Control User Guide

Commander C300 PM / HS30 PM

5 YEAR WARRANTY

Part Number: 0478-0699-04 Issue: 4

Original Instructions

Manufacturer: Nidec Control Techniques Limited ("we", "our")
Registered office: The Gro, Newtown, Powys, SY16 3BE United Kingdom
Registered in: England and Wales, company registration number 01236886
Manufacturer's EU Authorised Representative: Nidec Netherlands B.V., Kubus 155, 3364 DG Sliedrecht, the Netherlands, registered at the Dutch Trade Register under number 33213151; Tel. +31 (0)184 420 555, info.nl@mail.nidec.com

Original instructions
With reference to the UK Supply of Machinery (Safety) Regulations 2008 and the EU Machinery Directive 2006/42/EC, the English version of this User Guide constitutes the original instructions. User Guides published in other languages are translations of the original instructions and the English language version of this User Guide prevails over any other language version in the event of inconsistency.

Documentation and user software tools
User Guides, datasheets and software that we make available to users of our products can be downloaded from: **https://acim.nidec.com/en/drives/control-techniques/Downloads/mobile-applications**

MARSHAL (Mobile App): This application is available for download from the Google Play Store and the Apple App Store.

Warranty and liability
The contents of this User Guide are presented for information purposes only, and while every effort has been made to ensure their accuracy, they are not to be construed as warranties or guarantees, express or implied, regarding the products or services described herein or their use or applicability. All sales are governed by our terms and conditions, which are available on request. We reserve the right to modify or improve the designs, specifications or performance of our products at any time without notice. For full details of the warranty terms applicable to the product, contact the supplier of the product.

In no event and under no circumstances shall we 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 for the product, nor shall we be liable for consequential and incidental damages of any kind.

Environmental management
We operate an Environmental Management System which complies with the requirements of ISO 14001:2015. Further information on our Environmental Statement can be found at: www.controltechniques.com/environment.

Restriction and control of hazardous substances

The products covered by this User Guide comply with the following legislation and regulations on the restriction and control of hazardous substances:

UK Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012
EU restriction of the Use of certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) - Directive 2011/65/EU
UK REACH etc. (Amendment etc.) (EU Exit) Regulations 2020, European Union REACH Regulation EC 1907/2006
EC Regulation 1907/2006 on the Registration, Evaluation, authorisation, and restriction of Chemicals (REACH)
Chinese Administrative Measures for Restriction of Hazardous Substances in Electrical and Electronic Products 2016/07/01
U.S. Environmental Protection Agency ("EPA") regulations under the Toxic Substances Control Act ("TSCA")
MEPC 68/21 / Add.1, Annex 17, Resolution MEPC.269(68) 2015 Guidelines for the development of the inventory of hazardous materials
The products covered by this User Guide do not contain asbestos.
Further information on REACH and RoHS can be found at: http://www.drive-setup.com/environment.

Conflict minerals

With reference to the Conflict Minerals (Compliance) (Northern Ireland) (EU Exit) Regulations 2020, the U.S. Dodd-Frank Wall Street Reform and Consumer Protection Act and Regulation (EU) 2017/821 of the European Parliament and of the European Council:

We have implemented due diligence measures for responsible sourcing, we conduct conflict minerals surveys of relevant suppliers, we continually review due diligence information received from suppliers against company expectations and our review process includes corrective action management. We are not required to file an annual conflict minerals disclosure. Nidec Control Techniques Limited is not an issuer as defined by the U.S. SEC.

Disposal and Recycling (WEEE)

The products covered by this User Guide fall within the scope of the UK Waste Electrical and Electronic Equipment Regulations 2013 and EU Directive 2012/19/EU on Waste Electrical and Electronic Equipment (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. Our products are designed to be easily dismantled into their major component parts for efficient recycling. Most materials used in our products are suitable for recycling.

Our 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 the ground screws, can be recycled. When preparing to recycle or dispose of any product or packaging, please observe local legislation and best practice.

All references herein to legislation include any amendments thereto.

Copyright and trade marks

How to use this guide

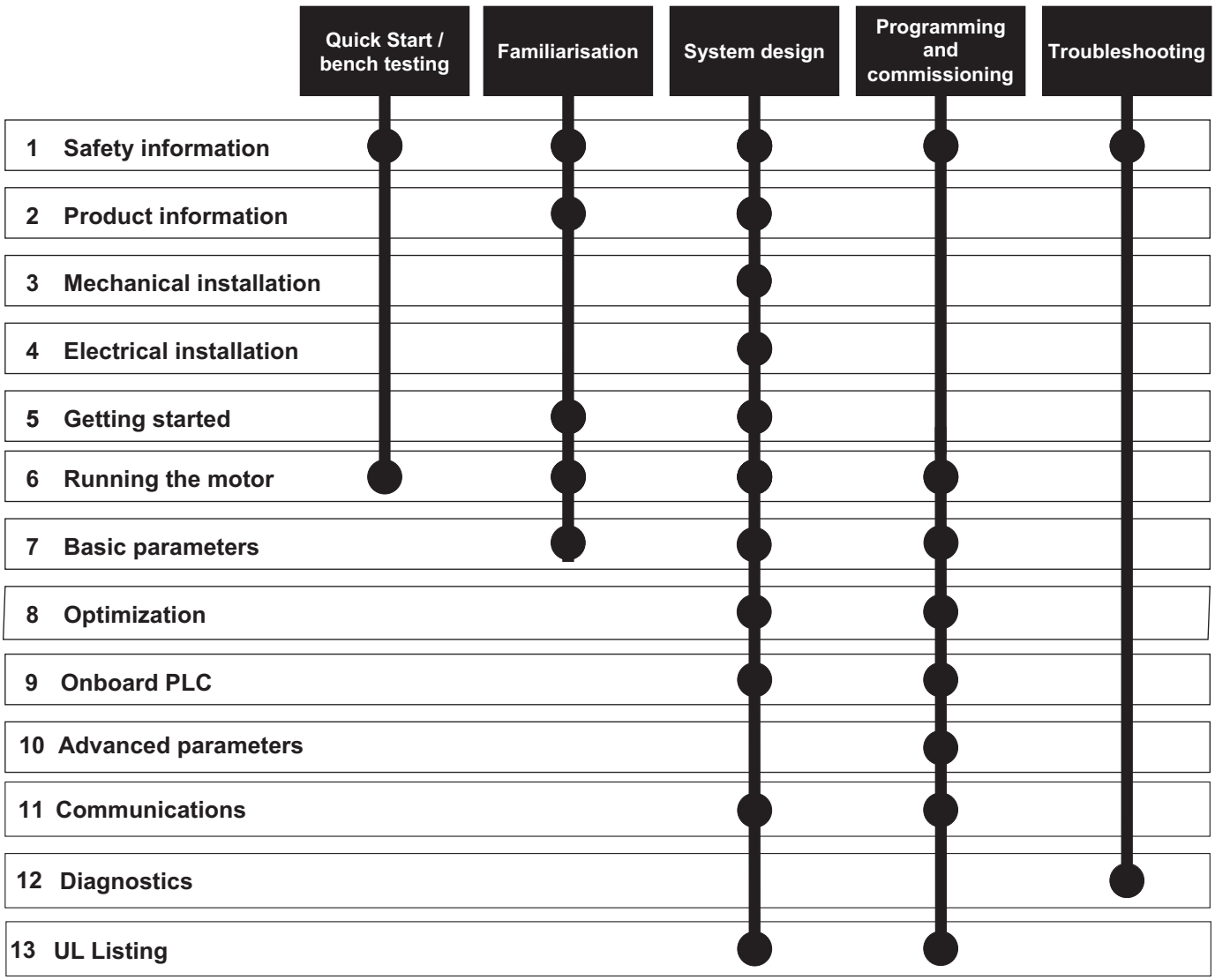
This user guide provides complete information for installing the drive.

The information is in logical order, taking the reader from receiving the drive through to installation.

NOTE

There are specific safety warnings throughout this guide, located in the relevant sections. In addition, Chapter 1 *Safety information* contains general safety information. It is essential that the warnings are observed and the information considered when working with or designing a system using the drive.

This map of the user guide helps to find the right sections for the task you wish to complete, but for specific information, refer to the table of contents overleaf.



Contents

EU Declaration of Conformity

1. Product range

Unidrive-M, Commander, Digitax HD and derivative products. Adjustable speed AC motor drives, including option modules and accessories.

2. Name and address of the manufacturer and authorised representative

Manuacturer	Authorised representative in the EU
Nidec Control Techniques Ltd The Gro Pool Road Newtown Powys SY16 3BE UK Registered in England and Wales. Company Reg. No. 01236886 Telephone: +44 1686 612000 E mail: cthoadmin@mail.nidec.com Web: www.controltechniques.com	Nidec Netherlands B.V. Kubus 155 3364 DG Sliedrecht Netherlands.

3. Responsibility

This declaration is issued under the sole responsibility of the manufacturer.

4. Object of the declaration

Variable speed drives

Model number	Interpretation	Model number nomenclature aaaa - bbc ddddde
aaaa	Basic series	C200, C300, M100, M101, M200, M201, M300, M400, M600, M608, M700, M701, M702, M708, M709, M750, M751, M753, M754, M880, M881, M882, M888, M889, E300, E301, F300, F600, H300, HS30, HS70, HS71, HS72, M000, RECT
bb	Frame size	01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11, 12
c	Voltage rating	1 = 100 V, 2 = 200 V, 4 = 400 V, 5 = 575 V, 6 = 690 V
ddddd	Current rating	Example 01000 = 100 A
e	Drive format	A = 6P Rectifier + Inverter with internal choke, D = Inverter, E = 6P Rectifier + Inverter, T = 12P Rectifier + Inverter

The model number may be followed by additional characters that do not affect the ratings.

Accessories

Model No.	Model number
Option Modules	SI-Applications Compact, SI-Applications Plus, SI- BACnet IP, SI-CANopen V2, SI-CiA417, SI-DeviceNet, SI-DCP, SI-Encoder V2, SI-EtherCAT, SI-Ethernet, SI-Interbus 500kBd, SI-Interbus 2MBd, SI-IO, SI-IO 24 Plus, SI-Powerlink, SI-PROFIBUS, SI-PROFINET V2, SI-PROFINET RT, SI-Option mounting kit, SI-Universal Encoder, Encoder breakout kit, PTi210, PTi210 V2, SI-Safety, SI-SLM, SI-Varan, MCi200, MCi200 V2, MCi210, MCi210 V2, MiS210, MiS250, KI-485 Adaptor, AI-485 Adaptor, AI-485 Adaptor 24V, AI-Backup adaptor, AI-Smart adaptor
Control pods	Mxxx-STANDARD011100A0100, Mxxx-MASTER11100A0100, M000-FOLLOWER011100A0100 (where Mxxx denotes M600, M700, M701, M702, HS70, HS71 or HS72)
Displays, keypads, other accessories	KI-Keypad, KI-Keypad RTC, KI-HOA keypad RTC, KI-Compact Display, KI-Compact 485 adaptor, Remote Keypad (LCD), Remote Keypad RTC, CI-Keypad, CI-485 Adaptor, Capacitor module M75C, External DC cable connection kit, Multi axis kit (standard - with and without SI option mounting kit fitted), Cable grommet kit, External EMC filter, Fan replacement kit, Input inductor, Vent kit, Compact brake resistor kit, External brake resistor 20/40 or 80 ohm, Digitax HD to Uni M panel mounted & through hole mounted DC bus paralleling kits

5. Declaration: The object of the declaration is in conformity with the relevant European Union harmonisation legislation.

Low Voltage Directive (2014/35/EU)
Electromagnetic Compatibility Directive (2014/30/EU)
Restriction of Hazardous Substances Directives (2011/65/EU and 2015/863/EU).
Regulation 2019/1781 of directive 2009/125/EC (Energy related products)

6. References to the relevant harmonised EN standards

The variable speed drive products listed above have been designed and manufactured in accordance with the following European harmonised standards:

EN 61800-5-1:2007 + A1:2017 + A11: 2021	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy
EN 61800-3: 2018	Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods
EN 61000-6-2: 2019	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
EN 61000-6-4: 2019	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
EN 61000-3-2:2019+A1:2021	Electromagnetic compatibility (EMC) - Part 3-2: Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)
EN 61000-3-3:2013+A1:2019 + A2:2021	Electromagnetic compatibility (EMC) - Part 3-3: Limitation of voltage changes, voltage fluctuations and flicker in public, low voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection
EN 61000-3-12: 2011	Electromagnetic compatibility (EMC) - Part 3-12: Limits. Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ≤ 75 A per phase.

7. Responsible person

Jon Holman-White
Vice President, Research and Development
Nidec Control Techniques Ltd
Date: 13th February 2025
Newtown, Powys, UK

UK Declaration of Conformity

1. Product range

Unidrive-M, Commander, Digitax HD and derivative products. Adjustable speed AC motor drives, including option modules and accessories.

2. Name and address of the manufacturer

Nidec Control Techniques Ltd
The Gro
Pool Road
Newtown
Powys
SY16 3BE
UK

Registered in England and Wales. Company Reg. No. 01236886
Telephone: 00 44 1686 612000
E mail: cthoadmin@mail.nidec.com
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5. Declaration

The object of the declaration is in conformity with the relevant UK statutory requirements:

Electrical Equipment (Safety) Regulations 2016
Electromagnetic Compatibility Regulations 2016
The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012
The Ecodesign for Energy-Related Products Regulations 2021 No. 745

6. References to the relevant designated British standards

The products listed above have been designed and manufactured in accordance with the following designated British standards:

EN 61800-5-1:2007 + A1:2017 + A11: 2021	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy
BS EN 61800-3: 2018	Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods
BS EN 61000-6-2: 2019	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
BS EN 61000-6-4: 2019	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
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7. Responsible person

Jon Holman-White
Vice President, Research and Development
Nidec Control Techniques Ltd
Date: 8th November 2023
Newtown, Powys, UK

1 Safety information

1.1 Warnings, Cautions and Notes

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

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.

1.2 Important safety information. Hazards. Competence of designers and installers

This guide applies to products which control electric motors either directly (drives) or indirectly (controllers, option modules and other auxiliary equipment and accessories). 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.

Specific warnings are given at the relevant places in this guide.

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/start-up and maintenance must be carried out by personnel who have the necessary training and competence. They must read this safety information and this guide carefully.

1.3 Responsibility

It is the responsibility of the installer to ensure that the equipment is installed correctly with regard to all instructions given in this 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.

1.4 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.

1.5 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 D.C. supply cables and connections
- Output cables and connections
- Many internal parts of the drive, and external option units

Unless otherwise indicated, control terminals are single insulated and must not be touched.

The supply must be disconnected by an approved electrical isolation device before gaining access to the electrical connections.

The STOP and Safe Torque Off functions of the drive do not isolate dangerous voltages from the output of the drive or from any external option unit.

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

1.6 Stored electrical charge

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

1.7 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.

With the sole exception of the Safe Torque Off function, 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 Safe Torque Off function may be used in a safety-related application. 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 Safe Torque Off function will only ensure the safety of a machine if it is correctly incorporated into a complete safety system. 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.

1.8 Access to equipment

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

1.9 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.

1.10 Hazardous environments

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

1.11 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. 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 parameter.

1.12 Mechanical brake control

Any brake control functions are provided to allow well co-ordinated operation of an external brake with the drive. While both hardware and software are designed to high standards of quality and robustness, they are not intended for use as safety functions, i.e. where a fault or failure would result in a risk of injury. In any application where the incorrect operation of the brake release mechanism could result in injury, independent protection devices of proven integrity must also be incorporated.

1.13 Adjusting parameters

Some parameters have a profound effect on the operation of the drive. They must not be altered without careful consideration of the impact on the controlled system. Measures must be taken to prevent unwanted changes due to error or tampering.

1.14 Electromagnetic compatibility (EMC)

Installation instructions for a range of EMC environments are provided in the relevant Power Installation Guide. 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.

2 Product information

2.1 Introduction

Commander C is Control Techniques' premium general purpose drive that delivers maximum machine performance for dynamic and efficient machine operation in a range of applications. The Commander C300 PM offers sensorless, closed-loop permanent magnet motor control and open loop induction motor control.

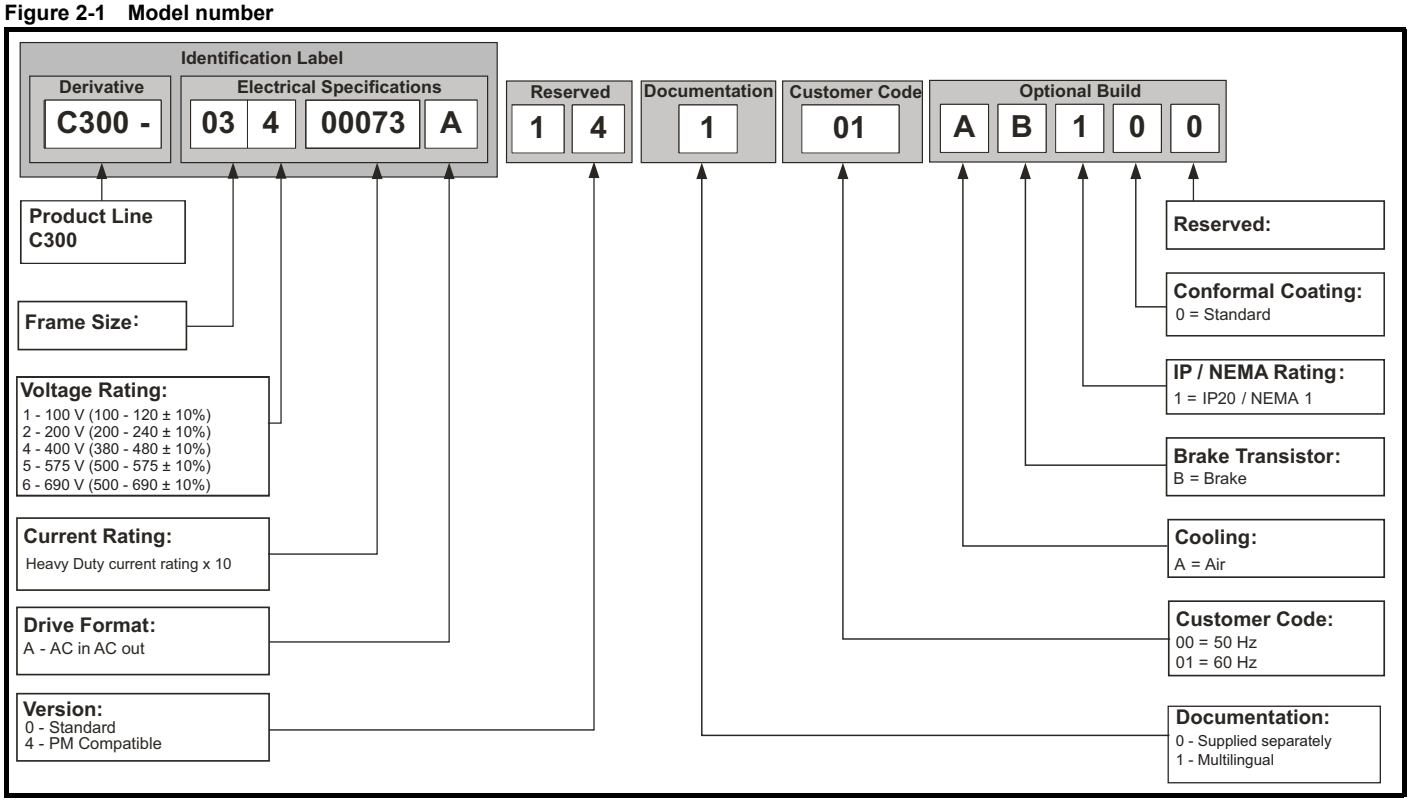
Features

- Enhance throughput with Machine Safety
- 24 Vdc backup supply (optional)
- EIA 485 serial communications interface (optional)
- Dual channel Safe Torque Off (STO) input
- Flexible machine integration through communications.

2.2 Model number

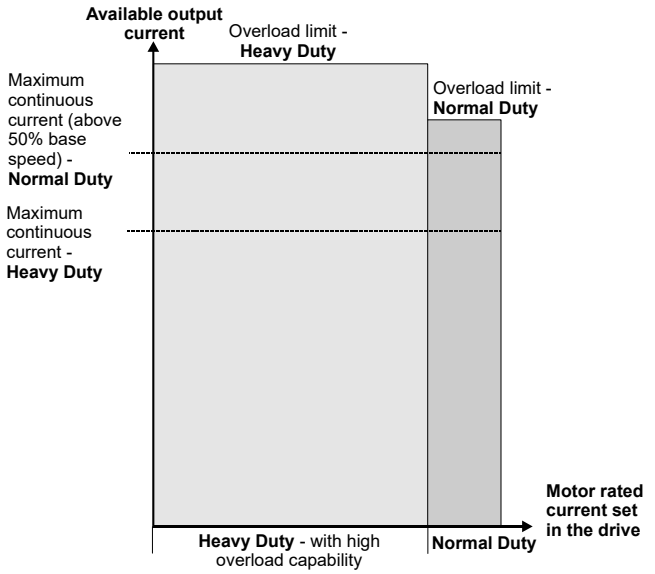
The way in which the model numbers for the Commander C range are formed is illustrated below:

Figure 2-1 Model number



2.3 Ratings

The size 1 to 4 drive is Heavy Duty rated only.
The size 5 to 9 drive is dual rated.
The setting of the motor rated current determines which rating applies - Heavy Duty or Normal Duty.
The two ratings are compatible with motors designed to IEC60034.
The graph aside illustrates the difference between Normal Duty and Heavy Duty with respect to continuous current rating and short term overload limits.



Normal Duty

Normal duty ratings should be used for applications that require a low overload capability and full torque at low speeds is not required (e.g. fans, pumps).
The thermal protection is set to protect self ventilated (TENV/TEFC) motors, but may need to be adjusted.
Self ventilated (TENV/TEFC) motors require increased protection against overload due to the reduced cooling effect of the fan at low speed. To provide the correct level of protection the I²t software operates at a level which is speed dependent. This is illustrated in the graph below.

NOTE

The speed at which the low speed protection takes effect can be changed by the setting of *Low Speed Thermal Protection Mode* (**P04.025**). The protection starts when the motor speed is below 15 % of base speed when **P04.025** = 0 (default) and below 50 % when **P04.025** = 1.

Heavy Duty (default)

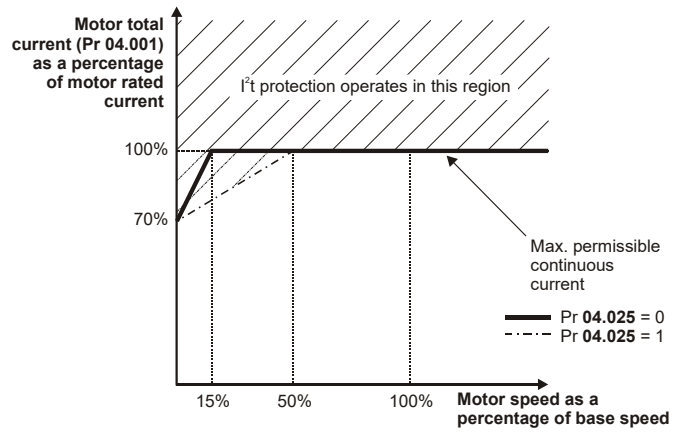
Heavy duty ratings should be used for constant torque applications or applications which require a high overload capability, or full torque is required at low speeds (e.g. winders, hoists).
The thermal protection is set to protect permanent magnet motors and induction motors.

NOTE

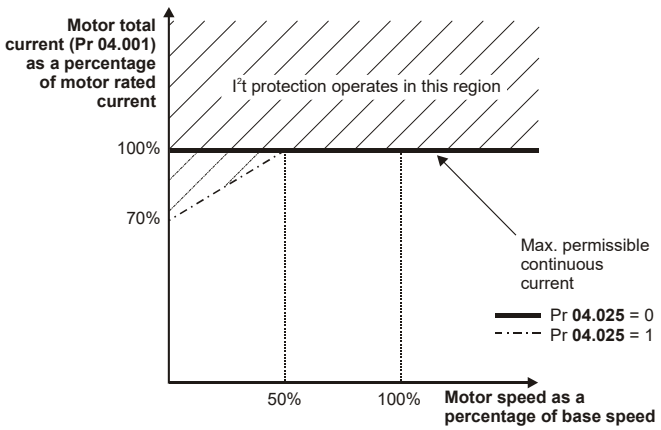
If the application uses a self ventilated (TENV/TEFC) motor and increased thermal protection is required for speeds below 50 % base speed, then this can be enabled by setting *Low Speed Thermal Protection Mode* (**P04.025**) = 1.

Operation of motor I^2t protection

Motor I²t protection is fixed as shown below and is compatible with:
- Self ventilated (TENV/TEFC) motors



Motor I²t protection defaults to be compatible with:
- Forced ventilation motors



2.4 Motor control modes

The Commander C can be used to run induction or permanent magnet motors.

2.4.1 Induction motor control

V to F Control

Linear V to F offer basic motor control and requires less configuration time than other modes.

This mode allows a level of fixed boost to be set to improve starting torque.

Linear V to F is suitable for most applications. Typically 100 % torque is available down to 4 Hz for a 50 Hz motor. Square V to F is suitable for fan and pump applications that do not require a high starting torque.

Use V to F control when the drive is running multiple motors.

Resistance Compensated Control

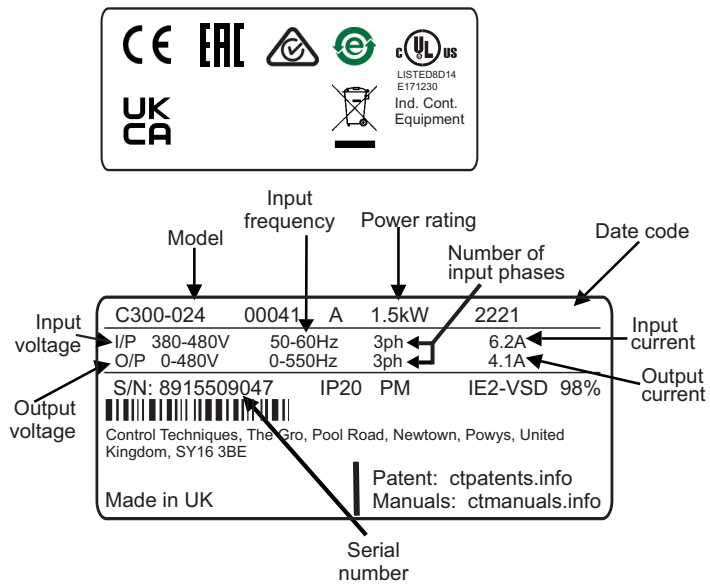
Resistance compensation control modes (Ur) provide improved torque performance compared to V to F control by applying vector-based compensation for the stator resistance below half of the motor rated frequency. Typically 100 % torque is available down to 1 Hz for a 50 Hz motor.

2.4.2 Permanent magnet motor control

PM mode provides sensorless closed-loop control for permanent magnet motors. The drive measures the current at the motor terminals to estimate the position of the motor poles in the rotor and provide closed-loop control.

2.5 Nameplate description

Figure 2-2 Typical drive rating labels size 2



Key to approvals		
CE	CE approval	Europe
C Tick	C Tick approval	Australia
cULus	UL / cUL approval	USA & Canada
RoHS	RoHS compliant	China
FUNCTIONAL SAFETY cULus LISTED	Functional safety	USA & Canada
UK CA	UK CA Approved	UK
EAC	EurAsian Conformity	EurAsia

Refer to Figure 2-1 *Model number* on page 12 for further information relating to the labels.

NOTE

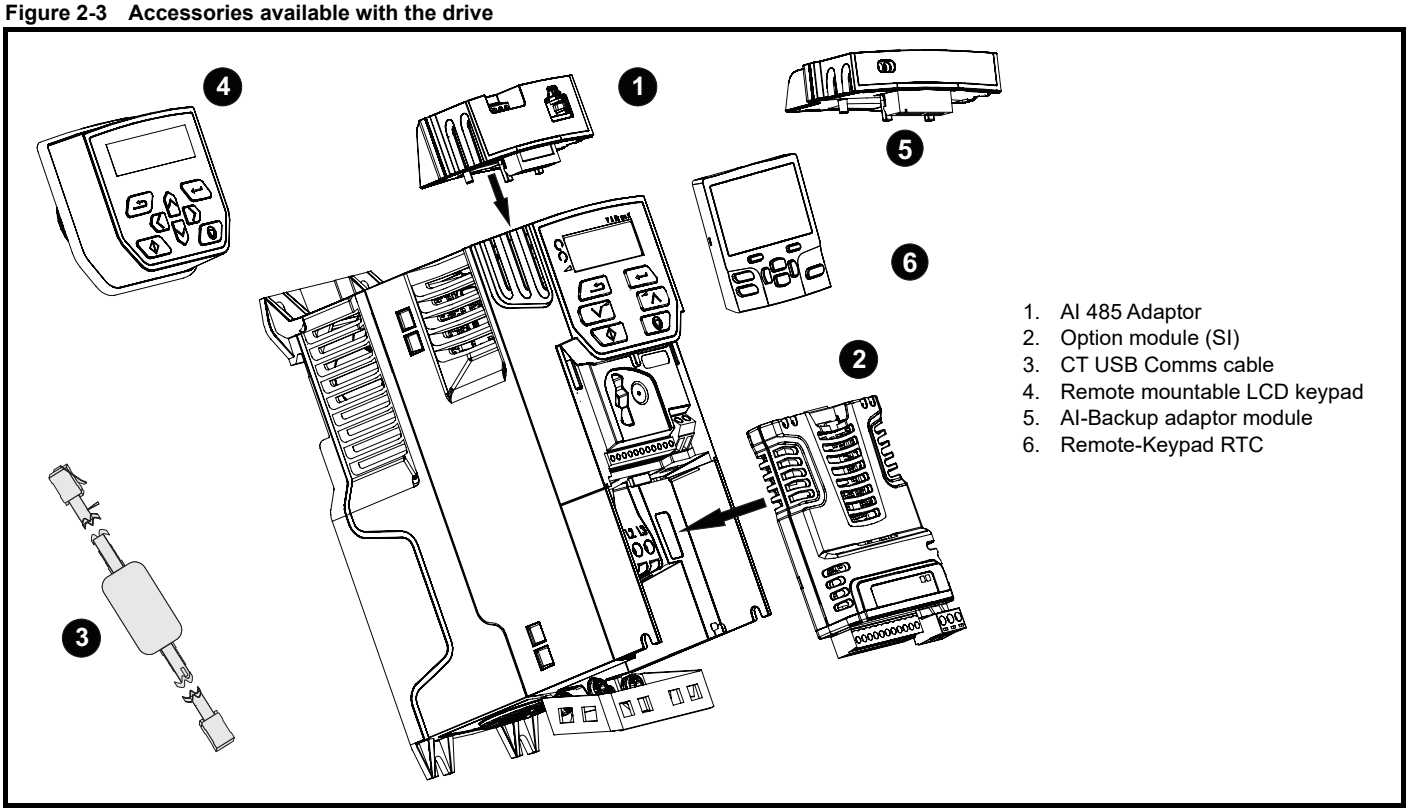
Date code format

The date code is four numbers. The first two numbers indicate the year and the remaining numbers indicate the week of the year in which the drive was built. This new format started in 2017.

Example:
A date code of **2210** would correspond to week 10 of year 2022.

2.6 Accessories

Figure 2-3 Accessories available with the drive



1. AI 485 Adaptor
2. Option module (SI)
3. CT USB Comms cable
4. Remote mountable LCD keypad
5. AI-Backup adaptor module
6. Remote-Keypad RTC

Table 2-1 System Integration (SI) option module identification

Type	Option module	Color	Name	Further details
Fieldbus		Purple	SI-PROFIBUS	**Profibus option (ID:443)** PROFIBUS adaptor for communications with the drive
		Medium Grey	SI-DeviceNet	**DeviceNet option (ID:447)** DeviceNet adaptor for communications with the drive
		Light Grey	SI-CANopen	**CANopen option (ID:448)** CANopen adaptor for communications with the drive
		Yellow Green	SI-PROFINET V2	**PROFINET V2 option (ID:434)** PROFINET V2 adapter for communications with the drive
		Beige	SI-Ethernet	**Ethernet option (ID:433)** External Ethernet module that supports EtherNet/IP, Modbus TCP/IP and RTMoE. The module can be used to provide global connectivity and integration with IT network technologies, such as wireless networking
		Water Blue	SI-BACnet IP	**BACnet IP option (ID:439)** BACnet IP adapter for communication with the drive.
		Brown Red	SI-EtherCAT	**EtherCAT option (ID:431)** EtherCAT adapter for communications with the drive
		Pale Blue	SI-POWERLINK	**POWERLINK (ID:436)**adapter for communications with the drive
		Dark Grey	SI-Interbus	**Interbus option (500 kBd ID:404 or 2 MBd ID:414)** Intberus adapter for communications with the drive
Automation (I/O expansion)		Orange	SI-I/O	**Extended I/O (ID:209)** Increases the I/O capability by adding the following combinations: • Digital I/O • Digital Inputs • Relays
Feedback		Brown	SI-Encoder V2	**Encoder Option (ID:105)** Incremental encoder input interface module. (speed feedback cannot be used for closed-loop speed control)

Table 2-2 Adaptor Interface (AI) option module identification

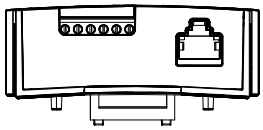
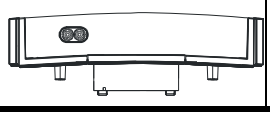
Type	Accessory	Name	Further details
Communications		AI-485 adaptor	**EIA 485 serial communications option** Provides a EIA 485 serial communications interface via an RJ45 connector or alternative screw terminals.
		AI-485 24V adaptor	**EIA 485 serial communications option +24 V backup supply terminals** Provides a EIA 485 serial communications interface via an RJ45 connector or alternative screw terminals. It also provides a 24 V Backup supply input.
		CT Comms Cable	Connects to the AI-485 adapter port to allow communication to the PC. This is required for use with software such as Connect and CT Scope
Backup		AI-Backup adaptor	**+24 V Backup** Provides a +24 V Backup supply input

Table 2-3 Keypad identification

Type	Keypad	Name	Further Details
Keypad		Remote-Keypad	**Remote LED keypad option** Remote Keypad with a LED display
		Remote-Keypad RTC	**Remote LCD keypad option** Remote Keypad with a LCD display and real time clock
		KI-Keypad Plus	**Remote colour TFT keypad option with Bluetooth connectivity** Remote multilingual keypad with a 2.8" colour TFT display, real time clock and Bluetooth connectivity.

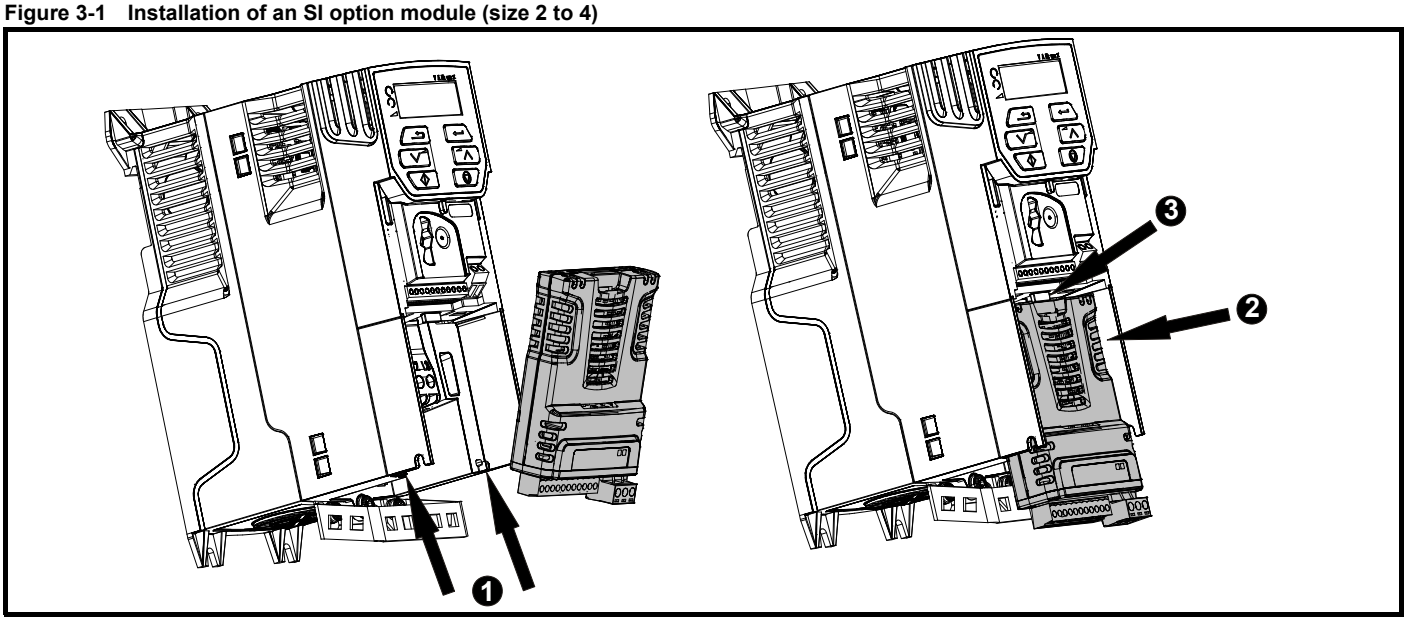
3 Mechanical installation

3.1 Installing / removing options

CAUTION

Power down the drive before installing / removing the SI option module. Failure to do so may result in damage to the product.

Figure 3-1 Installation of an SI option module (size 2 to 4)

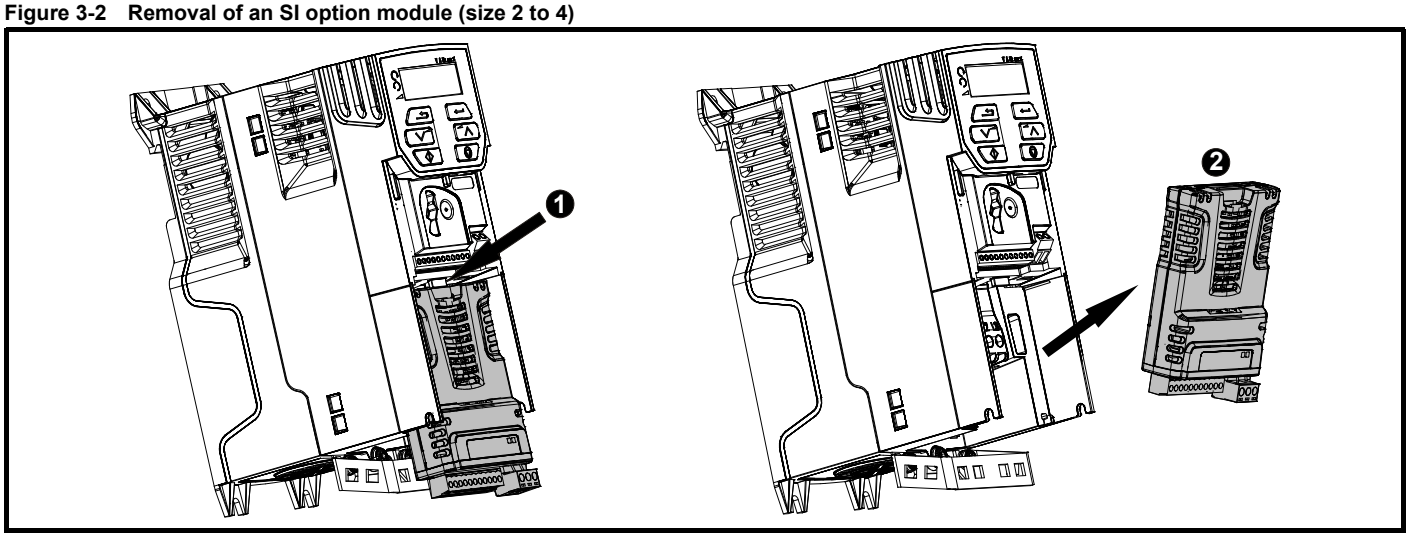


- With the option module tilted slightly backwards, align and locate the two holes in the rear of the option module onto the two tabs (1) on the drive.
- Press the option module onto the drive as shown in (2) until the connector mates with the drive, ensuring that the tab (3) retains the option module in place.

NOTE

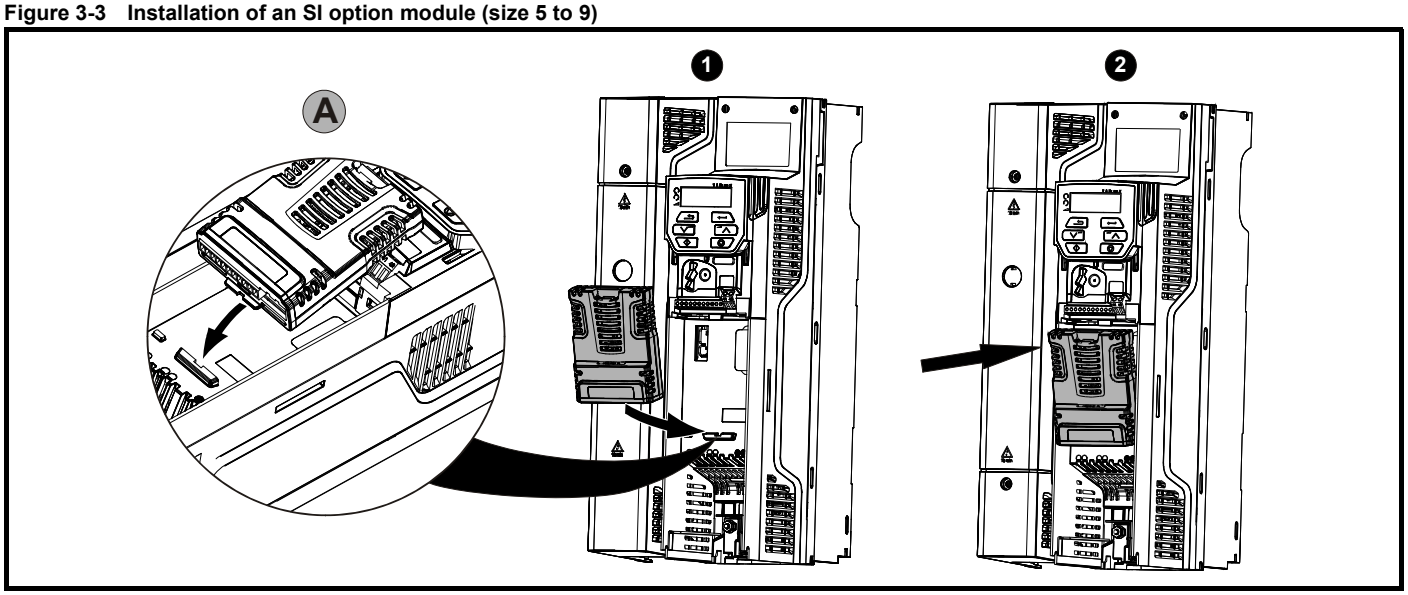
Check that the option module is securely located on the drive. Always ensure that the terminal cover is always replaced before use as this ensures that the option module is firmly secured.

