errors. When a manual reset is performed the auto-reset counter is reset to zero.
If *Number of Auto Reset Attempts* (P4.12) = 6 the auto-reset counter is held at zero and so there is no limit on the number of auto-reset attempts.

Parameter	P4.13 *Hold Drive Healthy on Auto Reset Attempts*		
Short description	Set to hold drive healthy if further auto-reset attempts are possible		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW		

If this parameter is set to Off (0) then Bit 5 (Healthy) in *Drive Status Indicators* (P1.10) is cleared every time the drive generates an error regardless of any auto-reset that may occur. If it is set to On (1) then Bit 5 (Healthy) is not cleared on an error if any further auto-reset attempts are possible.

NOTE

If the under-voltage state becomes active Bit 5 (Healthy) in *Drive Status Indicators* (P1.10) is always set to Off (0).

Parameter	P4.14 *Drive Reset When Enable or Run Applied*		
Short description	Reset an error with application of enable or run		
Minimum	0	**Maximum**	1
Default	1	**Units**	
Type	1 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

Errors are automatically reset on the application of an enable or run signal. This feature can be disabled by setting this parameter to Off (0).

Parameter	P4.15 *Motor Phase Loss Detection*		
Short description	Enable motor phase loss detection		
Minimum	0	**Maximum**	1
Default	1	**Units**	
Type	1 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW		

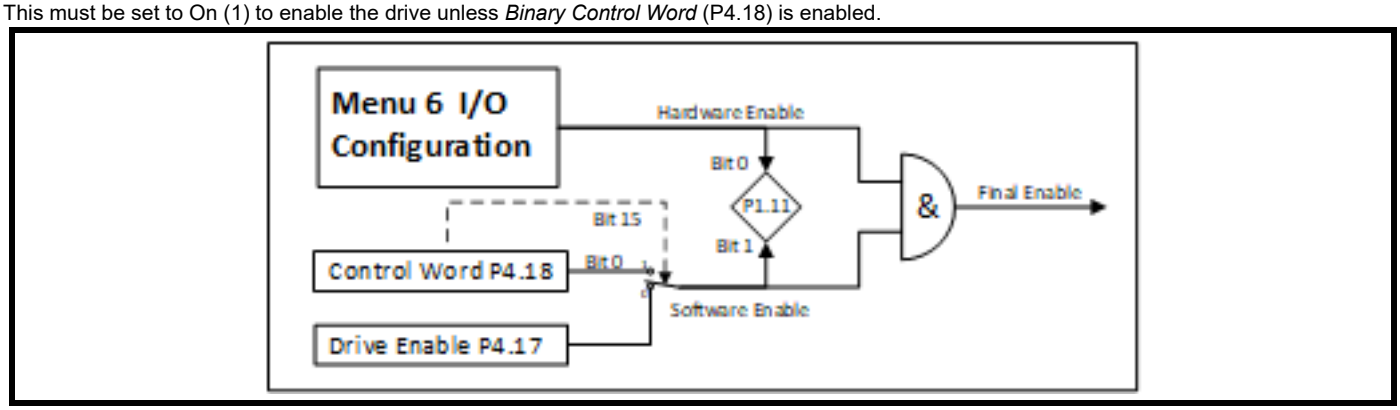
Output phase loss detection can be used to detect a disconnected motor phase or a break in the wire between the drive and the motor.
If the motor is running significantly faster than its *Motor Rated Speed* (P3.02) the phase loss may not be detected. If the motor is very heavily loaded it is likely to stall before the phase loss is detected.
This feature can be enabled by setting this parameter to On (1).

Parameter	P4.16 *User Error*		
Short description	Defines which user error is to occur		
Minimum	0	**Maximum**	255
Default	0	**Units**	
Type	8 Bit Volatile	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

This parameter is intended for use over communications only and not via the keypad.
An error number can be written to this parameter to generate that error in the drive, or a different (user defined) error if the number written is unused by the drive. This parameter can also be used to reset errors and clear the error log:
Set to 255 to clear the error history.
Set to 100 to reset the drive.
Setting to 0 will not result in an error.

Parameter	P4.17 *Drive Enable*		
Short description	Set to On to enable the drive		
Minimum	0	**Maximum**	1
Default	1	**Units**	
Type	1 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, BU		

This must be set to On (1) to enable the drive unless *Binary Control Word* (P4.18) is enabled.



Parameter	P4.18 *Binary Control Word*		
Short description	Controls the sequencer inputs if the control word is enabled		
Minimum	0 (Display: 0000000000000000	**Maximum**	65535 (Display: 1111111111111111)
Default	0 (Display: 0000000000000000)	**Units**	
Type	16 Bit Volatile	**Update Rate**	
Display Format	Binary	**Decimal Places**	0
Coding	RW, BU		

If Bit 15 in this parameter is set to zero then the parameter has no effect, but if it is set to one it overrides all of the corresponding inputs to the sequencer and other digital input functions shown in the table below. Once the control word has been enabled, it must continue to be written to at least once a second to prevent a *Watchdog* error (Error 30) from being generated. Disabling the control word returns the drive to terminal control and the parameter no longer needs to be refreshed to prevent the watchdog error.
Should only be used by serial communications.

Bit	Function	Description
Bit 0	Software Enable	Set to 1 to enable the drive
Bit 1	Run Forward	Set to 1 to run forwards
Bit 2	Jog Forward	Set to 1 to jog forwards
Bit 3	Run Reverse	Set to 1 to run in the reverse direction
Bit 4	Reverse	Set to 1 to reverse the direction
Bit 5	Run	Set to 1 to run
Bit 6	Run Permit (Not Stop)	Set to 1 to enable latching which will be cleared when set to 0
Bit 7	Reference Selector 0	Used to select which reference is used by the reference system

Bit 8	Reference Selector 1	Used to select which reference is used by the reference system
Bit 9	Jog Reverse	Set to 1 to jog in the reverse direction
Bit 10	Ramp Rate Selector	Used to select which ramp rates are used by the ramp system
Bit 11	Reserved	Not used by the drive
Bit 12	Initiate Error	Set to 1 to repeatedly initiate the control word error
Bit 13	Reset Drive	Set to 1 to reset the drive, clearing errors. This is automatically cleared
Bit 14	Reserved	Not used by the drive
Bit 15	Enable Control Word	Set to 1 to enable the binary control word

Parameter	**P4.19 *Save Parameters***		
Short description	Set to 1 to save parameters		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit Volatile	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW		

If this parameter is set to On (1) then a full save will be initiated. When the save is complete the parameter will be automatically reset to Off (0). Should only be used by serial communications because a any parameter changes made by the keypad are automatically saved upon exiting the parameter

Parameter	**P4.20 *Near Field Communication (NFC)***		
Short description	NFC Control		
Minimum	0	**Maximum**	2
Default	2	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

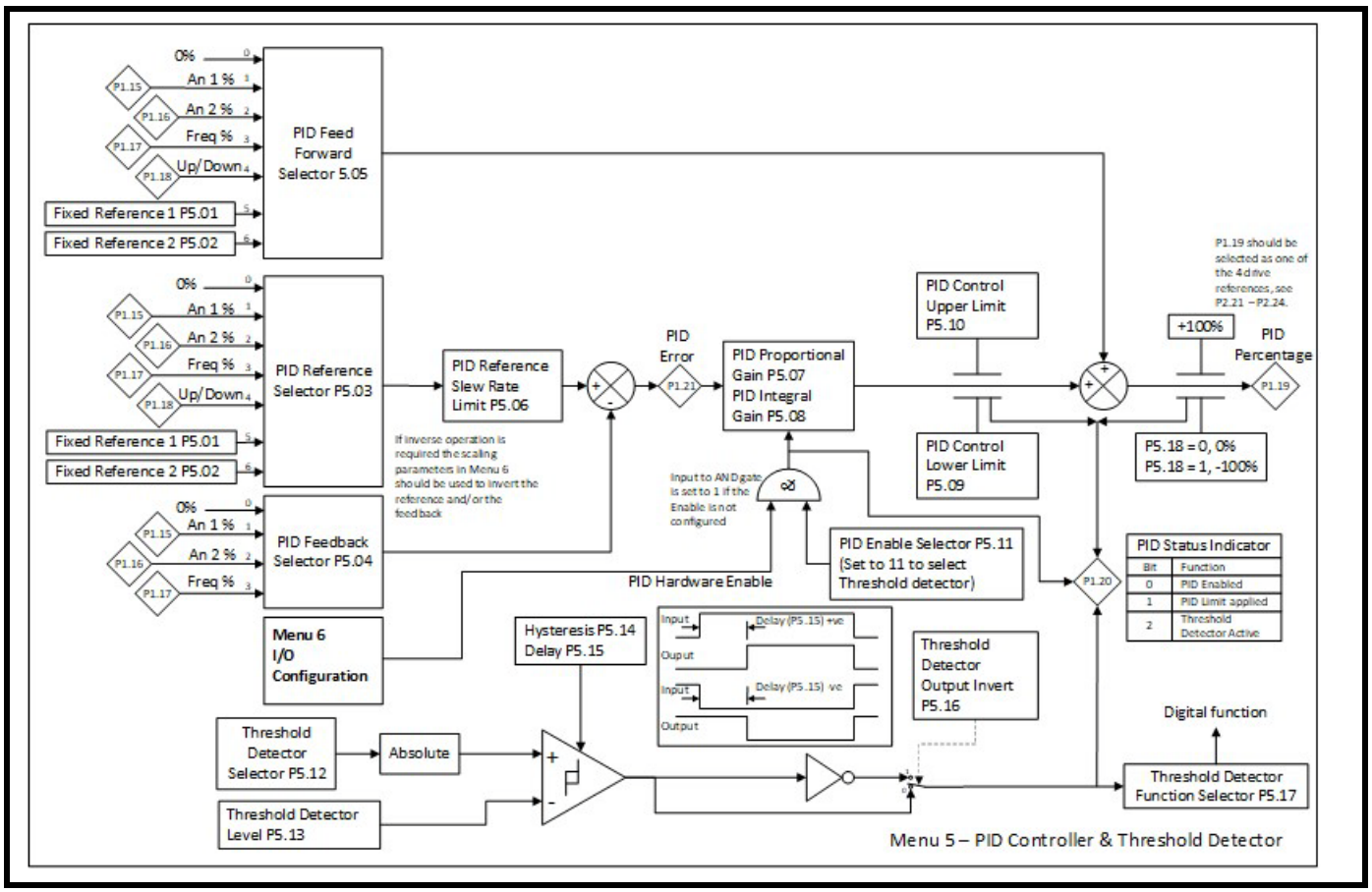
Value	***Text***	***Description***
0	Disabled	NFC communications are blocked
1	Read Only	The drive's NFC can be read offline by the app, and while on drive configuration files and parameters can be read
2	Read & Write	The drive's NFC features are fully enabled

3.10.5 Menu 5 – PID Controller

The PID controller is suitable for use in applications requiring basic closed-loop control of a system or process.

Associated Parameters

- *PID Percentage* (P1.19)
- *PID Status Indicators* (P1.20)
- *PID Error* (P1.21)
- *Reference Select 1* (P2.21)
- *T2 Analog Input 1 Type* (P6.01)
- T11 Digital Input 1 Function Select (P6.16)



Parameter	P5.01 *PID Fixed Reference Set-Point 1*		
Short description	Defines the value of fixed reference set point 1 for the PID controller		
Minimum	-100.00	**Maximum**	100.00
Default	0.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RW		

Used where a set point for the controller is fixed and does not change or could be updated via serial communications.

Parameter	P5.02 *PID Fixed Reference Set-Point 2*		
Short description	Defines the value of fixed reference set point 2 for the PID controller		
Minimum	-100.00	**Maximum**	100.00
Default	0.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RW		

Used where a set point for the controller is fixed and does not change or could be updated via serial communications.

Parameter	P5.03 *PID Reference Selector*		
Short description	Defines the input source for the reference of the PID controller		
Minimum	0	**Maximum**	6
Default	6	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	None	Fixed value of 0%
1	Analog 1 Percent	Scaled value of analog input 1
2	Analog 2 Percent	Scaled value of analog input 2
3	Frequency Input %	Scaled value of the frequency input
4	Up/Down Percent	Reference set by the Up/Down control
5	Fixed Reference 1	Fixed reference Set-Point 1 (P5.01)
6	Fixed Reference 2	Fixed reference Set-Point 2 (P5.02)

NOTE

The value of this parameter can be set by *Frequency Reference Configuration* (P2.03).

Parameter	P5.04 *PID Feedback Selector*		
Short description	Defines the input source for the feedback of the PID controller		
Minimum	0	**Maximum**	3
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	None	Fixed value of 0%
1	Analog 1 Percent	Scaled value of analog input 1
2	Analog 2 Percent	Scaled value of analog input 2
3	Frequency Input %	Scaled value of the frequency input

Parameter	P5.05 *PID Feed Forward Selector*		
Short description	Defines the input source for the feed-forward reference of the PID controller		
Minimum	0	**Maximum**	6
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	None	Fixed value of 0%
1	Analog 1 Percent	Scaled value of analog input 1
2	Analog 2 Percent	Scaled value of analog input 2
3	Frequency Input %	Scaled value of the frequency input
4	Up/Down Percent	Reference set by the Up/Down control
5	Fixed Reference 1	Fixed reference Set-Point 1 (P5.01)
6	Fixed Reference 2	Fixed reference Set-Point 2 (P5.02)

The PID can be used to provide a speed reference for the drive directly, or to provide a trim which is used to adjust a reference provided for the drive. This parameter selects the source of the input to be trimmed.

If this parameter is set to zero, PID Percent is given by:
PID Percentage (P1.19) = *PID Error* (P1.21) * [*PID Proportional Gain* (P5.07) + *PID Integral Gain* (P5.08) / s]

If an input has been selected as a feed Forward term, PID Percent is given by:
PID Percentage (P1.19) = *PID Error* (P1.21) * [*PID Proportional Gain* (P5.07) + *PID Integral Gain* (P5.08) / s] + Feed Forward Source

The PID integrator is held when the PID output reaches 100 %.

NOTE

The value of this parameter can be set by *Frequency Reference Configuration* (P2.03).

Parameter	P5.06 *PID Reference Slew Rate Limit*		
Short description	Defines the maximum rate of change of the reference to the PID controller		
Minimum	0.0	**Maximum**	3200.0
Default	0.0	**Units**	s
Type	16 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	1
Coding	RW, BU		

The time entered is the time for the reference to change from 0 to 100%. If using high PID gains, this parameter can be used to reduce over-shoot of a large step change in the PID reference.

Parameter	P5.07 *PID Proportional Gain*		
Short description	Defines the Kp gain used for the PID controller		
Minimum	0.000	**Maximum**	4.000
Default	1.000	**Units**	
Type	16 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	3
Coding	RW, BU		

This value is multiplied with the *PID Error* (P1.21).

If *PID Error* (P1.21) = 10%, the proportional term is a value of 10% if this parameter is set to 1.000.

A higher value will reduce response time. However, if the value is set too high it may introduce oscillation in the system.

Parameter	P5.08 *PID Integral Gain*		
Short description	Defines the Ki gain used for the PID controller		
Minimum	0.000	**Maximum**	4.000
Default	0.500	**Units**	
Type	16 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	3
Coding	RW, BU		

The PID integral gain increases the *PID Percentage* (P1.19) at an increasing rate.
This value is multiplied by the *PID Error* (P1.21) and the result added to the PID Output Percentage.

Setting a value of 0 disables the integral gain. Setting an integral value will remove any steady state error.
For a PID error = 100% and this parameter set to 0.5, then the integral term increases linearly by 50% per second.

Parameter	P5.09 *PID Output Lower Limit*		
Short description	Defines the minimum value of the output for the PID controller		
Minimum	-100.00	**Maximum**	100.00
Default	0.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RW		

The output of the PID controller is limited to this level. If the limit is reached Bit 1 in *PID Status Indicators* (P1.20) is set and the Integrator is prevented from decreasing further.