Figure 3-2 Removal of an SI option module (size 2 to 4)



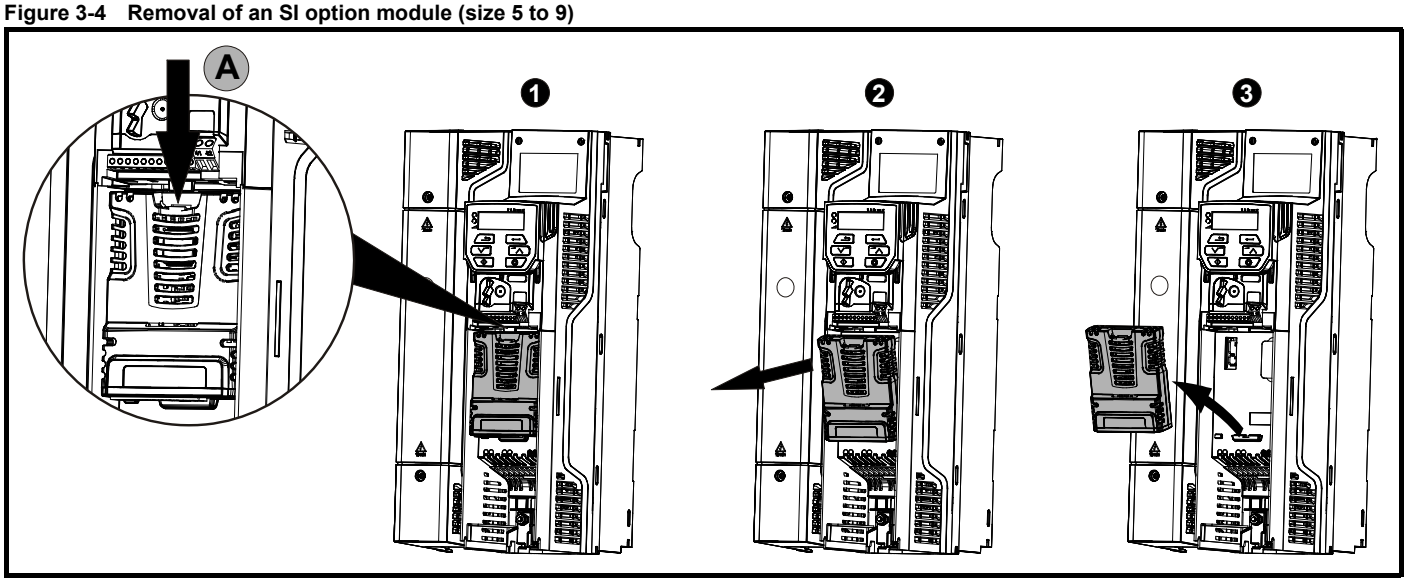
- Press down on the tab (1) to release the option module from the drive housing as shown.
- Tilt the option module slightly towards you and pull away from the drive housing (2).

Figure 3-3 Installation of an SI option module (size 5 to 9)



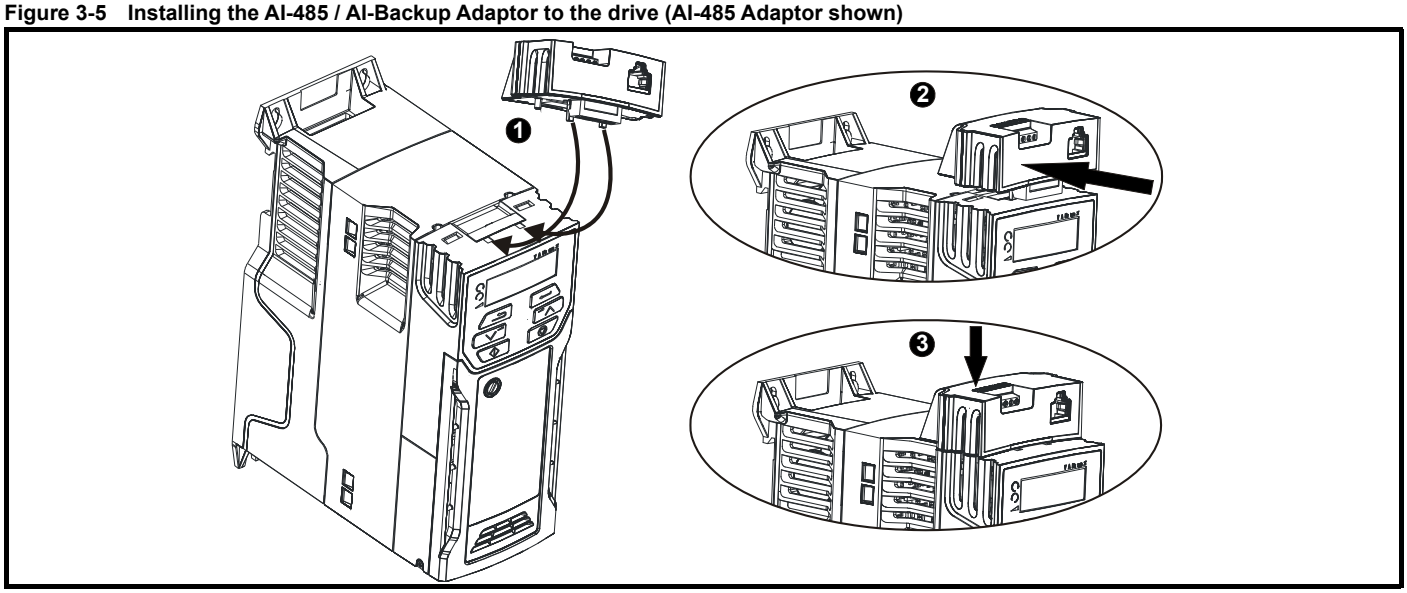
- Move the option module in the direction shown (1).
- Align and insert the option module tab into the slot provided (2), This is shown in the detailed view (A).
- Press down on the option module until it clicks in place.

Figure 3-4 Removal of an SI option module (size 5 to 9)



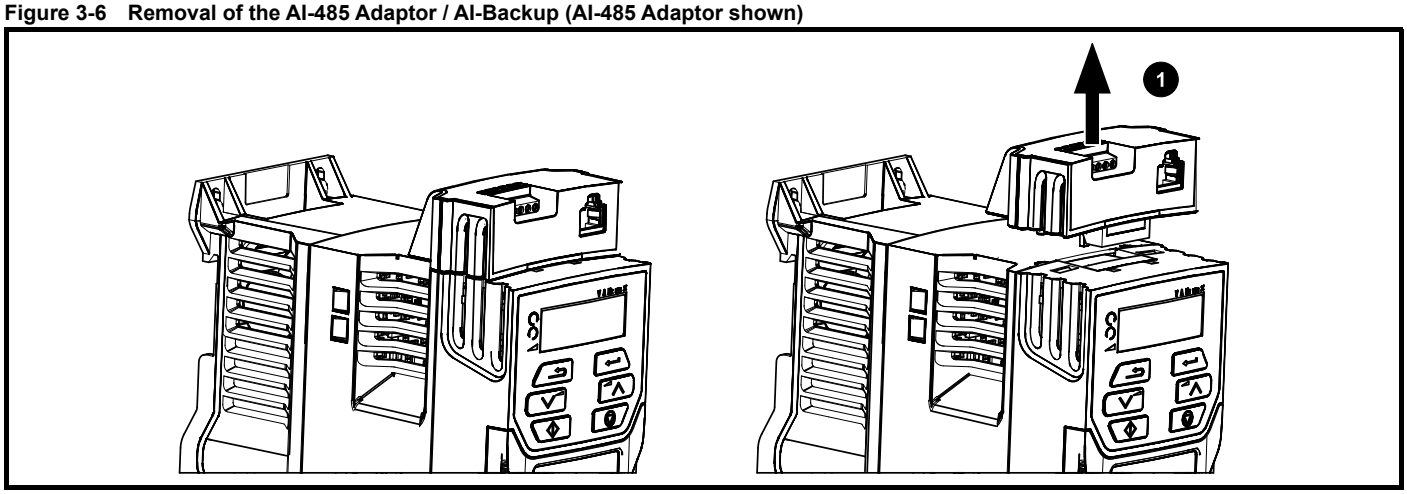
- To release the option module from the drive housing, press down on the tab (1) as shown in detailed view (A).
- Tilt the option module towards you as shown in (2).
- Remove the option module by lifting away from the drive as shown in (3).

Figure 3-5 Installing the AI-485 / AI-Backup Adaptor to the drive (AI-485 Adaptor shown)



- Identify the two plastic fingers on the underside of the AI-485 / AI-Backup Adaptor (1) - then insert the two fingers into the corresponding slots in the spring loaded sliding cover on the top of the drive.
- Hold the adaptor firmly and push the spring loaded protective cover towards the back of the drive to expose the connector block (2) below.
- Press the adaptor downwards (3) until the adaptor connector locates into the drive connection below.

Figure 3-6 Removal of the AI-485 Adaptor / AI-Backup (AI-485 Adaptor shown)



- To remove the AI-485 / AI-Backup adaptor, pull it up and away from the drive in the direction shown (1)

3.2 Real time clock battery replacement

Those keypads which have the real time clock feature contain a battery to ensure the clock works when the drive is powered down. The battery has a long life time but if the battery needs to be replaced or removed, follow the instructions below.

Low battery voltage is indicated by low battery symbol on the keypad display.

Figure 3-7 Remote Keypad RTC (rear view)

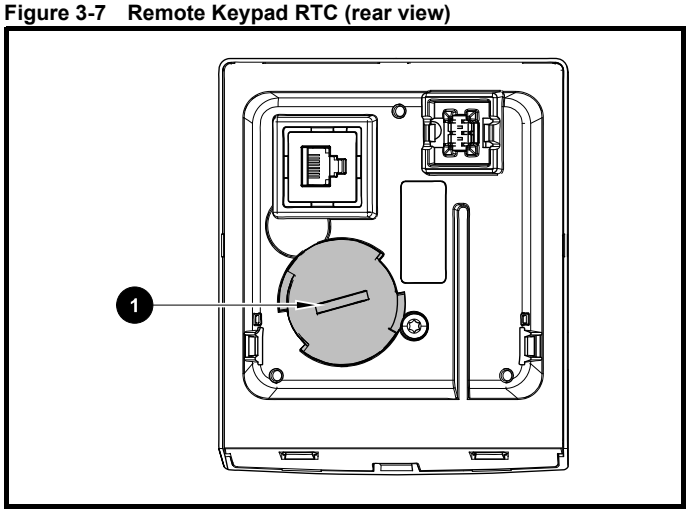


Figure 3-7 above illustrates the rear view of the Remote Keypad RTC.

1. To remove the battery cover insert a flat head screwdriver into the slot as shown (1), push and turn anti-clockwise until the battery cover is released.
2. Replace the battery (the battery type is: CR2032).
3. Reverse point 1 above to replace battery cover.

NOTE

Ensure the battery is disposed of correctly.

4 Electrical installation

4.1 24 Vdc supply

The 24 Vdc supply connected to the +24 V supply terminals on the AI-Backup adaptor provides the following functions:

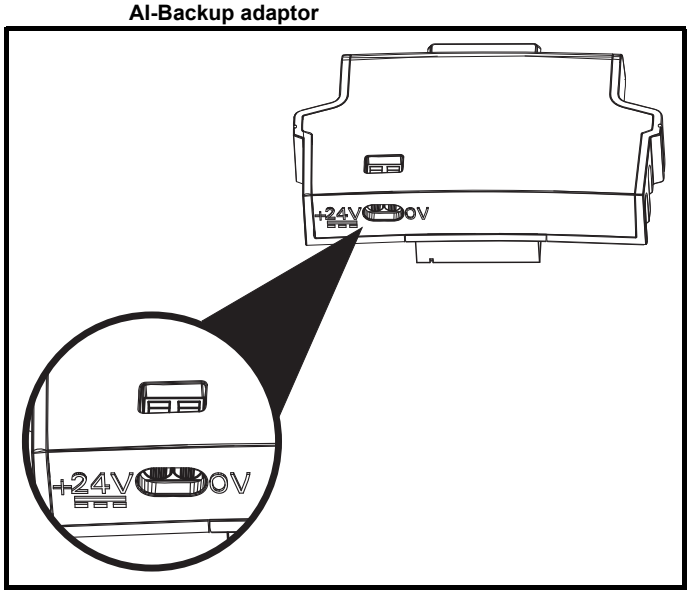
- It can be used as a back-up power supply to keep the control circuits of the drive powered up when the line power supply is removed. This allows any fieldbus modules or serial communications to continue to operate. If the line power supply is re-applied, then the normal operation can carry on after the drive automatically re-initializes the power board parameters.
- The keypad can be used to setup parameters if required. However, the drive will be in the Under Voltage state unless the line power supply is enabled, therefore diagnostics may not be possible. (Power down save parameters are not saved when using the 24 V back-up power supply input).

The working voltage range of the 24 V back-up power supply is as follows:

0V	**0V (connected internally to 0V common - Control terminal 1)**
+ 24 V	**+ 24 V Backup supply input**
Nominal operating voltage	24.0 Vdc
Minimum continuous operating voltage	19.2 V
Maximum continuous operating voltage	30.0 V
Minimum start up voltage	12.0 V
Minimum power supply requirement at 24 V	20 W
Recommended fuse	1 A, 50 Vdc

Minimum and maximum voltage values include ripple and noise. Ripple and noise values must not exceed 5 %.

Figure 4-1 Location of the 24 Vdc power supply connection on the AI-Backup adaptor



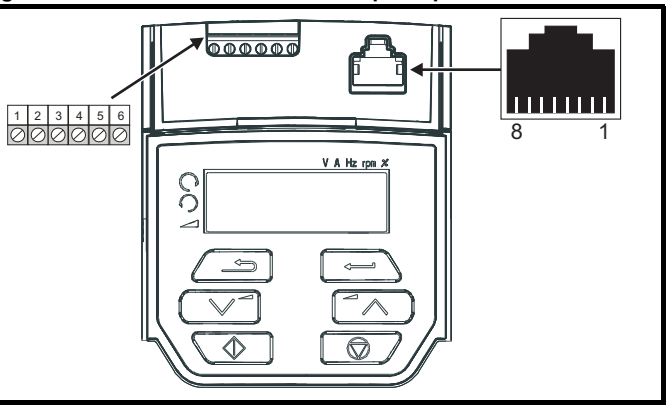
NOTE

The 24 Vdc Backup supply can be used on all frame sizes.

4.2 Communication connections

Installing an AI-485 Adaptor provides the drive with a 2 wire EIA 485 serial communications interface. This enables the drive set-up, operation and monitoring to be carried out with a PC or controller as required.

Figure 4-2 Location of the AI-485 Adaptor options



4.2.1 EIA 485 serial communications

The drive only supports Modbus RTU protocol. See Table 4-1 for the connection details.

NOTE

Standard Ethernet cables **must not be used** when connecting drives on a EIA 485 network as they do not have the correct twisted pairs for the pinout of the serial comms port.

Table 4-1 Serial communication port pin-outs (RJ45)

Pin	Function
1	120 Ω Termination resistor
2	RX TX
3	0V
4	+24 V (100 mA) output
5	Not connected
6	TX enable
7	RX\ TX\
8	RX\ TX\ (if termination resistors are required, link to pin 1)

Minimum number of connections are 2, 3, 7 and shield.

Table 4-2 Serial communication port pin-outs (screw terminal block)

Pin	Function
1	0V
2	RX\ TX\ (if termination resistor required, link to pin 4)
3	RX TX
4	120 Ω Termination resistor
5	TX Enable
6	+24 V (100 mA) output, Input for AI-485 24 V Adapter up to 600 mA

NOTE

The connections on the RJ45 connector and terminal block are in parallel.

4.2.2 Isolation of the EIA 485 serial communication port

The serial communication port is single insulated and meets the requirements for ELV.

WARNING

When using the communications port with a personal computer or centralised controller e.g. PLC, an isolation device must be included with a rated voltage at least equal to the drive supply voltage. Ensure that the correct fuses are installed at the drive input, and that the drive is connected to the correct supply voltage.
If a serial communications converter other than the CT Comms cable is used to connect to other circuits classified as Safety Extra Low Voltage (SELV) (e.g. to a personal computer), then a safety isolating barrier must be included to maintain the SELV classification.

An isolated serial communications lead has been designed to connect the drive to IT equipment (such as laptop computers), and is available from the supplier of the drive. See below for details:

Table 4-3 Isolated serial comms lead details

Part number	Description
4500-0096	CT USB Comms cable

The “isolated serial communications” lead has reinforced insulation as defined in IEC60950 for altitudes up to 3,000 m.

4.3 Control connections

4.3.1 General

Table 4-4 The control connections consist of:

Function	Qty	Control parameters available	Terminal number
Single ended analog input	2	Type, offset, invert, scaling, destination	2, 5
Analog output	1	Source, type, scaling,	7
Digital input	5	Destination, invert	5, 11, 12, 13, 14
Digital input / output	1	Input / output select, destination / source, invert	10
Frequency input	1	Maximum reference, input limit, scaling, destination	14
PWM or frequency output	1	Source, scaling, maximum output frequency, type	10
Motor thermistor input	1	Type, error threshold, reset threshold	14
Relay	1	Source, invert	41
Drive enable (Safe Torque Off)	2		31 (STO 2 input), 34 (STO 1 input) [frame 1- 4] 31 (STO 1 input), 35 (STO 2 input) [frame 5 - 9]
+10 V User output	1		4
+24 V User output	1		9
0V common	1		1
0V Safe Torque Off	2		32 (0 V STO 2), 33 (0 V STO 1) [frame 1- 4] 32 (0 V STO 1), 36 (0 V STO 2) [frame 5 - 9]

NOTE

The 0V terminals on the Safe Torque Off are isolated from each other and the 0V common (size 1 to 4). The 0V terminals of the Safe Torque Off function on size 5 to 9 are common with the user 0V terminals.

Key:

Destination parameter:	Indicates the parameter which is being controlled by the terminal / function
Source parameter:	Indicates the parameter being output by the terminal
Type parameter:	Analog - indicates the type of operation of the terminal, i.e. voltage 0-10 V, current 4-20 mA etc. Digital - indicates the type of operation of the terminal, (the Drive Enable terminal is fixed in positive logic).

All analog terminal functions can be programmed in menu 7.

All digital terminal functions (including the relay) can be programmed in menu 8.

WARNING

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

WARNING

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

CAUTION

If any of the digital inputs (including the drive enable input) 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.

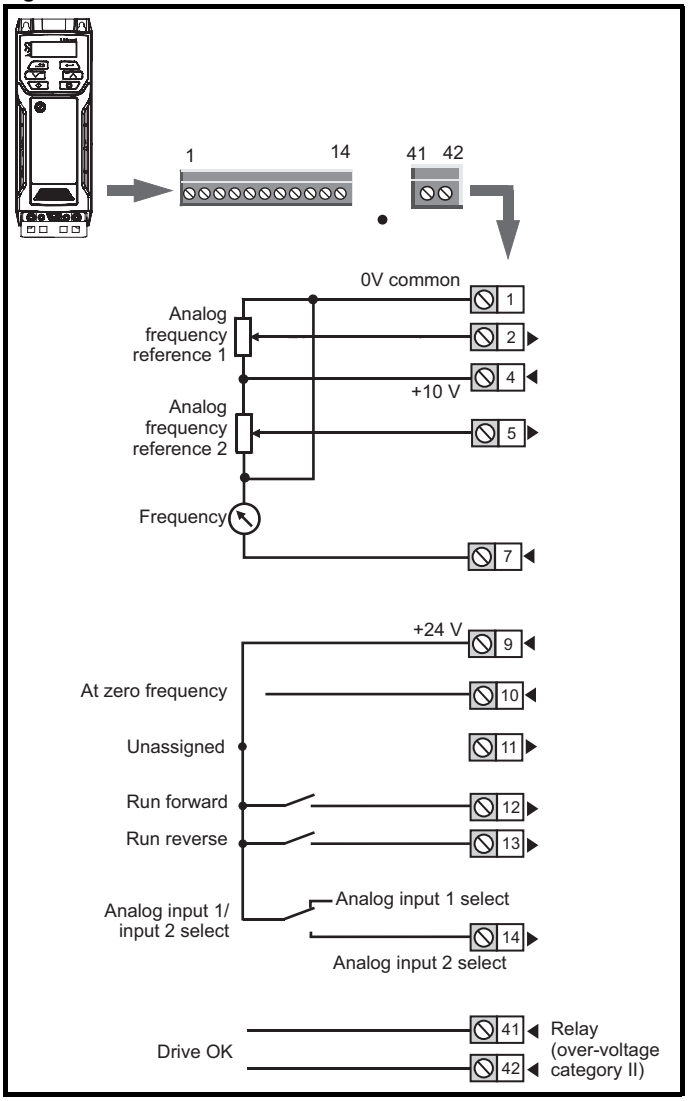
NOTE

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.

NOTE

The Safe Torque Off drive enable terminals are positive logic input only (see Figure 4-4 on page 24).

Figure 4-3 Default terminal functions



*C300 uses 'Safe Torque Off' so terminal 11 is unassigned on the Commander C300.

Figure 4-4 Safe Torque Off inputs (size 1 to 4)

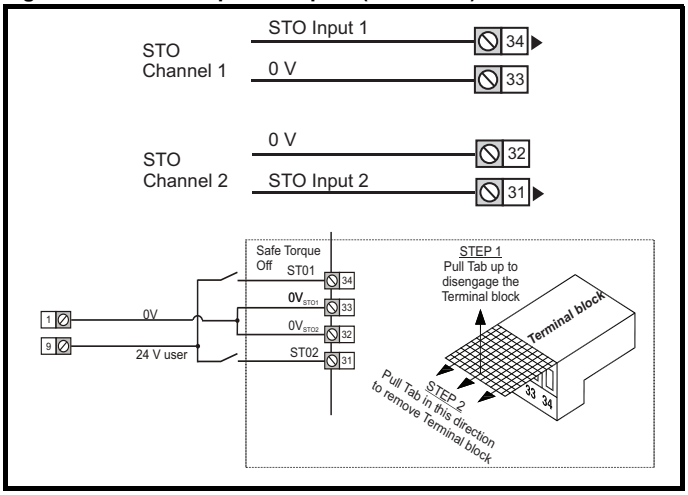
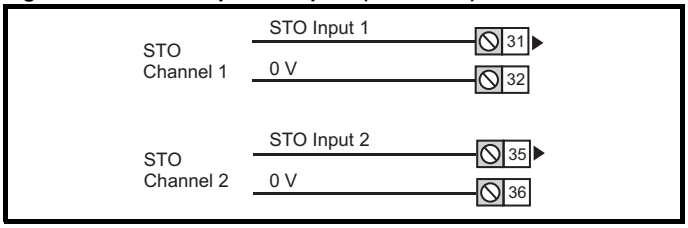


Figure 4-5 Safe Torque Off inputs (size 5 to 9)



4.3.2 Control terminal specification

1	0V common
Function	**Common connection for all external devices**

2	Analog input 1
Default function	**Frequency reference**
Type of input	Unipolar single-ended analog voltage or unipolar current
Type defined by…	**P07.007**
Operating in voltage mode (default)	
Full scale voltage range	0V to +10 V ±3 %
Maximum offset	±30 mV
Absolute maximum voltage range	-18 V to +30 V relative to 0V
Input resistance	100k Ω
Operating in current mode	
Current ranges	0 to 20 mA ±5 %, 20 to 0 mA ±5 %, 4 to 20 mA ±5 %, 20 to 4 mA ±5 %
Maximum offset	250 µA
Absolute maximum voltage (reverse bias)	-18 V to +30 V relative to 0V
Absolute maximum current	25 mA
Equivalent input resistance	165 Ω
Common to all modes	
Resolution	11 bits
Sample rate	4 ms

4	+10 V user output
Default function	**Supply for external analog devices**
Nominal voltage	10.2 V
Voltage tolerance	±3 %
Maximum output current	5 mA

5	Analog input 2
Default function	**Frequency reference**
Type of input	Unipolar single-ended analog voltage or positive logic only digital input
Type defined by....	**P07.011**
Operating in voltage mode (default)	
Full scale voltage range	0V to +10 V ±3 %
Maximum offset	±30 mV
Absolute maximum voltage range	-18 V to +30 V relative to 0V
Input resistance	100 k Ω
Resolution	11 bits
Sample rate	4 ms
Operating in digital mode	
Absolute maximum voltage range	-18 V to +30 V relative to 0V
Impedance	6.8 k Ω
Input threshold	10 V ±0.8 V (IEC 61131-2)
Sample rate	1 ms when routed to destinations **P06.035** or **P06.036**, otherwise 4 ms.

7	Analog output 1
Default function	**Frequency output**
Type of output	Unipolar single-ended analog voltage
Voltage range	+10 V
Maximum offset	15 mV
Load resistance	≥ 2k Ω
Protection	Short circuit relative to 0V
Resolution	0.1 %
Sample rate	4 ms

9	+24 V user output
Default function	**Supply for external digital devices**
Voltage tolerance	±20 %
Maximum output current	100 mA
Protection	Current limit and error

10	Digital I/O 1
Default function	**AT ZERO FREQUENCY output**
Type	Positive logic digital input, positive logic voltage source output. PWM or frequency output modes can be selected.
Type defined by …	**P08.031**
Operating as in input	
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)
Operating as an output	
Nominal maximum output current	50 mA
Maximum output current	100 mA (total including +24 Vout)
Common to all modes	
Voltage range	0V to +24 V
Sample rate	1 ms when routed to destinations **P06.035** or **P06.036**, otherwise 4 ms

11	Digital Input 2
12	Digital Input 3
13	Digital Input 4
Terminal 11 default function	**Unassigned**
Terminal 12 default function	**RUN FORWARD input**
Terminal 13 default function	**RUN REVERSE input**
Type	Positive logic only digital inputs
Voltage range	0V to +24 V
Absolute maximum applied voltage range	-18 V to +30 V relative to 0V
Impedance	6.8 kΩ
Input threshold	10 V ±0.8 V (IEC 61131-2)
Sample rate	1 ms when routed to destinations **P06.035** or **P06.036**, otherwise 4 ms.

14	Digital Input 5
Terminal 14 default function	**Analog INPUT 1 / INPUT 2 select**
Type	Positive logic only digital input. Frequency input or motor thermistor input (bias for DIN44081 ptc, KTY84, PT1000, PT2000 and other types)
Type defined by...	**P08.035**
Voltage range	0V to +24 V
Absolute maximum applied voltage range	-18 V to +30 V relative to 0V
Impedance	6.8 kΩ
Input threshold	10 V ±0.8 V (IEC 61131-2)
Sample rate	1 ms when routed to destinations **P06.035** or **P06.036**, otherwise 4 ms.

31 34	Safe Torque Off function (drive enable) (Frame 1 to 4)
Type	Positive logic only digital input
Voltage range	0 to +24 V
Absolute maximum applied voltage	30 V
Logic Threshold	10 V ±5 V
Low state maximum voltage for disable to SIL3 and PL e	5 V
Impedance	>4 mA @ 15 V, <15 mA @30 V (IEC 61131-2, type 1)
Low state maximum current for disable to SIL3 and PL e	0.5 mA
Response time	Nominal: 12 ms Maximum: 20 ms
The Safe Torque Off function may be used in a safety-related application in preventing the drive from generating torque in the motor to a high level of integrity. The system designer is responsible for ensuring that the complete system is safe and designed correctly according to the relevant safety standards. If the Safe Torque Off function is not required, these terminal are used for enabling the drive.	

32	0V STO2 (Frame 1 to 4)
Function	Common connection for STO2

33	0V STO1 (Frame 1 to 4)
Function	Common connection for STO1

31 35	Safe Torque Off function (drive enable) (Frame 5 to 9)
Type	Positive logic only digital input
Voltage range	0 to +24 V
Absolute maximum applied voltage	30 V
Logic Threshold	10 V ±5 V
Low state maximum voltage for disable to SIL3 and PL e	5 V
Impedance	>4 mA @ 15 V (IEC 61131-2, type 1, 3.3 kΩ)
Low state maximum current for disable to SIL3 and PL e	0.5 mA
Response time	Nominal: 6 ms Maximum: 20 ms
The Safe Torque Off function may be used in a safety-related application in preventing the drive from generating torque in the motor to a high level of integrity. The system designer is responsible for ensuring that the complete system is safe and designed correctly according to the relevant safety standards. If the Safe Torque Off function is not required, these terminal are used for enabling the drive.	

32	0V STO1 (Frame 5 to 9)
Function	Common connection for STO1

36	0V STO2 (Frame 5 to 9)
Function	Common connection for STO2

41 42	Relay contacts
Default function	**Drive OK indicator**
Contact voltage rating	240 Vac, Installation over-voltage category II
Contact maximum current rating	2 A AC 240 V 4 A DC 30 V resistive load 0.5 A DC 30 V inductive load (L/R = 40 ms)
Contact minimum recommended rating	12 V 100 mA
Contact type	Normally open
Default contact condition	Closed when power applied and drive OK
Update rate	1 ms

WARNING

To prevent the risk of a fire hazard in the event of a fault, a fuse or other over-current protection must be installed in the relay circuit.

4.4 Safe Torque Off (STO)

The Safe Torque Off function provides a means for preventing the drive from generating torque in the motor, with a very high level of integrity. It is suitable for incorporation into a safety system for a machine. It is also suitable for use as a conventional drive enable input.

The safety function is active when the STO input is in the logic-low state as specified in the control terminal specification. The function is defined according to EN 61800-5-2 and IEC 61800-5-2 as follows. (In these standards a drive offering safety-related functions is referred to as a PDS(SR)):

'Power that can cause rotation (or motion in the case of a linear motor) is not applied to the motor. The PDS(SR) will not provide energy to the motor which can generate torque (or force in the case of a linear motor)'

This safety function corresponds to an uncontrolled stop in accordance with stop category 0 of IEC 60204-1.

The Safe Torque Off function makes use of the special property of an inverter drive with a motor, which is that torque cannot be generated without the continuous correct active behaviour of the inverter circuit. All credible faults in the inverter power circuit cause a loss of torque generation.

The Safe Torque Off function is fail-safe, so when the Safe Torque Off input is disconnected the drive will not operate the motor, even if a combination of components within the drive has failed. Most component failures are revealed by the drive failing to operate. Safe Torque Off is also independent of the drive firmware. This meets the requirements of the following standards, for the prevention of operation of the motor.

Machinery Applications

The Safe Torque Off function has been independently assessed by Notified Body, TüV Rheinland for use as a safety component of a machine:

Prevention of unintended motor operation: The safety function "Safe Torque Off" can be used in applications up to Cat 4. PL e according to EN ISO 13849-1, SIL 3 according to EN 61800-5-2/ EN 62061/ IEC 61508 and in lift applications according to EN 81-1 and EN81-2.

Type examination certificate number	Date of issue	Models	Frame sizes
01/205/5387.02/18	2018-08-16	C300	5 to 9
01/205/5383.03/18	2018-08-16	C300	1 to 4

This certificate is available for download from the TüV Rheinland website at: http://www.tuv.com

Safety Parameters as verified by TüV Rheinland:

According to IEC 61508-1 to 07 / EN 61800-5-2 / EN 62061

Type	Value	Percentage of SIL 3 allowance	Frame sizes
Proof test interval	20 years		All
High demand or a continuous mode of operation			
PFH (1/h)	9.61×10^{-11} 1/h	< 1 %	1 to 4
PFH (1/h)	4.16×10^{-11} 1/h	< 1 %	5 to 9
Low demand mode of operation (not EN61800-5-2)			
PFDavg	8.4×10^{-6}	< 1 %	1 to 4
PFDavg	3.64×10^{-6}	< 1 %	5 to 9

According to EN ISO 13849-1

Type	Value	Classification
Category	4	
Performance Level (PL)	e	
$MTTF_D$ (STO1)	>2500 years	High
$MTTF_D$ (STO2)	>2500 years	High
$MTTF_D$ (Single channel STO)	>2500 years	High
DC_{avg}	≥99 %	High
Mission time	20 years	

NOTE

Logic levels comply with IEC 61131-2:2007 for type 1 digital inputs rated at 24 V. Maximum level for logic low to achieve SIL3 and PL e 5 V and 0.5 mA.

Lift (Elevator) Applications

The Safe Torque function has been independently assessed for use as a safety component in lift (elevator) applications by Notified Body, TüV Nord:

The drives Commander series with safe torque off (STO) function if applied according to the "Conditions of application" fulfil the safety requirements of the standards EN81-1, EN81-2, EN 81-50 and EN60664-1and are in conformity with all relevant requirements of the Directive 95/16/EC.

Certificate of Conformity number	Date of issue	Models
44 799 13196202	2015-04-08	C300

The Safe Torque Off function can be used to eliminate electro-mechanical contactors, including special safety contactors, which would otherwise be required for safety applications.

For further information contact the supplier of the drive.

UL Approval

The Safe Torque Off function has been independently assessed by Underwriters Laboratories (UL). The on-line certification (yellow card) reference is: FSPC.E171230.

Safety Parameters as verified by UL:

According to IEC 61508-1 to 7

Type	Value
Safety Rating	SIL 3
SFF	> 99%
PFH (1/h)	4.43×10^{-10} 1/h (< 1% of SIL 3 allowance)
HFT	1
Beta Factor	2 %
CCF	Not applicable

According to EN ISO 13849-1

Type	Value
Category	4
Performance Level (PL)	e
$MTTF_D$	2574 years
Diagnostic coverage	High
CCF	65

Two-channel Safe Torque Off

The Commander C300 models have dual channel STO.

The dual channel STO has two fully independent channels.

Each input meets the requirements of the standards as defined above.

If either or both inputs are set at a logic low state, there are no single faults in the drive which can permit the motor to be driven.

It is not necessary to use both channels to meet the requirements of the standards. The purpose of the two channels is to allow connection to machine safety systems where two channels are required, and to facilitate protection against wiring faults.

For example, if each channel is connected to a safety-related digital output of a safety related controller, computer or PLC, then on detection of a fault in one output the drive can still be disabled safely through the other output.

Under these conditions, there are no single wiring faults which can cause a loss of the safety function, i.e. inadvertent enabling of the drive.

In the event that the two-channel operation is not required, the two inputs can be connected together to form a single Safe Torque Off input.

In this case it is important to note that a single short-circuit from the Safe Torque Off input to a D.C. supply > 5 V could cause the drive to be enabled.

This might occur through a fault in the wiring. This can be excluded according to EN ISO 13849-2 by the use of protected wiring. The wiring can be protected by either of the following methods:

- By placing the wiring in a segregated cable duct or other enclosure.

or

- By providing the wiring with a grounded shield in a positive-logic grounded control circuit. The shield is provided to avoid a hazard from an electrical fault. It may be grounded by any convenient method; no special EMC precautions are required.

Note on response time of Safe Torque Off, and use with safety controllers with self-testing outputs:

Safe Torque Off has been designed to have a response time of greater than 1 ms so that it is compatible with safety controllers whose outputs are subject to a dynamic test with a pulse width not exceeding 1 ms.

The design of safety-related control systems must only be done by personnel with the required training and experience. The Safe Torque Off function will only ensure the safety of a machine if it is correctly incorporated into a complete safety system. 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

Safe Torque Off does not provide electrical isolation. The supply to the drive must be disconnected by an approved isolation device before gaining access to power connections.

Safe Torque Off inhibits the operation of the drive, this includes inhibiting braking. If the drive is required to provide both braking and Safe Torque Off in the same operation (e.g. for emergency stop) then a safety timer relay or similar device must be used to ensure that the drive is disabled a suitable time after braking. The braking function in the drive is provided by an electronic circuit which is not fail-safe. If braking is a safety requirement, it must be supplemented by an independent fail-safe braking mechanism.

It is essential to observe the maximum permitted voltage of 5 V for a safe low (disabled) state of Safe Torque Off. The connections to the drive must be arranged so that voltage drops in the 0V wiring cannot exceed this value under any loading condition. It is strongly recommended that the Safe Torque Off circuits be provided with a dedicated 0V conductors which should be connected to terminals 32 and 33 (sizes 1 to 4) and terminals 32 and 36 (sizes 5 to 9) at the drive.

Safe Torque Off over-ride

The drive does not provide any facility to over-ride the Safe Torque Off function, for example for maintenance purposes.

5 Getting started

This chapter introduces the user interfaces, menu structure and security levels of the drive.

5.1 Understanding the display

5.1.1 Keypad

The keypad display consists of a 6 digit LED display. The display shows the drive status or the menu and parameter number currently being edited.

The option module menu (S.mm.ppp) is only displayed if the option module is installed.

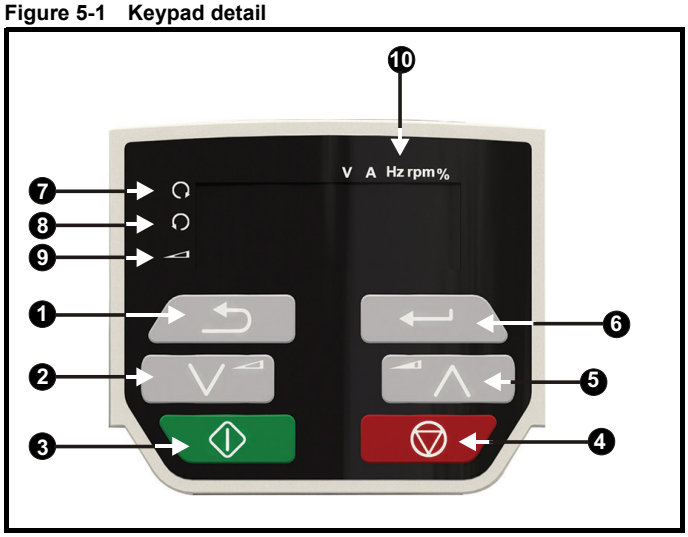
The display also includes LED indicators showing units and status as shown in Figure 5-1.

When the drive is powered up, the display will show the power up parameter defined by *Parameter Displayed At Power-Up* (**P11.022**).

NOTE

The values in the *Status Display Parameters* (**P00.022** and **P00.023**) shown on the display when the drive is running, can be toggled by using the escape button.

Figure 5-1 Keypad detail



1. Escape button
2. Down button
3. Start button (green)
4. Stop / Reset button (red)
5. Up button
6. Enter button
7. Run forward indicator
8. Run reverse indicator
9. Keypad reference indicator
10. Unit indicators

NOTE

The red stop button is also used to reset the drive if there is an error.

5.2 Status indicators

The following tables indicate the various possible mnemonics which can be displayed by the drive and their meaning.

Table 5-1 Status indicators

String	Description	Drive output stage
C300	The drive is initializing	N/A
inh	The drive is inhibited and cannot be run. The Safe Torque Off signal is not applied to Safe Torque Off terminals or **P06.015** is set to 0. The other conditions that can prevent the drive from enabling are shown as bits in *Enable Conditions* (**P06.010)**	Disabled
rdy	The drive is ready to run. The drive enable is active, but the drive inverter is not active because the final drive run is not active	Disabled
Stop	The drive is stopped / holding zero speed.	Enabled
S.Loss	Supply loss condition has been detected	Enabled
dc inj	The drive is applying dc injection braking	Enabled
UV	The drive is in the under voltage state either in low voltage or high voltage mode.	Disabled
HEAt	The motor pre-heat function is active	Enabled
decel	The drive is decelerating the motor to a stop	Enabled
P01.001	Parameter location Pmm.ppp where mm is the menu and ppp is the individual parameter	N/A
s.mm.ppp	Option module parameter where s = option slot location, mm = option menu, ppp = option parameter	N/A
E001	The drive has an active error and is no longer controlling the motor. The error code and sub-error appear on the display. see section 12 *Diagnostics* for the cause	Disabled
A.1	The drive is in an alarm state, check the code shown on the display in section 12 *Diagnostics* for the cause	Enables
HF.01	Hardware Fault - Contact the supplier of the drive	Disabled
- - - -	Enter the Security PIN. See section 5.6 *Security PIN* for more information	N/A

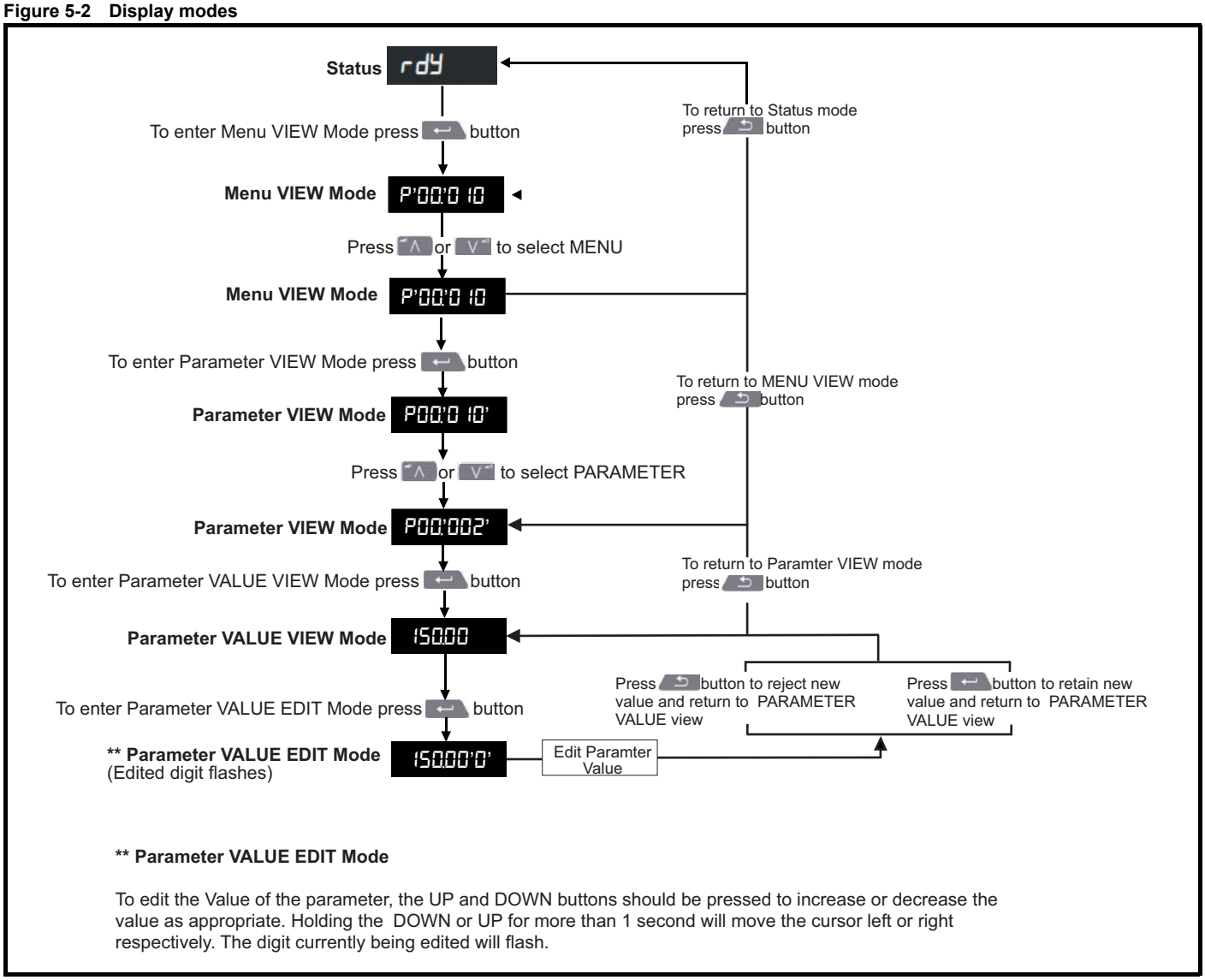
5.3 Keypad operation

5.3.1 Control buttons

The keypad consists of:

- Up and down button - Used to navigate the parameter structure and change parameter values.
- Enter button - Used to change between parameter edit and view mode, as well as entering data. This button can also be used to select between slot menu and parameter display.
- Escape button - Used to exit from parameter edit or view mode. In parameter edit mode, if parameter values are edited and the escape button pressed, the parameter value will be restored to the value it had on entry to edit mode.
- Start button - Used to provide a 'Run' command if keypad mode is selected.
- Stop / Reset button - Used to reset the drive. In keypad mode can be used for 'Stop'.

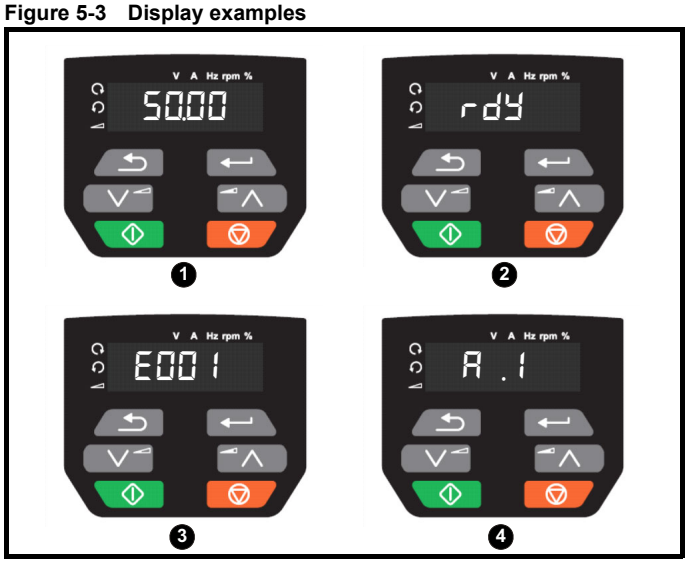
Figure 5-2 Display modes



NOTE

The up and down buttons can only be used to move between menus if *Menu Access Level* (**P11.044**) is set to *All* (2). Refer to section 5.5 *Menu Access Level* on page 31.

Figure 5-3 Display examples



1 Parameter view: Read write or Read only

2 Drive ready status

If the drive is ok and the parameters are not being edited or viewed, the display will show one of the following:

inh', 'rdy' or status parameter value.

3 Error status

When the drive has an error, the display will show the Error code. For further information regarding error codes, refer to section 12.2 *Errors* on page 136.

4 Alarm status

During an 'alarm' condition the display flashes between the drive status parameter value and the alarm.

WARNING

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

NOTE

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

NOTE

New parameter values entered via communications must be saved to ensure that the new values apply after the drive has been power cycled. Refer to section 5.7 *Saving parameters* on page 31.

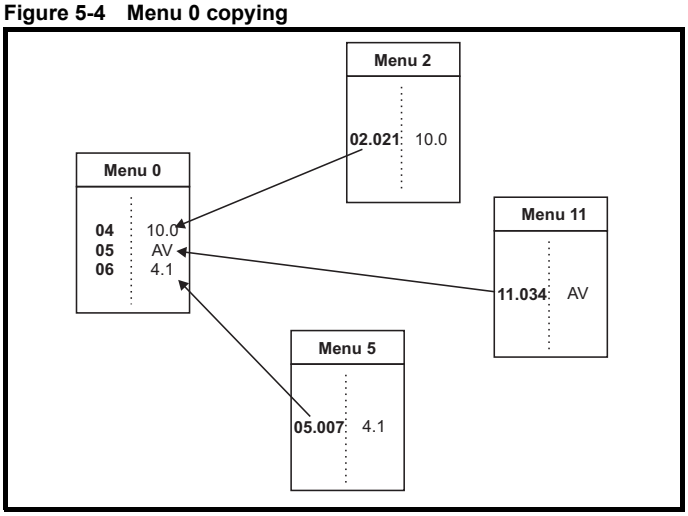
5.4 Menu structure

Menu 0 is used to bring together various commonly used parameters for basic set up of the drive. The parameters in Menu 0 can be configured in Menu 22.

Appropriate parameters are copied from the advanced menus into Menu 0 and thus exist in both locations.

For further information, refer to Chapter 7 *Basic parameters* on page 45.

Figure 5-4 Menu 0 copying



The advanced menus consist of groups or parameters appropriate to a specific function or feature of the drive. Menus 0 to 24 can be viewed on the Keypad.

The option module menu (1.mm.ppp) is only displayed if the option module is installed. Where 1 signifies the option module slot number and the mm.ppp signifies the menu and parameter number of the option module's internal menus and parameters.

Table 5-2 Advanced menu descriptions

Menu	Description
0	Basic parameters
1	Frequency references
2	Frequency ramps
3	Frequency control
4	Torque and current control
5	Motor setup
6	Sequencer and clock
7	Analog I/O
8	Digital I/O
9	Programmable logic, motorized pot, binary sum, timers
10	Status and error log
11	Drive set-up and identification, serial communications
12	Threshold detectors, variable selectors and mechanical brake controller
14	PID controller
15	Option module set-up menu
18	Application menu 1
20	Application menu 2
22	Menu 0 set-up
1.mm	Option menus*

* Only displayed when the option module is installed.

5.5 Menu Access Level

Set *Menu Access Level* (**P11.044**) to restrict access to parameters as detailed in Table 5-3. To prevent unauthorized users from changing this level, first set *Security PIN* (**P11.030**) as described in *section 5.6 Security PIN.*
By default **P11.044** is set to *All* (3) and users can access all menus.

Table 5-3 Menu Access Level

Menu Access Level	Description
Basic Menu 0 (0)	Only the first 10 parameters in Menu 0 are visible and available to be edited on the keypad.
Menu 0 (1)	All parameters in Menu 0 are visible and available for editing on the keypad.
All (2)	Parameters in all menus are visible and available for editing on the keypad.
Status Only (3)	Same access as Level 1. If a *Security PIN* (**P11.030**) is set this must be entered to leave the status view.
No Access (4)	Same access as Status Only (3). If the drive is locked by a *Security PIN* (**P11.030**) the drive will block communications

5.6 Security PIN

When set, the Security PIN prevents unauthorized access to any of the parameters in any menu.

Setting the Security PIN

Enter a value between 1 and 9999 in **P11.030** and press the  button; the Security PIN has now been set and the value must be entered before any parameter can be edited via the keypad. Parameters can still be edited via communications unless *Menu Access Level* (**P11.044**) is set to *No Access* (4). The value of **P11.030** will return to 0 in order to hide the security code.

Changing a parameter protected by the Security PIN

Select a parameter that needs to be edited and press the  button, the display will now show ‘Co’. Use the arrow buttons to enter the Security PIN and press the  button. With the correct security code entered, the display will revert to the parameter selected in edit mode.

If an incorrect security code is entered, the following message ‘Co.Err’ is displayed, and the display will revert to parameter view mode. Once the correct PIN is entered, the drive is "unlocked" and other parameters can be edited without having to re-enter the PIN. To lock the drive, return to Status view or power down the drive.

Disabling the Security PIN

Set *Security PIN* (**P11.030)** to 0 and press the  button. The User Security has now been disabled

5.7 Saving parameters

When changing a parameter in Menu 0, the new value is saved when pressing the Enter button  to return to parameter view mode from parameter edit mode.

If parameters have been changed in the advanced menus, then the change will not be saved automatically. A save function must be carried out.

Procedure

1. Select ‘Save' in **Pmm.000** (alternatively enter a value of 1001 in **Pmm.000**)
2. Either:

- Press the red  reset button
- Carry out a drive reset through serial communications by setting **P10.038** to 100

5.8 Restoring parameter defaults

Restoring parameter defaults by this method saves the default values in the drives memory. *User Access Level* (**P00.010**) and *Security PIN* (**P00.025**) are not affected by this procedure.

Procedure

1. Ensure the drive is not enabled, i.e. drive is in inhibit or under voltage state.
2. Select 'Def.50’ or 'Def.60' in **Pmm.000**. (alternatively, enter 1233 (50 Hz settings) or 1244 (60 Hz settings) in **Pmm.000**.
3. Either:

- Press the red  reset button
- Carry out a drive reset through serial communications by setting **P10.038** to 100

5.9 Displaying parameters with non-default values only

By selecting 'diff.d' in **Pmm.000** (Alternatively, enter 12000 in **Pmm.000**), the only parameters that will be visible to the user will be those containing a non-default value. This function does not require a drive reset to become active. In order to deactivate this function, return to **Pmm.000** and select 'none' (alternatively enter a value of 0). Please note that this function can be affected by the access level enabled, refer to section 5.5 *Menu Access Level* for further information regarding access level.

5.10 Displaying destination parameters only

By selecting 'dest' in **Pmm.000** (Alternatively enter 12001 in **Pmm.000**), the only parameters that will be visible to the user will be destination parameters. This function does not require a drive reset to become active. In order to deactivate this function, return to **Pmm.000** and select 'none' (alternatively enter a value of 0).

Please note that this function can be affected by the menu access level enabled, refer to section 5.5 *Menu Access Level* for further information.

6 Running the motor

This chapter takes the new user through all the essential steps to running a motor for the first time, in each of the possible operating modes.

For information on tuning the drive for the best performance, see Chapter 8 *Optimization* on page 65.

Ensure that no damage or safety hazard could arise from the motor starting unexpectedly.

The values of the motor parameters affect the protection of the motor.
The default values in the drive should not be relied upon.
It is essential that the correct value is entered in **P00.006** *Motor Rated Current*. This affects the thermal protection of the motor.

If the drive is started using the keypad it will run to the speed defined by the keypad reference (**P01.017**). This may not be acceptable depending on the application. The user must check in **P01.017** and ensure that the keypad reference has been set to 0.

If the intended maximum speed affects the safety of the machinery, additional independent over-speed protection must be used.

6.1 Quick start connections

6.1.1 Basic requirements

This section shows the basic connections which must be made for the drive to run in the required mode. For minimal parameter settings to run in each mode please see the relevant part of section 6.2 *Quick start commissioning / start-up* on page 37.

Table 6-1 Minimum control connection requirements for each control mode

Drive control method	Requirements
Terminal mode	Drive enable Speed / Torque reference Run forward / Run reverse
Keypad mode	Drive enable
Serial communications	Drive enable Serial communications link

Figure 6-1 Minimum connections to get the motor running in any operating mode (size 1 to 4)

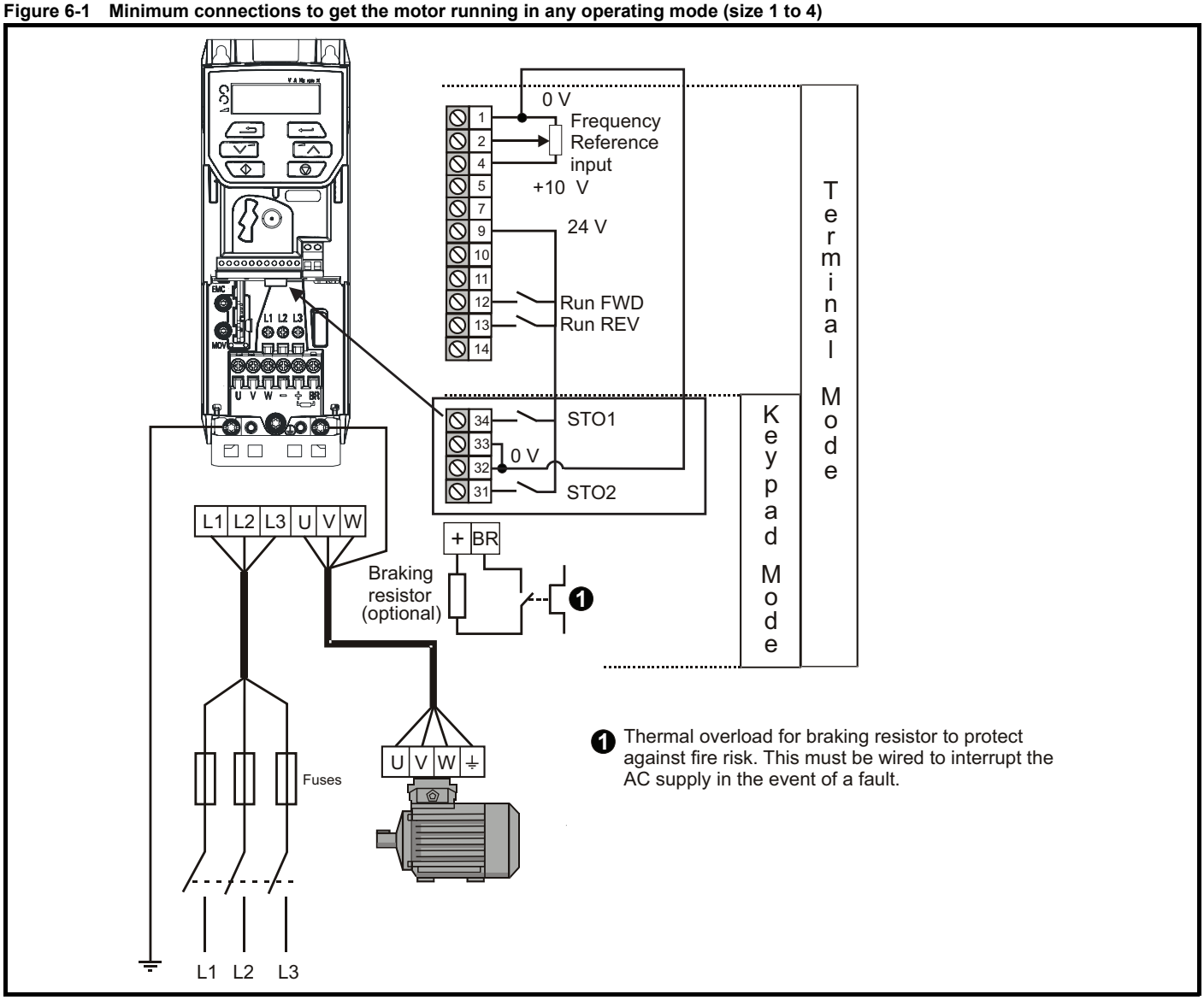


Figure 6-2 Minimum connections to get the motor running in any operating mode (size 5)

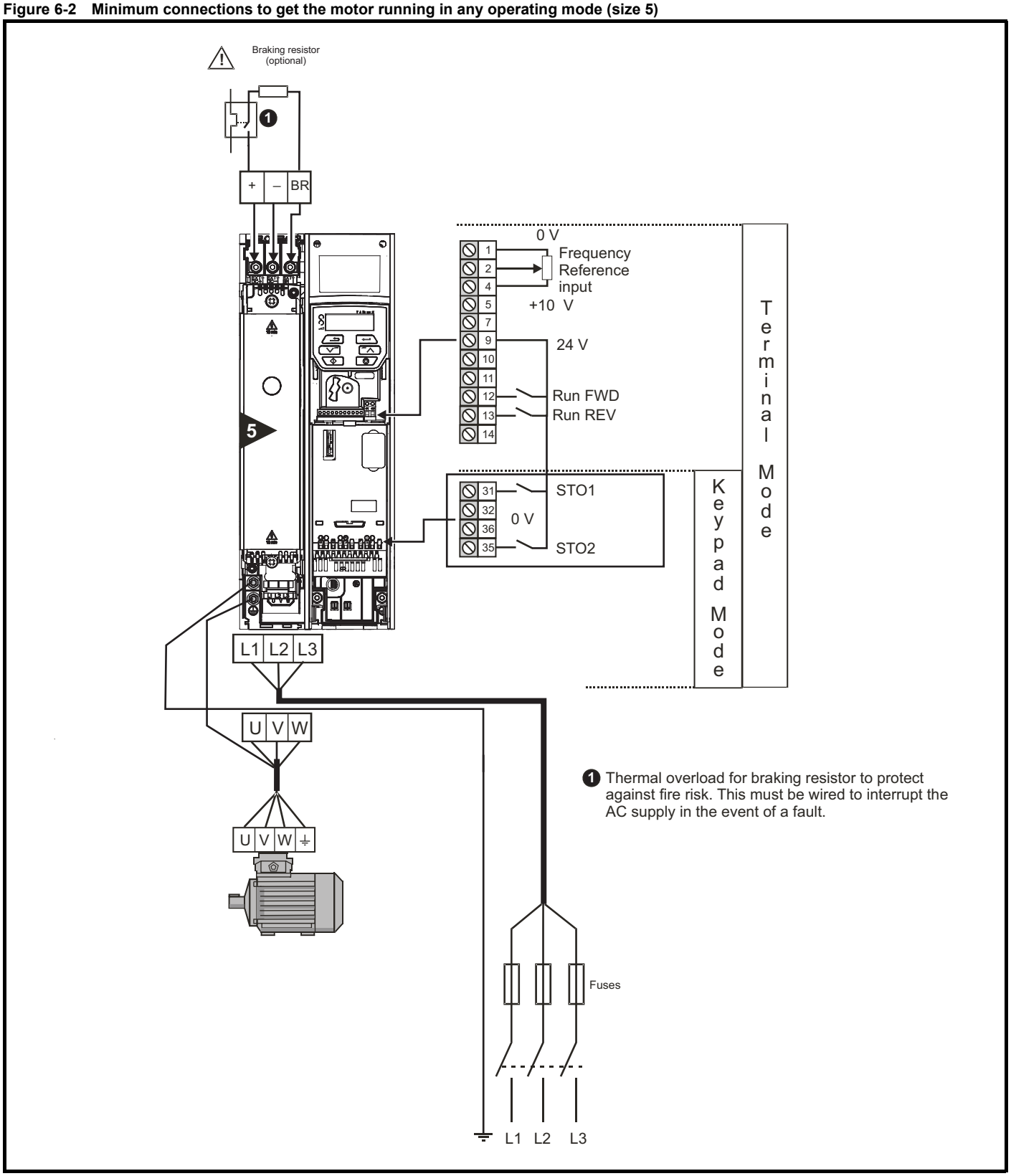


Figure 6-3 Minimum connections to get the motor running in any operating mode (size 6)

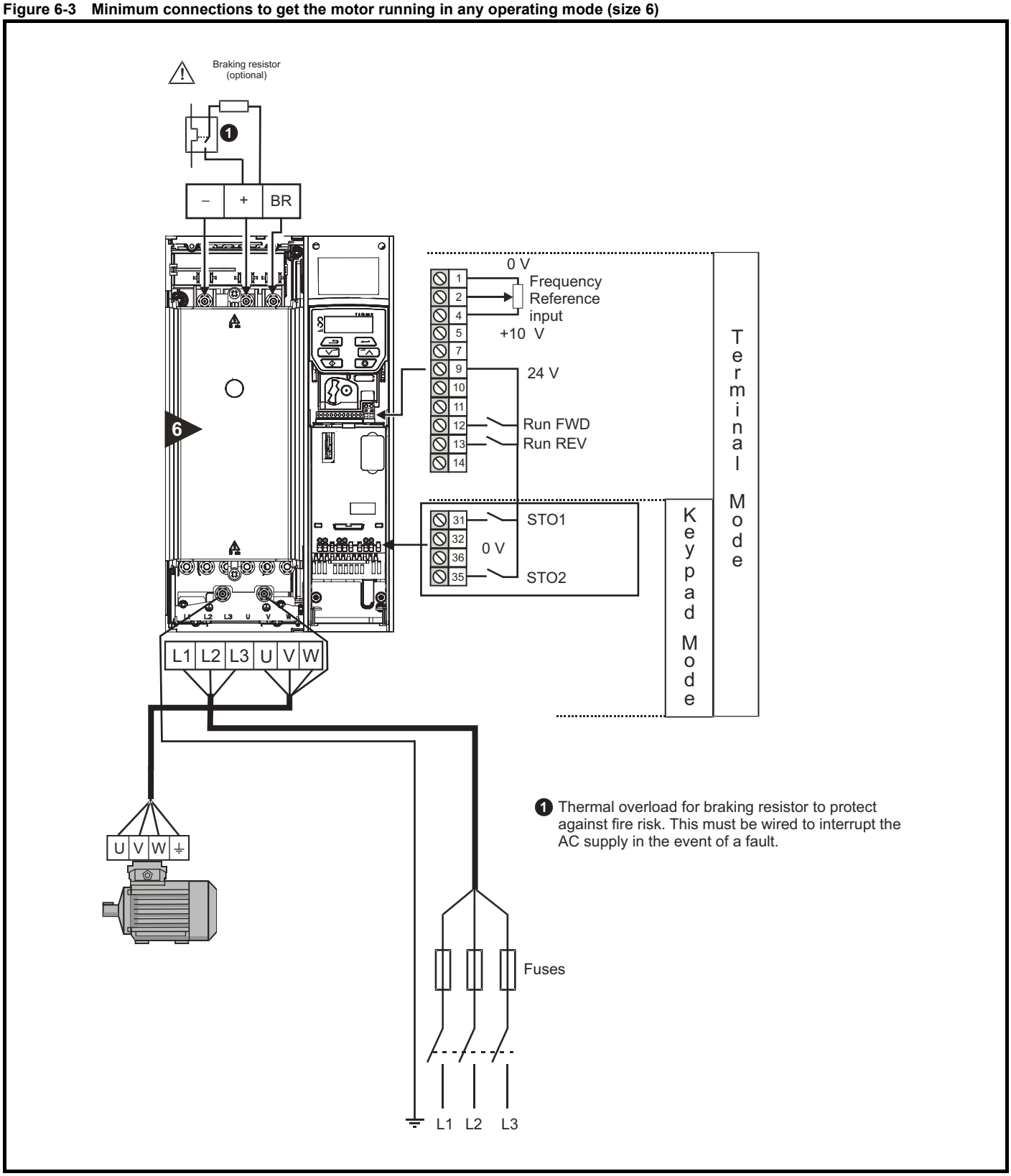
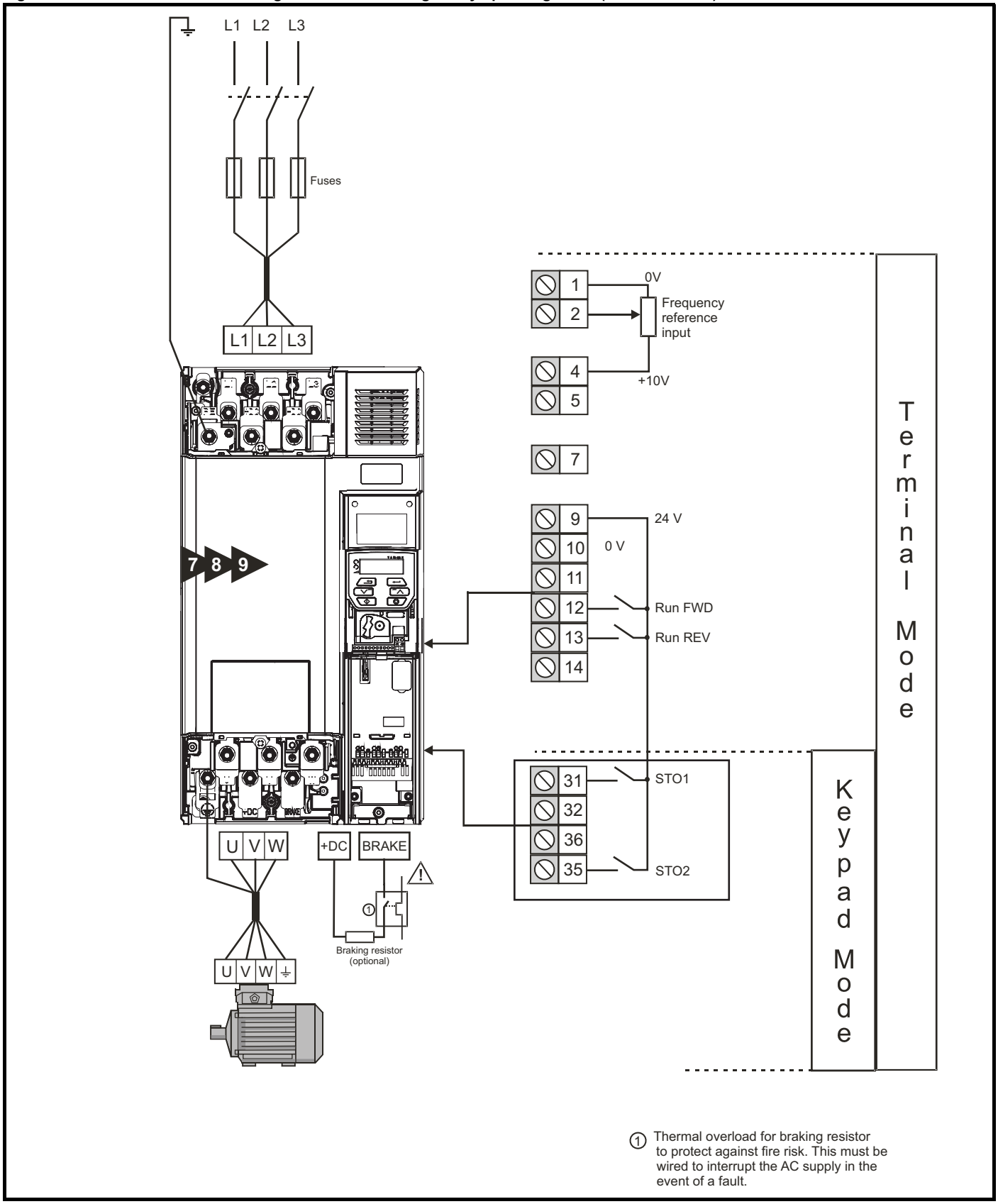
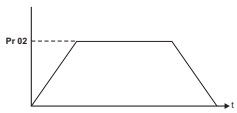
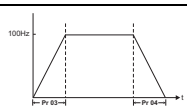
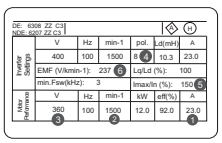


Figure 6-4 Minimum connections to get the motor running in any operating mode (size 7 onwards)

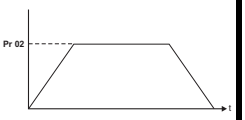
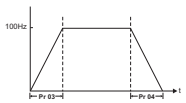
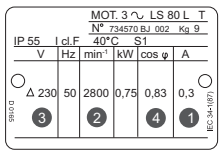


6.2 Quick start commissioning / start-up

6.2.1 Permanent magnet motor commissioning

Action	Detail	
Before power-up	Ensure: • The drive enable signal is not given (terminal 31 & 34 on size 1 to 4 or terminals 31 & 35 on size 5 to 9 is open) • Run signal is not given, terminal 12/13 is open. • Motor is connected to the drive. • The motor connection is correct for the drive ⅄ or △ connection. • The correct supply voltage is connected to the drive. In order to maintain performance at full speed Minimum supply voltage =>(Motor rated voltage x 1.414 (√2) X 1.05) / 1.35. See Pr **05.009** descrption for 110 V drives.	
Power-up the drive	Ensure: • Drive displays 'inh' (enable terminals are open).	
Set motor control mode	Set: • **P05.014** to PM (8)	
Set maximum speed	Enter: • Maximum speed in **P00.002** (Hz)	
Set acceleration / deceleration rates	Enter: • Acceleration rate in **P00.003** (s/Maximum Frequency) • Deceleration rate in **P00.004** (s/Maximum Frequency)	
Enter motor namplate details	❶ Motor rated current in **P05.007** (Amps) ❷ Motor rated speed in **P05.008** (rpm / min^{-1})* ❸ Motor rated voltage in **P05.009** (Volts) ❹ Number of motor poles in **P05.011** (Poles) ❺ Maximum motor current (to prevent magnetization) in **P05.069** (% of motor rated current) ❻ Back EMF. Volts per 1000 rpm. P**05.033**	
Auto-tune	Before running a permanent magnet motor the drive must perform a basic auto-tune to measure *Stator Resistance* (**P05.017**), *Ld* (**P05.024**), and *No-Load Lq* (**P05.072**). **Basic Auto-tune** • A stationary test for applications where the motor cannot be detached from the load. • To perform a basic auto-tune: • Ensure the motor is stationary and will not move during the test • Set **P00.013** to *Basic* (1) • Run the drive • Wait for the auto-tune to complete before removing run signals **NOTE** STO must be removed and re applied before a motor will restart after an autotune procedure	
Save parameters	Select 'Save' in **P00.000** or **Pmm.000** (alternatively enter a value of 1001) and press red reset button.	
Run	**Always ensure it is safe to start the motor before doing so.** Provide an Enable signal to the STO terminals. Provide a run signal to terminal 12 (Run Forward) or terminal 13 (Run Reverse).	
Increasing and decreasing motor speed	Increase or decrease the voltage across analog input 1 (terminal 2) and 0 V to increase or decrease the frequency reference or change the selected speed reference to required value if different from default.	
Stop	Remove the Run Forward (terminal 12) or Run Reverse (terminal 13) signals to stop the motor by following the selected deceleration rate. If the Enable signal is removed while the motor is running, the drive output is immediately disabled, and the motor will coast to a stop.	

6.2.2 Induction motor commissioning

Action	Detail	
Before power-up	Ensure: • The drive enable signal is not given (terminal 31 & 34 on size 1 to 4 or terminals 31 & 35 on size 5 to 9 is open) • Run signal is not given, terminal 12/13 is open. • Motor is connected to the drive. • The motor connection is correct for the drive ⅄ or Δ connection. • The correct supply voltage is connected to the drive.	
Power-up the drive	Ensure: • Drive displays 'inh' (enable terminals are open).	
Select motor control mode (optional)	**Linear V to F - Basic control suitable for most applications** • Set **P00.012** to *Fixed V to F* (2) **Square V to F - Basic control suitable for fans and pumps** • Set **P00.012** to *Square V to F* (5) **Resistance Compensation - Improved control** • Set **P00.012** to *Ur* (1)	
Set maximum speed	Enter: • Maximum speed in **P00.002** (Hz)	
Set acceleration / deceleration rates	Enter: • Acceleration rate in **P00.003** (s/Maximum Frequency) • Deceleration rate in **P00.004** (s/Maximum Frequency)	
Set motor poles to automatic	Set Number of Motor Poles, **P05.011** to *Automatic* (0).	
Enter motor namplate details	❶ Motor rated current in **P05.007** (Amps) ❷ Motor rated speed in **P05.008** (rpm / min^{-1}) ❸ Motor rated voltage in **P05.009** (Volts) ❹ Motor rated power factor (Cos φ) in **P05.010**	
Auto-tune (optional)	The drive can perform an auto-tune to measure motor parameters not included on the motor nameplate that allow the drive to run with improved control. **Basic Auto-tune** A stationary test for applications where the motor cannot be detached from the load. To perform a basic auto-tune: • Ensure the motor is stationary and will not move during the test • Set **P00.013** to *Basic* (1) • Run the drive • Wait for the auto-tune to complete before removing run signals **Improved Auto-tune** The drive performs a basic auto-tune before running a rotating test at 2/3 base speed. To perform an improved auto-tune: • Ensure the motor is unload and stationary, but free to move • Set **P00.013** to *Improved* (2) • Run the drive • Wait for the auto-tune to complete before removing run signals	 A rotating auto-tune will cause the motor to accelerate up to $^{2}/_{3}$ base speed in the direction selected regardless of the reference provided. Once complete the motor will coast to a stop. The enable signal must be removed before the drive can be made to run at the required reference. The drive can be stopped at any time by removing the run signal or removing the drive enable.
Save parameters	Select 'Save' in **P00.000** or **Pmm.000** (alternatively enter a value of 1001) and press red reset button.	

Action	Detail	
Run	**Always ensure it is safe to start the motor before doing so**. Provide an Enable signal to the STO terminals (C300). Provide a run signal to terminal 12 (Run Forward) or terminal 13 (Run Reverse).	
Increasing and decreasing motor speed	Increase or decrease the voltage across analog input 1 (terminal 2) and 0 V to increase or decrease the frequency reference.	
Stop	Remove the Run Forward (terminal 12) or Run Reverse (terminal 13) signals to stop the motor by following the selected deceleration rate. If the Enable signal is removed while the motor is running, the drive output is immediately disabled, and the motor will coast to a stop.	

6.3 Controlling the motor speed

The drive will run the motor at the speed defined by the currently selected reference. The user can select the type of drive reference in *Drive Configuration* (**P00.005**) or *Reference Selector* (**P01.014**) but digital inputs or comms can switch between references using the *Reference Select Flags* (**P01.041** to **P01.043**).

The setting of **P00.005** automatically sets the drive configuration.

Value	Text	Description
0	Voltage	Analog input 1 (voltage) or Analog input 2 (voltage) selected by terminal (Local/Remote)
1	Local / Remote	Analog input 1 (current) or Analog input 2 (voltage) selected by terminal (Local/Remote)
2	Voltage Input or Presets	Analog input 1 (voltage) or 3 presets selected by terminal
3	Current Input or Presets	Analog input 1 (current) or 3 presets selected by terminal
4	Presets	Four presets selected by terminal
5	Keypad	Keypad reference
6	Keypad Reference Only	Keypad reference with terminal control
7	Terminal Up / Down	Electronic Potentiometer
8	Torque Control	Torque mode, Analog input 1 (current frequency reference) or Analog input 2 (voltage torque reference) selected by terminal
9	PID	PID mode, Analog input 1 (current feedback source) and Analog input 2 (voltage reference source)

Action will only occur if the drive is inactive and no User Actions are running. Otherwise, the parameter will return to its pre altered value on exit from edit mode. All parameters are saved if this parameter changes.