Parameter	P5.10 *PID Output Upper Limit*		
Short description	Defines the maximum value of the output for the PID controller		
Minimum	0.00	**Maximum**	100.00
Default	100.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RW, BU		

The output of the PID controller is limited to this level. If the limit is reached Bit 1 in *PID Status Indicators* (P1.20) is set and the integrator is prevented from increasing further.

Parameter	P5.11 *PID Enable Selector*		
Short description	Selects an internal condition that can be used to enable the PID controller		
Minimum	0	**Maximum**	11
Default	0	**Units**	%
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	None	Off (No function selected)
1	Drive Running	On if the drive is running
2	At Speed	On if the output speed is within 1Hz of the reference
3	At Zero	On if the output is at 0Hz +/- 2Hz
4	Under Voltage	On if the drive is in the under-voltage state
5	External Error	On if the external error input has been set
6	Drive Ready	On if the drive is ready
7	Drive Healthy	On if the drive is healthy
8	Current Limit Active	On if the drive is limiting the output current
9	Reverse Selected	On if the reverse direction has been selected
10	An In Current Loss	On if an analog input current loss has been detected
11	Threshold Detector	On if the threshold detector is active

If it is required that an internal condition should be used to enable the PID, this parameter should be set to the required condition. For example, if it is required that the Threshold Detector should enable the PID, this parameter should be set to 11.
Enabling the PID is dependent on two conditions, the value set in this parameter and the digital input function *PID Hardware Enable* (13) as per the truth table below.

PID Enable Selector Function	PID Hardware Enable (13)	PID Enabled
None	Not Configured	Yes
None	0	No
None	1	Yes
0	Not Configured	No
0	0	No
0	1	No
1	Not Configured	Yes
1	0	No
1	1	Yes

Bit 0 in *PID Status Indicators* (P1.20) indicates whether the PID is enabled or not.

NOTE

The value of this parameter can be set by *Frequency Reference Configuration* (P2.03).

Parameter	**P5.12 *Threshold Detector Selector***		
Short description	Defines the analog source for the threshold detector		
Minimum	0	**Maximum**	15
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	***Text***	***Description***
0	None	0%
1	Ramp Input	The drive frequency reference before the ramps
2	Ramp Output	The drive frequency reference after the ramp has been applied
3	Output Frequency	The output frequency of the drive
4	Output Current	The magnitude of the output current
5	Torque Prod Current	The torque producing output current
6	Output Voltage	The output voltage
7	DC Bus Voltage	The DC bus voltage
8	Analog 1 Percentage	The value of analog 1 percentage
9	Analog 2 Percentage	The value of analog 2 percentage
10	Freq. input Percent	The value of the frequency input percentage
11	Output Power	The output power
12	Motor RPM	The motor RPM
13	Percentage Load	The percentage load
14	PID Percentage	The percentage output of the PID controller
15	PID Error	The error of the PID controller

An automatic scaling takes place when parameters are selected as a threshold source. The maximum value of the parameter is used as the full scale value such that the threshold input will be at 100% when the parameter value is at its maximum.

Parameter	**P5.13 *Threshold Detector Level***		
Short description	Defines the level for the threshold detector		
Minimum	0.00	**Maximum**	100.00
Default	0.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	4 ms
Display Format	Standard	**Decimal Places**	2
Coding	RW, BU		

PID Enable Selector **(P5.11)**	**Behaviour**
Source < Lower Threshold	Off
Lower Threshold ≤ Source < Upper Threshold	No change of state
Source ≥ Upper Threshold	On

Lower Threshold = *Threshold Detector Level* (P5.13) - (*Threshold Detector Hysteresis* (P5.14) / 2)
Upper Threshold = *Threshold Detector Level* (P5.13) + (*Threshold Detector Hysteresis* (P5.14) / 2)
The behaviour can then be delayed with *Threshold Detector Delay* (P5.15), and inverted with *Threshold Detector Output Invert* (P5.16).
The Threshold Detector output is shown in bit 2 of *PID Status Indicators* (P1.20).

Parameter	P5.14 *Threshold Detector Hysteresis*		
Short description	Defines the hysteresis for the threshold detector		
Minimum	0.00	**Maximum**	25.00
Default	0.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RW, BU		

The hysteresis behaviour and levels are described below.

Select source (*Threshold Detector Selector* (P5.12)) after scaling	**Output before delay applied**
Source < Lower Threshold	Off
Lower Threshold ≤ Source < Upper Threshold	No change of state
Source ≥ Upper Threshold	On

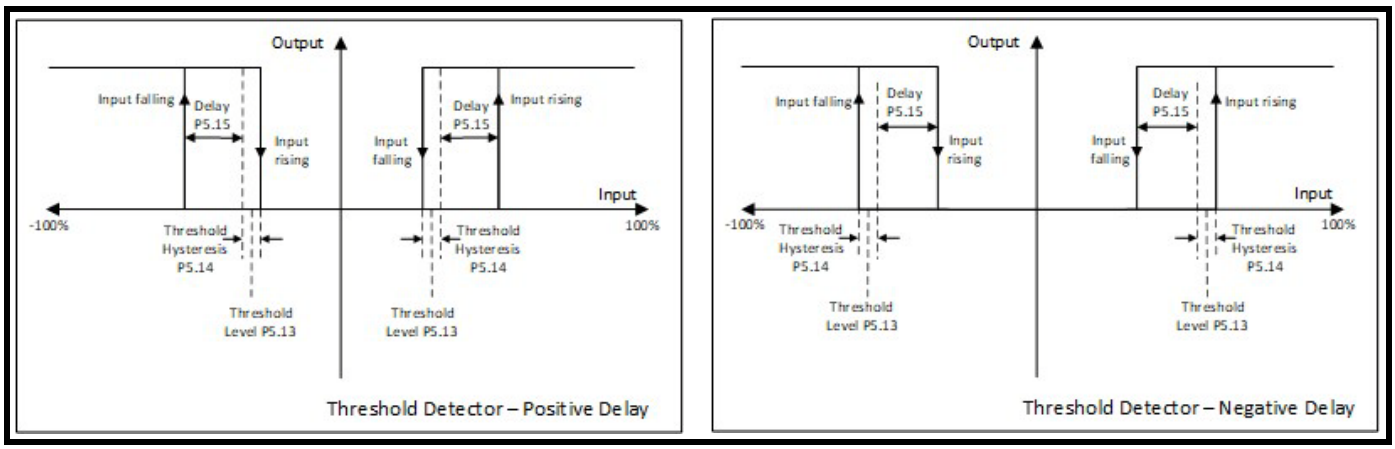
Lower Threshold = *Threshold Detector Level* (P5.13) - (*Threshold Detector Hysteresis* (P5.14) / 2)

Upper Threshold = *Threshold Detector Level* (P5.13) + (*Threshold Detector Hysteresis* (P5.14) / 2)

Parameter	P5.15 *Threshold Detector Delay*		
Short description	Set to the required time to delay the rising or falling edge of the detector output		
Minimum	-25.0	**Maximum**	25.0
Default	0.0	**Units**	s
Type	16 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	1
Coding	RW		

If this parameter is set to a positive value, then the output does not become On (1) until the input has been above the threshold for the programmed time. If it has been set to a negative value, then the output remains On (1) until the input has been below the threshold for the programmed time. See *Threshold Detector Level* (P5.13) for more information.

See below:



Parameter	P5.16 *Threshold Detector Output Invert*		
Short description	Set to 1 to invert the output of the threshold detector		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW		

This inverts the logic level from the Threshold Detector.

The Threshold Detector output is shown in bit 2 of *PID Status Indicators* (P1.20).