Figure 6-5 P00.005 = Voltage

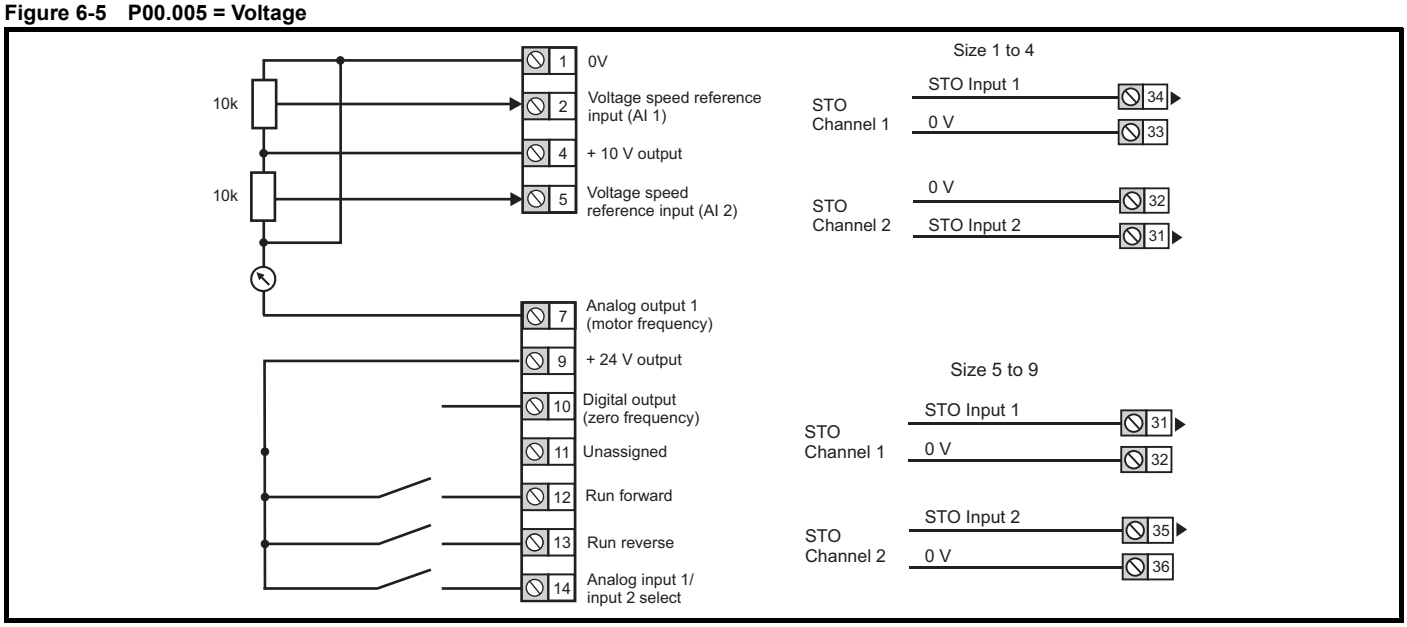


Figure 6-6 P00.005 = Local / Remote

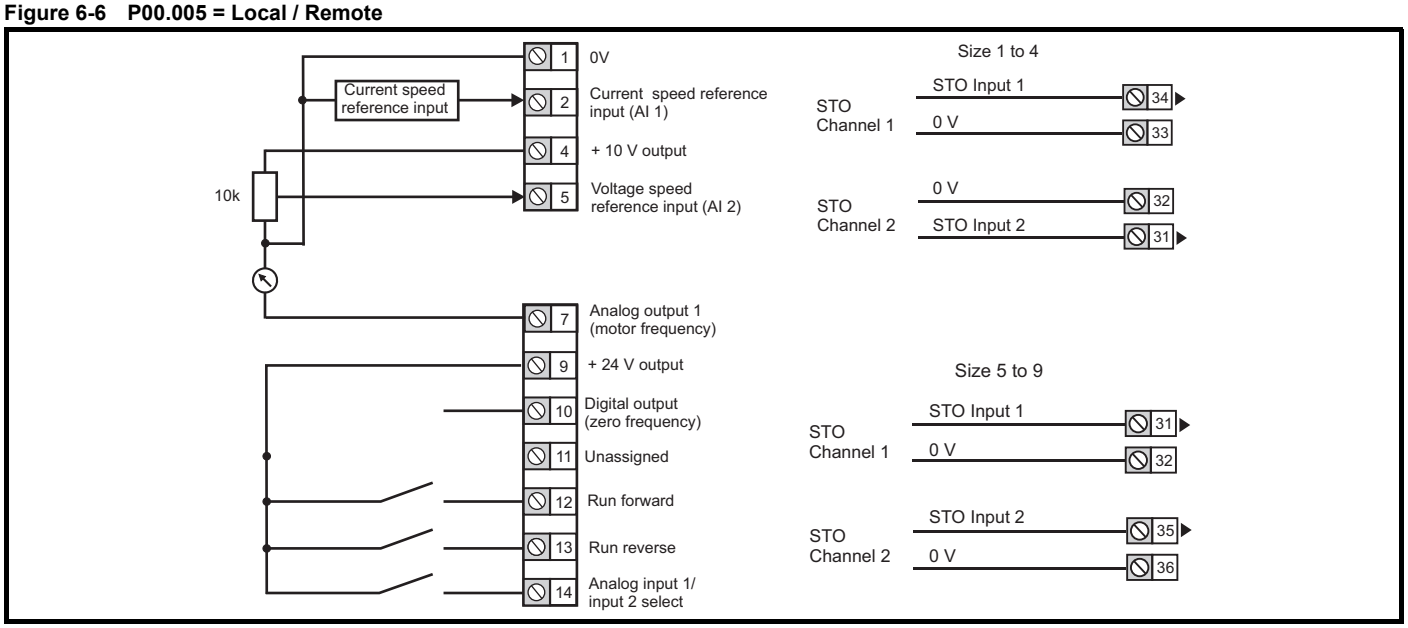
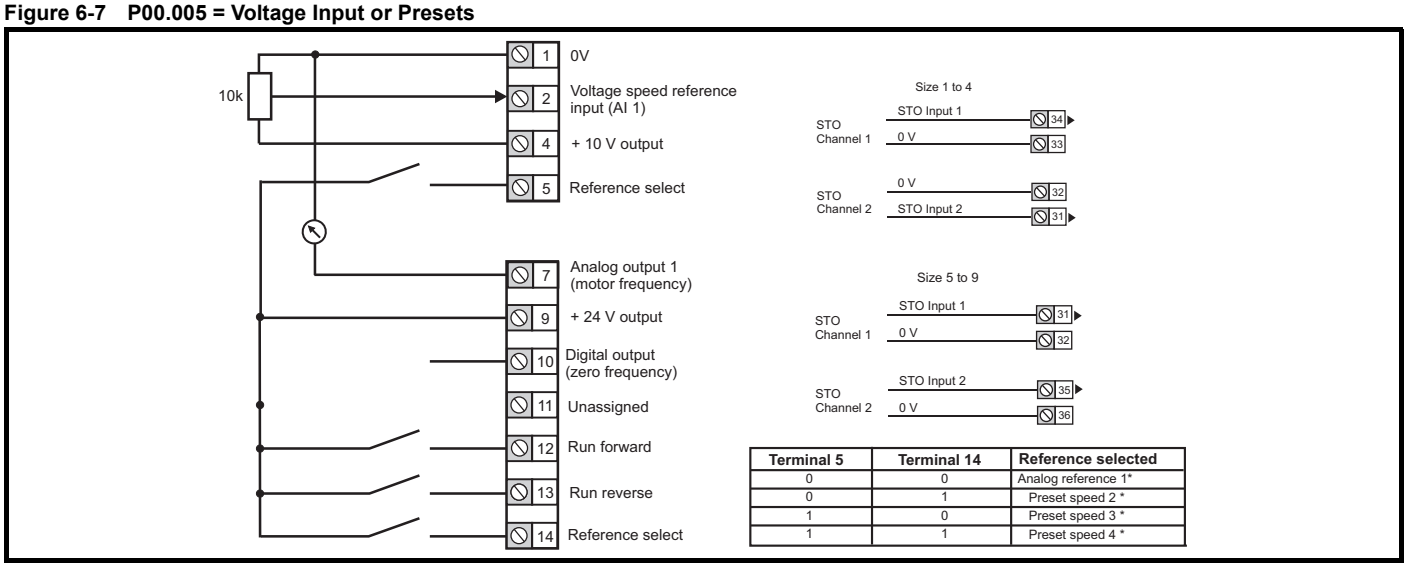


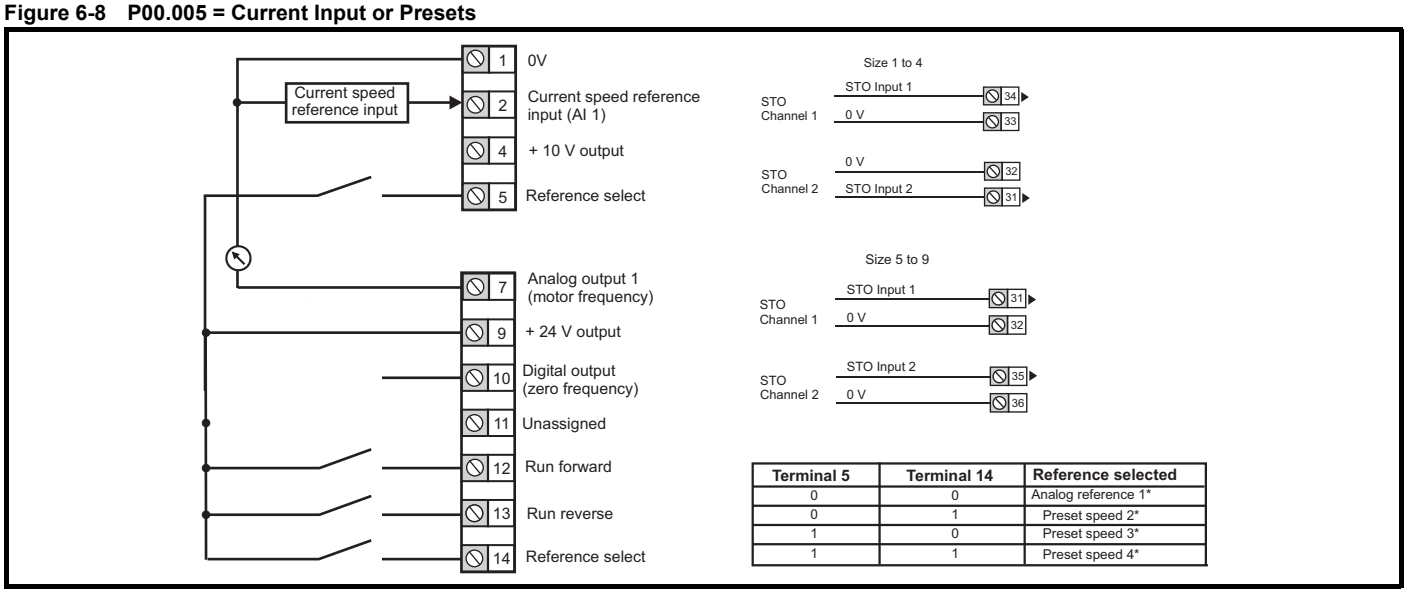
Figure 6-7 P00.005 = Voltage Input or Presets



Terminal 5	Terminal 14	Reference selected
0	0	Analog reference 1*
0	1	Preset speed 2 *
1	0	Preset speed 3 *
1	1	Preset speed 4 *

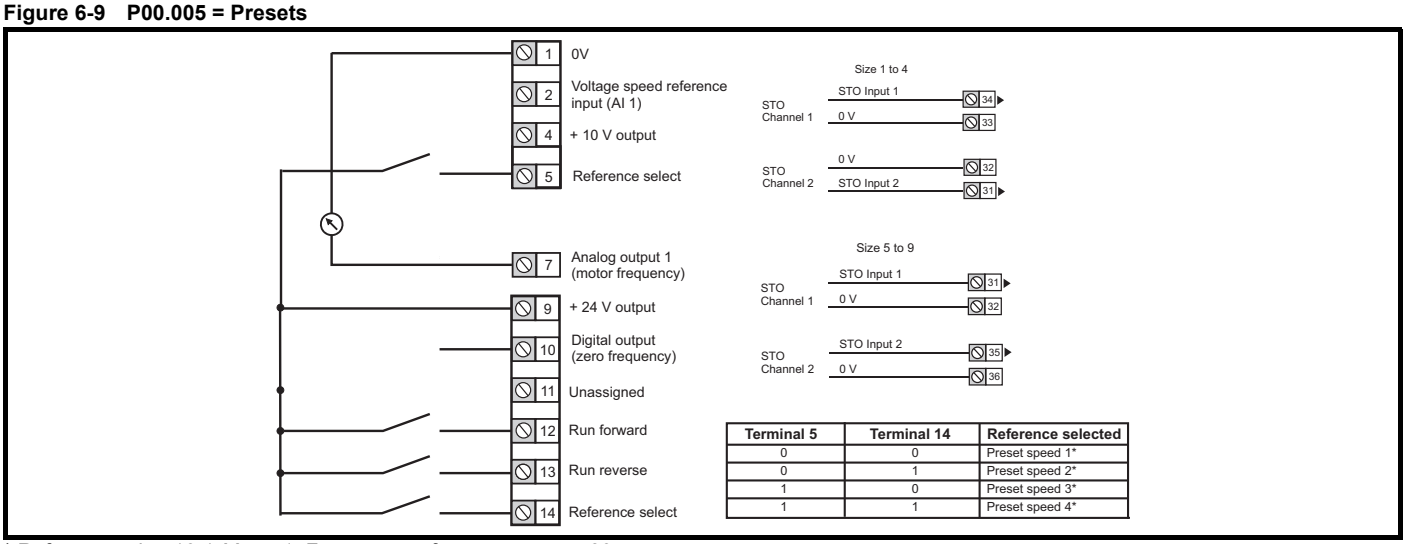
* Refer to section 10.1 *Menu 1: Frequency reference* on page 80.

Figure 6-8 P00.005 = Current Input or Presets



Terminal 5	Terminal 14	Reference selected
0	0	Analog reference 1*
0	1	Preset speed 2*
1	0	Preset speed 3*
1	1	Preset speed 4*

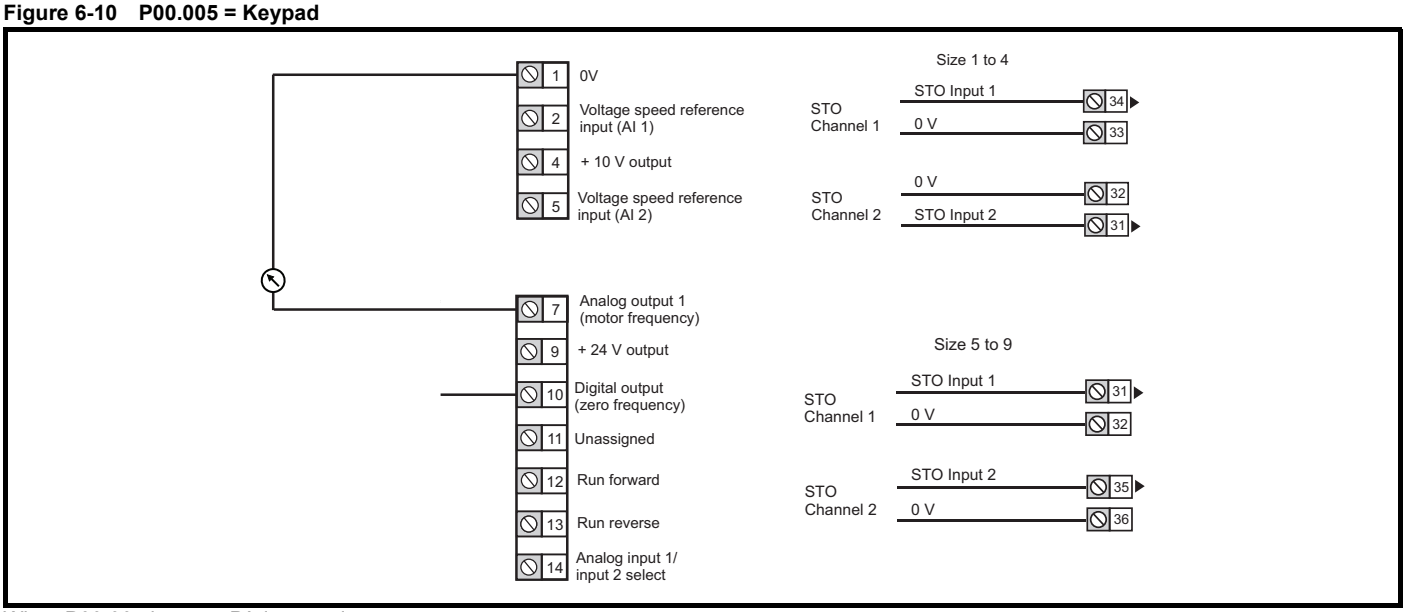
Figure 6-9 P00.005 = Presets



Terminal 5	Terminal 14	Reference selected
0	0	Preset speed 1*
0	1	Preset speed 2*
1	0	Preset speed 3*
1	1	Preset speed 4*

* Refer to section 10.1 *Menu 1: Frequency reference* on page 80.

Figure 6-10 P00.005 = Keypad



When **P00.005** is set to PAd, to run in reverse:

- Set **P00.017** to On. The Keypad reference can now be set to a negative frequency to run the motor in the reverse direction.

Figure 6-11 P00.005 = Keypad Reference Only

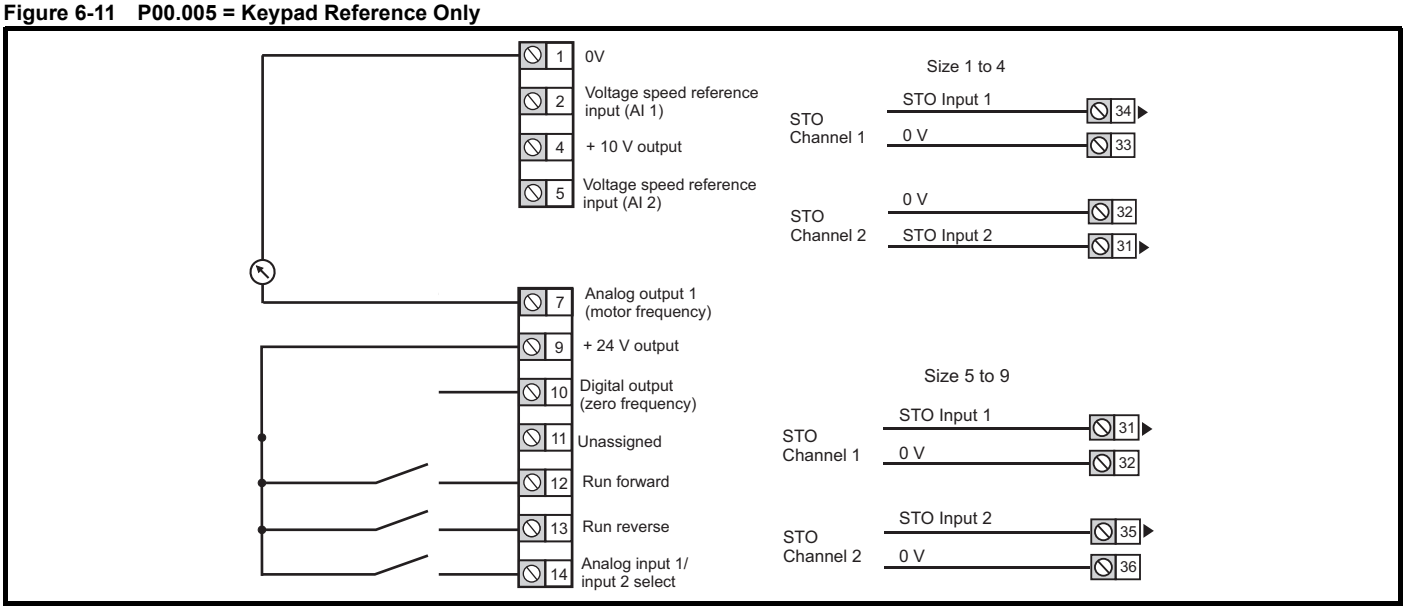
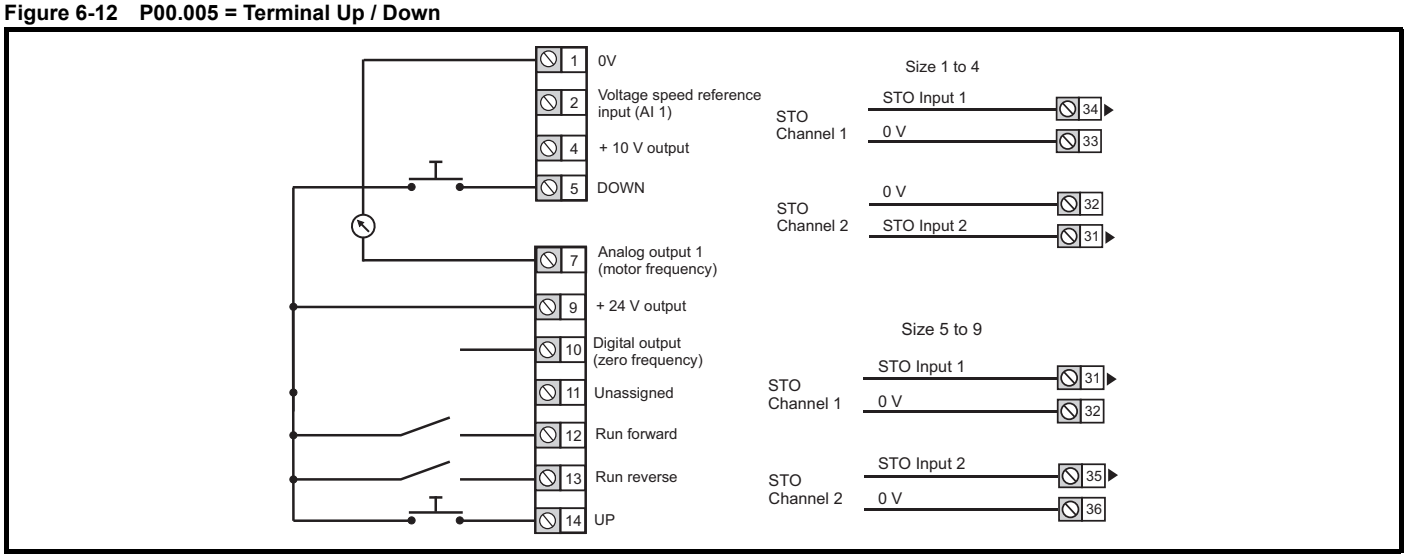


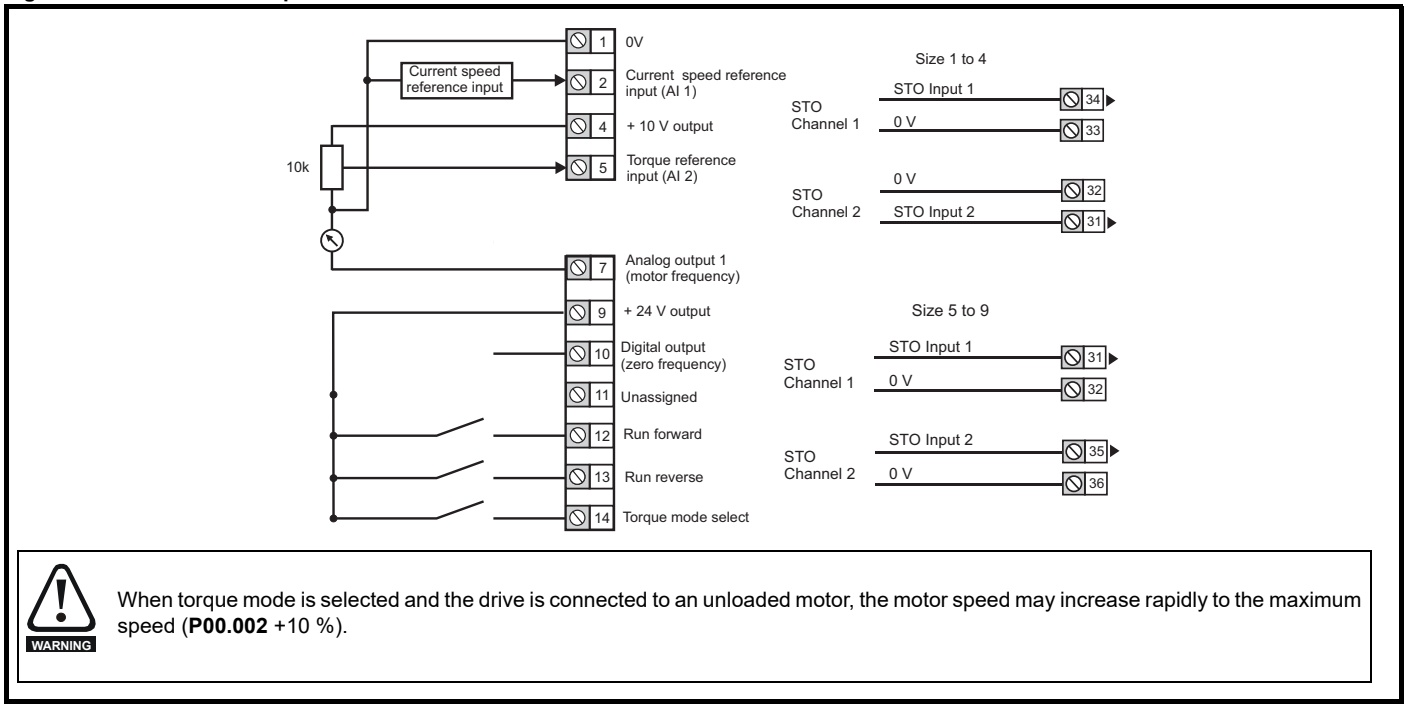
Figure 6-12 P00.005 = Terminal Up / Down



When **P00.005** is set to E.Pot, the following parameters may need to be adjusted:

- **P09.023**: Motorized pot up/down rate (s/100 %)
- **P09.022**: Motorized pot bipolar select (0 = unipolar, 1 = bipolar)
- **P09.021**: Motorized pot mode: 0 = zero at power-up, 1 = last value at power-up, 2 = zero at power-up and only change when drive is running, 3 = last value at power-up and only change when drive is running, 4 = zero at power-up and drive disabled, only change when drive is running.

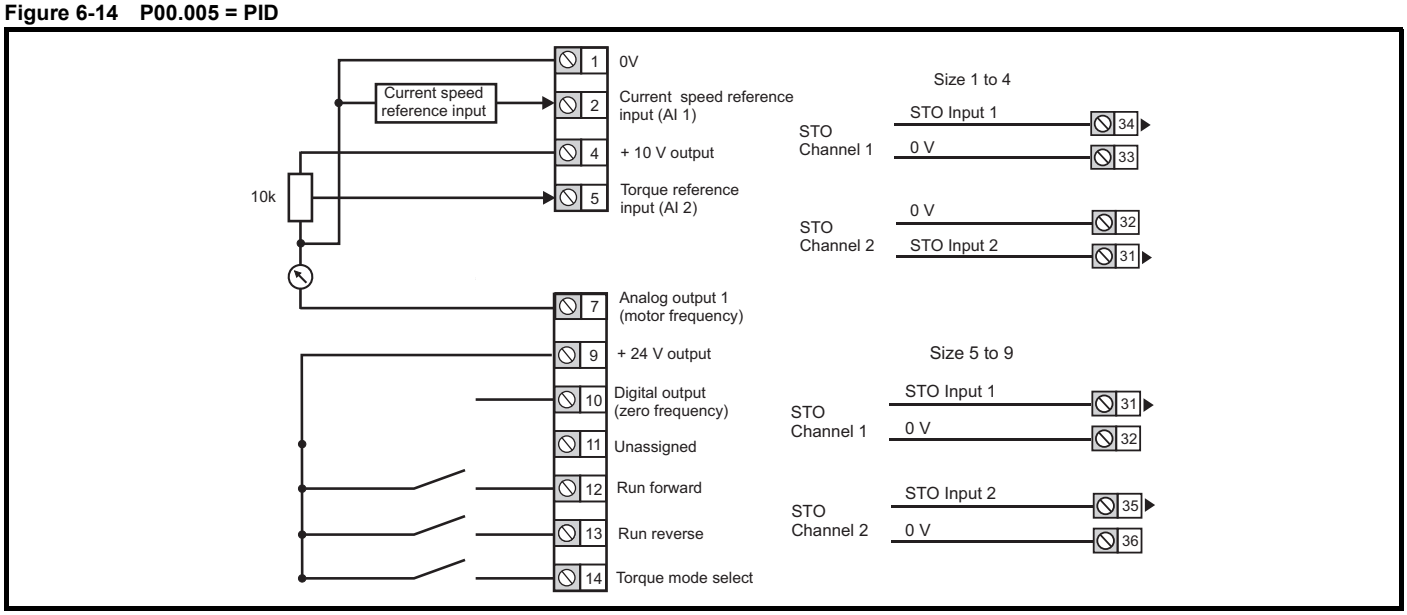
Figure 6-13 P00.005 = Torque Control



WARNING

When torque mode is selected and the drive is connected to an unloaded motor, the motor speed may increase rapidly to the maximum speed (**P00.002** +10 %).

Figure 6-14 P00.005 = PID



When **P00.005** is set to Pid, the following parameters may need to be adjusted:

- PID proportional gain*
- PID integral gain*
- PID feedback invert*
- PID output upper limit (%)*
- PID output lower limit (%)*

* Refer to section 10.13 *Menu 14: User PID controller* on page 120.

7 Basic parameters

Menu 0 is used to bring together various commonly used parameters for basic easy set up of the drive. All the parameters in Menu 0 appear in other menus in the drive (denoted by {…}). Menu 22 can be used to configure the parameters in Menu 0.

Some parameters in the drive have a variable range which is dependent on the setting of other parameters or the drive rating. This is important to consider when assigning a parameter as a source or destination (for example when represented on T7 Analog Output) because the input or output will scale differently depending on the range.

7.1 Menu 0: Single line descriptions

Parameter			Range	Default	Type					
P00.001	Minimum Frequency Limit	**{P01.007}**	0.00 to *Maximum Frequency Limit Hz* [1]	0.00 Hz	RW	Num				US
P00.002	Maximum Frequency Limit	**{P01.006}**	0.00 to 599.00 Hz (HS30 PM 0 to 1000 Hz)	150 Hz	RW	Num				US
P00.003	Acceleration Rate 1	**{P02.011}**	0.0 to 32000.0 s/Maximum Frequency	5.0 s/Maximum Frequency	RW	Num				US
P00.004	Deceleration Rate 1	**{P02.021}**	0.0 to 32000.0 s/Maximum Frequency	10.0 s/Maximum Frequency	RW	Num				US
P00.005	Drive Configuration	**{P11.034}**	Voltage (0), Local/Remote (1), Voltage Input or Presets (2), Current Input or Presets (3), Presets (4), Keypad (5), Keypad Reference Only (6), Terminal Up/Down (7), Torque Control (8), PID (9)	Voltage (0)	RW	Txt			PT	US
P00.006	Motor Rated Current	**{P05.007}**	0.00 to Drive Rating A	*Maximum Heavy Duty Rating A*	RW	Num		RA		US
P00.007	Motor Rated Speed	**{P05.008}**	0.0 to 36000.0 rpm (HS30 PM 0.0 to 60000.0)	3000 rpm	RW	Num				US
P00.008	Motor Rated Voltage	**{P05.009}**	0 to Drive Rated Voltage V	110 V drive: 230 V 200 V drive: 230 V 400 V drive 50 Hz: 400 V 400 V drive 60 Hz: 460 V 575 V drive: 575 V 690 V drive: 690 V	RW	Num		RA		US
P00.009	Motor Rated Power Factor	**{P05.010}**	0.00 to 1.00	1.00	RW	Num		RA		US
P00.010	Menu Access Level	**{P11.044}**	Basic Menu 0 (0), Menu 0 (1), All Menus (2), Status (3), No Access (4)	All Menus (2)	RW	Num	ND		PT	
P00.011	Start/Stop Logic Select	**{P06.004}**	Enable + Run Forward + Run Reverse (0), Run Forward + Run Reverse (3 Wire) (1), Enable + Run + Reverse (2), Run + Reverse (3 Wire) (3), Run + Jog (3 Wire) (4), Run Forward + Run Reverse (5), Custom (6)	Run Forward + Run Reverse (5)	RW	Num				US
P00.012	Motor Control Mode	**{P05.014}**	Ur S (0), Ur (1), Linear V to F (2), Ur Auto (3),Ur I (4), Square V to F (5),Permanent Magnet (8)	Linear V to F (2)	RW	Txt				
P00.013	Perform Auto-tune	**{P05.012}**	None (nonE (0), Basic(bASic) (1), Rotating(bEttEr) (2), Inertia(inErti) (3)	None (0)	RW	Num	NC			
P00.015	Jog Frequency	**{P01.005}**	0.00 to 300.00 Hz	1.50 Hz	RW	Num				US
P00.016	T2 Analog Input 1 Type	**{P07.007}**	4-20 mA Stop (-6), 20-4 mA Stop (-5), 4-20 mA Low (-4), 20-4 mA Low (-3), 4-20 mA Hold (-2), 20-4 mA Hold (-1), 0-20 mA (0), 20-0 mA (1), 4-20 mA Error (2), 20-4 mA Error (3), 4-20 mA No Alarm (4), 20-4 mA No Alarm (5), 0-10 V (6)	0-10 V (6)	RW	Txt				US
P00.017	Bipolar Reference Enable	**{P01.010}**	Off (0) or On (1)	Off (0)	RW	Bit				US
P00.018	Preset Reference 1	**{P01.021}**	0.00 to *Maximum Frequency Limit Hz* [2]	0.00 Hz	RW	Num				US
P00.019	Preset Reference 2	**{P01.022}**	0.00 to *Maximum Frequency Limit Hz* [2]	0.00 Hz	RW	Num				US
P00.020	Preset Reference 3	**{P01.023}**	0.00 to *Maximum Frequency Limit Hz* [2]	0.00 Hz	RW	Num				US
P00.021	Preset Reference 4	**{P01.024}**	0.00 to *Maximum Frequency Limit Hz* [2]	0.00 Hz	RW	Num				US
P00.022	Status Mode Parameter 2	**{P11.019}**	0.000 to 30.999	4.020	RW	Num			PT	US
P00.023	Status Mode Parameter 1	**{P11.018}**	0.000 to 30.999	2.001	RW	Num			PT	US
P00.024	Status Display Parameter 1 Scaling	**{P11.021}**	0.000 to 10.000	1.000	RW	Num				US
P00.025	Security PIN	**{P11.030}**	0000 to 9999	0000	RW	Num	ND		PT	US
P00.027	Power-up Keypad Control Mode Reference	**{P01.051}**	Reset (0), Last (1), Preset (2)	Reset (0)	RW	Txt				US
P00.028	Deceleration Ramp Type	**{P02.004}**	Fast (0), Standard (1), Standard + Boost (2), Fast + Boost (3)	Standard (1)	RW	Txt				US
P00.029	Ramp Enable	**{P02.002}**	Off (0) or On (1)	On (1)	RW	Bit				US
P00.031	Stop Mode	**{P06.001}**	Coast (0), Ramp (1), Ramp D.C. I (2) D.C. I (3), Timed D.C. I (4), Disable (5), Limit Stop (6), Distance (7)	Ramp (1)	RW	Txt				US
P00.032	Energy Optimizer	**{P05.013}**	Off (0) or On (1)	Off (0)	RW	Num				US
P00.033	Catch a Spinning Motor	**{P06.009}**	Disable (0), Enable (1), Forwards Only (2), Reverse Only (3)	Disable (0)	RW	Txt				US
P00.034	T14 Digital Input 5 Type	**{P08.035}**	Digital Input (0), ThermShortDetect (1), Thermistor (2), Therm.NoError (3), Frequency input (4)	Digital Input (0)	RW	Txt				US
P00.035	T10 Digital Output 1 Control	**{P08.091}**	User Defined (0), Drive Active (1), At Frequency (2), Motor Overload (5), Under Voltage (6), External Error (7), Above Frequency (8), Below Frequency (9), At Zero (10), Drive Ready (14), Drive Healthy (15), Brake Release (18), In Current Limit (19), Reverse Running (20)	At Zero (10)	RW	Num				US

Parameter			Range	Default	Type					
P00.036	T7 Analog Output 1 Function Select	**{P07.055}**	User Defined (0), Post Ramp Ref (1), Pre Ramp Ref (2), Motor RPM (3), Current Output (4), Percentage Load (6), Torque Current (7), Voltage Output (8), DC Bus Voltage (9), Analog Input 1 (10), Analog Input 2 (11), Power Output (12), Current Limit (13), Torque Reference (14)	Post Ramp Ref (1)	RW	Txt				US
P00.037	Maximum Switching Frequency	**{P05.018}**	2 (2), 3 (3), 4 (4), 6 (5), 8 (6), 12 (7) kHz	3 (3) kHz	RW	Txt				US
P00.039	Motor Rated Frequency	**{P05.006}**	0.0 to 599.00 Hz (HS30 PM 0.0 to 1000 Hz)	150 Hz	RW	Num		RA		US
P00.040	Number of Motor Poles	**{P05.011}**	Auto (0) to 32 (16) [4]	6 (3) Poles	RW	Num				US
P00.042	Low Frequency Voltage Boost	**{P05.015}**	0.0 to 25.0 %	Rating Dependent	RW	Num				US
P00.043	Serial Baud Rate	**{P11.025}**	600 (1), 1200 (2), 2400 (3), 4800 (4), 9600 (5), 19200 (6), 38400 (7), 57600 (8), 76800 (9), 115200 (10) Baud	115200 (10) Baud	RW	Txt				US
P00.044	Serial Node Address	**{P11.023}**	1 to 247	1	RW	Num				US
P00.046	BC Upper Current Threshold	**{P12.042}**	0 to 200 %	50 %	RW	Num				US
P00.047	BC Lower Current Threshold	**{P12.043}**	0 to 200 %	10 %	RW					US
P00.048	BC Brake Release Frequency	**{P12.044}**	0.00 to 20.00 Hz	1.00 Hz	RW	Num				US
P00.049	BC Brake Apply Frequency	**{P12.045}**	0.00 to 20.00 Hz	2.00 Hz	RW	Num				US
P00.050	BC Brake Delay	**{P12.046}**	0.0 to 25.0 s	1.0 s	RW	Num				US
P00.051	BC Post-brake Release Delay	**{P12.047}**	0.0 to 25.0 s	1.0 s	RW	Num				US
P00.053	BC Initial Direction	**{P12.050}**	Reference (0), Forward (1), Reverse (2)	Reference (0)	RW	Txt				US
P00.054	BC Brake Apply Through Zero Threshold	**{P12.051}**	0.00 to 20.00 Hz	1.00 Hz	RW	Num				US
P00.055	BC Enable	**{P12.041}**	Disable (0), Relay (1), Digital Output (2), Custom (3)	Disable (0)	RW	Txt				US
P00.056	Error	**{P10.020}**	0 to 255		RO	Txt	ND	NC	PT	PS
P00.057	Error History 1	**{P10.021}**	0 to 255		RO	Txt	ND	NC	PT	PS
P00.058	Error History 2	**{P10.022}**	0 to 255		RO	Txt	ND	NC	PT	PS
P00.059	Onboard User Program: Enable	**{P11.047}**	Stop (0) or Run (1)	Run (1)	RW	Txt				US
P00.060	Onboard User Program: Status	**{P11.048}**	Stop (0), Run (1), Not Present (3)		RO	Num	ND	NC	PT	
P00.064	Ramp Rate Units	**{P02.039}**	s/100 Hz (0), s/Maximum Frequency (1), s/1000 Hz (2)	s/Maximum Frequency (1)	RW	Num				US
P00.065	Frequency Controller Proportional Gain Kp1	**{P03.010}**	0.000 to 200.000 s/rad	0.030 s/rad	RW	Num				US
P00.066	Frequency Controller Integral Gain Ki1	**{P03.011}**	0.00 to 655.35 s²/rad	0.10 s²/rad	RW	Num				US
P00.067	Sensorless Mode Filter	**{P03.079}**	4 (0), 5 (1), 6 (2), 8 (3), 12 (4), 20 (5) ms	8 (3) ms	RW	Txt				US
P00.069	Spin Start Boost	**{P05.040}**	0.0 to 10.0	1.0	RW	Num				US
P00.070	PID1 Output Percentage	**{P14.001}**	± 100.00 %		RO	Num	ND	NC	PT	
P00.071	PID1 Proportional Gain	**{P14.010}**	0.000 to 4.000	1.000	RW	Num				US
P00.072	PID1 Integral Gain	**{P14.011}**	0.000 to 4.000	0.500	RW	Num				US
P00.073	PID1 Feedback Invert	**{P14.006}**	Off (0) or On (1)	Off (0)	RW	Bit				US
P00.074	PID1 Output Upper Limit	**{P14.013}**	0.00 to 100.00 %	100.00 %	RW	Num				US
P00.075	PID1 Output Lower Limit	**{P14.014}**	± 100.00 %	-100.00 %	RW	Num				US
P00.076	Action on Error Detection	**{P10.037}**	0 to 31 [3]	0	RW	Num				US
P00.077	Maximum Heavy Duty Rating	**{P11.032}**	0.00 to Drive HD Current Rating A		RO	Num	ND	NC	PT	
P00.078	Software Version	**{P11.029}**	00.00.00.00 to 99.99.99.99		RO	Num	ND	NC	PT	
P00.081	Reference Selected	**{P01.001}**	± Maximum Frequency Limit Hz [2]		RO	Num	ND	NC	PT	
P00.082	Ramp Input	**{P01.003}**	± Maximum Frequency Limit Hz [2]		RO	Num	ND	NC	PT	
P00.083	Final Demand Reference	**{P03.001}**	± Maximum Frequency Limit Hz [2]		RO	Num	ND	NC	PT	FI
P00.084	D.C. Bus Voltage	**{P05.005}**	0 to Maximum D.C. Bus Voltage V (110 V, 200 V Drive = 415 V, 400 V Drive = 830 V, 575 V Drive = 990 V, 690 V Drive = 1190 V)		RO	Num	ND	NC	PT	FI
P00.085	Output Frequency	**{P05.001}**	± 599.00 Hz (HS30 PM 1000 Hz)		RO	Num	ND	NC	PT	FI
P00.086	Output Voltage	**{P05.002}**	0 to 930 V		RO	Num	ND	NC	PT	FI
P00.087	Motor RPM	**{P05.004}**	± 36000.0 rpm (See PRG for HS30 PM)		RO	Num	ND	NC	PT	FI
P00.088	Current Magnitude	**{P04.001}**	0 to Drive Maximum Current A		RO	Num	ND	NC	PT	FI
P00.089	Torque Producing Current	**{P04.002}**	± Drive Maximum Current A		RO	Num	ND	NC	PT	FI
P00.090	Digital I/O Indicators	**{P08.020}**	bit 0 - T10 Digital I/O 1 bit 1 - T11 Digital Input 2 bit 2 - T12 Digital Input 3 bit 3 - T13 Digital Input 4 bit 4 - T14 Digital Input 5 bit 7 & 8 - STO bit 9 - Relay		RO	Bin	ND	NC	PT	
P00.091	Reference On	**{P01.011}**	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P00.092	Reverse Select	**{P01.012}**	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P00.093	Jog Select	**{P01.013}**	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P00.094	T2 Analog Input 1 Percentage	**{P07.001}**	0.00 to 100.00 %		RO	Num	ND	NC	PT	FI
P00.095	T5 Analog Input 2 Percentage	**{P07.002}**	0.00 to 100.00 %		RO	Num	ND	NC	PT	FI

[1] If *Negative Minimum Limit Enable* (**P01.008**) = On (1), the range is *-maximum frequency limit* to *+ maximum frequency limit* (**P01.006**) Hz

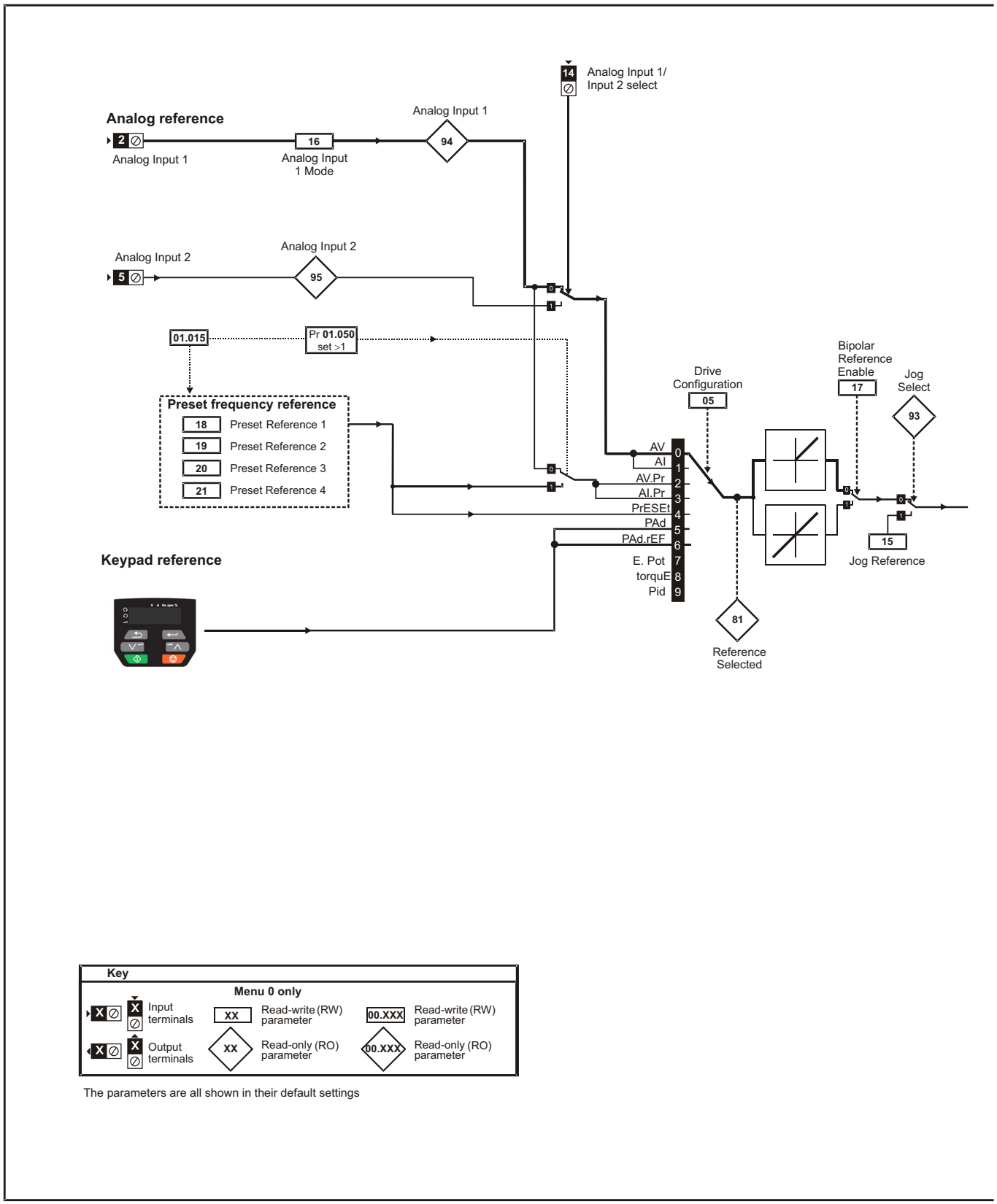
[2] If the absolute value of *Minimum Frequency Limit* (**P01.007**) is larger than the *Maximum Frequency Limit* (**P01.006**) the range is **- P01.007** to **P01.006** Hz.

[3] For further details refer to section 7.3

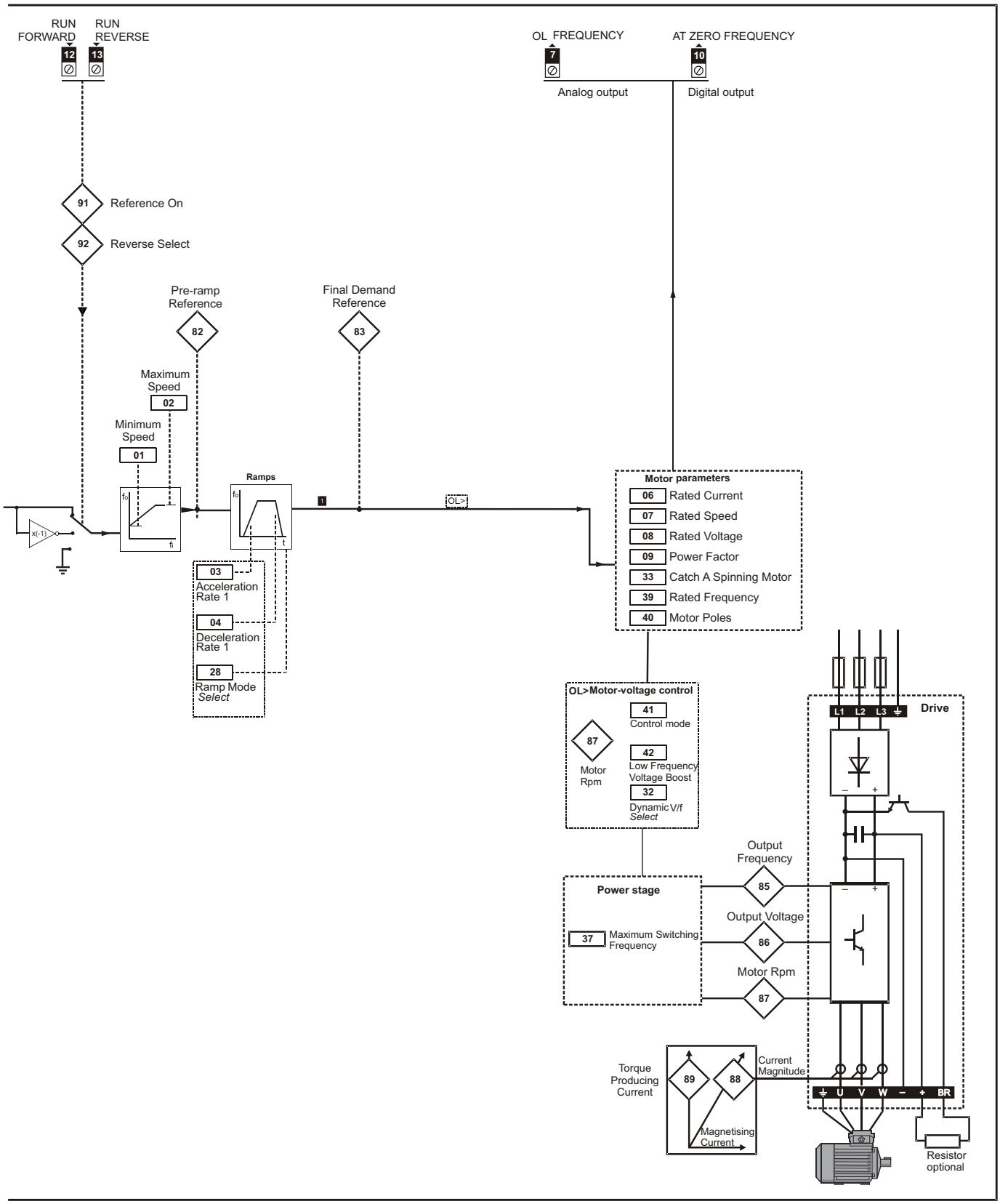
[4] If this parameter is read via serial communications, it will show pole pairs.

RW	Read / Write	RO	Read only	Num	Number parameter	Bit	Bit parameter	Txt	Text string	Bin	Binary parameter	FI	Filtered
ND	No default value	NC	Not copied	PT	Protected parameter	RA	Rating dependent	US	User save	PS	Power-down save	DE	Destination
IP	IP address	Mac	Mac address	Date	Date parameter	Time	Time parameter						

Figure 7-1 Menu 0 logic diagram



The parameters are all shown in their default settings


RUN FORWARD
RUN REVERSE
12
13
OL FREQUENCY
AT ZERO FREQUENCY
7
10
Analog output
Digital output
91 Reference On
92 Reverse Select
Pre-ramp Reference
82
Final Demand Reference
83
Maximum Speed
02
Minimum Speed
01
Ramps
1
OL>
Motor parameters
06 Rated Current
07 Rated Speed
08 Rated Voltage
09 Power Factor
33 Catch A Spinning Motor
39 Rated Frequency
40 Motor Poles
03 Acceleration Rate 1
04 Deceleration Rate 1
28 Ramp Mode Select
OL>Motor-voltage control
41 Control mode
87 Motor Rpm
42 Low Frequency Voltage Boost
32 Dynamic V/f Select
Drive
L1 L2 L3
Output Frequency
85
Power stage
37 Maximum Switching Frequency
Output Voltage
86
Motor Rpm
87
Torque Producing Current
89
88
Current Magnitude
Magnetising Current
U V W BR
Resistor optional

7.2 Parameter 0 Functions

Parameter 0 (**Pmm.000)** is available in all menus, commonly used functions are provided as text strings in **Pmm.000** shown in Table 7-1. The functions in Table 7-1 can also be selected by entering the appropriate numeric values (as shown in Table 7-2) The drive will require a reset for the functions to take affect unless specified otherwise below. To reset via the keypad press the red reset button  . To reset via communications set **P10.038** to 100.

Table 7-1 Commonly used functions in Pmm.000

String	Action
None	No action
SAVE	Save drive parameters under all conditions. See section 5.7 *Saving parameters*.
diff.d	Only display parameters that are different from their default value. See section 5.9 *Displaying parameters with non-default values only*.
dest	Only display parameters that are used to set-up destinations. See section 5.10 *Displaying destination parameters only*.
def.50	Load 50 Hz defaults. See section 5.8 *Restoring parameter defaults*.
def.60	Load 60 Hz defaults. See section 5.8 *Restoring parameter defaults*.
rst.opt	Reset option module

Table 7-2 Advanced functions in Pmm.000

Value	Action
1000	Save parameters when *Under Voltage Active* (**P10.016**) is not active.
1001	Save parameters under all conditions
1070	Reset option module
1233	Load standard (50 Hz) defaults
1234	Load standard (50 Hz) defaults to all menus except option module menu 15
1244	Load US (60 Hz) defaults
1245	Load US (60 Hz) defaults to all menus except option module menu 15
1299	Reset Stored HF error (E221).
12000	Only display parameters that are different from their default value. This action does not require a drive reset.
12001	Only display parameters that are used to set-up destinations (i.e. DE format bit is 1). This action does not require a drive reset.
59999*	Delete onboard user program

* Program cannot be deleted if the drive is active or if the user program is running. P**11.047**

7.3 Menu 0 parameter descriptions

P00.001	**Minimum Frequency Limit**		
Range:	0.00 to *Maximum Frequency Limit* (**P01.006**)	**Default:**	0.00 Hz
Set **P00.001** at the required minimum output frequency of the drive for both directions of rotation. The drive speed reference is scaled between **P00.001** and **P00.002**. **P00.001** is a nominal value; slip compensation may cause the actual frequency to be higher. When the drive is jogging, **P00.001** has no effect.			

P00.002	**Maximum Frequency limit**		
Range:	0.00 to 599.00 Hz (HS30 PM 1000 Hz)	**Default:**	150.00 Hz
Set **P00.002** at the required maximum output frequency for both directions of rotation. The drive speed reference is scaled between **P00.001** and **P00.002**. **P00.002** is a nominal value; slip compensation may cause the actual frequency to be higher. The drive has additional over-speed protection.			

P00.003	**Acceleration Rate 1**		
Range:	0.0 to 32000.0 s/Maximum Frequency	**Default:**	5.0 s/Maximum Frequency
Defines the acceleration time from 0 Hz to the *Maximum Frequency Limit* (**P00.002**). An acceleration rate applies when the frequency is changing away from 0 Hz.			

P00.004	**Deceleration Rate 1**		
Range:	0.0 to 32000.0 s/Maximum Frequency	**Default:**	10.0 s/Maximum Frequency
Defines the deceleration time from the *Maximum Frequency Limit* (**P00.002**) to 0 Hz. A deceleration rate applies when the frequency is changing towards 0 Hz. The drive may increase the ramp time due to the D.C. bus voltage controller, see *Deceleration Ramp Type* (**P02.004**).			

P00.005	**Drive Configuration**		
Range:	Voltage (0), Local/Remote (1), Voltage Input or Presets (2), Current Input or Presets (3), Presets (4), Keypad (5), Keypad Reference Only (6), Terminal Up/Down (7), Torque Control (8), PID (9)	**Default:**	Voltage (0)

Use *Drive Configuration* to automatically set parameters and I/O functions to configure the drive for common applications. See details and wiring guides in section 6.3 *Controlling the motor speed*. Parameter changes when drive configuration is set can be found below:

Parameter number	**Description**	**Drive Configuration**									
		(0)	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
P01.014	Reference select	0	0	1	1	3	4	6	3	0	1
P06.004	Run/Stop Configuration	5	5	5	5	5	5	5	5	5	5
P07.007	Analog input 1 mode	6	4	6	4	6	6	6	6	4	4
P07.010	Analog input 1 destination	01.036	01.036	01.036	01.036	01.036	01.036	01.036	01.036	01.036	0.000
P07.011	Analog input 2 mode	6	6	7	7	7	6	6	7	6	6
P07.014	Analog input 2 destination	01.037	01.037	01.046	01.046	01.046	01.037	01.037	09.027	04.008	0.000
P07.051	Analog input 1 control	0	0	0	0	0	0	0	0	0	0
P07.052	Analog input 2 control	0	0	0	0	0	0	0	0	0	0
P08.022	Digital input 2 destination	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P08.025	Digital input 5 destination	01.041	01.041	01.045	01.045	01.045	01.041	01.041	09.026	04.011	14.008
P08.085	DI 5 Control	0	0	0	0	0	0	0	0	0	0
P09.025	Motorized pot destination	0.000	0.000	0.000	0.000	0.000	0.000	0.000	01.021	0.000	0.000
P14.003	PID 1 reference source	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	07.002
P14.004	PID 1 feedback source	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	07.001
P14.016	PID 1 destination	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	01.036

P00.006	**Motor Rated Current**		
Range:	0.00 to Drive Rating A	**Default:**	Maximum Heavy Duty Rating A
Motor Rated Current must be set to the maximum continuous current of the motor (taken from the name plate).			

P00.007	**Motor Rated Speed**		
Range:	0.0 to 36000.0 rpm (HS30 PM 60000.0 rpm)	**Default:**	3000 rpm

Set to the rated speed of the motor (taken from the motor name plate). The motor rated speed is used to calculate the correct slip speed for the motor.
When the drive is controlling an induction motor in open-loop, setting Motor Rated Speed allows the drive to compensate for motor slip. Slip compensation can be used throughout the speed range of the motor, i.e. below base speed and in the field weakening region, to correct the motor speed to minimize the change of speed with load. Slip Compensation Gain (**P05.027**) is provided for the user to be able to set the compensation applied.
Slip compensation can be disabled by setting Motor Rated Speed to synchronous speed or 0. If Motor Rated Speed is set to 0, Number Of Motor Poles (**P05.011**) must be set up manually for Motor RPM (**P05.004**) to show the correct speed.

P00.008	**Motor Rated Voltage**		
Range:	0 to 765 V	**Default:**	110 V drive: 230 V 200 V drive: 230 V 400 V drive 50 Hz: 400 V 400 V drive 60 Hz: 460 V 575 V drive: 575 V 690 V drive: 690V

When controlling a permanent magnet motor, setting Motor Rated Voltage incorrectly will limit the maximum speed. For an induction motor the Rated Voltage (**P00.008**) and the Rated Frequency (**P00.039**) are used to define the voltage to frequency characteristic applied to the motor.
The Rated Frequency (**P00.039**) is also used in conjunction with the Motor Rated Speed (**P00.007**) to calculate the rated slip for slip compensation.

P00.009	**Motor Rated Power Factor**		
Range:	0.00 to 1.00	**Default:**	1.00

This parameter is not applicable when controlling permanent magnet motors. Motor Rated Power Factor should be set to the rated power factor of the induction motor, cos phi. This can be taken from the motor name plate or measured by the drive during a rotating auto-tune.
If Stator Inductance (**P05.025**) is non-zero, Motor Rated Power Factor is continuously set to the calculated value of rated power factor by the drive.
If Stator Inductance (**P05.025**) is set to zero, then Motor Rated Power Factor is used to estimate the rated magnetising current.

P00.010	**Menu Access Level**		
Range:	Basic Menu 0 (0), Menu 0 (1), All Menus (2), Status (3), No Access (4)	**Default:**	All Menus (2)

Defines the *Menu Access Level* as follows:

Value	Text	Function
0	Basic Menu 0	Only the first 10 parameters in Menu 0 are visible and available to be edited on the keypad.
1	Menu 0	All parameters in Menu 0 are visible and available for editing on the keypad.
2	All Menus	Parameters in all menus are visible and available for editing on the keypad.
3	Status	Same access as Level 1. If a *Security PIN* (**P11.030**) is set this must be entered to leave the status view.
4	No Access	Same access as Status Only (3). If the drive is locked by a *Security PIN* (**P11.030**) the drive will block communications

P00.011	**Start/Stop Logic Select**		
Range:	Enable + Run Forward + Run Reverse (0), Run Forward + Run Reverse (3 Wire) (1), Enable + Run + Reverse (2), Run + Reverse (3 Wire) (3), Run + Jog Forward (3 Wire) (4), Run Forward + Run Reverse (5) User Programmable (6)	**Default:**	Run Forward + Run Reverse (5)

This parameter changes the functions of the input terminals which are normally associated with the enabling, running and stopping the drive.

P00.011	Terminal 11	Terminal 12	Terminal 13	Latching
0	User programmable	Run Forward	Run Reverse	No
1	/Stop	Run Forward	Run Reverse	Yes
2	User programmable	Run	Reverse	No
3	/Stop	Run	Reverse	Yes
4	/Stop	Run	Jog Forward	Yes
5	User programmable	Run Forward	Run Reverse	No
6	User programmable	User programmable	User programmable	User programmable

Action will only occur if the drive is inactive. If the drive is active, the parameter will return to its pre-altered value on exit from edit mode.

P00.012	**Motor Control mode**		
Range:	Ur s (0), Ur (1), Linear V to F (2), Ur Auto (3), Ur I (4), Square V to F (5), Permanent Magnet (8)	**Default:**	Linear V to F (2)

Defines the motor control characteristic used by the drive.

Value	Text	Description
0	Ur S	Induction Motor Control Mode: A linear voltage to frequency characteristic with stator resistance compensation for induction motors. The stator resistance is measured each drive run.
1	Ur	Induction Motor Control Mode: A linear voltage to frequency characteristic with stator resistance compensation for induction motors. The drive uses the resistance defined by Stator Resistance (**P05.017**)
2	Linear V to F	Induction Motor Control Mode: A linear voltage to frequency characteristic for induction motors
3	Ur Auto	Induction Motor Control Mode: A linear voltage to frequency characteristic with stator resistance compensation for induction motors. The stator resistance is measured once, the first time the drive is made to run.
4	Ur I	Induction Motor Control Mode: A linear voltage to frequency characteristic with stator resistance compensation for induction motors. The stator resistance is measured on the first drive run after each power-up.
5	Square V to F	Induction Motor Control Mode: A square voltage to frequency characteristic for induction motors.
8	PM	Permanent Magnet Motor Control Mode: Sensorless closed-loop flux control for permanent magnet motors

See section 8 *Optimization* for further details

P00.013	**Perform Auto-tune**		
Range:	None (0), Basic (1), Reserved (2), Inertia (3)	**Default:**	None (0)

Value	Auto-tune	Description
0	None	No auto-tune will be performed
1	Basic	A stationary test to measure basic parameters required for Catch an already spinning motor and resistance compensation control modes.
2	Improved	Rotating autotune for resistance for induction motor.
3	Inertia	A rotating test to measure the motor and load inertia.

Set *Motor Control Mode* (**P05.014**) prior to performing an auto-tune.

1: Basic Auto-tune

A stationary test to measure *Stator Resistance* (**P05.017**), *Transient Inductance or Ld* (**P05.024**), *Maximum Deadtime Compensation* (**P05.059**), *Current At Maximum Deadtime Compensation* (**P05.060**) and *No-load Lq* (**P05.074**) when the drive is controlling a permanent magnet motor.

To perform a basic auto-tune:

- Set *Motor Control Mode* (**P05.014**) prior to performing an auto-tune.
- Ensure motor is stationary and will not move during the test.
- Set Perform Auto-tune to 1 and run the drive.

2:Improved (Induction Only)

A basic auto-tune is conducted first followed by a rotating test to measure parameters for improved performance. In addition to the parameters measured in the basic auto-tune, this test measures *Saturation Breakpoint 1* (**P05.029**), *Saturation Breakpoint 3* (**P05.030**), *Saturation Breakpoint 2* (**P05.062**), *Saturation Breakpoint 4* (**P05.063**), and *Stator Inductance* (**P05.025**) which is used to calculate *Motor Rated Power Factor* (**P05.010**).

To perform an improved auto-tune:

- Set *Motor Control Mode* (P**00.012**) prior to performing an auto-tune
- Ensure motor is unloaded and stationary but free to move
- Set *Perform Auto-tune* (**P00.013**) to Improved (2) and run the drive

3: Inertia Auto-tune (PM Only)

The drive performs a load measurement to determine the *Motor and Load Inertia* (**P03.018**). This will improve control when accelerating high inertia loads.

Before performing an inertia auto-tune ensure all motor details are correct and perform a basic auto-tune. To perform an inertia auto-tune:

- Connect the load to the motor
- Ensure that the load is stationary but free to move
- Set Perform Auto-tune to 3 and run the drive.

NOTE

Once a test is completed the drive state will switch to locked inhibit state so run and enable signals will need to be removed before the drive will run again. This is also true if an error occurs during the test.

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

WARNING

A rotating auto-tune will cause the motor to accelerate up to 2/3 base speed in the direction selected regardless of the reference provided. Once complete the motor will coast to a stop. The Safe Torque Off signals must be removed before the drive can be made to run at the required reference.The drive can be stopped at any time by removing the run signal or removing the drive enable.

Error Code	Error	Reason
E018	Auto-tune Stopped	The final drive enable, or the final drive run were removed before the test was completed.
E033	Resistance	The measured value of *Stator Resistance* (**P05.017**) exceeded the range of the parameter.
E011	Auto-tune 1	The motor did not reach the required speed during rotating auto-tune or mechanical load measurement.
E013	Auto-tune 3	The measured inertia exceeds the parameter range.

P00.015	**Jog Frequency**		
Range:	0.00 to 300.00 Hz	**Default:**	1.50 Hz

Defines the reference when jog is enabled.

P00.016	**Analog Input 1 Type**		
Range:	4-20 mA Stop (-6), 20-4 mA Stop (-5), 4-20 mA Low (-4), 20-4 mA Low (-3), 4-20 mA Hold (-2), 20-4 mA Hold (-1), 0-20 mA (0), 20-0 mA (1), 4-20 mA Error (2), 20-4 mA Error (3), 4-20 mA No Alarm (4), 20-4 mA No Alarm (5), 0-10 V (6)	**Default:**	0-10 V (6)

Defines the mode of analog input 1.

The table below gives all the possible analog input modes.

Value	Text	Function
-6	4-20 mA Stop	Stop on loss
-5	20-4 mA Stop	Stop on loss
-4	4-20 mA Low	4-20 mA switching to equivalent of 4 mA input current on loss
-3	20-4 mA Low	20-4 mA switching to equivalent of 20 mA input current on loss
-2	4-20 mA Hold	4-20 mA hold at level before loss on loss
-1	20-4 mA Hold	20-4 mA hold at level before loss on loss
0	0-20 mA	0-20 mA
1	20-0 mA	20-0 mA
2	4-20 mA Error	4-20 mA error on loss
3	20-4 mA Error	20-4 mA error on loss
4	4-20 mA No Alarm	4-20 mA no action on loss
5	20-4 mA No Alarm	20-4 mA no action on loss
6	0-10 V	Voltage

NOTE If configured as a 4-20 mA or 20-4 mA input, loss of the input is detected if the current falls below 3 mA.

NOTE If both analog inputs (A1 and A2) are to be set-up as voltage inputs, and if the potentiometers are supplied from the drive +10 V rail (terminal T4), they must have a resistance > 4 kΩ each.

P00.017	**Bipolar Reference Enable**		
Range:	Off (0) or On (1)	**Default:**	Off (0)

Determines whether the reference is uni-polar or bi-polar.
See *Minimum Frequency Limit* (**P00.001**). Allows negative speed reference in keypad mode.

P00.018 to 21	**Preset Reference 1 to 4**		
Range:	0.00 to *Maximum Frequency Limit* (**P00.002**)	**Default:**	0.00 Hz

If the preset reference has been selected, the speed at which the motor runs is determined by these parameters.
See *Drive Configuration* (**P00.005**).

P00.022	**Status Mode Parameter 2**		
Range:	0.000 to 30.999	**Default:**	4.020

Status Mode Parameter 1 (**P00.023**) and *Status Mode Parameter 2* (**P00.022)** define which parameters are displayed in Status mode. The values can be alternated by pressing the Escape key, if the drive is running.

P00.023	**Status Mode Parameter 1**		
Range:	0.000 to 30.999	**Default:**	2.001

See *Status Mode Parameter 2* (**P00.022**).

P00.024	**Customer Defined Scaling**		
Range:	0.000 to 10.000	**Default:**	1.000

Defines the scaling applied to *Status Mode Parameter 1* (**P00.023**). The scaling is only applied in the Status mode.

P00.025	**Security PIN**		
Range:	0 to 9999	**Default:**	0000

Defines the 4 digit security PIN of the drive. This parameter can be set to a value other than 0 to prevent un-authorized write access to the drive. If a value has been set, the security PIN must be entered before any parameter can be adjusted via the keypad.

P00.027	**Keypad Reference at Power Up**		
Range:	Reset (0), Last (1), Preset (2)	**Default:**	Reset (0)

Defines the value of the keypad reference at power-up.

Value	Text	Description
0	Reset	Keypad reference is zero
1	Last	Keypad reference is the last used value
2	Preset	Keypad reference is set to the value of *Preset Reference 1* (**P00.018**)

P00.028	**Deceleration Ramp Type**		
Range:	Fast (0), Standard (1), Standard Boost (2), Fast Boost (3)	**Default:**	Standard (1)

Defines the ramp type used for decelerating.

Value	Ramp Type	Description
0	Fast	The drive will always try to achieve the specified deceleration rate but if set too fast, may result in an over voltage error.
1	Standard	Drive aims to achieve the deceleration rate but will increase the deceleration time to prevent an over voltage error.
2	Standard Boost	With this ramp type the drive boosts the voltage applied to the motor to increase the losses to reduce the deceleration time that can be achieved. The drive will always try to achieve the specified deceleration rate but if set too fast, may result in an over voltage
3	Fast Boost	With this ramp type the drive boosts the voltage applied to the motor to increase the losses to reduce the deceleration time that can be achieved.

If *Fast* (0) or *Fast Boost* (3) are selected the drive will decelerate the motor at the selected deceleration rate. If the deceleration time is set too short the energy from the load may cause the D.C. bus to rise too high which will result in an over-voltage error. Therefore, these ramp types should be selected when a brake resistor is installed. *Standard Boost* (2) and *Fast Boost* (3) increase the voltage applied to the motor to increase the losses to reduce the deceleration time that can be achieved. **Note** that with applications requiring a lot of deceleration cycles this could overheat the motor.

P00.029	**Ramp Enable**		
Range:	Off (0) or On (1)	**Default:**	On (1)

Set to *Off* (0) to disable the ramps. This is generally used when the drive is required to closely follow a speed reference which already contains acceleration and deceleration ramps.

P00.031	**Stop Mode**		
Range:	Coast (0), Ramp (1), Ramp & DC Brake (2), DC Brake + StopDetect (3), Timed DC Brake (4), Disable (5), No Ramp (6), Distance (7)	**Default:**	Ramp (1)

Defines how the motor is controlled when the run signal is removed from the drive.

Value	Text	Description
0	Coast	Coast stop
1	Ramp	Ramp stop
2	Ramp & DC Brake	Ramp stop + 1 second dc injection
3	DC Brake + StopDetect	Injection braking stop with detection of zero speed
4	Timed DC Brake	Timed injection braking stop
5	Disable	Disable
6	No Ramp	The motor is decelerated as quickly as possible with the current held at the current limit. Only selectable when using a closed loop motor control mode (**P05.014** ≥ 7).
7	Distance	Stops in the same distance from any speed as it would at the specified deceleration rate from the maximum frequency. Distance stop will not function if S-ramp has been enabled.

P00.032	**Energy Optimizer**		
Range:	0 to 1	**Default:**	0

Reserved.

When controlling an induction motor, enabling the Energy Optimizer provides energy efficient motor control (sometimes referred to as Dynamic V to F or Flux Optimization). The Energy Optimizer should be enabled where power loss should be kept to a minimum under low load conditions, but dynamic performance is not important.

P00.033	**Catch a Spinning Motor**		
Range:	Disable (0), Enable (1), Forwards Only (2), Reverse Only (3)	**Default:**	Disable (0)

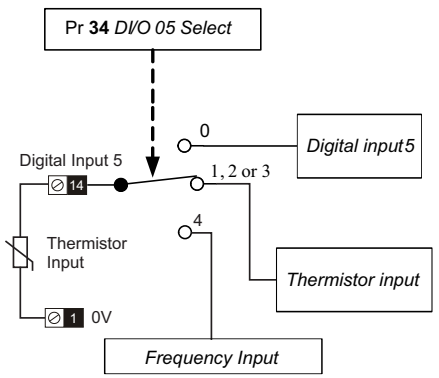
Defines the behaviour of the drive when the drive is enabled whilst the motor is rotating.
If it is possible that the motor is spinning when the run signal is given, then this parameter should be set for the required action. If this parameter is > 0, a test is carried out to measure the frequency that the motor is freewheeling at when the drive enters the run state. The measured frequency is used to 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* (**P03.018**) and *Motor Rated Speed* (**P03.002**), are configured correctly.

P00.033	Text	Function
0	Disable	Disabled
1	Enable	Detect all frequencies
2	Forwards Only	Detect positive frequencies only
3	Reverse Only	Detect negative frequencies only

P00.034	**T14 Digital Input 5 Type**		
Range:	Digital Input (0), ThermShortDetect (1), Thermistor (2), Therm.NoError (3), Frequency Input (4)	**Default:**	Digital Input (0)

Defines the input type for Digital Input 5 (terminal 14).

Value	Text	Function
0	Digital Input	Digital input
1	ThermShortDetect	Temperature measurement input with short circuit detection (Resistance <50 Ω). A thermistor error (E024) will occur if the temperature exceeds the level defined by the *Thermistor Error Threshold* (**P07.048**).
2	Thermistor	Temperature measurement input without short circuit detection. A thermistor error (E024) will occur if the temperature exceeds the level defined by the *Thermistor Error Threshold* (**P07.048**).
3	Therm.NoError	Temperature measurement input but the drive will continue to run if the temperature exceeds *Thermistor Error Threshold* (**P07.048**).
4	Frequency Input	Frequency input with a maximum frequency of 100 kHz, see *Maximum Reference Frequency* (**P03.043**).



P00.035	**T10 Digital Output 1 Control**		
Range:	0 to 20	**Default:**	10

Selects the drive state that controls the digital output 1 signal on terminal 10.
T10 Digital I/O 1 Type (**P08.031**) must be set to Digital Output (1) for this parameter to have an effect.

Value	Description
0	Defined by Digital I/O1 Source/Destination A
1	Drive active
2	At frequency
5	Motor Overload
6	Under Voltage
7	External Error
8	Above Frequency
9	Below Frequency
10	At zero
14	Ready
15	Drive Healthy
18	Brake Release
19	Current Limit
20	Reverse Running

P00.036	**T7 Analog Output Function Select**		
Range:	0 to 14	**Default:**	1

Defines the functionality of Analog Output 1 (terminal 7). The output is scaled such that 10 V or 20 mA is equivalent to the parameter's maximum value. It can be further scaled by *T7 Analog Output 1 Scaling* (**P07.020**).

Value	Description
0	User defined by **P07.019**
1	Ramp Output
2	Ramp Input
3	Motor RPM
4	Current Magnitude
6	Percentage Load
7	Torque Producing Current
8	Output Voltage
9	D.C Bus Voltage
10	T2 Analog Input 1 Percentage
11	Analog Input 2
12	Output Power
13	Current Limit
14	Torque reference

P00.037	**Maximum Switching Frequency**		
Range:	2 (2), 3 (3), 4 (4), 6 (5), 8 (6), 12 (7) kHz	**Default:**	3 (3) kHz

Defines the maximum switching frequency that can be used by the drive. The drive will operate at this frequency unless the drive becomes too hot.

P00.037	Text	Description
2	2	2 kHz switching frequency
3	3	3 kHz switching frequency
4	4	4 kHz switching frequency
5	6	6 kHz switching frequency
6	8	8 kHz switching frequency
7	12	12 kHz switching frequency

In closed loop control modes the sample rate of the controller is increased which can provide better response to changes in load.

It is recommended that a minimum ratio of 12:1 for the switching frequency compared to the maximum output frequency is used.

If the drive becomes too hot it will gradually reduce the switching frequency from the Maximum Switching Frequency to the *Minimum Switching Frequency* (**P05.038**). It is not recommended but this can be disabled by setting *Auto-switching Frequency Change Disable* (**P05.035)** = 1. The actual switching frequency is shown in *Switching Frequency* (**P05.037**).

At higher switching frequencies, the acoustic noise from the motor will be reduced, but results in increased losses in the drive and the continuous output current is derated.

See the *Power Installation Guide* for drive derating data.

P00.039	**Motor Rated Frequency**		
Range:	0.0 to 599.00 Hz (HS30 PM 1000 Hz)	**Default:**	150 Hz

Set to the rated frequency of the motor from the motor nameplate.

P00.040	**Number of Motor Poles**		
Range:	Auto (0) to 32 (16)	**Default:**	6 (3) Poles

Set to the number of poles of the motor. The auto mode calculates the number of motor poles from the settings of *Motor Rated Speed* (**P00.007**) and *Motor Rated Frequency* (**P00.039**)

P00.042	**Low Frequency Voltage Boost**		
Range:	0.0 to 25.0 %	**Default:**	Frame size dependent

Defines the level of voltage boost at 0 Hz as a percentage of the *Motor Rated Voltage* (**P05.009**) when *Control Mode* (**P05.014**) is set to Induction Linear V to F (2) or Induction Square V to F (5). It can be used to increase low frequency torque performance, but if set too high will cause excessive motor current which could result in a motor overload error.

P00.043	**Serial Baud Rate**		
Range:	600 (1), 1200 (2), 2400 (3), 4800 (4), 9600 (5), 19200 (6), 38400 (7), 57600 (8), 76800 (9), 115200 (10)	**Default:**	115200 (10)

Defines the serial baud rate of the drive.
Changing the parameters does not immediately change the serial communications settings. See *Reset Serial Communications* (**P00.045**) for more details.

P00.044	**Serial Address**		
Range:	1 to 247	**Default:**	1

Used to define the unique address for the drive for the serial interface.
Changing the parameters does not immediately change the serial communications settings. See *Reset Serial Communications* (**P00.045**) for more details.

P00.046	**Brake Controller Upper Current Threshold**		
Range:	0 to 200 %	**Default:**	50 %

Defines the upper current threshold for the brake. See Brake Controller Brake Release in *Parameter Reference Guide*.

P00.047	**Brake Controller Lower Current Threshold**		
Range:	0 to 200 %	**Default:**	10 %

Defines the lower current limit for the brake. See Brake Controller Brake Release in *Parameter Reference Guide*.

P00.048	**Brake Controller Brake Release Frequency**		
Range:	0.00 to 20.00 Hz	**Default:**	1.00 Hz
Defines the Brake Release Frequency. See Brake Controller Brake Release in *Parameter Reference Guide*.			
P00.049	**Brake Controller Brake Apply Frequency**		
Range:	0.00 to 20.00 Hz	**Default:**	2.00 Hz
Defines the Brake Apply Frequency. See Brake Controller Brake Release in *Parameter Reference Guide*.			
P00.050	**Brake Controller Brake Delay**		
Range:	0.0 to 25.0 s	**Default:**	1.0 s
Defines the pre-brake release delay. See Brake Controller Brake Release in *Parameter Reference Guide*.			
P00.051	**Brake Controller Post-brake Release Delay**		
Range:	0.0 to 25.0 s	**Default:**	1.0 s
Defines the post-brake release delay.			
P00.053	**Brake Controller Initial Direction**		
Range:	Reference (0), Forward (1), Reverse (2)	**Default:**	Ref (0)

Defines the initial direction of the brake.

Value	Text
0	Reference
1	Forward
2	Reverse

See Brake Controller Brake Release in *Parameter Reference Guide*.

P00.054	**Brake Controller Brake Apply Through Zero Threshold**		
Range:	0.00 to 20.00 Hz	**Default:**	1.00 Hz
Defines if the brake is applied through zero threshold. See Brake Controller Brake Release in *Parameter Reference Guide*.			
P00.055	**Brake Controller Enable**		
Range:	Disable (0), Relay (1), Digital Output (2), Custom (3)	**Default:**	Disable (0)

Defines the initial direction of the brake.

Value	Text
0	Disable
1	Relay
2	Digital Output
3	Custom

If *Brake Controller Enable* (**P00.055**) = *Disable* (0), the brake controller is disabled.

If *Brake Controller Enable* (**P00.055**) = *Relay* (1), the brake controller is enabled with I/O set up to control the brake via the relay output. Drive ok is re-routed to digital I/O.

If *Brake Controller Enable* (**P00.055**) = *Digital Output* (2), the brake controller is enabled with I/O set up to control the brake via digital output. Drive ok is routed to the relay output.

If *Brake Controller Enable* (**P00.055**) = *Custom* (3), the brake controller is enabled, but no parameters are set up to select the brake output.

P00.056 **P00.057** **P00.058**	**Error** **Error History 1** **Error History 2**		
Range:	0 to 255	**Default:**	N/A
Displays the most recent error (including an active error). Previous errors are listed with Error History 1 being more recent than Error History 2.			
P00.059	**Onboard User Program: Enable**		
Range:	Stop (0) or Run (1)	**Default:**	Run (1)

Enables the onboard user program.
Onboard user programming provides a background task that loops continuously and a timed task that is executed each time at a defined rate. For further information, refer to the *Parameter Reference Guide*.

P00.060 Onboard User Program: Status

Range:	0 to 3	Default:	Run (1)

This parameter indicates the status of the user program in the drive. For further information, refer to the *Parameter Reference Guide*.

Value	Text	Description
0	Stopped	A user program is present but is stopped
1	Running	A user program is running
2	Exception	The user program has an exception
3	No Program	No user program is present

P00.064 Ramp Rate Units

Range:	0: (s/100Hz), 1: (s/Maximum Frequency), 2: (s/1000Hz)	Default:	s/Maximum Frequency (1)

The ramp rate parameters are defined by the time to change from 0 Hz to a frequency defined by Ramp Rate Units.

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

Maximum frequency is defined by *Maximum Frequency Limit* (**P01.006**).

P00.065 Frequency Controller Proportional Gain Kp1

Range:	0.000 to 200.000 s/rad	Default:	0.030 s/rad

Defines the proportional gain for frequency controller 1 used by the closed-loop motor control modes. See details in section 8.5.3 *Tuning the frequency controller gains*.

P00.066 Frequency Controller Integral Gain Ki1

Range:	0.00 to 655.35 s^2/rad	Default:	0.10 s^2/rad

Defines the integral gain for frequency controller 1 used by the closed-loop motor control modes. See details in section 8.5.3 *Tuning the frequency controller gains*..

P00.067 Sensorless Mode Filter

Range:	4 (0), 5 (1), 6 (2), 8 (3), 12 (4), 20 (5) ms	Default:	8 (3) ms

Defines the time constant for the filter applied to the output of the frequency estimator system.

P00.069 Spin Start Boost

Range:	0.0 to 10.0	Default:	1.0

Spin Start Boost (**P00.069**) is used by the algorithm that detects the frequency of a spinning motor when the drive is enabled and Catch an Already *Spinning Motor* (**P00.033**)= 1.
For smaller motors the default value of 1.0 is suitable, but for larger motors *Spin Start Boost* (**P00.069**) may need to be increased.
If *Spin Start Boost* (**P00.069**) is too small the drive will detect zero speed whatever the frequency of the motor, and if *Spin Start Boost* (**P00.069**) is too large the motor may accelerate away from standstill when the drive is enabled.

P00.070 PID Output Percentage

Range:	±100.00 %	Default:	N/A

This parameter is the output of the PID controller. For further information, refer to the *Parameter Reference Guide*.

P00.071 PID Proportional Gain

Range:	0.000 to 4.000	Default:	1.000

Proportional gain applied to the PID error. For further information, refer to the *Parameter Reference Guide*.

P00.072 PID Integral Gain

Range:	0.000 to 4.000	Default:	0.500

Integral gain applied to the PID error. For further information, refer to the *Parameter Reference Guide*.

P00.073 PID Feedback Invert

Range:	Off (0) or On (1)	Default:	Off (0)

This parameter allows the PID feedback source to be inverted. For further information, refer to the *Parameter Reference Guide*

P00.074 PID Output Upper Limit

Range:	0.00 to 100.00 %	Default:	100.00 %

This parameter with *PID1 Output Lower Limit* (**P00.075**) allows the output to be limited to a range. For further information, refer to the *Parameter Reference Guide.*

P00.075 PID Output Lower Limit

Range:	±100.00 %	Default:	-100.00 %

See *PID1 Output Upper Limit* (**P00.074**).

P00.076	**Action On Error Detection**		
Range:	0 to 31	**Default:**	0

Set the bits in Action on Error Detection to 1 to define the drive behavior when an error occurs.

Bit 0: Stop on defined non-important errors

If bit 0 is set to one the drive will attempt to stop using the defined stop mode if any of the following error conditions are detected: I/O Overload (**E026**), Keypad Removed (**E034**), Motor Temp (**E020**) or Defaults Loaded (**E031**).

Bit 1: Disable braking resistor overload detection

Set bit 1 to one to prevent Brake Resistor Temp (**E019**) errors. See *Braking Resistor Rated Power* (**P10.030**) in the Parameter Reference Guide for more information.

Bit 2: Disable phase loss stop

Normally the drive will stop when the supply phase loss condition is detected. If this bit is set to 1 the drive will continue to run and will only enter the error state when the drive is brought to a stop by the user.

Bit 4: Disable parameter freeze on error.

If this bit is 0 then the parameters listed below are frozen on error until the error is cleared. If this bit is 1 then this feature is disabled.

Reference Selected (**P01.001)**

Pre-skip Filter Reference (**P01.002**)

Ramp Input (**P01.003**)

Final Demand Reference (**P03.001**)

Frequency Reference (**P03.045**)

Current Magnitude (**P04.001**)

Torque Producing Current (**P04.002**)

Magnetizing Current (**P04.017**)

Output Frequency (**P05.001**)

Output Voltage (**P05.002**)

Output Power (**P05.003**)

D.C. Bus Voltage (**P05.005**)

T2 Analog Input 1 Percentage (**P07.001**)

T5 Analog Input 2 Percentage (**P07.002**)

P00.077	**Maximum Heavy Duty Rating**		
Range:	0.00 to Drive HD Current Rating A	**Default:**	N/A

Displays the maximum heavy duty current rating of the drive.

P00.078	**Software Version**		
Range:	00.00.00.00 to 99.99.99.99	**Default:**	N/A

Displays the software version in the drive.

P00.081	**Reference Selected**		
Range:	± Maximum Frequency Limit (**P01.006**) Hz	**Default:**	N/A

This is the basic reference selected from the available sources.

P00.082	**Ramp Input**		
Range:	± Maximum Frequency Limit (**P01.006**) Hz	**Default:**	N/A

The *Ramp Input* is the final output from the reference system that is fed into the ramp system.

P00.083	**Final Demand Reference**		
Range:	± Maximum Frequency Limit (**P01.006**) Hz	**Default:**	N/A

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

Open-loop modes: Final Demand Reference shows the fundamental drive output frequency from the Post Ramp Reference and the Hard Frequency Reference.

P00.084	**D.C. Bus Voltage**		
Range:	0 to Maximum D.C. Bus Voltage V	**Default:**	N/A

Displays the voltage on the D.C bus of the drive.
This voltage must exceed the under voltage (UV) level for the drive to run.

Drive Rated Voltage	Under Voltage Level	Maximum D.C Bus Voltage
110 V	205 V	415 V
200 V	205 V	415 V
400 V	410 V	830 V
575 V	540 V	990 V
690 V	540 V	1150 V

P00.085	**Output Frequency**		
Range:	±599.00 Hz (HS30 PM 1000 Hz)	**Default:**	N/A

Closed-loop modes: The output frequency is not controlled directly, but the *Output Frequency* is a measurement of the frequency applied to the motor.
Open-loop modes: The Output Frequency is the sum of the Post Ramp Reference and the motor slip compensation frequency.

P00.086	**Output Voltage**		
Range:	0 to Maximum Output Voltage V	**Default:**	N/A

The *Output Voltage* is the r.m.s line to line voltage at the motor terminals on the drive.

Drive Rated Voltage	Maximum Output Voltage
110 V	325 V
200 V	325 V
400 V	650 V
575 V	780 V
690 V	930 V

P00.087	**Motor RPM**		
Range:	±36000.0 rpm (HS30 PM 60000 rpm)	**Default:**	N/A

Displays the motor RPM. The *Ramp Output* (**P02.001**) is converted to the equivalent RPM using the number of motor poles. The actual motor RPM could be different to that indicated if the *Motor Rated Speed* (**P00.007**) has not been set up correctly.