Parameter	P5.17 *Threshold Detector Function Select*		
Short description	Selects the function of the threshold detector output		
Minimum	0	**Maximum**	19
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	None	No Digital Function
1	Hardware Enable	Allows the drive to come out of the inhibit state
2	Run Forward	Commands the drive to run forwards
3	Run Reverse	Commands the drive to run reverse
4	Run Permit (/Stop)	Permits a Run command when set, resets any run latch when clear (enables latching when selected as a function)
5	Forward Limit Switch	Prevents a run in the forwards direction
6	Reverse Limit Switch	Prevents a run in the reverse direction
7	Up/Down % Increase	Increases the Up/Down percentage
8	Up/Down % Decrease	Decreases the Up/Down percentage
9	Up/Down % Reset	Resets the Up/Down percentage
10	Ref Select Bit 0	Used to select Reference 1, 2, 3 or 4 using I/O
11	Ref Select Bit 1	Used to select Reference 1, 2, 3 or 4 using I/O
12	Ramp Select	Used to select Acceleration and Deceleration Rate 1 or 2 using I/O
13	PID Hardware Enable	Enables and disables the PID controller. If no Hardware Enable is required, this configuration should not be selected
14	External Error	Used to generate an Error from an external condition
15	Drive Reset	Used to reset the drive from and Error condition
16	Run	Commands the drive to run
17	Reverse	Reverses the direction
18	Jog Forward	Jogs forwards
19	Jog Reverse	Jogs reverse

Selects the function of the threshold detector. If the threshold detector is required to enable the PID then this parameter is not used as *PID Enable Selector* (P5.11) is used to select the detector output.

Parameter	P5.17 *Threshold Detector Function Select*		
Short description	Selects the function of the threshold detector output		
Minimum	0	**Maximum**	19
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Setting this parameter to On (1) allows *PID Percentage* (P1.19) to be negative which will cause the motor to rotate in the reverse direction.

3.10.6 Menu 6 – IO Configuration

This menu contains parameters related to the setup of the drive's inputs and outputs. To use an analog input or frequency input as a drive reference, the appropriate value should be set in a Frequency Reference Selector parameter (P2.21 – P2.24).

Associated Parameters

- *Sequencer Inputs and Outputs* (P1.11)
- *Run & Direction Indicators* (P1.12)
- *T2 Analog Input 1 Percentage* (P1.15)
- *T4 Analog Input 2 Percentage* (P1.16)
- *T15 Frequency Input 1 Percentage* (P1.17)
- *Digital IO Indicators* (P1.25)
- *Frequency Reference 1 Selector* (P2.21)

Parameter	P6.01 *T2 Analog Input 1 Type*		
Short description	Defines the type of input, voltage or current		
Minimum	0	**Maximum**	5
Default	2	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	0-10V	A voltage input where 0 V is 0% and 10 V is 100%
1	0-20mA	A current input where 0 mA is 0% and 20 mA is 100%
2	4-20mA	A current input where 4 mA is 0% and 20 mA is 100%
3	4-20mA Hold	A current input where 4 mA is 0% and 20 mA is 100%. The value is held if current < 3 mA
4	4-20mA Stop	A current input where 4 mA is 0% and 20 mA is 100%. The drive will stop if current < 3 mA and not restart
5	4-20mA Error	A current input where 4 mA is 0% and 20 mA is 100%. An error is generated if current < 3 mA

The analog inputs can be set up as voltage or a current type as defined above. They can also be used as digital inputs where the switching thresholds are at 70% and 80% for a voltage input and 45% and 55% for a current input. Using an analog input as a digital input does not prevent the analog function from being used, its digital operation is in addition to the normal analog function. When used as a digital input the terminal does not sink or source current and so if the input is not being driven an appropriate pull up or pull down must be fitted externally. The resolution of the conversion is 11 bits.

In 4-20mA current input modes a current input less than 3 mA is detected as a current loop loss.

It is not recommended that the input is used as a digital input if 4-20 mA Hold (3) is selected because the input will not change if the current loop is lost.

NOTE

The value of this parameter can be set by *Frequency Reference Configuration* (P2.03).

NOTE

To avoid the scenario where a wire break occurs, meaning controller loses control of the reference, the analog input should be configured as a 4-20 mA type.

Parameter	P6.02 *T4 Analog Input 2 Type*		
Short description	Defines the type of input, voltage or current		
Minimum	0	**Maximum**	5
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

See *T2 Analog Input 1 Type* (P6.01).

Parameter	P6.03 *T6 Analog Output Type*		
Short description	Defines the type of output, voltage or a current type		
Minimum	0	**Maximum**	2
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	0-10V	A voltage output where 0% is 0 V and 100% is 10 V
1	0-20mA	A current output where 0% is 0 mA and 100% is 20 mA
2	4-20mA	A current output where 0% is 4 mA and 100% is 20 mA

The analog output can be set up as voltage or a current type as defined above. For each type, the minimum output is equivalent to a zero value of the output variable, and the maximum output is equivalent to the maximum value of the output variable. This can be changed using *T6 Analog Output Scaling* (P6.07).

Parameter	P6.04 *T11 Digital IO 1 Type*		
Short description	Defines the digital I/O type		
Minimum	0	**Maximum**	4
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	Digital Input	The low level input must be < 9 V and the high level input > 10 V
1	Digital Output	Positive logic digital output
2	Frequency Output	A frequency output between 0 Hz and 10 kHz
3	PWM Output	A PWM output running at 1 kHz
4	Digital Out Inverted	Positive logic digital output with the selected function inverted

Defines the digital IO type for digital I/O 1.

As a Digital Output, the maximum source current is 50 mA (but 100 mA total limit on digital output and 24 V output), and there is a 6 - 7 kΩ internal pull down resistor to 0 V which will sink some current.

As a Frequency Output, 10 kHz is equivalent to the maximum value of the output variable. This can be scaled using *T11 Frequency/ PWM Output Scaling* (P6.11). The resolution of the frequency output is 12 bit.

As a PWM Output, the output frequency is fixed at 1 kHz and 100% duty is equivalent to the maximum value of the output variable. This can be changed using *T11 Frequency/PWM Output Scaling* (P6.11). The resolution of the PWM output is 12 bit. In this mode the output can be connected to an analog meter for monitoring purposes only as the PWM amplitude only has the accuracy of the 24 V output voltage. The output may require filtering before connecting to a meter if the meter used is not responsive enough to pick up the 1 kHz output frequency.

NOTE

The value of this parameter can be set by *Frequency Reference Configuration* (P2.03).

Parameter	P6.05 *T15 Digital Input 5 Type*		
Short description	Defines the type, digital input or a frequency input		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE		

Value	*Text*	*Description*
0	Digital Input	The low level input must be < 9 V and the high level input > 10 V
1	Frequency Input	Frequency input with a maximum frequency of 100 kHz

Defines the input type for digital input 5.

The frequency input can be scaled, limited and inverted using the associated scaling parameters as described by *T15 Frequency Input Minimum Input* (P6.29).

NOTE

The value of this parameter can be set by *Frequency Reference Configuration* (P2.03).

Parameter	P6.06 *T6 Analog Output Function Select*		
Short description	Selects the parameter that the analog output should represent		
Minimum	0	**Maximum**	17
Default	2	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	None	0%
1	Ramp Input	The drive frequency reference before the ramps
2	Ramp Output	The drive frequency reference after the ramp has been applied
3	Output Frequency	The output frequency of the drive
4	Output Current	The magnitude of the output current
5	Torque Prod Current	The torque producing output current
6	Output Voltage	The output voltage
7	DC Bus Voltage	The DC bus voltage
8	Analog 1 Percentage	The value of analog 1 percentage
9	Analog 2 Percentage	The value of analog 2 percentage
10	Freq. input Percent	The value of the frequency input percentage
11	Output Power	The output power
12	Motor RPM	The motor RPM
13	Percentage Load	The percentage load
14	PID Percentage	The percentage output of the PID controller
15	PID Error	The error of the PID controller
16	Motor Thermal %	The thermal percentage to error level of the motor
17	Drive Thermal %	The thermal percentage to error level of the drive

Selects the parameter that the analog output should represent. The absolute of the chosen parameter is scaled such that 10 V or 20 mA is equivalent to the parameter's maximum value. It can be further scaled by *T6 Analog Output Scaling* (P6.07).

Parameter	P6.07 *T6 Analog Output Scaling*		
Short description	Defines the scaling factor for the analog output		
Minimum	0.000	**Maximum**	40.000
Default	1.000	**Units**	
Type	16 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	3
Coding	RW, BU		

Defines the scaling factor for the analog output.