P00.088	**Current Magnitude**		
Range:	Drive Rated Current x 2.2	**Default:**	N/A

Displays the total output current to the motor. This is made up of two components, the *Torque Producing Current* (**P04.002**) and the *Magnetizing Current* (**P04.017**).

P00.089	**Torque Producing Current**		
Range:	Drive Rated Current x 2.2	**Default:**	N/A

Displays the component of the *Output Current* (**P04.001**) that is in phase with the voltage and does not include the magnetizing current of the motor. This torque includes the load torque and acceleration torque.
If the Output Frequency is positive (forward rotation), a positive value of Torque Producing Current would hold the motor load or cause the motor to accelerate.
If the Output Frequency is negative (reverse rotation), a negative value of Torque Producing Current would hold the motor load or cause the motor to accelerate.
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.

P00.090	**Digital I/O Indicators**		
Range:	0 to 2047	**Default:**	N/A

Digital I/O Read Word reflects the state of digital inputs/outputs 1 to 5, the STO and the relay.

***Digital I/O Read Word* bit**	**Terminal**
0	DI/O 1 (T10)
1	DI/O 2 (T11)
2	DI 3 (T12)
3	DI 4 (T13)
4	DI 5 (T14)
7	STO
8	STO
9	Relay (T41)

P00.091	**Reference On**		
Range:	Off (0) or On (1)	**Default:**	N/A

Indicates that the drive output is active.

P00.092	**Reverse Select**		
Range:	Off (0) or On (1)	**Default:**	N/A

Indicates if the drive has an active Run Reverse, Reverse, or Jog Reverse signal. If Reverse Select = 1, the drive will run at the inverse of *Reference Selected* (**P00.081**) or the *Jog Reference* (**P00.015**).

P00.093	**Jog Select**		
Range:	Off (0) or On (1)	**Default:**	N/A

Indicates if the drive has an active *Jog Forward* or *Jog Reverse* signal.

P00.094	**T2 Analog Input 1 Percentage**		
Range:	±100.00 %	**Default:**	N/A

Displays the level of the analog signal present at analog input 1 (terminal 2).

P00.095	**T5 Analog Input 2 Percentage**		
Range:	±100.00 %	**Default:**	N/A

Displays the level of the analog signal present at analog input 2 (terminal 5).

8 Optimization

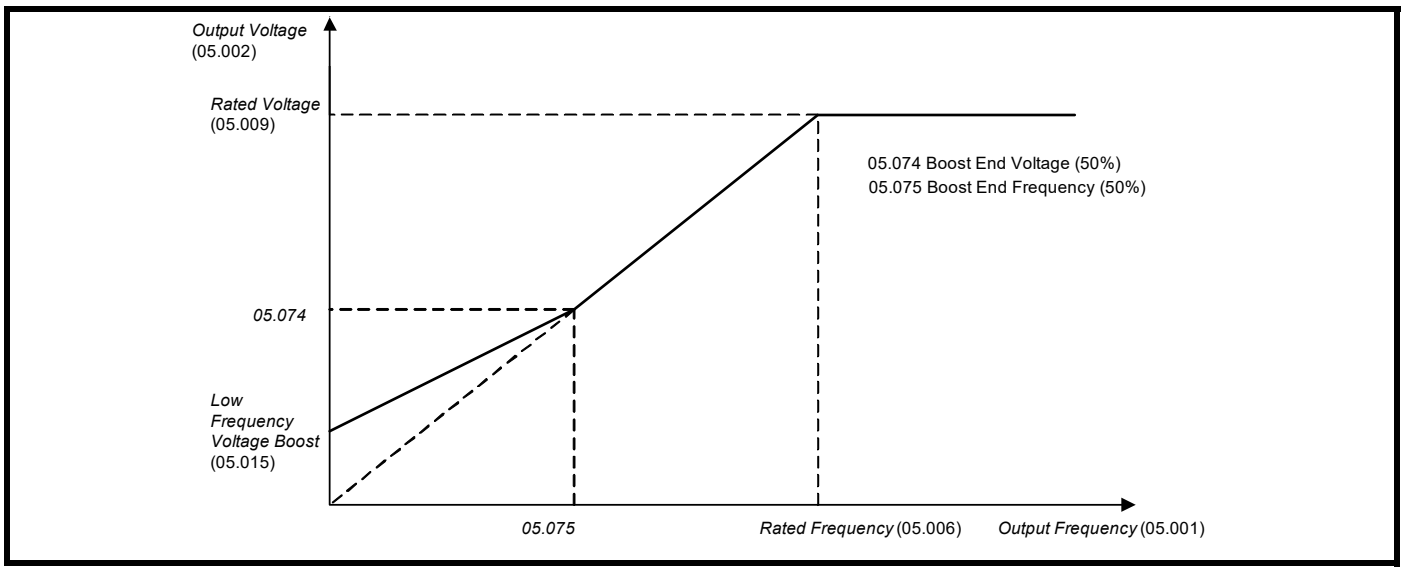
8.1 Motor starting boost for V to F control of induction motors

Voltage to frequency modes offer basic motor control and require less configuration time than other modes. For each mode you are able to apply a level of fixed boost to improve starting torque and general torque performance when the drive is running at a low frequency. If the boost is set too high it can cause excessive motor current which would result in a motor overload error.

Linear V to F provides the motor with a linear voltage characteristic from 0 Hz to *Motor Rated Frequency* (**P00.039**). The fixed boost is defined by the Motor Starting Boost and the point at the frequency the control becomes linear again, as shown in Figure 8-1.

Define Motor Starting Boost (**P00.042**) as a percentage of *Motor Rated Voltage* (P00.008).
Define Motor Starting Boost End Voltage (**P05.074**) as a percentage of *Motor Rated Voltage* (**P00.008**).
Define Motor Starting Boost End Frequency (**P05.075**) as a percentage of *Motor Rated Frequency* (**P00.039**).

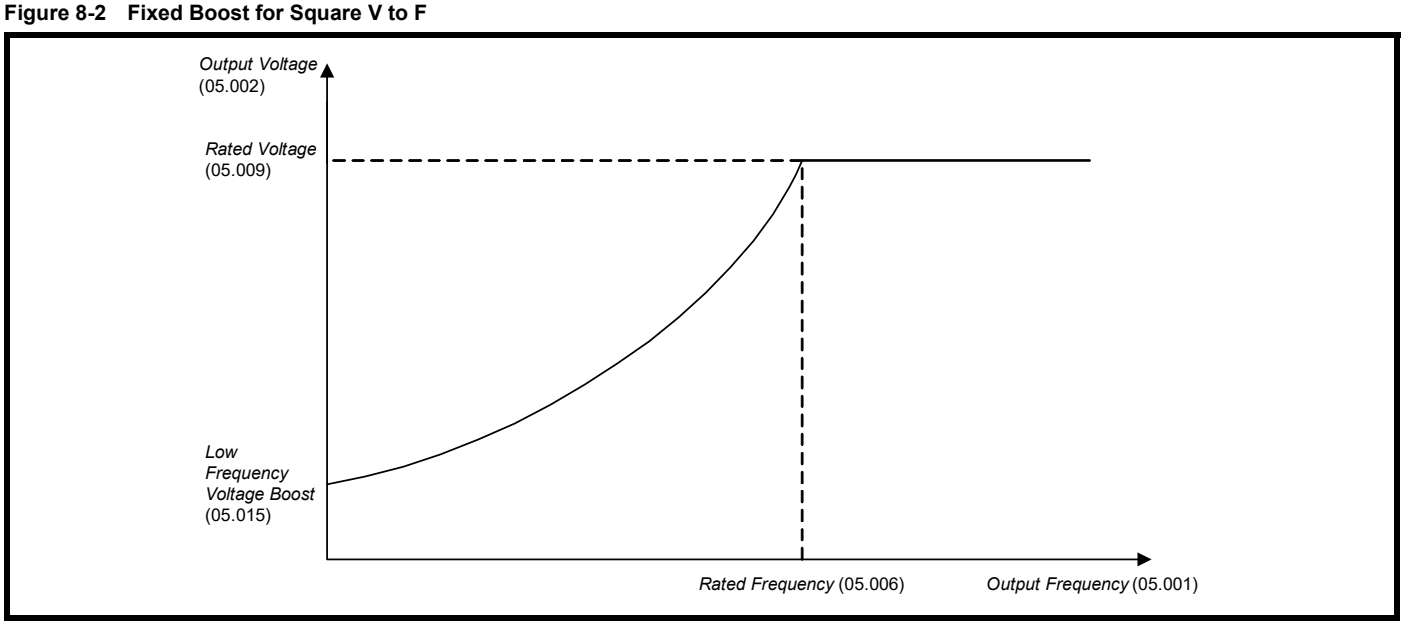
Figure 8-1 Fixed Boost for Linear V to F



Square V to F provides the motor with a quadratic voltage characteristic from 0 Hz to *Motor Rated Frequency* (**P00.039**). The fixed boost is defined by the Motor Starting Boost as shown in Figure 8-2.

Define *Motor Starting Boost* (**P00.042**) as a percentage of *Motor Rated Voltage* (**P00.008**).

Figure 8-2 Fixed Boost for Square V to F



8.2 Resistance compensated (Ur) control of induction motors

Resistance compensation (Ur) control modes provide improved torque performance compared to V to F control by applying vector-based compensation for the stator resistance below half of the motor rated frequency. The stator resistance can be measured via an auto-tune but as the motor temperature changes the stator resistance will vary. To negate this, some of the resistance compensation modes below will measure the stator resistance periodically to ensure the drive is providing the best performance. The test can only be done with a stationary motor so, these modes

should only be used if the motor is guaranteed to be stationary when the drive is made to run. Measuring the resistance on each drive run can result in a slight delay to the start time of the motor.

Select one of the following in *Motor Control Mode* (**P00.041**):

(0) *Ur.S* = The stator resistance is measured each drive run. The test is not done if the drive is made to run less than a second after the drive has decelerated to a stop. In this case, previously measured values are used. Note that the measured value of stator resistance is not automatically saved to the drive.

(4) *Ur.I* = The stator resistance is measured on the first drive run after each power-up. Note that the measured value of stator resistance is not automatically saved to the drive.

(1) *Ur* = The stator resistance is not measured. The user can enter the motor and cabling resistance into the Stator Resistance (P05.017) manually or perform a basic auto-tune using *Perform Auto-tune* (**P00.038**).

(3) *Ur.Auto* = The stator resistance is measured once, the first time the drive is made to run. After the test has been completed successfully the *Motor Control Mode* (**P05.014**) is set to **Ur** (1) mode. The new *Stator Resistance* **(P05.017**) and *Motor Control Mode* (**P05.014**) values are saved in the drive. If the test fails, the control mode will stay at Ur.Auto and the test will be repeated next time the drive is made to run.

8.3 Closed-loop control of permanent magnet motors

PM mode provides sensorless closed-loop control for permanent magnet motors. The drive monitors the output current to provide a closed-loop control and to estimate the position of the motor poles in the rotor. Because the drive is using closed-loop control, the overload limit in PM mode is 180 % rated current for 60 s (cold) or 3 s (from 100 %) rather than the open loop modes that have an overload limit of 150 % rated current for 60 s (cold) or 8 s (from 100 %).

To configure this mode ensure P05.033 Volts per 1000 rpm, *Motor Rated Current* (**P00.006**), *Motor Rated Speed* (**P00.007**) and *Number of Motor Poles* (**P00.040**) are set correctly. For maximum performance at full speed the DC bus of the drive needs to be 5 % higher than the motor rated voltage x 1.414 (√2).

Minimum supply voltage =>(Motor rated voltage x 1.414 (√ 2) X 1.05)/ 1.35 IE P05.009 must be lower than (0.95 x P05.005)/1.414 . This allows the current controller head room to work. Then perform a basic auto-tune using *Perform Auto-tune* (**P00.013**). If there is instability in the motor when running, it may be required to tune the frequency controller of the drive, see section 8.5 *Sensorless closed-loop control*.

8.4 Perform Auto-tune

Set *Motor Control Mode* (**P00.012**) before performing an auto-tune. Select the auto-tune test in *Perform Auto-tune* (**P00.013**) to measure motor parameters.

1: Basic Auto-tune

A stationary test to measure *Stator Resistance* (**P05.017**), *Transient Inductance or Ld* (**P05.024**), *Maximum Deadtime Compensation* (**P05.059**), *Current At Maximum Deadtime Compensation* (**P05.060**) and *No-load Lq* (**P05.074**) when the drive is controlling a permanent magnet motor.

To perform a basic auto-tune:

- Set *Motor Control Mode* (**P00.012**) prior to performing an auto-tune
- Ensure motor is stationary and will not move during the test
- Set *Perform Auto-tune* (**P00.013**) to Basic (1) and run the drive

3: Inertia Auto-tune

The drive performs a load measurement to determine the *Motor and Load Inertia* (**P03.018**). This will improve control when accelerating high inertia loads.

Before performing an inertia auto-tune ensure all motor details are correct and perform a basic auto-tune.

To perform an inertia auto-tune:

- Connect the load to the motor
- Ensure that the load is stationary but free to move
- Set *Perform Auto-tune* (**P00.013**) to *Inertia* (3) and run the drive.

NOTE

Once an autotune test is completed the drive state will switch to locked inhibit state so run and enable signals will need to be removed before the drive will run again. This is also true if an error occurs during the test.

8.5 Sensorless closed-loop control

The Commander C is capable of sensorless closed-loop control of permanent magnet and induction motors. This not only provides the best level of performance for dynamic applications but because the drive is using closed-loop control, the overload limit is 180 % rated current for 60 s (cold) or 3 s (from 100 %) rather than the open loop modes that have an overload limit of 150 % rated current for 60 s (cold) or 8 s (from 100 %).

Before following the steps of this section, ensure motor details have been entered correctly and the correct auto-tune has been performed as described in section 6.2 *Quick start commissioning / start-up*.

8.5.1 Tuning the current controller gains

The current controller proportional (Kp) and integral (Ki) gains define the drives response to a change in torque demand.

The default values give satisfactory operation with most motors. However, for optimal performance in dynamic applications it may be necessary to change the gains to improve the performance. The *Current Controller Kp Gain* (**P04.013**) is the most critical value in controlling the performance.

The values for the current loop gains can be calculated by performing a basic or improved auto-tune, see *Perform Auto-tune* (**P00.013**). This will give a step response with minimum overshoot after a step change of current reference. The proportional gain can be increased by a factor of 1.5 giving a similar increase in bandwidth; however, this gives a step response with approximately 12.5 % overshoot. The equation for the integral gain gives a conservative value.

8.5.2 Adjusting the sensorless filter

When using sensorless control the measured speed can include some ripple. A filter is applied to the estimated speed to and *Sensorless Mode Filter* (**P03.079**) defines the time constant. The default time constant is 4 ms, but this can be extended to improve the filtering. This is particularly useful when using standard ramp or Catch an Already Spinning Motor with a low friction high inertia load, and can prevent over voltage errors when the drive has no braking resistor.

8.5.3 Tuning the frequency controller gains

The frequency loop gains control the response of the frequency controller to a change in frequency demand. The frequency controller includes proportional (Kp) and integral (Ki) feed forward terms, and a differential (Kd) feedback term.

Frequency Controller Proportional Gain Kp (**P00.065**)
If the proportional gain has a value and the integral gain is set to zero the controller will only have a proportional term, and there must be a frequency error to produce a torque reference. Therefore as the motor load increases there will be a difference between the reference and actual frequencies. This effect, called regulation, depends on the level of the proportional gain, the higher the gain the smaller the frequency error for a given load. If the proportional gain is too high either the acoustic noise becomes unacceptable, or the stability limit is reached.

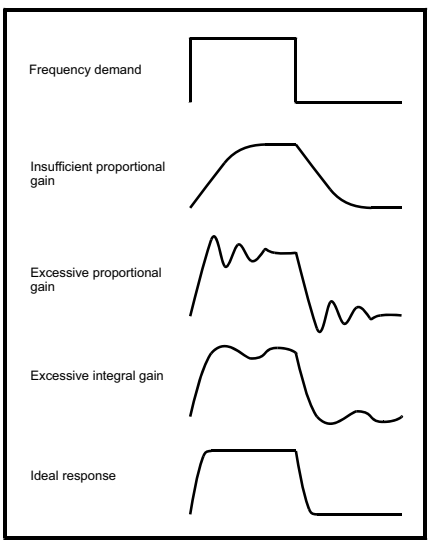
Frequency Controller Integral Gain Ki (**P00.066**)
The integral gain is provided to prevent frequency regulation. The error is accumulated over a period of time and used to produce the necessary torque demand without any frequency error. Increasing the integral gain reduces the time taken for the frequency to reach the correct level and increases the stiffness of the system, i.e. it reduces the positional displacement produced by applying a load torque to the motor. Unfortunately increasing the integral gain also reduces the system damping giving overshoot after a transient. For a given integral gain, the damping can be improved by increasing the proportional gain. A compromise must be reached where the system response, stiffness and damping are all adequate for the application. It is unlikely that the integral gain can be increased much above 0.50.

Differential Feedback Gain Kd (**P03.012**)
The differential gain is provided in the feedback of the frequency controller to give additional damping. The differential term is implemented in a way that does not introduce excessive noise normally associated with this type of function. Increasing the differential term reduces the overshoot produced by under-damping, however, for most applications the proportional and integral gains alone are sufficient.

Tuning the frequency loop gains:
This involves connecting an oscilloscope to analog output 1 to monitor the frequency feedback. Give the drive a step change in frequency reference and monitor the response of the drive on the oscilloscope. The proportional gain (Kp) should be set up initially. The value should be increased up to the point where the frequency overshoots and then reduced slightly. The integral gain (Ki) should then be increased up to the point where the frequency becomes unstable and then reduced slightly. It may now be possible to increase the proportional gain to a higher value and the process should be repeated until the system response approaches the ideal response as shown.

Figure 8-3 shows the effect of incorrect P and I gain settings as well as the ideal response.

Figure 8-3 Tuning the frequency controller gains



8.6 Switching frequency

The default switching frequency is 3 kHz, however this can be increased up to a maximum of 12 kHz by **P00.037**.

If switching frequency is increased from 3 kHz the following apply:

1. Increased heat loss in the drive, which means that derating to the output current must be applied.
   See the derating tables for switching frequency and ambient temperature in the *Power Installation Guide*.
2. Reduced heating of the motor - due to improved output waveform quality.

3. Reduced acoustic noise generated by the motor.
4. Increased sample rate on the speed and current controllers. A trade off must be made between motor heating, drive heating and the demands of the application with respect to the sample time required.

Table 8-1 Sample rates for various control tasks at each switching frequency

	3, 6, 12 kHz	2, 4, 8 kHz	Open loop	PM
Level 1	83 µs	125 µs		Position estimation
Level 2	Runs at switching frequency		Peak limit	Current controllers
Level 3	250 µs		Ramps, torque control, current control, voltage control & D.C. bus control	Ramps, frequency control, torque control & D.C. bus control
Level 5	4 ms		Thermal model	
Background			Non-time critical user interface	

8.6.1 Maximum frequency

In all operating modes the maximum output frequency is limited to 599 Hz (HS30 PM 1000 Hz).

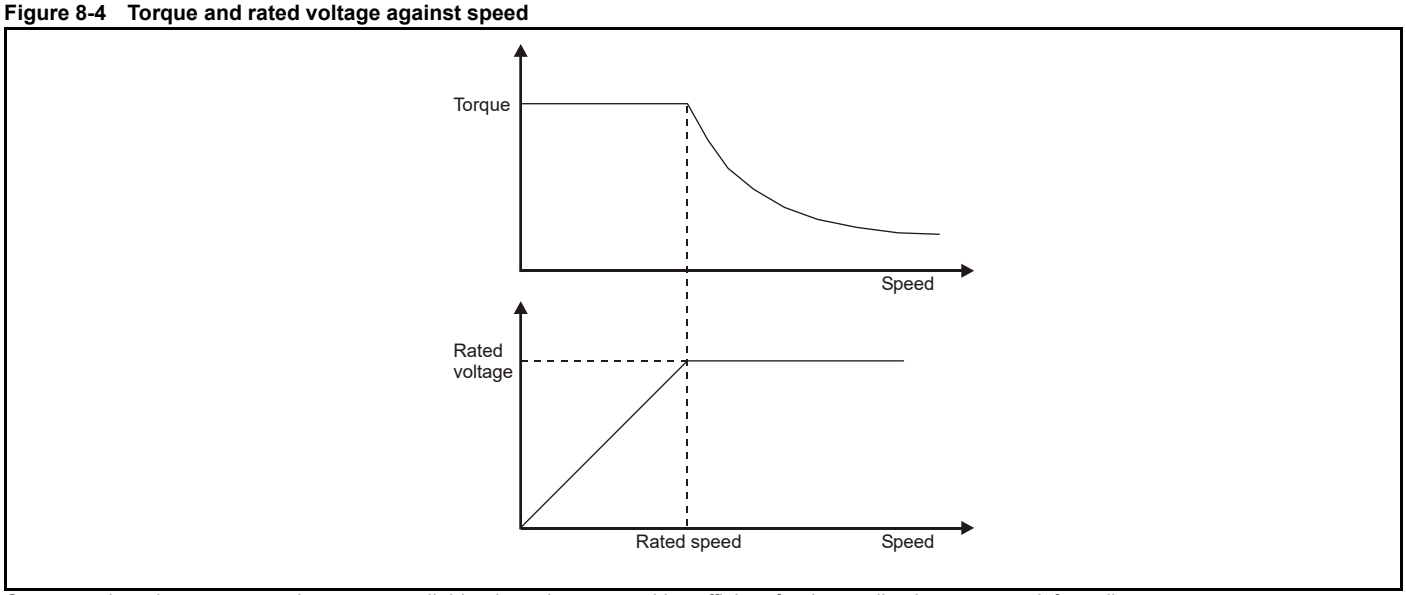
8.6.2 Switching frequency/Output frequency ratio

With a default switching frequency of 3 kHz, the maximum output frequency should be limited to 250 Hz. Ideally, a minimum ratio of 12:1 should be maintained between the switching frequency and the output frequency. This ensures the number of switchings per cycle is sufficient to ensure the output waveform quality is maintained at a minimum level.

8.6.3 Field weakening (constant power) operation

The drive can be used to run an induction machine above synchronous speed into the constant power region. The speed continues to increase and the available shaft torque reduces. The characteristics below show the torque and output voltage characteristics as the speed is increased above the rated value.

Figure 8-4 Torque and rated voltage against speed



Care must be taken to ensure the torque available above base speed is sufficient for the application to run satisfactorily.

8.6.4 Over-modulation (open-loop only)

The maximum output voltage level of the drive is normally limited to an equivalent of the drive input voltage minus voltage drops within the drive (the drive will also retain a few percent of the voltage in order to maintain current control). If the motor rated voltage is set at the same level as the supply voltage, some pulse deletion will occur as the drive output voltage approaches the rated voltage level. If **P05.020** (Over-modulation enable) is set to 1 the modulator will allow over modulation, so that as the output frequency increases beyond the rated frequency the voltage continues to increase above the rated voltage.

This can be used for example:

- To obtain high output frequencies with a low switching frequency which would not be possible with space vector modulation limited to unity modulation depth,

or

- In order to maintain a higher output voltage with a low supply voltage.

The disadvantage is that the machine current will be distorted as the modulation depth increases above unity, and will contain a significant amount of low order odd harmonics of the fundamental output frequency. The additional low order harmonics cause increased losses and heating in the motor.

8.7 Maximum motor rated current

Size 1 to 4:

The maximum motor rated current is the *Maximum Heavy Duty Current Rating* (**P00.077**).

The values for the Heavy Duty rating can be found in the *Power Installation Guide*.

Size 5 onwards:

The maximum motor rated current for size 5 drives and above depends on whether the current demand of the application is suitable for heavy duty operation or normal duty operation. Heavy duty operation has a lower maximum motor rated current but a higher overload limit. If the *Motor Rated Current* (**P00.006**) is set above the *Maximum Heavy Duty Curretn Rating* (**P00.077**), the drive changes to normal duty operation and the current limits and the motor thermal protection scheme are modified (see section 8.8 *Current limits* and section 8.9 *Motor thermal protection* below for further information).

8.8 Current limits

The default setting for the current limit parameters is:

- 165 % x motor rated torque producing current

There are three parameters which control the current limits:

- Motoring current limit: power flowing from the drive to the motor
- Regen current limit: power flowing from the motor to the drive

- Symmetrical current limit: current limit for both motoring and regen operation

The lowest of either the motoring and regen current limit, or the symmetrical current limit applies.

The maximum setting of these parameters depends on the values of motor rated current, drive rated current and the power factor.

With size 5 upwards, increasing the motor rated current (**P00.006** / **P05.007**) above the Heavy Duty rating (default value), will automatically reduce the current limits in **P04.005** to **P04.007**. If the motor rated current is then set to or below the Heavy Duty rating, the current limits will be left at their reduced values.

The drive can be oversized to permit a higher current limit setting to provide higher accelerating torque as required up to a maximum of 1000 %. Oversize drive is limited to 4 to 1 ratio 400 %.

8.9 Motor thermal protection

A time constant thermal model is provided to estimate the motor temperature as a percentage of its maximum allowed temperature.

The motor thermal protection is modelled using losses in the motor. The losses in the motor are calculated as a percentage value, so that under these conditions the *Motor Protection Accumulator* (**P04.019**) would eventually reach 100 %.

Percentage losses = 100 % x [Load related losses]

Where:

Load related losses = $[I / (K_1 \times I_{Rated})]^2$

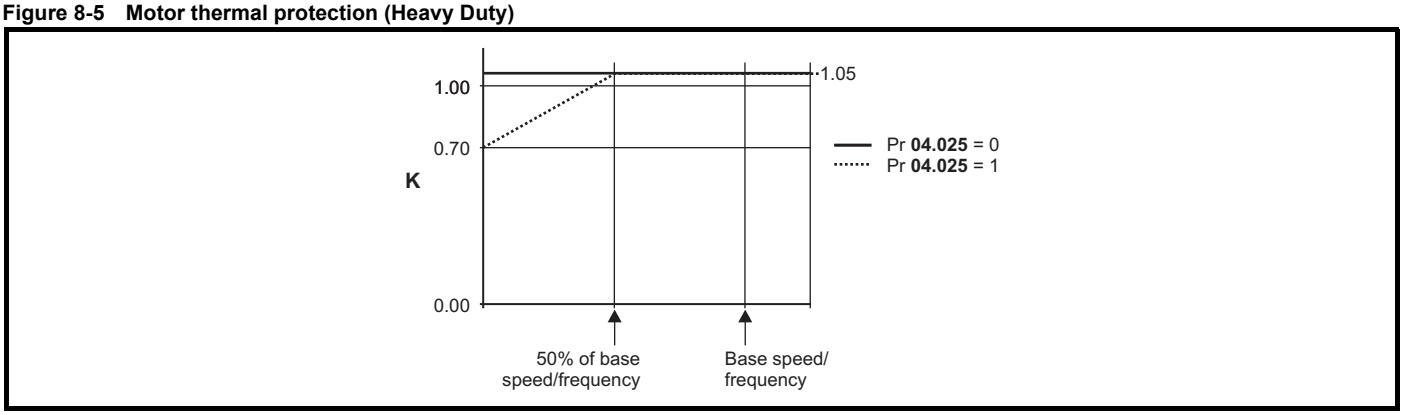
Where:

I = *Current Magnitude* (**P00.088**)

I_{Rated} = *Motor Rated Current* (**P00.006**)

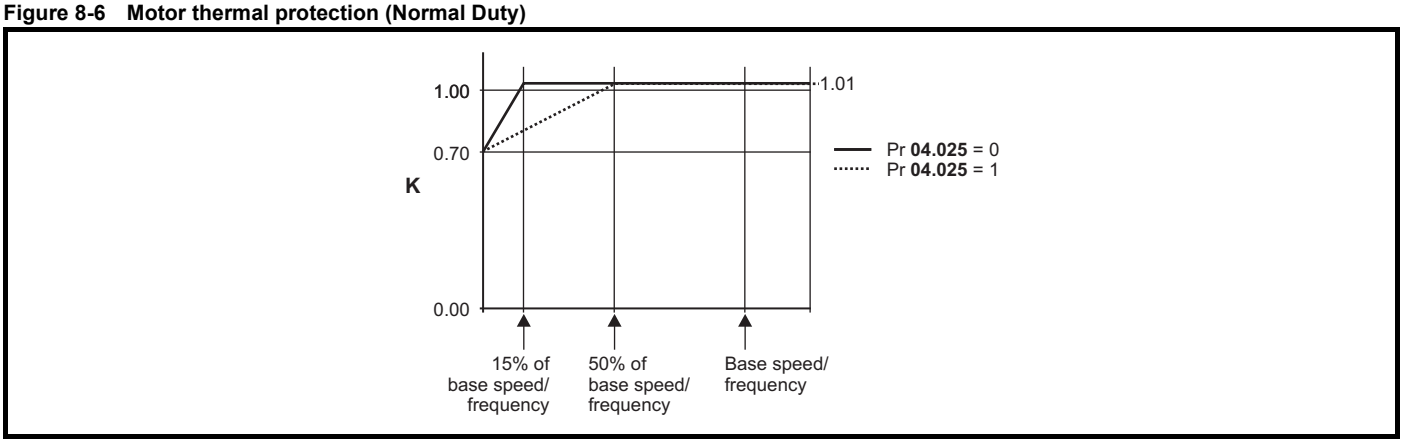
If *Motor Rated Current* (**P00.006**) ≤ *Maximum Heavy Duty Current* (**P00.077**)

Figure 8-5 Motor thermal protection (Heavy Duty)



If **P04.025** is 0 the characteristic is for a motor which can operate at rated current over the whole speed range. Motors with this type of characteristic normally have forced cooling. If **P04.025** is 1 the characteristic is intended for motors where the cooling effect of motor fan reduces with reduced motor speed below 50 % of base speed/ frequency. The maximum value for K is 1.05, so that above the knee of the characteristics the motor can operate continuously up to 105 % current.

Figure 8-6 Motor thermal protection (Normal Duty)



Both settings of **P04.025** are intended for motors where the cooling effect of the motor fan reduces with reduced motor speed, but with different speeds below which the cooling effect is reduced. If **P04.025** is 0 the characteristic is intended for motors where the cooling effect reduces with motor speed below 15 % of base speed/frequency. If **P04.025** is 1 the characteristic is intended for motors where the cooling effect reduces with motor speed below 50 % of base speed/frequency. The maximum value for K is 1.01, so that above the knee of the characteristics the motor can operate continuously up to 101 % current.

When the estimated temperature in **Pr 04.019** reaches 100 % the drive takes some action depending on the setting of **P04.016**. If **P04.016** is 0, the drive will error when **P04.019** reaches 100 %. If **P04.016** is 1, the current limit is reduced to (K - 0.05) x 100 % when **P04.019** reaches 100 %.

Thermal Protection Mode (**P04.016**) defines the action taken by the drive when motor and/or drive thermal monitoring parameters approach their error levels.

Value	Text	Description
0	Both Error	Motor and drive protected with an error
1	Motor Limiting	Motor protected via limiting and drive protected with an error
2	Drive Limiting	Motor protected with an error and drive protected via limiting
3	Both Limiting	Motor and drive protected via limiting
4	Drive Error Only	Drive protected with an error and motor unprotected
6	Drive Limit Only	Drive protected via limiting and motor unprotected

The current limit is set back to the user defined level when **P04.019** falls below 95 %. The thermal model temperature accumulator accumulates the temperature of the motor while the drive remains powered-up. By default, the accumulator is set to the power down value at power up. If the rated current defined by **P00.006** is altered, the accumulator is reset to zero.

The default setting of the thermal time constant (**P04.015**) is 179 s which is equivalent to an overload of 150 % for 120 s from cold.

8.10 Running motor above base speed

Care must be taken when high speed mode (**P05.022**) is enabled (or limited) to avoid damaging the drive. The voltage produced by the magnet flux is proportional to speed. For high speed operation the drive must apply currents to the motor to counter-act the flux produced by the magnets. It is possible to operate the motor at very high speeds that would give a very high motor terminal voltage, but this voltage is prevented by the action of the drive. If however, the drive is disabled (or an error occurs) when the motor voltages would be higher than the rating of the drive without the currents to counter-act the flux from the magnets, it is possible to damage the drive. If high speed mode is enabled the motor speed must be limited to the levels given in the table below unless an additional hardware protection system is used to limit the voltages applied to the drive output terminals to a safe level.

Drive Voltage Rating	Maximum Motor Speed (rpm)	Maximum Safe Line to Line Voltage at the Motor Terminals (V r.m.s.)
200	400 x 1000 / (Ke x √2)	400 / √2
400	800 x 1000 / (Ke x √2)	800 / √2
575	955 x 1000 / (Ke x √2)	955 / √2
690	1145 x 1000 / (Ke x √2)	1145 / √2

Ke is the ratio between r.m.s. line to line voltage produced by the motor and the speed in V/1000 rpm.

NOTE

When operating above base speed in the field weakening region the motor produces constant power (motor torque reduces with speed)

Disabled (0):

The motor flux is not modified to limit the motor voltage. The motor voltage will increase as the speed is increased until the motor line to line voltage x √2 is equal to the *DC Bus Voltage* (**P05.005**). It will not be possible to further increase the speed significantly. This mode is safe because the motor voltage with no current flowing in the motor cannot exceed a level that can damage the drive.

Limit (1):

The motor flux is modified to limit the motor voltage to the level defined by *Motor Rated Voltage* (**P05.009**). An E007 *Motor Over Speed error* is initiated if the measured motor speed exceeds the levels defined in the table above to protect the drive. This mode is intended for motors that have relatively low saliency. The motor torque is restricted to prevent the drive from operating close to, or beyond, the voltage based torque limit of the motor. This prevents the motor from operating in a region where it could become unstable, or the drive could lose control of the motor. This is not generally a problem for servo motors as they do not go close to their torque limit or only operate transiently in flux weakening during the last part of their acceleration to maximum speed, and so the flux controller is too slow to provide much flux weakening. However, for more general purpose motors for slower applications, such as fans and pumps, it may be necessary for the drive to prevent the motor from operating close to its voltage based torque limit.

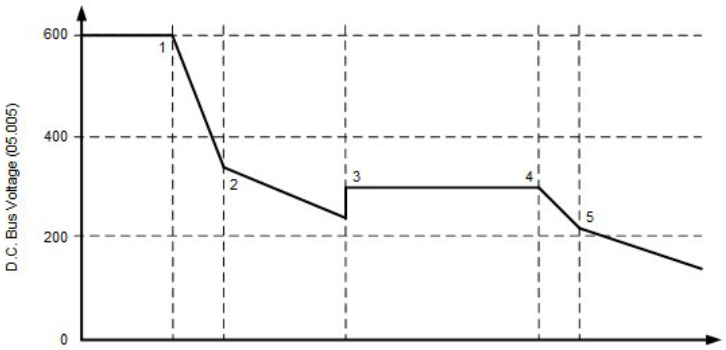
Enable (2):

This is similar to Limit mode except that an error is not produced if the motor speed exceeds the maximum safe level. An indication that cannot be cleared is stored in *Potential Drive Damage Conditions* (**P10.106**). The motor manufacturer should always be consulted before using this mode as care must be taken not to de-magnetise the motor.

8.11 Low DC link operation.

On the 400 V product, setting *Low DC Link Operation* (**P06.077**) to a value of 1 will enable the drive to operate on a 200 VAC input. See Figure 8-7 *Low DC link operation*

Figure 8-7 Low DC link operation



1. The mains AC supply is removed
2. A power down save is performed
3. Backup AC supply is applied
4. Backup AC supply is removed
5. Drive goes into Under Voltage. A power down save is not performed

Note: If the DC voltage is greater than 425 V after 2 then everything will return to normal

Low AC Alarm (**P10.107**) is displayed from step 2 on the figure above.

The functionality described for *Low DC Link Operation* (**P06.077**) is supported accross Frames 02-09. For frames 05, and above, the minimum supply voltage supported is 330 VDC (233 VAC RMS)

NOTE

When operating in low voltage mode *Ride Thru* (2) will be disabled for *Supply Loss Mode* (**P06.003**).

9 Onboard PLC

9.1 Onboard PLC and Machine Control Studio

The drive has the ability to store and execute a 30 kB (less 4 kB of proxy) Onboard PLC user program without the need for additional hardware in the form of an option module.

Machine Control Studio is an IEC61131-3 development environment designed for use with Commander and compatible application modules. Machine Control Studio is based on CODESYS from 3S-Smart Software Solutions.

All of the programming languages defined in the IEC standard IEC 61131-3 are supported in the Machine Control Studio development environment.

- ST (Structured text)
- LD (Ladder diagram)
- FBD (Function block diagram)
- IL (Instruction list)
- SFC (Sequential function chart)
- CFC (Continuous Function Chart). CFC is an extension to the standard IEC programming languages

Machine Control Studio provides a complete environment for the development of user programs. Programs can be created, compiled and downloaded to a Commander for execution, via the communications port on the front of the drive. The run-time operation of the compiled program on the target can also be monitored using Machine Control Studio and facilities are provided to interact with the program on the target by setting new values for target variables and parameters.

The Onboard PLC and Machine Control Studio form the first level of functionality in a range of programmable options for Commander.

Machine Control Studio can be downloaded from www.controltechniques.com.

See the Machine Control Studio help file for more information regarding using Machine Control Studio, creating user programs and downloading user programs to the drive.

9.2 Benefits

The combination of the Onboard PLC and Machine Control Studio, means that the drive can replace nano and some micro PLCs in many applications

Machine Control Studio benefits from access to the standard CODESYS function and function block libraries as well as those from third parties. Functions and function blocks available as standard in Machine Control Studio include, but not limited to, the following:

- Arithmetic blocks
- Comparison blocks
- Timers
- Counters
- Multiplexers
- Latches
- Bit manipulation

Typical applications for the Onboard PLC include:

- Ancillary pumps
- Fans and control valves
- Interlocking logic
- Sequence routines
- Custom control words.

9.3 Features

The Commander Onboard PLC user program has the following features:

9.3.1 Tasks

The Onboard PLC allows use of two tasks.

- Clock: A high priority real time task. The clock task interval can be set from 16 ms to 262 s in multiples of 16 ms. The parameter *Onboard User Program: Clock Task Time Used* (**P11.051**) shows the percentage of the available time used by clock task. A read or write of a drive parameter by the user program takes a finite period of time. It is possible to select up to 10 parameters as fast access parameter which reduced the amount of time it takes for the user program to read from or write to a drive parameter. This is useful when using a clock task with a fast update rate as selecting a parameter for fast access reduces the amount of the clock task resource required to access parameters.
- Freewheeling: A non-real time background task. The freewheeling task is scheduled for a short period once every 256 ms. The time for which the task is scheduled will vary depending on the loading of the drive's processor. When scheduled, several scans of the user program may be performed. Some scans may execute in microseconds. However, when the main drive functions are scheduled there will be a pause in the execution of the program causing some scans to take many milliseconds. The parameter *Onboard User Program: Freewheeling Tasks Per Second* (**P11.050**) shows the number of times the freewheeling task has started per second.

9.3.2 Variables

The Onboard PLC supports the use of variables with the data types of Boolean, integer (8 bit, 16 bit and 32 bit, signed and unsigned), floating point (64 bit only), strings and time.

9.3.3 Custom menu

Machine Control Studio can construct a custom drive menu to reside in menu 30 on the drive. The following properties of each parameter can be defined using Machine Control Studio:

- Parameter name
- Number of decimal places
- The units for the parameter to be display on the keypad.
- The minimum, maximum and default values
- Memory handling (i.e. power down save, user save or volatile)
- Data type. The drive provides a limited set of 1 bit, 8 bit, 16 bit and 32 bit integer parameters to create the customer menu.

Parameters in this customer menu can be accessed by the user program and will appear on the keypad.

9.3.4 Limitations

The Onboard PLC user program has the following limitations:

- The flash memory allocated to the Onboard PLC is 30 kB which includes the user program and its header which results in a maximum user program size of about 12 kB
- The Onboard PLC is provided with 2 kB of RAM.
- The drive is rated for 100 program downloads. This limitation is imposed by the flash memory used to store the program within the drive.
- There is only one real-time task with a minimum period of 16 ms.
- The freewheeling background task runs at a low priority. The drive is prioritized to perform the clock task and its major functions first, e.g. motor control, and will use any remaining processing time to execute the freewheeling task as a background activity. As the drive's processor becomes more heavily loaded, less time is spent executing the freewheeling task.
- Breakpoints, single stepping and online program changes are not possible.
- The Graphing tool is not supported.
- The variable data types REAL (32 bit floating point), LWORD (64 bit integer) and WSTRING (Unicode string), and retained variables are not supported.

9.4 Onboard PLC parameters

The following parameters are associated with the Onboard PLC user program.

P11.047	Onboard User Program: Enable					
RW	Txt				US	
⇳	Stop (0) or Run (1)			⇨	Run (1)	

This parameter stops and starts the user program.

0 - Stop the User Program

The onboard user program is stopped.

1 - Run the User Program

The user program will execute. Background task starts from the beginning.

P11.048	Onboard User Program: Status					
RO	Txt		NC	PT		
⇳	-2147483648 to 2147483647			⇨		

This parameter is read-only and indicates the status of the user program in the drive. The user program writes the value to this parameter.

0: Stopped

1: Running

2: Exception

3: No user program present

P11.049	Onboard User Program: Programming Events					
RO	Uni		NC	PT	PS	
⇳	0 to 65535			⇨		

This parameter holds the number of times an Onboard PLC user program download has taken place and is 0 on dispatch from the factory. The drive is rated for one hundred program downloads. This parameter is not altered when defaults are loaded.

P11.050	Onboard User Program: Freewheeling Tasks Per Second					
RO	Uni		NC	PT		
⇳	0 to 65535			⇨		

This parameter shows the number of times the freewheeling task has started per second.

P11.051	Onboard User Program: Clock Task Time Used					
RO			NC	PT		
⇳	0.0 to 100.0 %			⇨		

This parameter shows the percentage of the available time used by the user program clock task.

P11.055	Onboard User Program: Clock Task Scheduled Interval					
RO			NC	PT		
⇳	0 to 262128 ms			⇨		

This parameter shows the interval at which the clock task is scheduled to run at in ms.

9.5 Onboard PLC errors

If the drive detects an error in the user program it will initiate a User Program error. The sub-error number for the User Program error details the reason for the error. See Chapter 12 *Diagnostics* on page 135 for more information on the User Program error.

10 Advanced parameters

This is a quick reference to all parameters in the drive showing units, ranges limits etc, with block diagrams to illustrate their function. Full descriptions of the parameters can be found in the *Parameter Reference Guide*.

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

Table 10-1 Menu descriptions

Menu	Description
0	Basic parameters
1	Frequency references
2	Frequency ramps
3	Frequency control
4	Torque and current control
5	Motor setup
6	Sequencer and clock
7	Analog I/O
8	Digital I/O
9	Programmable logic, motorized pot, binary sum, timers
10	Status and error log
11	Drive set-up and identification, serial communications
12	Threshold detectors, variable selectors and mechanical brake controller
14	PID controller
15	Option module set-up menu
18	Application menu 1
20	Application menu 2
22	Menu 0 set-up
1.mm	Option menus*

* Only displayed when the option module is installed.

Table 10-2 Feature look-up table

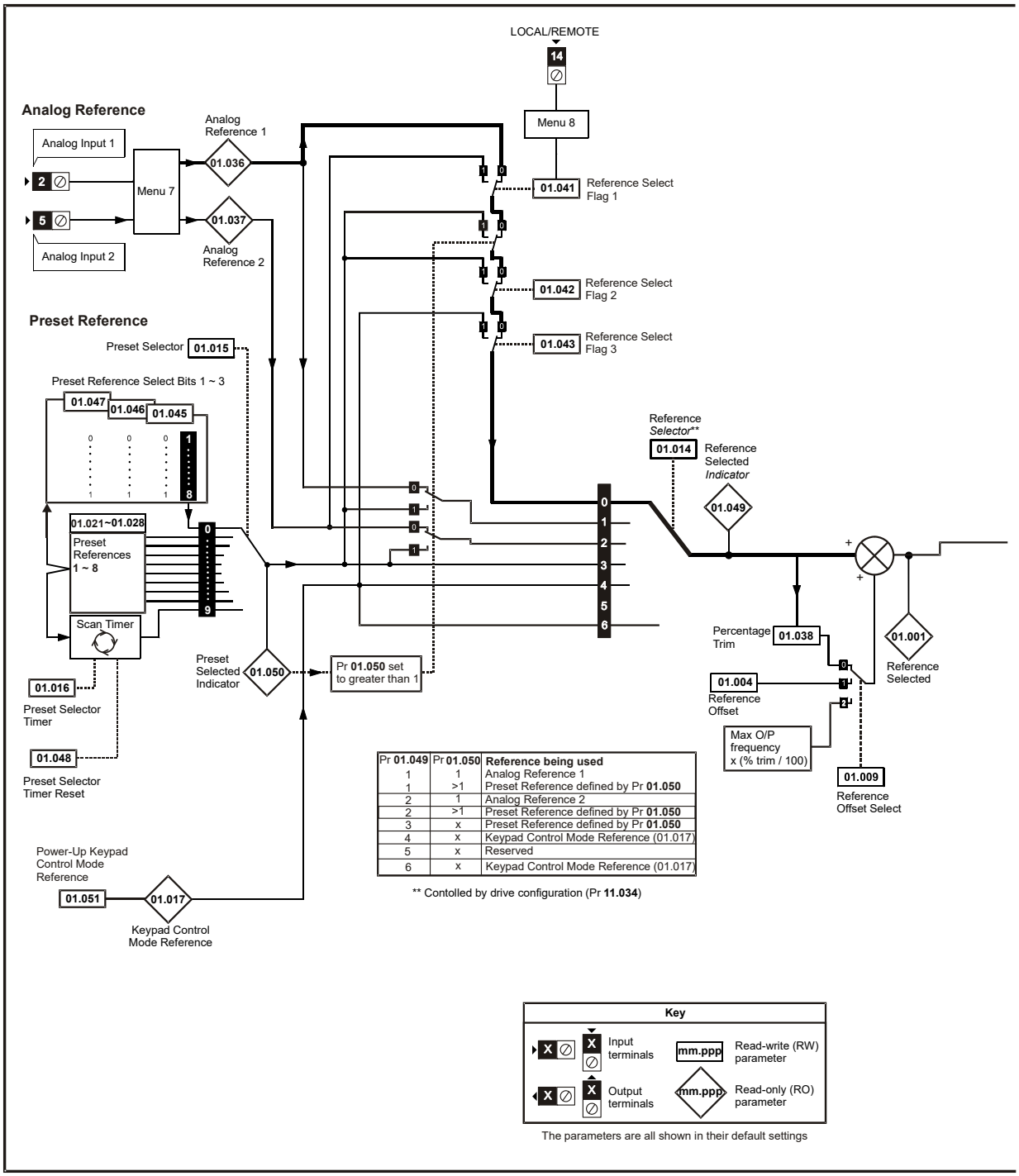
Features	Related parameters												
Acceleration rates	02.010	02.011 to 02.019		02.032	02.033	02.034	02.002						
Analog input 1	07.001	07.007	07.008	07.009	07.010	07.028	07.051	07.030	07.061	07.062	07.063	07.064	
Analog input 2	07.002	07.011	07.012	07.013	07.014	07.031	07.052	07.065	07.066	07.067	07.068		
Analog output 1	07.019	07.020	07.055	07.099									
At frequency	03.006	03.007	03.009	10.006	10.005	10.007							
Auto-reset on error	10.034	10.035	10.036	10.001									
Auto-tune	05.012	05.017	05.021	05.024	05.025	05.010	05.029	05.030	05.062	05.063	05.059	05.060	
Binary sum	09.029	09.030	09.031	09.032	09.033	09.034							
Bipolar reference	01.010												
Brake control	12.040 to 12.047		12.050	12.051									
Braking	10.011	10.010	10.030	10.031	06.001	02.004	02.002	10.012	10.039	10.040			
Catch a spinning motor	06.009	05.040											
Closed loop control	05.014												
Coast to stop	06.001												
Current controller	04.013	04.014											
Current feedback	04.001	04.002	04.017	04.004	04.020	04.024	04.026	10.008	10.009	10.017			
Current limits	04.005	04.006	04.007	04.018	04.015	04.019	04.016	05.007	05.010	10.008	10.009	10.017	
D.C. bus voltage	05.005	02.008											
D.C. injection braking	06.006	06.007	06.001										
Deceleration rates	02.020	02.021 to 02.029		02.004	02.035 to 02.037		02.002	02.008	06.001	10.030	10.031	10.039	02.009
Defaults	11.043	11.046											
Digital I/O read word	08.020												
Digital I/O 1	08.001	08.011	08.021	08.031	08.081	08.091	08.121						
Digital input 2	08.002	08.012	08.022	08.082	08.122								
Digital input 3	08.003	08.013	08.023	08.083	08.123								
Digital input 4	08.004	08.014	08.024	08.084	08.124								
Digital input 5	08.005	08.015	08.025	08.035	08.085	08.125							
Direction	10.013	06.030	06.031	01.003	10.014	02.001	03.002	08.003	08.004	10.040			
Drive active	10.002	10.040											
Drive OK	10.001	08.028	08.008	08.018	10.036	10.040							
Dynamic performance	05.026												
Enable	06.015	06.038											
Energy meter	06.016	06.017	06.024	06.025	06.026	06.027							
Energy Optimizer	05.013												
Error detection	10.037	10.038	10.020 to 10.029										
Error history	10.020 to 10.029		10.041 to 10.060		10.070 to 10.079								
Estimated frequency	03.002	03.003	03.004										
External error	10.032												
Fan speed	06.045												
PM Control field weakening	05.029	05.030	01.006	05.028	05.062	05.063	05.022						
Filter change	06.019	06.018	06.021	06.022	06.023								
Fire Mode	01.053	01.054											
Firmware version	11.029	11.035											
Frequency controller	03.010 to 03.017												
Frequency reference selection	01.014	01.015											
Frequency slaving	03.001	03.013	03.014	03.015	03.016	03.017	03.018						

Features	Related parameters												
Hard frequency reference	03.022	03.023											
Heavy duty rating	05.007	11.032											
I/O sequencer	06.004	06.030	06.031	06.032	06.033	06.034	06.042	06.043	06.041				
Inertia compensation	02.038	04.022	03.018										
Jog reference	01.005	02.019	02.029										
Keypad reference	01.017	01.014	01.043	01.051	06.012	06.013							
Limit switches	06.035	06.036											
Logic function 1	09.001	09.004	09.005	09.006	09.007	09.008	09.009	09.010					
Logic function 2	09.002	09.014	09.015	09.016	09.017	09.018	09.019	09.020					
Maximum speed	01.006												
Minimum speed	01.007	10.004											
Motor rating data	05.006	05.007	05.008	05.009	05.010	05.011							
Motorized potentiometer	09.021	09.022	09.023	09.024	09.025	09.026	09.027	09.028	09.003				
Motor stability optimizer	05.019												
Offset reference	01.004	01.038	01.009										
Operating mode	11.031	05.014											
Output	05.001	05.002	05.003	05.004									
Over frequency threshold	03.008												
Power up parameter	11.022												
Preset speeds	01.015	01.021 to 01.028		01.014	01.042	01.045 to 01.047		01.050					
Programmable logic	Menu 9												
Ramp (accel / decel) mode	02.004	02.008	06.001	02.002	02.003	10.030	10.031	10.039					
Reference selection	01.014	01.015	01.049	01.050	01.001								
Regenerating	10.010	10.011	10.030	10.031	06.001	02.004	02.002	10.012	10.039	10.040			
Relay output	08.008	08.018	08.028										
Reset	10.001	10.033	10.034	10.035	10.036	10.038							
Resistance compensation	05.014	05.017	05.088										
S ramp	02.006	02.007	02.040	02.045									
Sample rates	05.018												
Security code	11.030	11.044											
Serial comms	11.023 to 11.027		11.099	11.020									
Skip references	01.029	01.030	01.031	01.032	01.033	01.034	01.035						
Slip compensation	05.027	05.008											
Status word	10.040												
Supply	05.005	06.003	06.048	06.051	06.059								
Supply loss	06.003	10.015	10.016	05.005	06.046	06.048	06.051						
Switching frequency	05.018	05.035	05.037	05.038									
Thermal protection - drive	05.018	05.035	07.004	07.005	07.035	10.018							
Thermal protection - motor	04.015	05.007	04.019	04.016	04.025	08.035							
Thermistor input	07.046	07.047	07.048	07.049	07.050	08.035							
Threshold detector 1	12.001	12.003 to 12.007											
Threshold detector 2	12.002	12.023 to 12.027											
Time - filter change	06.019	06.018	06.021	06.022	06.023								
Time - powered up log	06.020	06.019	06.017	06.018	06.084								
Time - run log	06.019	06.017	06.018	06.084									
Torque	04.003	04.026	05.032										
Torque mode	04.008	04.011											

Features	Related parameters												
Under voltage	05.005	10.016	10.015	10.068									
V to F	05.015	05.014	05.074	05.075									
Variable selector 1	12.008 to 12.016												
Variable selector 2	12.028 to 12.036												
Voltage controller	05.031												
Voltage rating	11.033	05.009	05.005										
Voltage supply	05.005												
Warning	10.019	10.012	10.017	10.018	10.040								
Zero frequency indicator bit	03.005	10.003											

10.1 Menu 1: Frequency reference

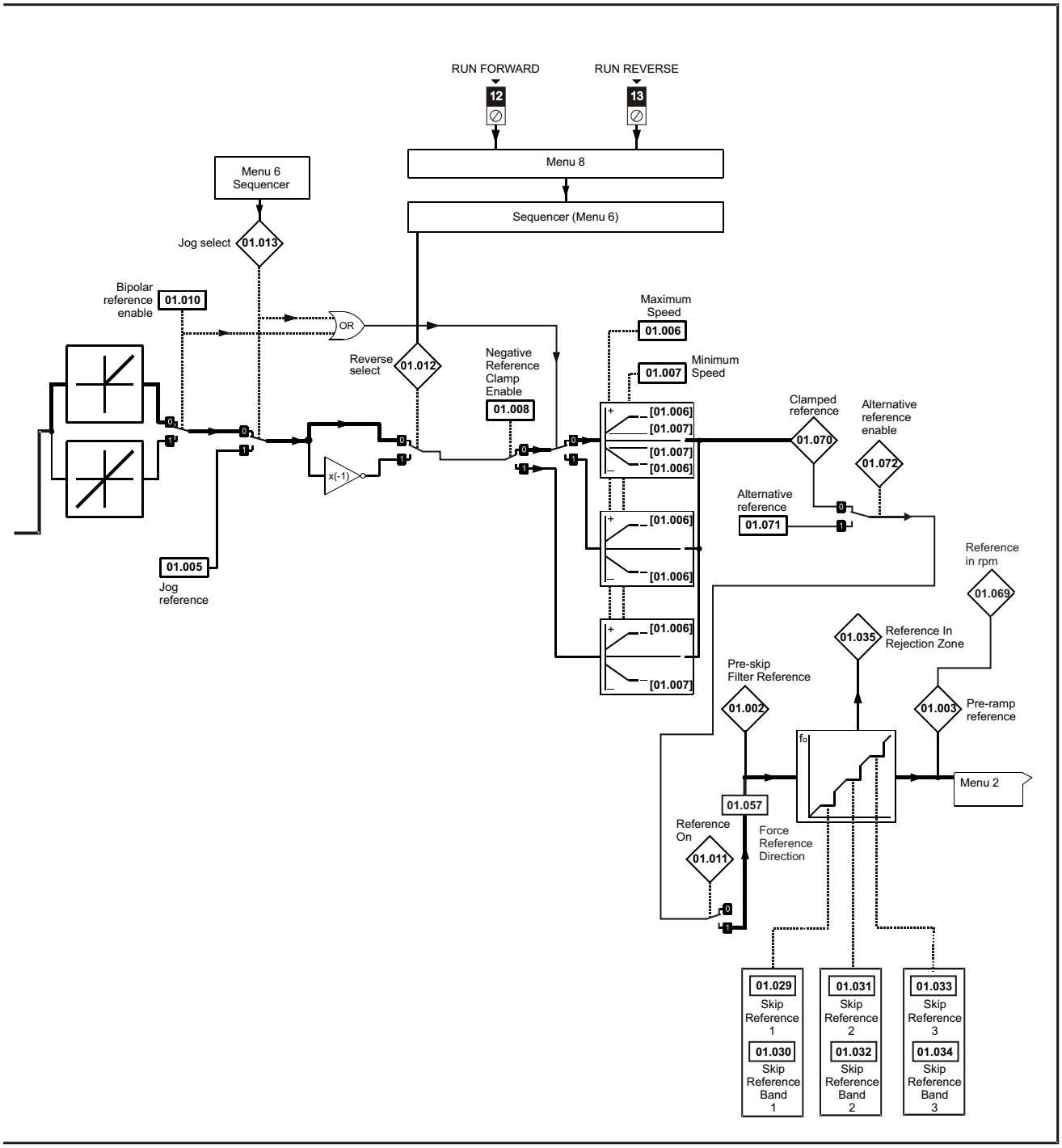
Figure 10-1 Menu 1 logic diagram



Pr **01.049**	Pr **01.050**	**Reference being used**
1	1	Analog Reference 1
1	>1	Preset Reference defined by Pr **01.050**
2	1	Analog Reference 2
2	>1	Preset Reference defined by Pr **01.050**
3	x	Preset Reference defined by Pr **01.050**
4	x	Keypad Control Mode Reference (01.017)
5	x	Reserved
6	x	Keypad Control Mode Reference (01.017)

** Contolled by drive configuration (Pr **11.034**)

The parameters are all shown in their default settings


RUN FORWARD
12
RUN REVERSE
13
Menu 8
Sequencer (Menu 6)
Menu 6 Sequencer
Jog select 01.013
Bipolar reference enable 01.010
OR
Reverse select 01.012
Negative Reference Clamp Enable 01.008
Maximum Speed 01.006
Minimum Speed 01.007
[01.006]
[01.007]
[01.007]
[01.006]
[01.006]
[01.006]
[01.006]
[01.007]
x(-1)
01.005 Jog reference
Clamped reference 01.070
Alternative reference enable 01.072
Alternative reference 01.071
Reference in rpm 01.069
01.035 Reference In Rejection Zone
Pre-skip Filter Reference 01.002
01.003 Pre-ramp reference
Menu 2
01.057
Reference On 01.011
Force Reference Direction
01.029 Skip Reference 1
01.030 Skip Reference Band 1
01.031 Skip Reference 2
01.032 Skip Reference Band 2
01.033 Skip Reference 3
01.034 Skip Reference Band 3

Parameter		Range	Default	Type					
P01.001	Reference Selected	± Maximum Frequency Limit Hz *		RO	Num	ND	NC	PT	
P01.002	Pre-skip Filter Reference	± Maximum Frequency Limit Hz *		RO	Num	ND	NC	PT	
P01.003	Ramp Input	± Maximum Frequency Limit Hz *		RO	Num	ND	NC	PT	
P01.004	Reference Offset	± Maximum Frequency Limit Hz *	0.00 Hz	RW	Num				US
P01.005	Jog Frequency	0.00 to 300.00 Hz	1.50 Hz	RW	Num				US
P01.006	Maximum Frequency Limit	0.00 to 599.00 Hz (HS30 PM 1000 Hz)	150.00 Hz	RW	Num				US
P01.007	Minimum Frequency Limit	0.00 to Maximum Frequency Limit Hz **	0.00 Hz	RW	Num				US
P01.008	Negative Frequency Limit Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
P01.009	Reference Offset Select	Percentage Trim of Reference (trinn) (0) Reference Offset(Add) (1) Percentage Trim of Limit (2) (2)	Percentage Trim of Reference (trinn) (0)	RW	Num				US
P01.010	Bipolar Reference Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
P01.011	Reference On	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P01.012	Reverse Select	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P01.013	Jog Select	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P01.014	Reference Selector	Analog 1/Analog 2 FLAGS(FLA95) (0), Analog 1/Presets (A1.Pr) (1), Analog 2/Presets(A2.Pr) (2), Presets(PrESEt) (3), Keypad (with Run/Stop) (PAd) (4), Keypad (Reference Only)(PAd.rEF) (6)	Analog 1/Analog 2 FLAGS (0)	RW	Txt				US
P01.015	Preset Selector	Preset Bits FLAGS(FLA95) (0) Preset 1 to 8 (1 to 8) Timer (9)	Preset Bits FLAGS (0)	RW	Num				US
P01.016	Preset Selector Timer	0 to 400.0 s	10.0 s	RW	Num				US
P01.017	Keypad Control Reference	± Maximum Frequency Limit Hz *		RO	Num		NC	PT	PS
P01.021	Preset Reference 1	± Maximum Frequency Limit Hz *	0.00 Hz	RW	Num				US
P01.022	Preset Reference 2	± Maximum Frequency Limit Hz *	0.00 Hz	RW	Num				US
P01.023	Preset Reference 3	± Maximum Frequency Limit Hz *	0.00 Hz	RW	Num				US
P01.024	Preset Reference 4	± Maximum Frequency Limit Hz *	0.00 Hz	RW	Num				US
P01.025	Preset Reference 5	± Maximum Frequency Limit Hz *	0.00 Hz	RW	Num				US
P01.026	Preset Reference 6	± Maximum Frequency Limit Hz *	0.00 Hz	RW	Num				US
P01.027	Preset Reference 7	± Maximum Frequency Limit Hz *	0.00 Hz	RW	Num				US
P01.028	Preset Reference 8	± Maximum Frequency Limit Hz *	0.00 Hz	RW	Num				US
P01.029	Skip Reference 1	0.00 to maximum frequency limit Hz (HS30 PM 0.0 to 1000.00 Hz)	0.00 Hz	RW	Num				US
P01.030	Skip Reference Band 1	0.00 to 25.00 Hz	0.50 Hz	RW	Num				US
P01.031	Skip Reference 2	0.00 to maximum frequency limit Hz (HS30 PM 0.0 to 1000.00 Hz)	0.00 Hz	RW	Num				US
P01.032	Skip Reference Band 2	0.00 to 25.00 Hz	0.50 Hz	RW	Num				US
P01.033	Skip Reference 3	0.00 to maximum frequency limit Hz (HS30 PM 0.0 to 1000.00 Hz)	0.00 Hz	RW	Num				US
P01.034	Skip Reference Band 3	0.00 to 25.00 Hz	0.50 Hz	RW	Num				US
P01.035	Reference In Rejection Zone	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P01.036	Analog Reference 1	± Maximum Frequency Limit Hz *		RO	Num		NC		
P01.037	Analog Reference 2	± Maximum Frequency Limit Hz *		RO	Num		NC		
P01.038	Percentage Trim	± 100.00 %	0.00 %	RW	Num		NC		
P01.041	Reference Select Flag 1	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P01.042	Reference Select Flag 2	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P01.043	Reference Select Flag 3	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P01.045	Preset Select Flag 1	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P01.046	Preset Select Flag 2	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P01.047	Preset Select Flag 3	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P01.048	Preset Selector Timer Reset	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P01.049	Reference Selected Indicator	1 to 6		RO	Num	ND	NC	PT	
P01.050	Preset Selected Indicator	1 to 8		RO	Num	ND	NC	PT	
P01.051	Keypad Control Configuration	Reset (0), Last (1), Preset (2)	Reset (0)	RW	Txt				US
P01.053	Fire Mode Reference	± Maximum Frequency Limit Hz *	0.00 Hz	RW	Num				US
P01.054	Fire Mode Activate	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P01.057	Force Reference Direction	None (0), Forward (1), Reverse (2)	None (0)	RW	Txt				
P01.069	Reference in rpm	± 36000.0 rpm (HS30 PM ±60000 rpm)		RO	Num	ND	NC	PT	
P01.070	Clamped Reference	± Maximum Frequency Limit Hz *		RO	Num	ND	NC	PT	
P01.071	Alternative Reference	± Maximum Frequency Limit Hz *	0.00 Hz	RW	Num		NC	PT	
P01.072	Alternative Reference Enable	Off (0) or On (1)		RO	Bit	ND	NC	PT	

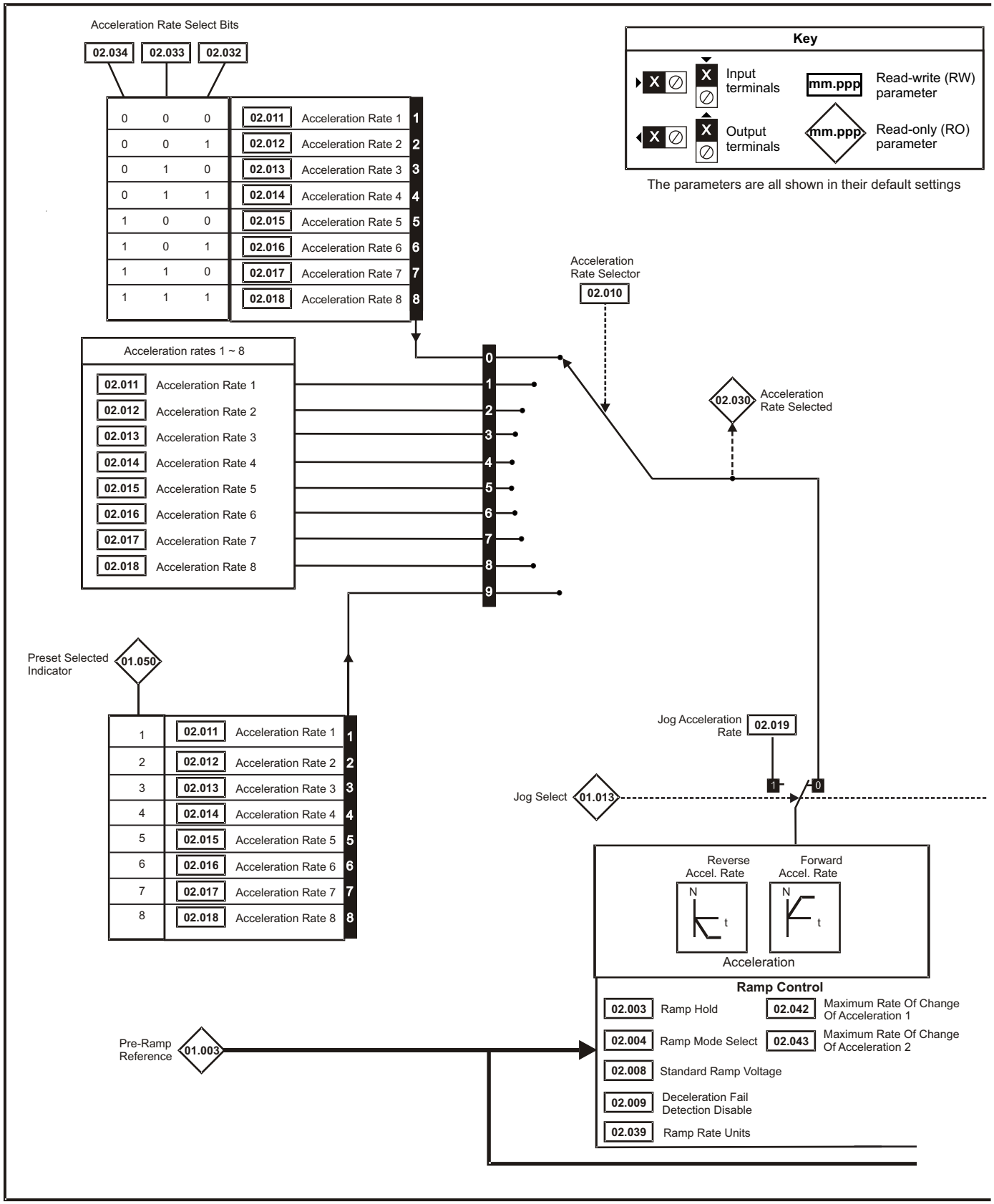
* If the absolute value of *Minimum Frequency Limit* (**P01.007**) is larger than the *Maximum Frequency Limit* (**P01.006**) the range is - **P01.007** to **P01.006** Hz.

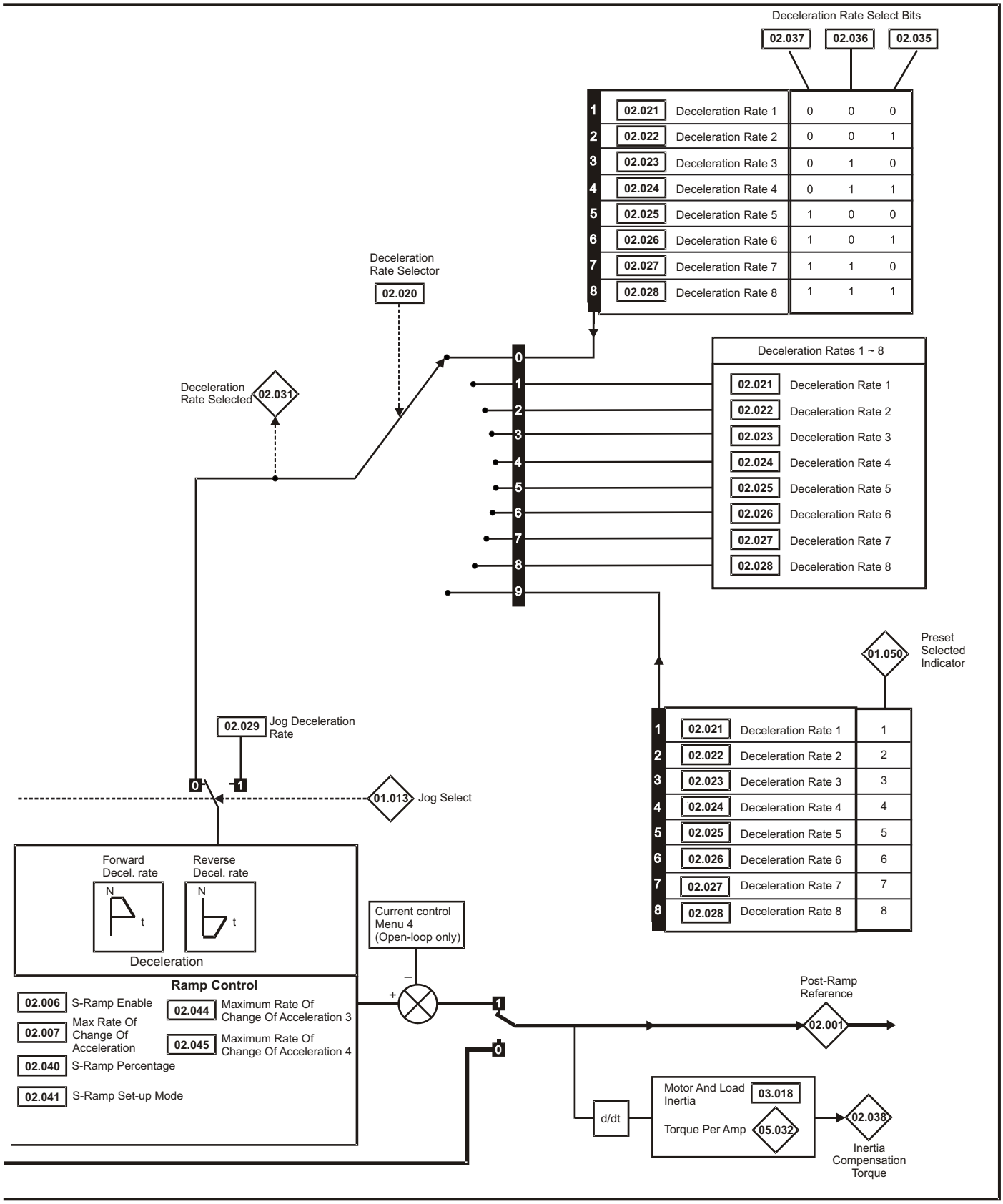
** If *Negative Minimum Limit Enable* (**P01.008**) = On (1), the range is -599.00 to *Maximum Frequency Limit* (**P01.006**) Hz.

RW	Read / Write	RO	Read only	Num	Number parameter	Bit	Bit parameter	Txt	Text string	Bin	Binary parameter	FI	Filtered
ND	No default value	NC	Not copied	PT	Protected parameter	RA	Rating dependent	US	User save	PS	Power-down save	DE	Destination

10.2 Menu 2: Ramps

Figure 10-2 Menu 2 logic diagram




Deceleration Rate Select Bits
02.037
02.036
02.035
1 02.021 Deceleration Rate 1 0 0 0
2 02.022 Deceleration Rate 2 0 0 1
3 02.023 Deceleration Rate 3 0 1 0
4 02.024 Deceleration Rate 4 0 1 1
5 02.025 Deceleration Rate 5 1 0 0
6 02.026 Deceleration Rate 6 1 0 1
7 02.027 Deceleration Rate 7 1 1 0
8 02.028 Deceleration Rate 8 1 1 1
Deceleration Rate Selector
02.020
Deceleration Rate Selected
02.031
0
1
2
3
4
5
6
7
8
9
Deceleration Rates 1 ~ 8
02.021 Deceleration Rate 1
02.022 Deceleration Rate 2
02.023 Deceleration Rate 3
02.024 Deceleration Rate 4
02.025 Deceleration Rate 5
02.026 Deceleration Rate 6
02.027 Deceleration Rate 7
02.028 Deceleration Rate 8
01.050
Preset Selected Indicator
1 02.021 Deceleration Rate 1 1
2 02.022 Deceleration Rate 2 2
3 02.023 Deceleration Rate 3 3
4 02.024 Deceleration Rate 4 4
5 02.025 Deceleration Rate 5 5
6 02.026 Deceleration Rate 6 6
7 02.027 Deceleration Rate 7 7
8 02.028 Deceleration Rate 8 8
02.029 Jog Deceleration Rate
01.013 Jog Select
Forward Decel. rate
Reverse Decel. rate
N
t
Deceleration
Ramp Control
02.006 S-Ramp Enable
02.007 Max Rate Of Change Of Acceleration
02.040 S-Ramp Percentage
02.041 S-Ramp Set-up Mode
02.044 Maximum Rate Of Change Of Acceleration 3
02.045 Maximum Rate Of Change Of Acceleration 4
Current control Menu 4 (Open-loop only)
Post-Ramp Reference
02.001
d/dt
Motor And Load Inertia
03.018
Torque Per Amp
05.032
02.038
Inertia Compensation Torque

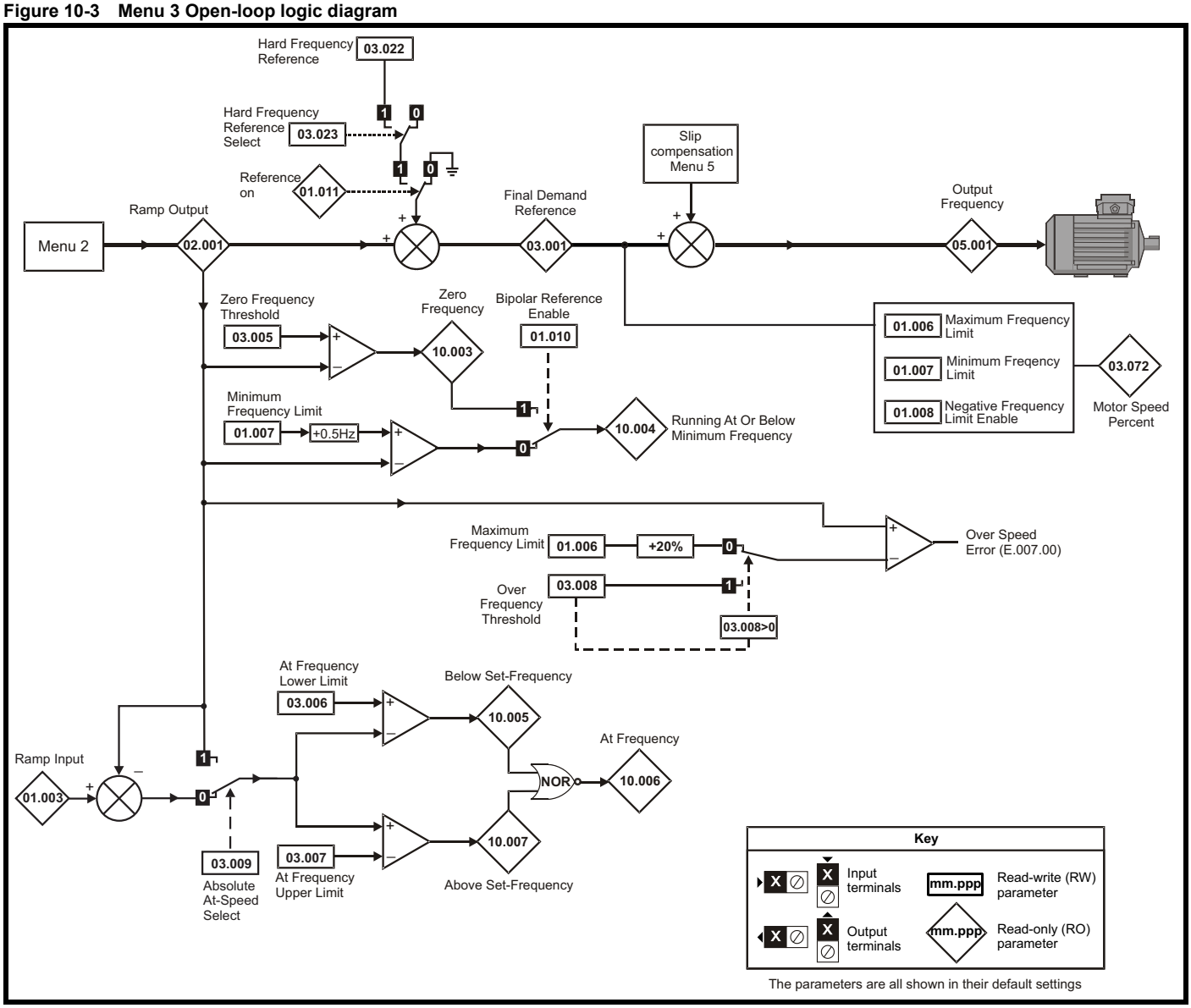
Parameter		Range	Default	Type					
P02.001	Ramp Output	± Maximum Frequency Limit Hz *		RO	Num	ND	NC	PT	
P02.002	Ramp Enable	Off (0) or On (1)	On (1)	RW	Bit				US
P02.003	Ramp Hold	Off (0) or On (1)	Off (0)	RW	Bit				US
P02.004	Deceleration Ramp Type	Fast (0), Standard (1), Standard + Boost (2), Fast + Boost (3)	Standard (1)	RW	Txt				US
P02.005	Disable Ramp Output	Off (0) or On (1)	Off (0)	RW	Bit				US
P02.006	S-Ramp Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
P02.007	Max Rate Of Change Of Acceleration	0.0 to 300.0 s²/100Hz	3.1 s²/100 Hz	RW	Num				US
P02.008	Standard Ramp Voltage	Drive Rating Dependent V	110 V drive: 375 V 200 V drive: 375 V 400 V drive 50 Hz: 750 V 400 V drive 60 Hz: 775 V 575 V drive: 895 V 690 V drive: 1075 V	RW	Num		RA		US
P02.009	Deceleration Fail Detection Disable	Off (0) or On (1)	Off (0)	RW	Bit				US
P02.010	Acceleration Rate Selector	Binary (0) Acceleration Rate 1 to 8 (1 to 8) Preset select (9)	Binary (0)	RW	Num				US
P02.011	Acceleration Rate 1	0.0 to 32000.0 s/Maximum Frequency	5.0 s/Maximum Frequency	RW	Num				US
P02.012	Acceleration Rate 2			RW	Num				US
P02.013	Acceleration Rate 3			RW	Num				US
P02.014	Acceleration Rate 4			RW	Num				US
P02.015	Acceleration Rate 5			RW	Num				US
P02.016	Acceleration Rate 6			RW	Num				US
P02.017	Acceleration Rate 7			RW	Num				US
P02.018	Acceleration Rate 8			RW	Num				US
P02.019	Jog Acceleration Rate	0.0 to 32000.0 s/Maximum Frequency	0.2 s/Maximum Frequency	RW	Num				US
P02.020	Deceleration Rate Selector	Binary (0) Deceleration Rate 1 to 8 (1 to 8) Preset select (9)	Binary (0)	RW	Num				US
P02.021	Deceleration Rate 1	0.0 to 32000.0 s/Maximum Frequency	10.0 s/Maximum Frequency	RW	Num				US
P02.022	Deceleration Rate 2			RW	Num				US
P02.023	Deceleration Rate 3			RW	Num				US
P02.024	Deceleration Rate 4			RW	Num				US
P02.025	Deceleration Rate 5			RW	Num				US
P02.026	Deceleration Rate 6			RW	Num				US
P02.027	Deceleration Rate 7			RW	Num				US
P02.028	Deceleration Rate 8			RW	Num				US
P02.029	Jog Deceleration Rate	0.0 to 32000.0 s/Maximum Frequency	0.2 s/Maximum Frequency	RW	Num				US
P02.030	Acceleration Rate Selected	1 to 8		RO	Num	ND	NC	PT	
P02.031	Deceleration Rate Selected	1 to 8		RO	Num	ND	NC	PT	
P02.032	Acceleration Rate Select Bit 0	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P02.033	Acceleration Rate Select Bit 1	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P02.034	Acceleration Rate Select Bit 2	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P02.035	Deceleration Rate Select Bit 0	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P02.036	Deceleration Rate Select Bit 1	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P02.037	Deceleration Rate Select Bit 2	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P02.038	Inertia Compensation Torque	±1000.0 %		RO	Num	ND	NC	PT	
P02.039	Ramp Rate Units	s/100 Hz(S-100) (0), s/(FuLL)Maximum Frequency(S-FuLL) (1), s/1000 Hz(S-1000) (2	s/(FuLL)Maximum Frequency (1)	RW	Num				US
P02.040	S Ramp Percentage	0.0 to 50.0 %	0.0 %	RW	Num				US
P02.041	S Ramp Set-up Mode	P02.007 (I rAtE) (0) P02.040 (PErCEN) (1) P02.042 to P02.044 (4 rAtE) (2)	P02.007 (I rAtE) (0)	RW	Num				US
P02.042	Maximum Rate Of Change Of Acceleration 1	0.0 to 300.0 s²/100 Hz	0.0 s²/100 Hz	RW	Num				US
P02.043	Maximum Rate Of Change Of Acceleration 2	0.0 to 300.0 s²/100 Hz	0.0 s²/100 Hz	RW	Num				US
P02.044	Maximum Rate Of Change Of Acceleration 3	0.0 to 300.0 s²/100 Hz	0.0 s²/100 Hz	RW	Num				US
P02.045	Maximum Rate Of Change Of Acceleration 4	0.0 to 300.0 s²/100 Hz	0.0 s²/100 Hz	RW	Num				US

* If the absolute value of *Minimum Frequency Limit* (**P01.007**) is larger than the *Maximum Frequency Limit* (**P01.006**) the range is - **P01.007** to **P01.006** Hz.