An automatic scaling takes place when parameters are selected for an analog output. The maximum value of the parameter is used as the full scale value such that the analog output will be at full scale when the parameter value is at its maximum value. Some parameters do not reach their maximum values and so this parameter is provided for the user to apply further scaling and configure a bigger range of the analog output to be used.

If a scale set here causes the output to exceed 100%, the output value is limited to 10 V or 20 mA.

Parameter	P6.08 *T41-T43 Relay Function Select*		
Short description	Selects the drive state that controls the relay output		
Minimum	0	**Maximum**	11
Default	7	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	None	Off (No function selected)
1	Drive Active Running	On if the drive is running
2	At Speed	On if the output speed is within 1Hz of the reference
3	At Zero	On if the output is at 0Hz +/- 2Hz
4	Under Voltage	On if the drive is in the under-voltage state
5	External Error	On if the external error input has been set
6	Drive Ready	On if the drive is ready
7	Drive Healthy	On if the drive is healthy
8	Current Limit Active	On if the drive is limiting the output current
9	Reverse Selected	On if the reverse direction has been selected
10	Analog Input Current Loss	On if an analog input current loss has been detected
11	Threshold Detector	On if the threshold detector is active

Selects the drive function state that controls the relay.

The relay has 3 terminals; normally open (T41), common (T42), and normally closed (T43).

If the function selected is at 0, the common is connected to the normally closed terminal. When the function selected is at 1, common is connected to the normally open terminal.

Parameter	P6.09 *T11 Digital Output 1 Function Select*		
Short description	Selects the drive state that controls the output		
Minimum	0	**Maximum**	11
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Selects the drive state that is indicated by Digital Output 1. The state is inverted if *T11 Digital IO 1 Type* (P6.04) is set to Digital Output Inverted (4).

See *T41-T43 Relay Function Select* (P6.08) for output options.

NOTE

T11 Digital IO 1 Type (P6.04) must be set to Digital Output (1) or Digital Output Inverted (4) for this parameter to have any effect.

Parameter	P6.10 *T11 Frequency/PWM Output Function Select*		
Short description	Selects the parameter that is represented by the output frequency or PWM duty cycle when Digital I/O 1 is in one of these modes		
Minimum	0	**Maximum**	17
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Selects the parameter that Digital Output 1 should represent in Frequency or PWM output modes. The absolute of the chosen parameter is scaled such that Maximum output is equivalent to the parameter's maximum value. It can be further scaled by *T11 Frequency/PWM Output Scaling* (P6.11). See *T11 Digital IO 1 Type* (P6.04) for setting up the output type.

See *T6 Analog Output Function Select* (P6.06) for output options.

Parameter	P6.11 *T11 Frequency/PWM Output Scaling*		
Short description	Defines the scaling factor applied to the frequency or PWM output		
Minimum	0.000	**Maximum**	40.000
Default	1.000	**Units**	
Type	16 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	3
Coding	RW, BU		

Defines the scaling factor for Digital Output 1 in *Frequency* (2) and *PWM* (3) modes.

An automatic scaling takes place when parameters are selected for this output. The maximum value of the parameter is used as the full scale value such that the output will be at full scale when the parameter value is at its maximum value. Some parameters do not reach their maximum values and so this parameter is provided for the user to apply further scaling and configure a bigger range of the Frequency or PWM outputs to be used.

Parameter	P6.12 *Negative Logic (NPN Sensor) Select*		
Short description	Set to 1 to enable negative logic (NPN Sensor)		
Minimum	0	**Maximum**	1
Default	0	**Units**	
Type	1 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW		

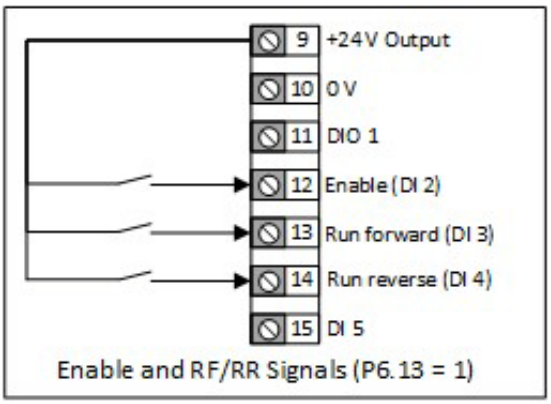
As default the digital inputs are Positive Logic inputs (sinking inputs) to suit PNP sensors. This parameter allows the digital inputs to be set to Negative Logic inputs (sourcing inputs) to suit NPN type sensors. When analog inputs are also used as digital inputs, they do not source or sink current, but the logic is inverted when this parameter is set. This parameter has no effect on the digital output or analog inputs.

Parameter	P6.13 *Run/Stop Configuration*		
Short description	Defines how the digital inputs or keypad are used to run and stop the drive		
Minimum	0	**Maximum**	10
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

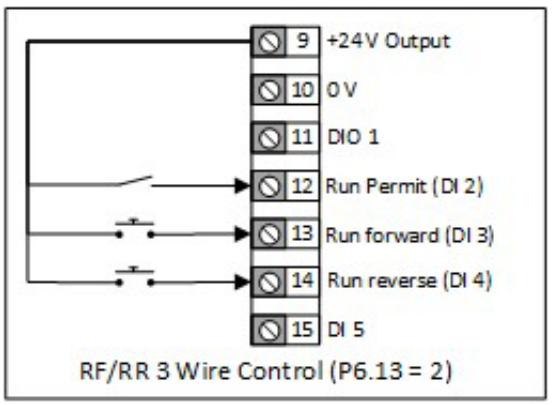
Value	*Text*	*Description*
0	Custom	Parameters have been changed from a standard configuration
1	Enable + Run Forward +Run Reverse	Enable on T12, Run Forward on T13, Run Reverse on T14
2	Run Forward + Run Reverse (3 wire)	Run Permit on T12, Run Forward on T13, Run Reverse on T14
3	Enable + Run + Reverse	Enable on T12, Run on T13, Reverse on T14
4	Run + Reverse	Run Permit on T12, Run on T13, Reverse on T14
5	Run + Jog	Run Permit on T12, Run on T13, Jog Forward on T14
6	Run Forward + Run Reverse	Run Forward on T13, Run Reverse on T14
7	Run + Reverse	Run on T13, Reverse on T14
8	Keypad	Press Up and Down keys together to run and Reset/Stop key to stop
9	Keypad with Enable	Enable on T12 then Press Up and Down keys together to run and press the Reset/Stop key to stop.
10	Keypad Jog	Hold the Up and Down keys together to jog the motor forwards

This parameter allows quick setup of digital inputs 2 - 4 to control the hardware enable, run, direction and jog commands according to pre-defined configurations; as well as configuring the drive's keypad for run and stop control.
The assignments are made and saved after the configuration parameter has been edited. Anything marked as "Not Changed" is left at its current value. If a parameter in the table below is changed after it has been set here, this parameter is automatically set to Custom (0). If the configuration is set to Custom (0), then no assignments are made so input functions would have to be set manually.

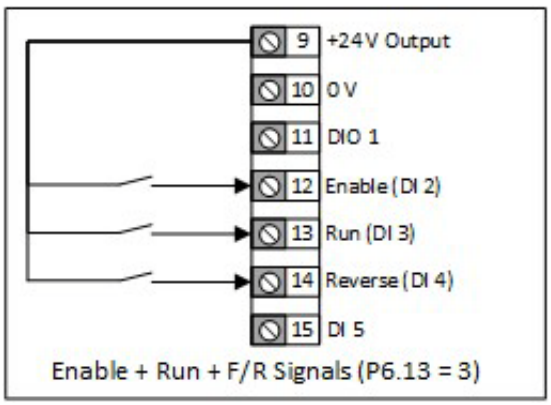
Value	Configuration	*T12 Digital Input 2 Function Select* (P6.17)	*T13 Digital Input 3 Function Select* (P6.18)	*T14 Digital Input 4 Function Select* (P6.19)	*Keypad Run andStop Function Select* (P4.07)
0	Custom	Not Changed	Not Changed	Not Changed	Not Changed
1	Enable + Run Forward +Run	1 (Hardware Enable)	2 (Run Forward)	3 (Run Reverse)	0 (Disabled)
2	Run Forward + Run Reverse (3 wire)	4 (Run Permit)	2 (Run Forward)	3 (Run Reverse)	0 (Disabled)
3	Enable + Run + Reverse	1 (Hardware Enable)	16 (Run)	17 (Reverse)	0 (Disabled)
4	Run + Reverse	4 (Run Permit)	16 (Run)	17 (Reverse)	0 (Disabled)
5	Run + Jog	4 (Run Permit)	16 (Run)	18 (Jog Forward)	0 (Disabled)
6	Run Forward + Run Reverse	0 (None)	2 (Run Forward)	3 (Run Reverse)	0 (Disabled)
7	Run + Reverse	0 (None)	16 (Run)	17 (Reverse)	0 (Disabled)
8	Keypad	0 (None)	0 (None)	0 (None)	1 (Run and Stop Enabled)
9	Keypad with Enable	1 (Hardware Enable)	0 (None)	0 (None)	1 (Run and Stop Enabled)
10	Keypad Jog	0 (None)	0 (None)	0 (None)	2 (Keypad Jog Enabled)



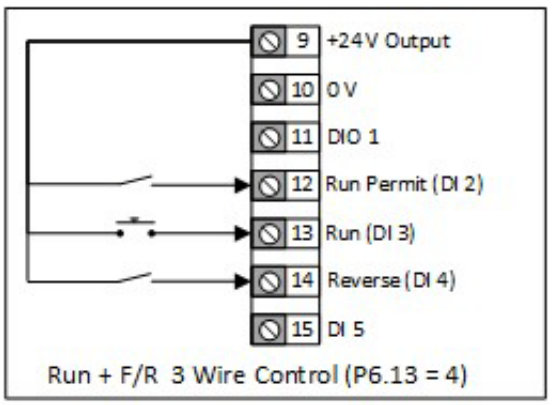
Enable and RF/RR Signals (P6.13 = 1)



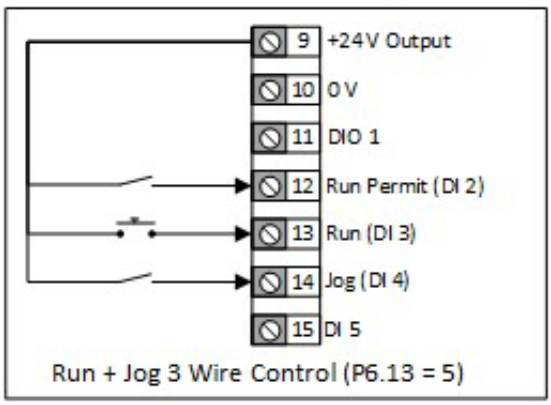
RF/RR 3 Wire Control (P6.13 = 2)



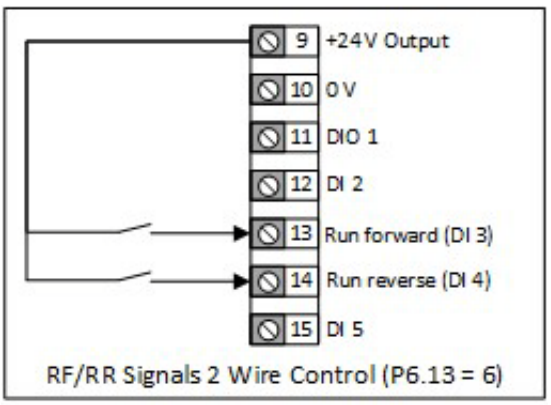
Enable + Run + F/R Signals (P6.13 = 3)



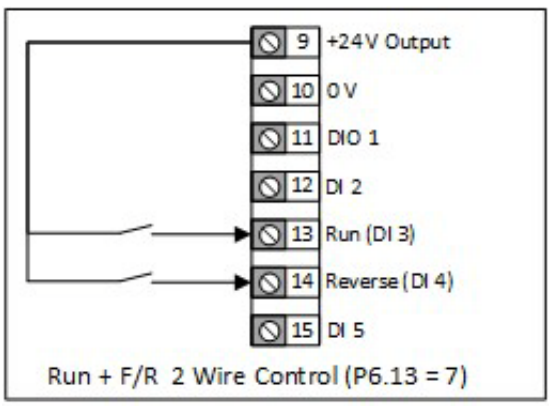
Run + F/R 3 Wire Control (P6.13 = 4)



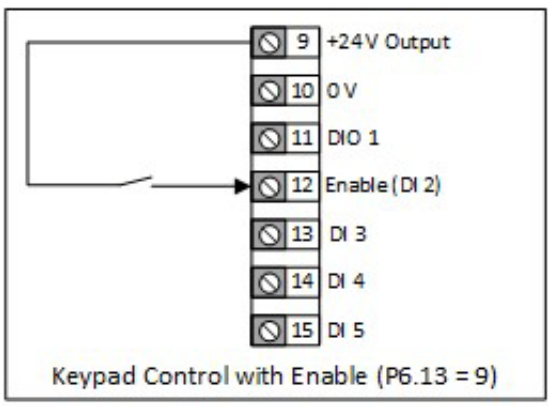
Run + Jog 3 Wire Control (P6.13 = 5)



RF/RR Signals 2 Wire Control (P6.13 = 6)



Run + F/R 2 Wire Control (P6.13 = 7)



Keypad Control with Enable (P6.13 = 9)

Parameter	P6.14 *T2 Analog Input 1 Digital Function Select*		
Short description	Selects the digital function of analog input 1		
Minimum	0	**Maximum**	19
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Selects a digital function of Analog Input 1. The terminal does not have to be configured to be used as a dedicated digital input. Using an analog input as a digital input does not prevent the analog function from being used, its digital operation is in addition to the normal analog function. See *T2 Analog Input 1 Type* (P6.01).

See *T11 Digital Input 1 Function Select* (P6.16) for a list of functions.

NOTE

When used as a digital input in voltage mode, the input terminal cannot sink or source current. If driven from a PNP sensor (positive logic), a 6k8 resistor should be fitted between T4 and T3; and if driven by a NPN sensor (negative logic), a 6k8 resistor should be connected between T4 and T9.

Parameter	P6.15 *T4 Analog Input 2 Digital Function Select*		
Short description	Selects the digital function of analog input 2		
Minimum	0	**Maximum**	19
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Selects a digital function of Analog Input 2. The terminal does not have to be configured to be used as a dedicated digital input. Using an analog input as a digital input does not prevent the analog function from being used, its digital operation is in addition to the normal analog function. See *T2 Analog Input 1 Type* (P6.01).

See *T11 Digital Input 1 Function Select* (P6.16) for a list of functions.

NOTE

When used as a digital input in voltage mode, the input terminal cannot sink or source current. If driven from a PNP sensor (positive logic), a 6k8 resistor should be fitted between T4 and T3; and if driven by a NPN sensor (negative logic), a 6k8 resistor should be connected between T4 and T9.

Parameter	P6.16 *T11 Digital Input 1 Function Select*		
Short description	Selects the function of the digital input if it is in digital input mode		
Minimum	0	**Maximum**	19
Default	0	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Value	*Text*	*Description*
0	None	No Digital Function
1	Hardware Enable	Allows the drive to come out of the inhibit state
2	Run Forward	Commands the drive to run forwards
3	Run Reverse	Commands the drive to run reverse
4	Run Permit (/Stop)	Permits a Run command when set, resets any run latch when clear (enables latching when selected as a function)
5	Forward Limit Switch	Prevents a run in the forwards direction
6	Reverse Limit Switch	Prevents a run in the reverse direction
7	Up/Down % Increase	Increases the Up/Down percentage
8	Up/Down % Decrease	Decreases the Up/Down percentage
9	Up/Down % Reset	Resets the Up/Down percentage
10	Ref Sel Bit 0	Used to select Reference 1, 2, 3 or 4 using I/O
11	Ref Sel Bit 1	Used to select Reference 1, 2, 3 or 4 using I/O
12	Ramp Select	Used to select Acceleration and Deceleration Rate 1 or 2 using I/O
13	PID Hardware Enable	Enables and disables the PID controller. If no Hardware Enable is required, this configuration should not be selected
14	External Error	Used to generate an Error from an external condition
15	Drive Reset	Used to reset the drive from and Error condition
16	Run	Commands the drive to run
17	Reverse	Reverses the direction
18	Jog Forward	Jogs forwards
19	Jog Reverse	Jogs reverse

Selects the function of *Digital I/O 1 if T11 Digital IO 1 Type* (P6.04) = 0.

Notes on function selection:

Selecting the Run Permit (Not Stop) function (4) automatically enables a latch on the Run inputs (Run Forward, Run Reverse, and Run), see Run & Direction Indicators (P1.12). Providing the Run Permit input is active, activation of the Run inputs is latched so that a momentary switch can be used to start the drive. When Run Permit is made inactive (Stop), all latches are cleared and no Run command is accepted.

If Run Forward or Run Reverse is made active, the Reverse function will be ignored i.e. explicate Run Forward and Run Reverse commands override the direction selection.

A Jog command is only accepted when the drive is not running.

A Run command overrides a Jog command.

NOTE

The value of this parameter can be set by Frequency Reference Configuration (P2.03).

Parameter	P6.17 *T12 Digital Input 2 Function Select*		
Short description	Selects the function of the digital input		
Minimum	0	**Maximum**	19
Default	1	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Selects the function of Digital Input 2. See *T11 Digital Input 1 Function Select* (P6.16).

NOTE

The value of this parameter can be set by *Run/Stop Configuration* (P6.13).

Parameter	P6.18 *T13 Digital Input 3 Function Select*		
Short description	Selects the function of the digital input		
Minimum	0	**Maximum**	19
Default	2	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Selects the function of Digital Input 3. See *T11 Digital Input 1 Function Select* (P6.16).

NOTE

The value of this parameter can be set by *Run/Stop Configuration* (P6.13).

Parameter	P6.19 *T14 Digital Input 4 Function Select*		
Short description	Selects the function of the digital input		
Minimum	0	**Maximum**	19
Default	3	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Selects the function of Digital Input 4. See *T11 Digital Input 1 Function Select* (P6.16).

NOTE

The value of this parameter can be set by *Run/Stop Configuration* (P6.13).

Parameter	P6.20 *T15 Digital Input 5 Function Select*		
Short description	Selects the function of the digital input if it is in digital input mode		
Minimum	0	**Maximum**	19
Default	10	**Units**	
Type	8 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	0
Coding	RW, TE, BU		

Selects the function of Digital Input 5 when *T15 Digital Input 5 Type* (P6.05) = 0 (Digital Input). See *T11 Digital Input 1 Function Select* (P6.16).

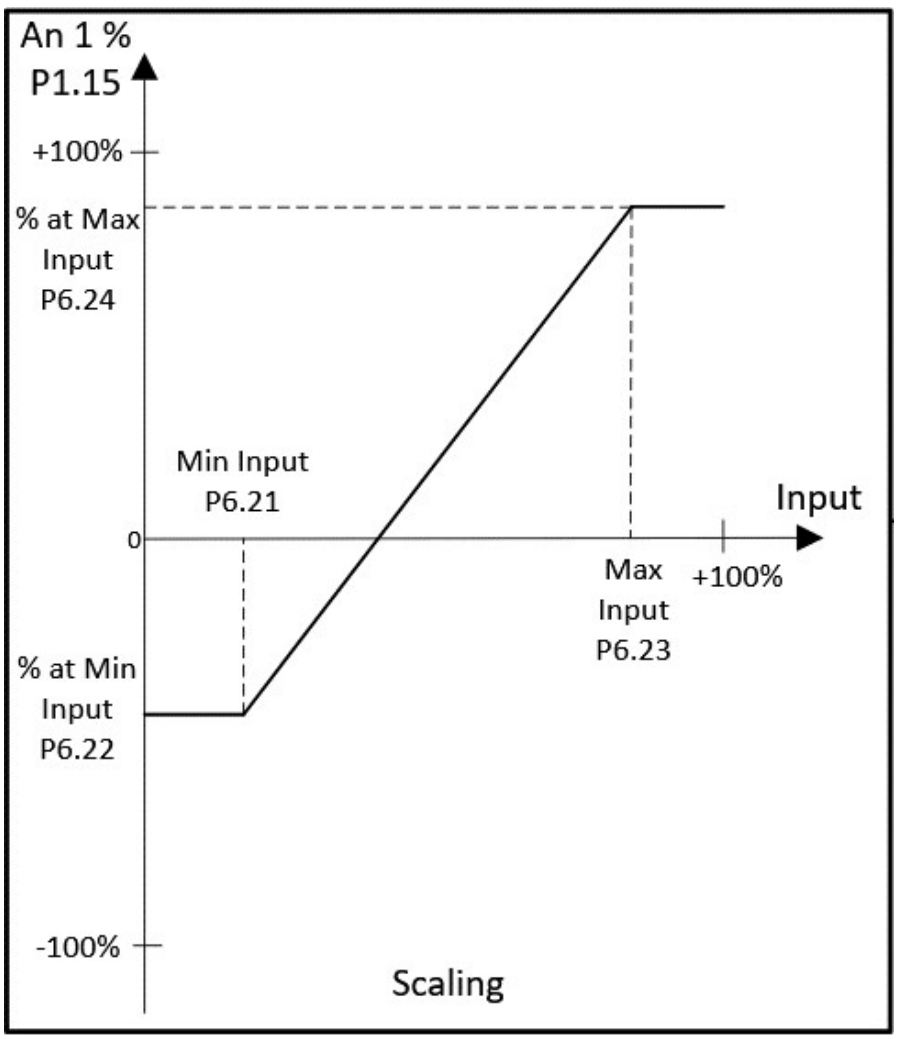
NOTE

The value of this parameter can be set by *Run/Stop Configuration* (P6.13).

Parameter	P6.21 *T2 Analog Input 1 Minimum Input*		
Short description	Defines the minimum value used for analog input 1		
Minimum	0.00	**Maximum**	100.00
Default	0.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RW		

This parameter defines the minimum input level for Analog Input 1 and can be used to limit the range of the measured input.

The used range of the measured input (0 % - 100 %) is defined by two parameters, this parameter being the minimum value used, and *T2 Analog Input 1 Maximum Input* (P6.23) being the maximum value used. Changing the default values of these parameters limits the used range of Analog Input 1. This limited range is then converted to a Percentage input that changes between a level defined for the minimum input with *T2 Analog Input 1 Percentage at Minimum Input* (P6.22), and a level defined for the maximum input with *T2 Analog Input 1 Percentage at Maximum Input* (P6.24). See the diagram below.



When *T2 Analog Input 1 Percentage* (P1.15) is used as a motor frequency reference in References & Ramps, there is a conversion from percent to Hz. See *Frequency Reference 1 Selector* (P2.21).

This parameter limits the measured input and should be increased if only part of the analog inputs measurable range is to be used. See the example below which assumes the analog input is set as a voltage type, P6.22 - P6.24 and the Minimum and Maximum Reference Limits are at default values.

Example: If 5 V on the input should equal 0 % of *T2 Analog Input 1 Percentage* (P1.15), this parameter should be set to 50 %. If the Analog Input is selected as a reference, 0 V to 5 V would equal a reference of 0 Hz, 6 V would equal a reference of 10 Hz, and 10 V = 50 Hz.

If *T2 Analog Input 1 Minimum Input* (P6.21) ≥ T2 *Analog Input 1 Maximum Input* (P6.23) then *T2 Analog Input 1 Percentage* (P1.15) = 0.00 % whatever the input level.

Parameter	P6.22 *T2 Analog Input 1 Percentage at Minimum Input*		
Short description	Defines the value of analog input 1 percentage at minimum input		
Minimum	-100.00	**Maximum**	100.00
Default	0.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RW		

Defines the percentage value at the minimum input level for Analog Input 1 and can be used to scale or invert the measured value.

The used range of the measured input (0 % - 100 %) is defined by two parameters, *T2 Analog Input 1 Minimum Input* (P6.21) being the minimum value used, and *T2 Analog Input 1 Maximum Input* (P6.23) being the maximum value used. Changing the default values of these parameters limits the used range of Analog Input 1. This limited range is then converted to a Percentage input that changes between a level defined for the minimum input with this parameter, and a level defined for the maximum input with *T2 Analog Input 1 Percentage at Maximum Input* (P6.24). See the diagram in *T2 Analog Input 1 Minimum Input* (P6.21).

When *T2 Analog Input 1 Percentage* (P1.15) is used as a motor frequency reference in *References & Ramps*, there is a conversion from percent to Hz. See *Frequency Reference 1 Selector* (P2.21).

See the examples below which assumes the Analog Input is set as a voltage type. P6.21, P6.23, P6.24 and the Minimum and Maximum Reference Limits are at default values.

Scaling Example: If 0 V on the input should equal 50 % of *T2 Analog Input 1 Percentage* (P1.15), this parameter should be set to 50 %. If the Analog Input is selected as a reference, 0 V would equal a reference of 25 Hz, 5 V would equal 37.5 Hz, and 10 V = 50 Hz. (Assuming P6.24 = 100 %)

To invert the input, this parameter should be set larger than *T2 Analog Input 1 Percentage at Maximum Input* (P6.24).
Invert example: If the input should be inverted, this parameter should be set to 100 %
and *T2 Analog Input 1 Percentage at Maximum Input* (P6.24) should be set to 0 %. If the Analog Input is selected as a reference, 0 V would equal a reference of 50 Hz, 5 V would equal a reference of 25 Hz, and 10 V = 0 Hz.

Parameter	P6.23 *T2 Analog Input 1 Maximum Input*		
Short description	Defines the maximum value used for analog input 1		
Minimum	0.00	**Maximum**	100.00
Default	100.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RW		

This parameter defines the maximum input level for Analog Input 1 and can be used to scale the input if a limited range of the analog input level is available.

The used range of the measured input (0 % - 100 %) is defined by two parameters, this parameter being the maximum value used, and *T2 Analog Input 1 Minimum Input* (P6.21) being the minimum value used. Changing the default values of these parameters limits the used range of Analog Input 1. This limited range is then converted to a Percentage input that changes between a level defined for the minimum input with *T2 Analog Input 1 Percentage at Minimum Input* (P6.22), and a level defined for the maximum input with *T2 Analog Input 1 Percentage at Maximum Input* (P6.24). See the diagram in *T2 Analog Input 1 Minimum Input* (P6.21).

When *T2 Analog Input 1 Percentage* (P1.15) is used as a motor frequency reference in *References & Ramps*, there is a conversion from percent to Hz. See *Frequency Reference 1 Selector* (P2.21).

This parameter limits the measured input and should be decreased if only part of the analog inputs measurable range is to be used. See the example below which assumes the analog input is set as a voltage type, P6.21, P6.22, P6.24 and the Minimum and Maximum Reference Limits are at default values.
Example: If 5 V on the input should equal 100 % of *T2 Analog Input 1 Percentage* (P1.15), this parameter should be set to 50 %. If the Analog Input is selected as a reference, 0 V would equal a reference of 0 Hz, 2 V would equal a reference of 20 Hz, and 5 V to 10 V would be a reference of 50 Hz.

Parameter	P6.24 *T2 Analog Input 1 Percentage at Maximum Input*		
Short description	Defines the value of analog input 1 percentage reference at maximum input		
Minimum	-100.00	**Maximum**	100.00
Default	100.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RW		

Defines the percentage value at the maximum input level for Analog Input 1 and can be used to scale or invert the measured value.

The used range of the measured input (0 % - 100 %) is defined by two parameters, *T2 Analog Input 1 Minimum Input* (P6.21) being the minimum value used, and *T2 Analog Input 1 Maximum Input* (P6.23) being the maximum value used. Changing the default values of these parameters limits the used range of Analog Input 1. This limited range is then converted to a Percentage input that changes between a level defined for the minimum input with *T2 Analog Input 1 Percentage at Minimum Input* (P6.22), and a level defined for the maximum input with this parameter. See the diagram in *T2 Analog Input 1 Minimum Input* (P6.21).

When *T2 Analog Input 1 Percentage* (P1.15) is used as a motor frequency reference in *References & Ramps*, there is a conversion from percent to Hz. See *Frequency Reference 1 Selector* (P2.21).

See the examples below which assumes the Analog Input is set as a voltage type. P6.21 - P6.23 and the Minimum and Maximum Reference Limits are at default values.

Scaling Example: If 10 V on the input should equal 50 % of *T2 Analog Input 1 Percentage* (P1.15), this parameter should be set to 50 %. If the Analog Input is selected as a reference, 0 V would equal a reference of 0 Hz, 2 V would equal 5 Hz, and 10 V = 25 Hz.

To invert the input, this parameter should be set smaller than *T2 Analog Input 1 Percentage at Minimum Input* (P6.22).
Invert example: If the input should be inverted, this parameter should be set to 0 %
and *T2 Analog Input 1 Percentage at Minimum Input* (P6.22) should be set to 100 %. If the Analog Input is selected as a reference, 0 V would equal a reference of 50 Hz, 5 V would equal a reference of 25 Hz, and 10 V = 0 Hz.

Parameter	P6.25 *T4 Analog Input 2 Minimum Input*		
Short description	Defines the minimum value used for analog input 2		
Minimum	0.00	**Maximum**	100.00
Default	0.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RW		

This parameter defines the minimum input level for Analog Input 2 and can be used to limit the range of the measured input.

See *T2 Analog Input 1 Minimum Input* (P6.21).

Parameter	P6.26 *T4 Analog Input 2 Percentage at Minimum Input*		
Short description	Defines the value of analog input 2 percentage at minimum input		
Minimum	-100.00	**Maximum**	100.00
Default	0.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RW		

Defines the percentage value at the minimum input level for Analog Input 2 and can be used to scale or invert the measured value.

See *T2 Analog Input 1 Percentage at Minimum Input* (P6.22).

Parameter	P6.27 *T4 Analog Input 2 Maximum Input*		
Short description	Defines the maximum value used for analog input 2		
Minimum	0.00	**Maximum**	100.00
Default	100.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RW		

See *T2 Analog Input 1 Maximum Input* (P6.23).

Parameter	P6.28 *T4 Analog Input 2 Percentage at Maximum Input*		
Short description	Defines the value of analog input 2 percentage at maximum input		
Minimum	-100.00	**Maximum**	100.00
Default	100.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RW		

Defines the percentage value at the maximum input level for Analog Input 2 and can be used to scale or invert the measured value.

See *T2 Analog Input 1 Percentage at Maximum Input* (P6.24).

Parameter	P6.29 *T15 Frequency Input Minimum Input*		
Short description	Defines the minimum value used for the frequency input		
Minimum	0.00	**Maximum**	100.00
Default	0.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RW		

This parameter defines the minimum input level for the Frequency Input and can be used to limit the range of the measured input.

See *T2 Analog Input 1 Minimum Input* (P6.21).

Parameter	P6.30 *T15 Frequency Input Percentage at Minimum Input*		
Short description	Defines the value the frequency percentage at minimum input		
Minimum	-100.00	**Maximum**	100.00
Default	0.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RW		

Defines the percentage value at the minimum input level for the Frequency Input and can be used to scale or invert the measured value.

See *T2 Analog Input 1 Percentage at Minimum Input* (P6.22).

Parameter	P6.31 *T15 Frequency Input Maximum Input*		
Short description	Defines the maximum value used for the frequency input		
Minimum	0.00	**Maximum**	100.00
Default	100.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RW		

This parameter defines the maximum input level for the Frequency Input and can be used to scale the input if a limited range of the frequency input level is available.

See *T2 Analog Input 1 Maximum Input* (P6.23).

Parameter	P6.32 *T15 Frequency Input Percentage at Maximum Input*		
Short description	Defines the value the frequency percentage at maximum input		
Minimum	-100.00	**Maximum**	100.00
Default	100.00	**Units**	%
Type	16 Bit User Save	**Update Rate**	
Display Format	Standard	**Decimal Places**	2
Coding	RW		

Defines the percentage value at the maximum input level for the Frequency Input and can be used to scale or invert the measured value.

See *T2 Analog Input 1 Percentage at Maximum Input* (P6.24).

0478-0640-00