RW	Read / Write	RO	Read only	Num	Number parameter	Bit	Bit parameter	Txt	Text string	Bin	Binary parameter	FI	Filtered
ND	No default value	NC	Not copied	PT	Protected parameter	RA	Rating dependent	US	User save	PS	Power-down save	DE	Destination

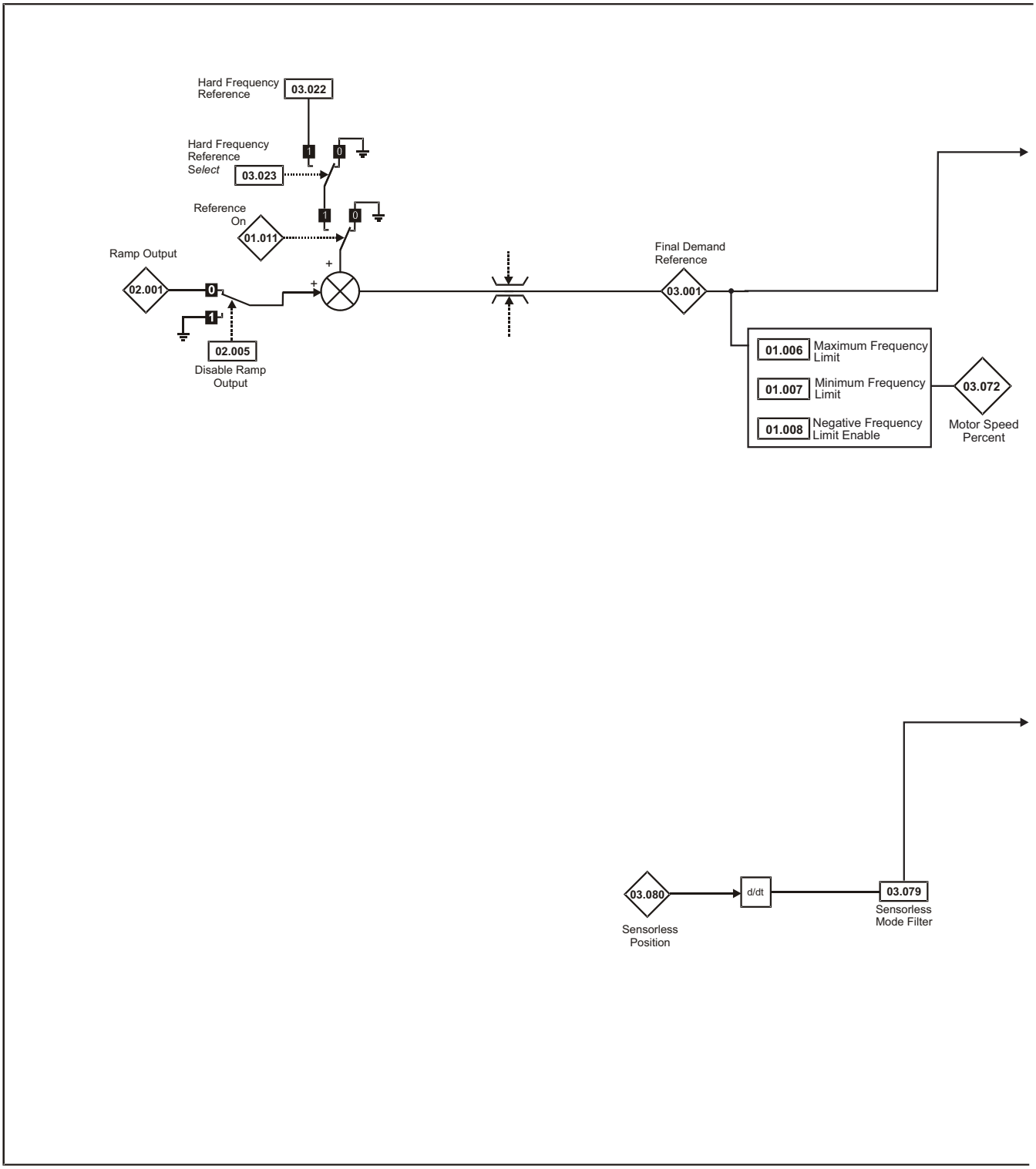
10.3 Menu 3: Frequency control

Figure 10-3 Menu 3 Open-loop logic diagram



The parameters are all shown in their default settings

Figure 10-4 Menu 3 Closed-loop logic diagram



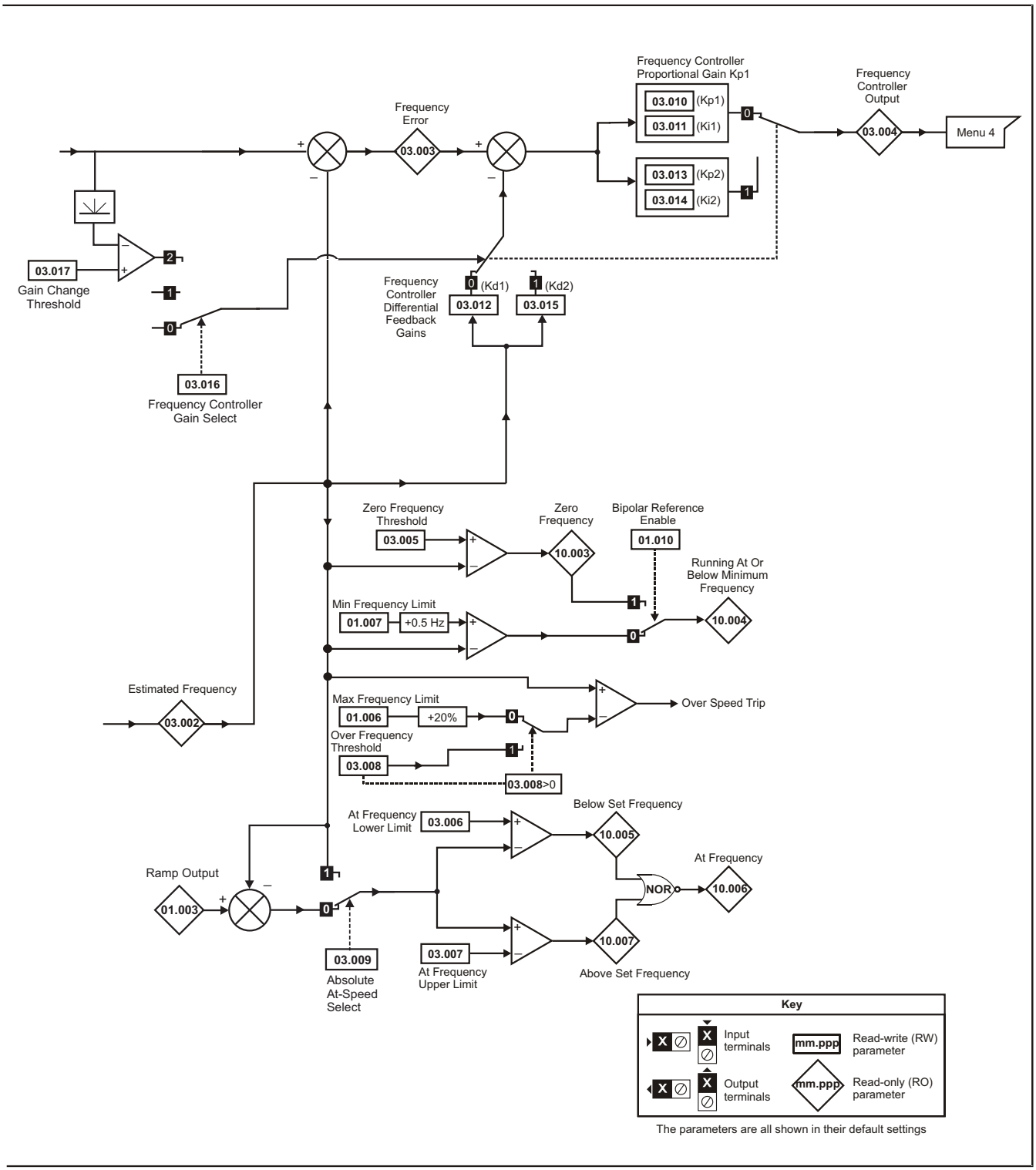
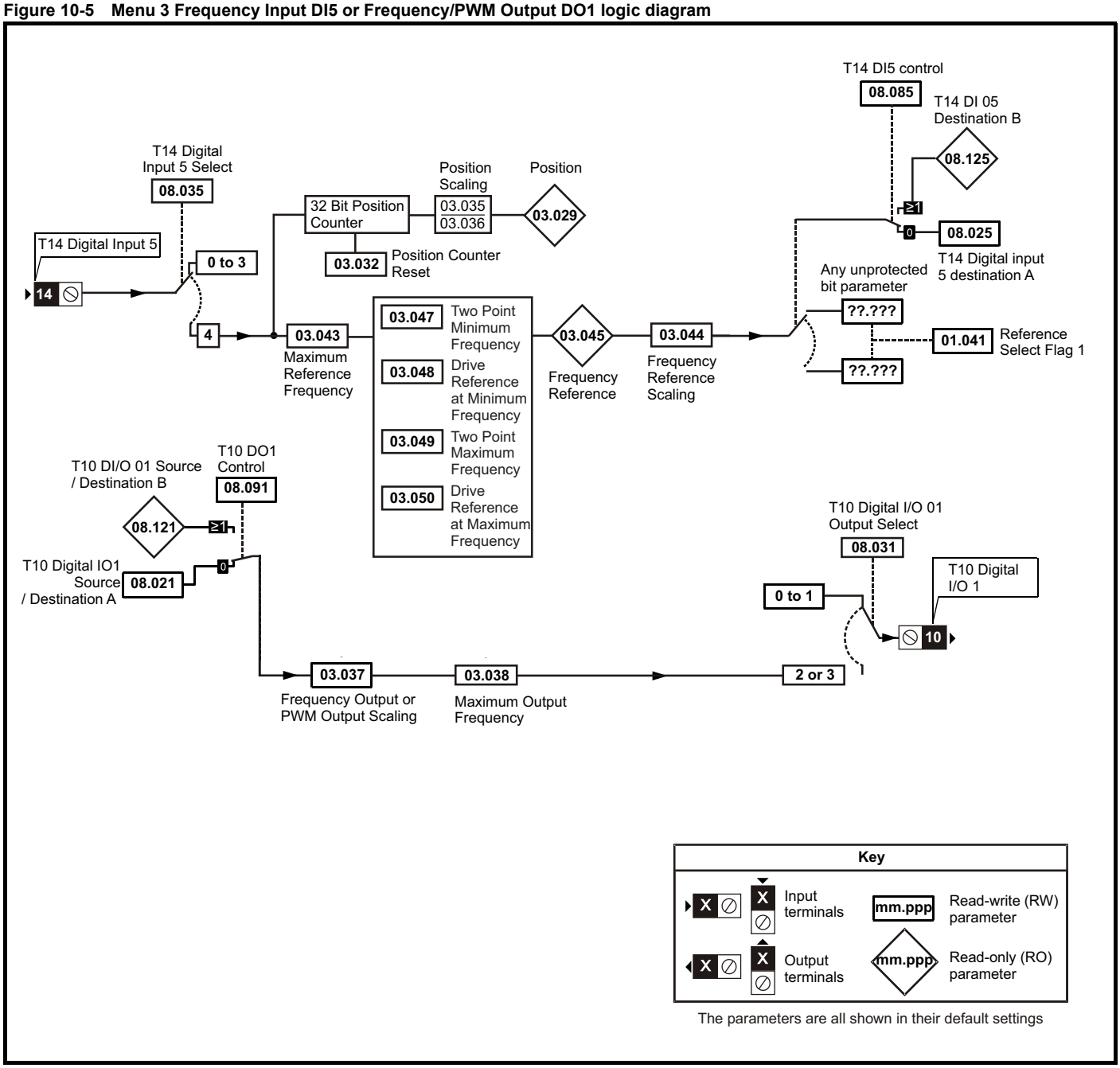

Frequency Controller Proportional Gain Kp1
03.010 (Kp1)
03.011 (Ki1)
03.013 (Kp2)
03.014 (Ki2)
Frequency Controller Output
03.004
Menu 4
Frequency Error
03.003
03.017
Gain Change Threshold
03.016
Frequency Controller Gain Select
Frequency Controller Differential Feedback Gains
03.012 (Kd1)
03.015 (Kd2)
Zero Frequency Threshold
03.005
Zero Frequency
10.003
Bipolar Reference Enable
01.010
Running At Or Below Minimum Frequency
10.004
Min Frequency Limit
01.007
+0.5 Hz
Estimated Frequency
03.002
Max Frequency Limit
01.006
+20%
Over Speed Trip
Over Frequency Threshold
03.008
03.008>0
At Frequency Lower Limit
03.006
Below Set Frequency
10.005
At Frequency
10.006
NOR
Ramp Output
01.003
03.009
Absolute At-Speed Select
03.007
At Frequency Upper Limit
10.007
Above Set Frequency
Key
Input terminals
Output terminals
mm.ppp
Read-write (RW) parameter
Read-only (RO) parameter
The parameters are all shown in their default settings

Figure 10-5 Menu 3 Frequency Input DI5 or Frequency/PWM Output DO1 logic diagram



The parameters are all shown in their default settings

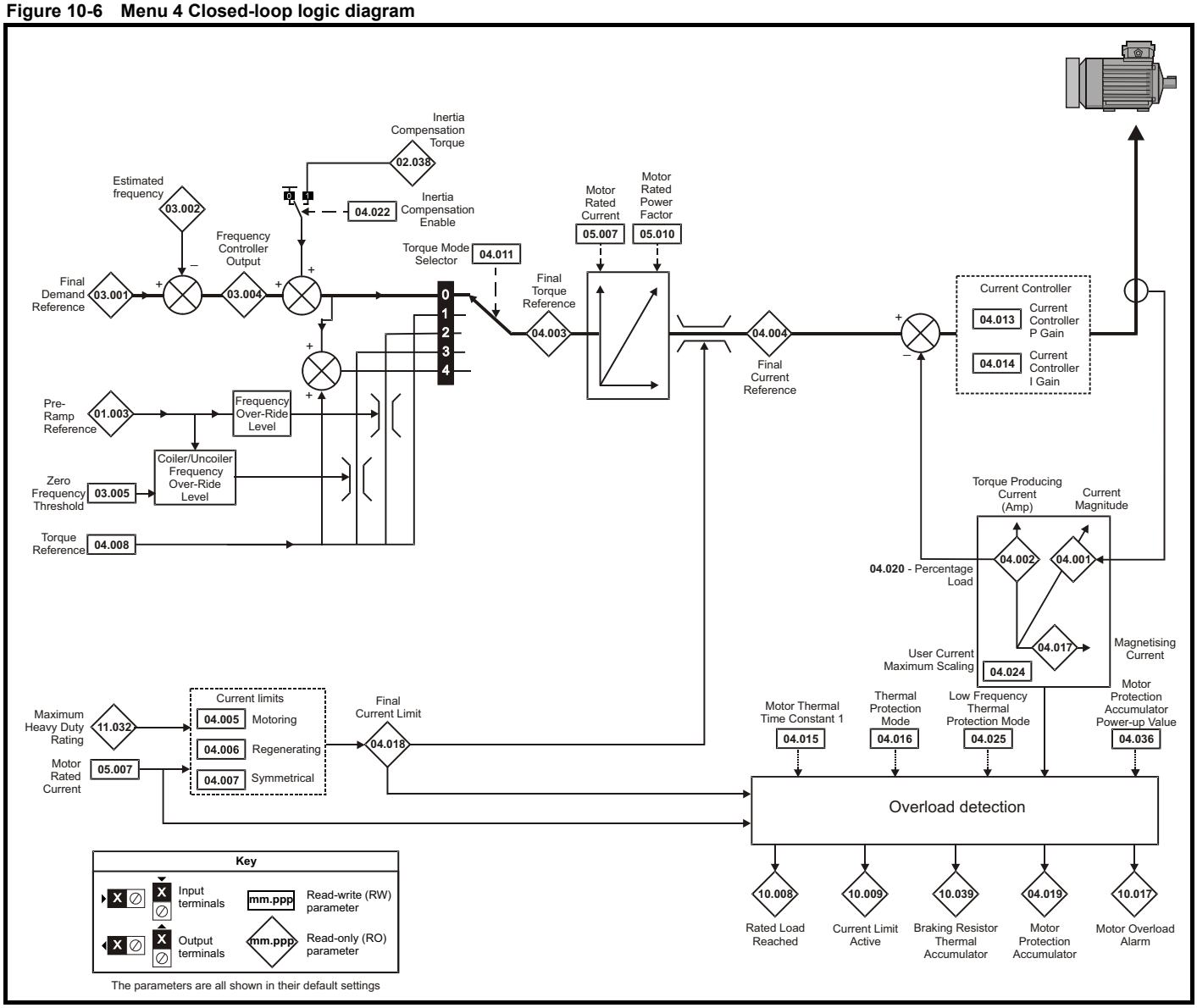
Parameter		Range	Default	Type					
P03.001	Final Demand Reference	± Maximum Frequency Limit Hz *		RO	Num	ND	NC	PT	FI
P03.002	Estimated Frequency	± Maximum Frequency Limit Hz *		RO	Num	ND	NC	PT	FI
P03.003	Frequency Error	± Maximum Frequency Limit Hz *		RO	Num	ND	NC	PT	FI
P03.004	Frequency Controller Output	± Torque Current Maximum Limit %		RO	Num	ND	NC	PT	FI
P03.005	Zero Frequency Threshold	0.00 to 20.00 Hz	2.00 Hz	RW	Num				US
P03.006	At Frequency Lower Limit	0.00 to 599.00 Hz (HS30 PM 1000 Hz)	1.00 Hz	RW	Num				US
P03.007	At Frequency Upper Limit	0.00 to 599.00 Hz (HS30 PM 1000 Hz)	1.00 Hz	RW	Num				US
P03.008	Over Frequency Threshold	0.00 to 599.00 Hz (HS30 PM 1000 Hz)	0.00 Hz	RW	Num				US
P03.009	Absolute At Frequency Select	Off (0) or On (1)	Off (0)	RW	Bit				US
P03.010	Frequency Controller Proportional Gain Kp1	0.000 to 200.000 s/rad	0.030 s/rad	RW	Num				US
P03.011	Frequency Controller Integral Gain Ki1	0.00 to 655.35 s²/rad	0.10 s²/rad	RW	Num				US
P03.012	Frequency Controller Differential Feedback Gain Kd1	0.00000 to 0.65535 1/rad	0.00000 1/rad	RW	Num				US
P03.013	Frequency Controller Proportional Gain Kp2	0.000 to 200.000 s/rad	0.030 s/rad	RW	Num				US
P03.014	Frequency Controller Integral Gain Ki2	0.00 to 655.35 s²/rad	0.10 s²/rad	RW	Num				US
P03.015	Frequency Controller Differential Feedback Gain Kd2	0.00000 to 0.65535 1/rad	0.00000 1/rad	RW	Num				US
P03.016	Frequency Controller Gain Select	Gain Set 1 (0) Gain Set 2 (1) Change at Threshold (2)	Gain Set 1 (0)	RW	Num				US
P03.017	Gain Change Threshold	0.00 to 599.00 Hz (HS30 PM 1000 Hz)	0.00 Hz	RW	Num				FI
P03.018	Motor and Load Inertia	0.000 to 999.999 kgm²	0.000 kgm²	RW	Num				US
P03.022	Hard Frequency Reference	± Maximum Frequency Limit Hz *	0.00 Hz	RW	Num				US
P03.023	Hard Frequency Reference Select	Off (0) or On (1)	Off (0)	RW	Bit				US
P03.029	T14 Position	0 to 65535		RO	Num	ND	NC	PT	FI
P03.032	T14 Position Counter Reset	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P03.035	T14 Position Scaling Numerator	0.000 to 1.000	1.000	RW	Num				US
P03.036	T14 Position Scaling Denominator	0.000 to 100.000	1.000	RW	Num				US
P03.037	T10 Frequency/PWM Output Scaling	0.000 to 4.000	1.000	RW	Num				US
P03.038	T10 Frequency Output Maximum	1 (0), 2 (1), 5 (2), 10 (3) kHz	5 (2) kHz	RW	Txt				US
P03.042	T14 Frequency Input High Precision Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
P03.043	T14 Frequency Input Maximum	0.00 to 100.00 kHz	10.00 kHz	RW	Num				US
P03.044	T14 Frequency Input Scaling	0.000 to 4.000	1.000	RW	Num				US
P03.045	T14 Frequency Input Percentage	0.00 to 100.00 %		RO	Num	ND	NC	PT	FI
P03.047	T14 Frequency Input Minimum Input	0.00 to 100.00 %	0.00 %	RW	Num				US
P03.048	T14 Frequency Input Percentage at Minimum Input	0.00 to 100.00 %	0.00 %	RW	Num				US
P03.049	T14 Frequency Input Maximum Input	0.00 to 100.00 %	100.00 %	RW	Num				US
P03.050	T14 Frequency Input Percentage at Maximum Input	0.00 to 100.00 %	100.00 %	RW	Num				US
P03.072	Motor Speed Percent	± 150.0 %		RO		ND	NC	PT	FI
P03.079	Sensorless Mode Filter	4 (0), 5 (1), 6 (2), 8 (3), 12 (4), 20 (5) ms	8 (3) ms	RW	Txt				US
P03.080	Sensorless Position	0 to 65535		RO	Num	ND	NC	PT	

* If the absolute value of *Minimum Frequency Limit* (**P01.007**) is larger than the *Maximum Frequency Limit* (**P01.006**) the range is - P01.007 to P01.006 Hz.

RW	Read / Write	RO	Read only	Num	Number parameter	Bit	Bit parameter	Txt	Text string	Bin	Binary parameter	FI	Filtered
ND	No default value	NC	Not copied	PT	Protected parameter	RA	Rating dependent	US	User save	PS	Power-down save	DE	Destination

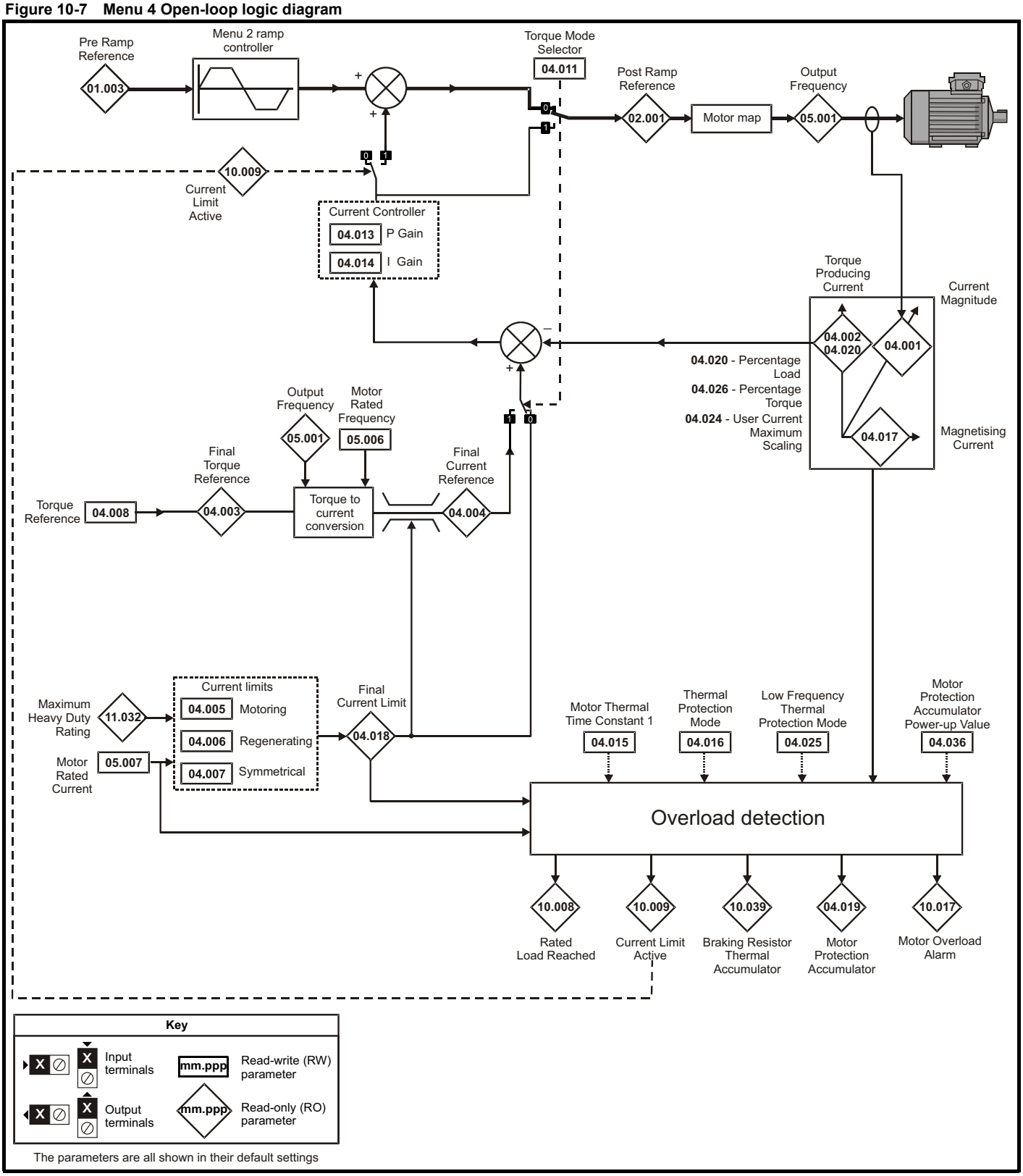
10.4 Menu 4: Torque and current control

Figure 10-6 Menu 4 Closed-loop logic diagram



The parameters are all shown in their default settings

Figure 10-7 Menu 4 Open-loop logic diagram



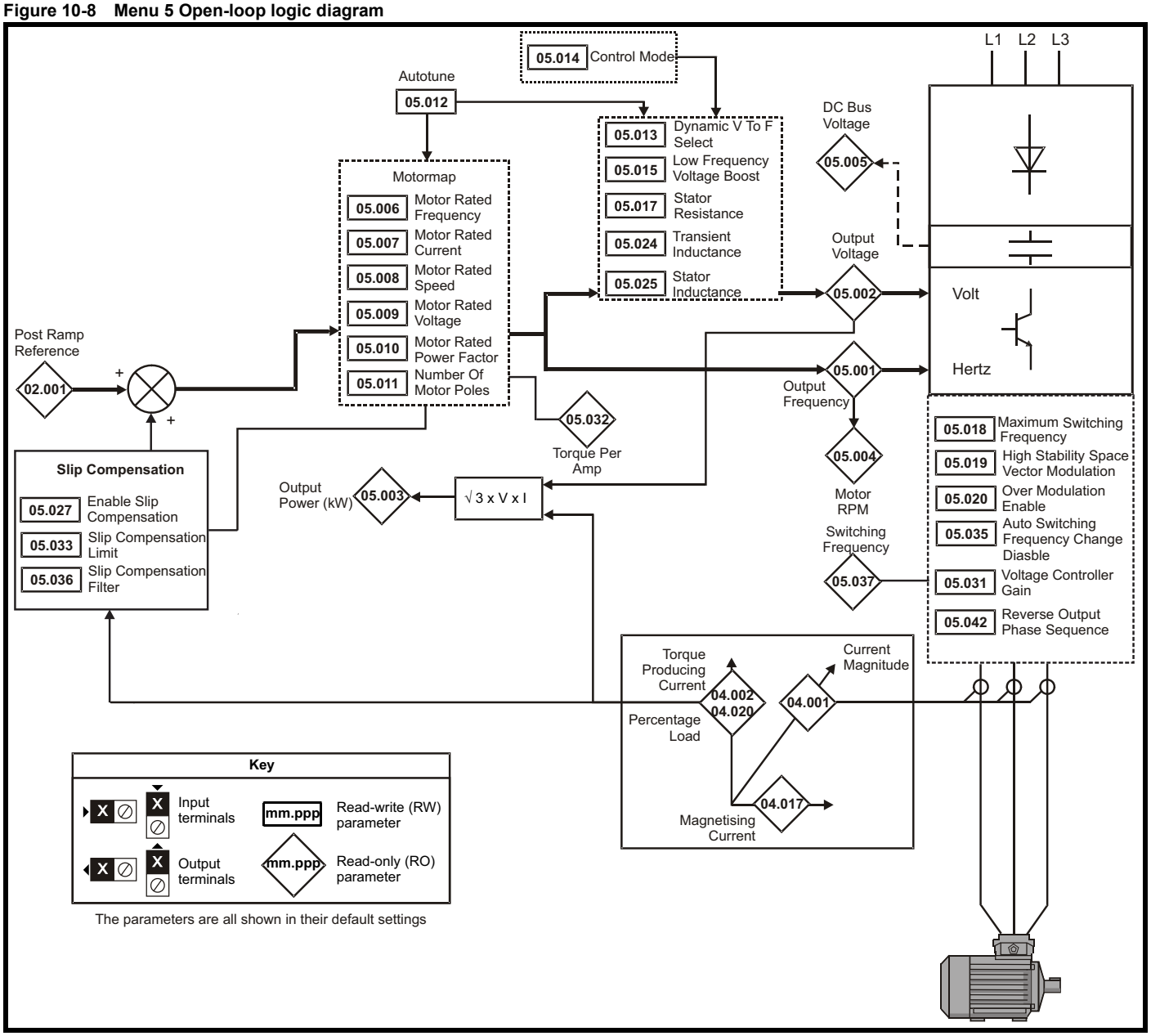
Parameter		Range	Default	Type					
P04.001	Current Magnitude	0 to Drive Maximum Current A		RO	Num	ND	NC	PT	FI
P04.002	Torque Producing Current	± Drive Maximum Current A		RO	Num	ND	NC	PT	FI
P04.003	Final Torque Reference	± Torque Current Maximum Limit %		RO	Num	ND	NC	PT	FI
P04.004	Final Current Reference	± Torque Current Maximum Limit %		RO	Num	ND	NC	PT	FI
P04.005	Motoring Current Limit	0.0 to Torque Current Maximum Limit	Rating Dependent	RW	Num		RA		US
P04.006	Regenerating Current Limit	0.0 to Torque Current Maximum Limit	Rating Dependent	RW	Num		RA	US	
P04.007	Symmetrical Current Limit	0.0 to Torque Current Maximum Limit	Rating Dependent	RW	Num		RA		US
P04.008	Torque Reference	± User Current Maximum Scaling (**P04.024**) %	0.0 %	RW	Num				US
P04.011	Torque Mode Selector	Frequency Control (0) Torque Control (1) TC with Frequency Override (2) Coiler/Uncoiler (3) FC with Torque Feed-forward (4) Bi-direction TC (5) *	Frequency Control (0)	RW	Num				US
P04.013	Current Controller Kp Gain	0.00 to 4000.00	40.00	RW	Num				US
P04.014	Current Controller Ki Gain	0.000 to 600.000	20.000	RW	Num				US
P04.015	Motor Thermal Time Constant	1 to 3000 s	179 s	RW	Num				US
P04.016	Thermal Protection Action	Both Error (0), Motor Limiting (1), Drive Limiting (2), Both Limiting (3), Drive Error Only (4), Drive Limit Only (6)	Both Error 0 (0)	RW	Bin				US
P04.017	Magnetising Current	0 to Drive Maximum Current A		RO	Num	ND	NC	PT	FI
P04.018	Torque Current Limit	VM_TORQUE_CURRENT %		RO	Num	ND	NC	PT	
P04.019	Motor Protection Percentage	0.0 to 100.0 %		RO	Num	ND	NC	PT	PS
P04.020	Percentage Load	VM_USER_CURRENT %		RO	Num	ND	NC	PT	FI
P04.022	Inertia Compensation Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
P04.024	User Current Maximum Scaling	0.0 to Torque Current Maximum Limit	Rating Dependent	RW	Num		RA		US
P04.025	Low Frequency Thermal Protection Enable	Off (0) or On (1)	Off (0)	RW	Num				US
P04.026	Percentage Torque	± User Current Maximum Scaling %		RO	Num	ND	NC	PT	FI
P04.036	Motor Protection Accumulator Power-up Value	Power Down (Pr.dn) (0) Zero (0) (1) Real Time (rEAL t) (2)	Power Down (Pr.dn) (0)	RW	Txt				US

* Range limited from 0 to 1 in *Motor Control Mode* (**P05.014**) is set to an open-loop control mode.

RW	Read / Write	RO	Read only	Num	Number parameter	Bit	Bit parameter	Txt	Text string	Bin	Binary parameter	FI	Filtered
ND	No default value	NC	Not copied	PT	Protected parameter	RA	Rating dependent	US	User save	PS	Power-down save	DE	Destination

10.5 Menu 5: Motor control

Figure 10-8 Menu 5 Open-loop logic diagram



The parameters are all shown in their default settings

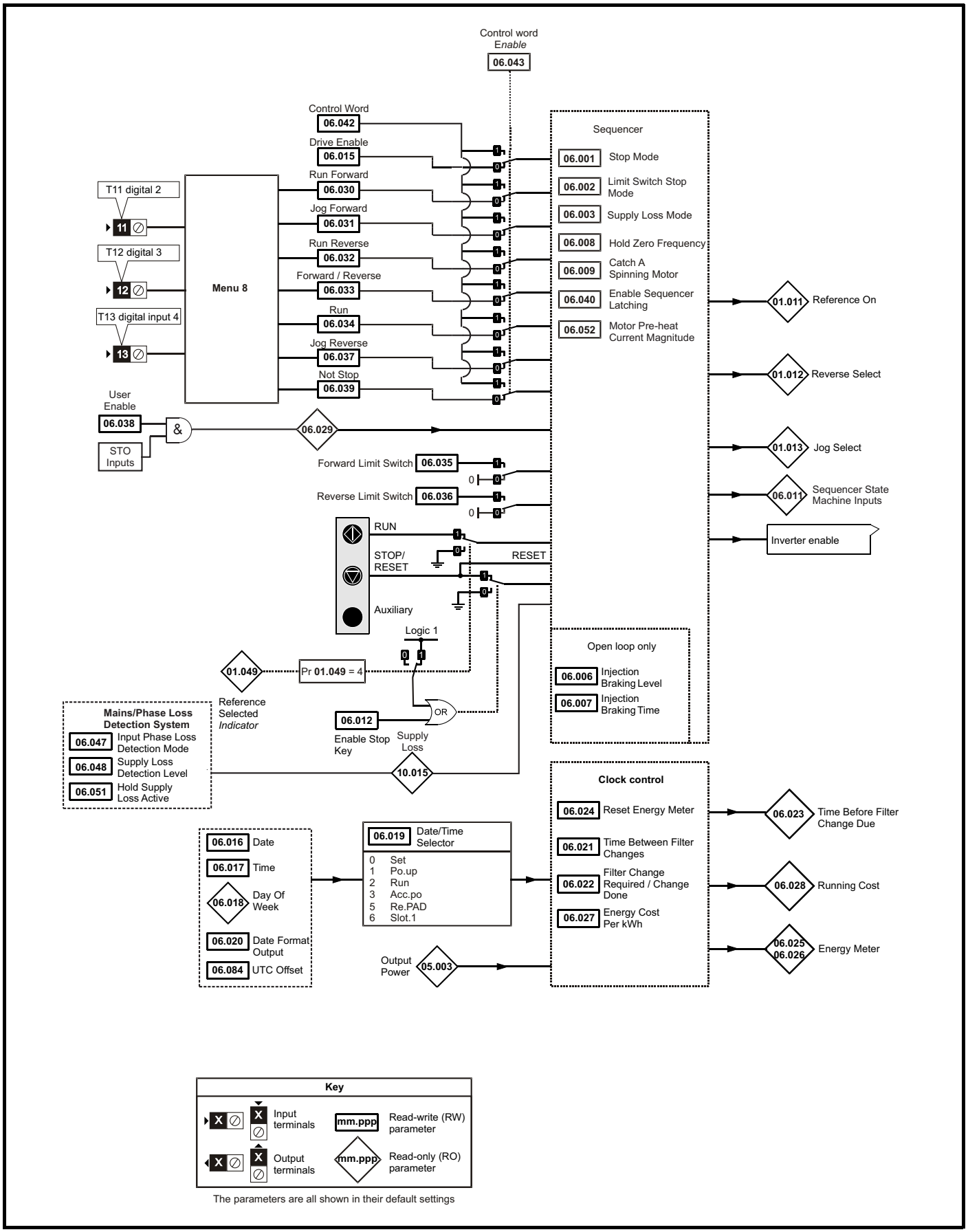
Parameter		Range	Default	Type					
P05.001	Output Frequency	± 599.00 Hz (HS30 PM 1000 Hz)		RO	Num	ND	NC	PT	FI
P05.002	Output Voltage	0 to 930 V		RO	Num	ND	NC	PT	FI
P05.003	Output Power	VM_POWER kW		RO	Num	ND	NC	PT	FI
P05.004	Motor Rpm	± 36000.0 rpm		RO	Num	ND	NC	PT	FI
P05.005	D.C. Bus Voltage	0 to Maximum D.C. Bus Voltage V (110 V, 200 V Drive = 415 V, 400 V Drive = 830 V, 575 V Drive = 990 V, 690 V = 1190 V)		RO	Num	ND	NC	PT	FI
P05.006	Motor Rated Frequency	0.00 to 599.00 Hz	150 Hz	RW	Num		RA		US
P05.007	Motor Rated Current	0.00 to Drive Rating A	Maximum Heavy Duty Rating (P11.032)	RW	Num		RA		US
P05.008	Motor Rated Speed	0.0 to 36000.0 rpm (HS30 60000 rpm)	3000 rpm	RW	Num				US
P05.009	Motor Rated Voltage	0 to Drive Rated Voltage V	110 V drive: 230 V 200 V drive: 230 V 400 V drive 50 Hz: 400 V 400 V drive 60 Hz: 460 V 575 V drive: 575 V 690 V drive: 690 V	RW	Num		RA		US
P05.010	Motor Rated Power Factor	0.00 to 1.00	1	RW	Num		RA		US
P05.011	Number Of Motor Poles*	Auto (0) to 32 (16)	6 (3) Poles	RW	Num				US
P05.012	Perform Auto-tune	None (nonE (0), Basic(bASic) (1), Rotating(bEttEr) (2), Inertia(inErti) (3)	None (0)	RW	Num		NC		
P05.013	Energy Optimizer	Off (0) or On (1)	Off (0)	RW	Num				US
P05.014	Motor Control Mode	Ur S (0), Ur (1), Linear V to F (2), Ur Auto (3), Ur I (4), Square V to F (5),Permanent Magnet (8)	PM (Prn) (8)	RW	Txt				US
P05.015	Low Frequency Voltage Boost	0.0 to 25.0 %	3 %	RW	Num				US
P05.017	Stator Resistance	0.0000 to 210.0000 Ω	0.0000 Ω	RW	Num		RA		US
P05.018	Maximum Switching Frequency	2 (2), 3 (3), 4 (4), 6 (5), 8 (6), 12 (7) kHz	3 (3) kHz	RW	Txt		RA		US
P05.019	Motor Stability Optimiser	Off (0) or On (1)	Off (0)	RW	Bit				US
P05.021	Mechanical Load Test Level	0 to 100 %	0 %	RW	Bit				US
P05.022	High Speed mode	Disable (diS) (0) Limit (CAP) (1) Enable (EnAbLE) (2)	Disable (diS) (0)	RW	Txt				
P05.024	Transient Inductance or Ld	0.000 to 500.000 mH	0.000 mH	RW	Num		RA		US
P05.025	Stator Inductance	0.00 to 5000.00 mH	0.00 mH	RW	Num		RA		US
P05.027	Slip Compensation Gain	± 150.0 %	100 %	RW	Num				US
P05.028	Flux Compensation Mode	Flux Estimate (0), Torque Disable (1), Torque & Freq (2)	Flux Estimate (0)	RW	Bit				US
P05.029	Saturation Breakpoint 1	0.0 to 100.0 %	50.0 %	RW	Num				US
P05.030	Saturation Breakpoint 3	0.0 to 100.0 %	75.0 %	RW	Num				US
P05.031	D.C. Bus Controller Gain	1 to 30	1	RW	Num				US
P05.032	Torque Per Amp	0.00 to 500.00 N m/A	Rating Dependent	RW	Num	ND	NC	PT	
P05.033	Volts per 1000 rpm	0 to 10000 V/1000 rpm	98 V/1000 rpm	RW	Num				US
P05.034	Percentage Flux	0.0 to 150.0 %		RO	Num	ND	NC	PT	
P05.035	Hold Switching Frequency	Off (0) or On (1)	Off (0)	RW	Num				US
P05.037	Switching Frequency	2 (2), 3 (3), 4 (4), 6 (5), 8 (6), 12 (7) kHz		RO	Txt	ND	NC	PT	
P05.038	Minimum Switching Frequency	0 to Maximum Switching Frequency kHz	2 kHz (2)	RW	Txt		RA		
P05.040	Spin Start Boost	0.0 to 10.0	1.0	RW	Num				US
P05.042	Reverse Motor Direction	Off (0) or On (1)	Off (0)	RW	Bit				US
P05.062	Saturation Breakpoint 2	0.0 to 100.0 %	62.5 %	RW	Num				US
P05.063	Saturation Breakpoint 4	0.0 to 100.0 %	87.5 %	RW	Num				US
P05.069	Over-current Error Level	0 to 1000 %	0 %	RW	Num				US
P05.071	PM Start Boost	0.0 to 1000.0 %	50.0 %	RW	Num				US
P05.072	No-Load Lq	0.000 to 500.000 mH	0.000 mH	RW	Num				US
P05.073	PM Start Boost Ramp	0.00 to 1.00 s	0.20 s	RW	Num				US
P05.074	Motor Starting Boost End Voltage	0.0 to 100.0 %	50.0 %	RW	Num				US
P05.075	Motor Starting Boost End Frequency	0.0 to 100.0 %	50.0 %	RW	Num				US
P05.078	Lq at Rated Current	0.000 to 500.000 mH	0.000 mH	RW	Num				US
P05.086	Estimated Lq	0.000 to 500.000 mH		RO	Num	ND	NC	PT	FI
P05.088	Resistance Compensation Pre-flux Delay	0.0 to 0.7 s	0.1 s	RW	Num				US

*If this parameter is read via serial communications, it will show pole pairs.

RW	Read / Write	RO	Read only	Num	Number parameter	Bit	Bit parameter	Txt	Text string	Bin	Binary parameter	FI	Filtered
ND	No default value	NC	Not copied	PT	Protected parameter	RA	Rating dependent	US	User save	PS	Power-down save	DE	Destination

10.6 Menu 6: Sequencer and clock

Figure 10-9 Menu 6 logic diagram



The parameters are all shown in their default settings

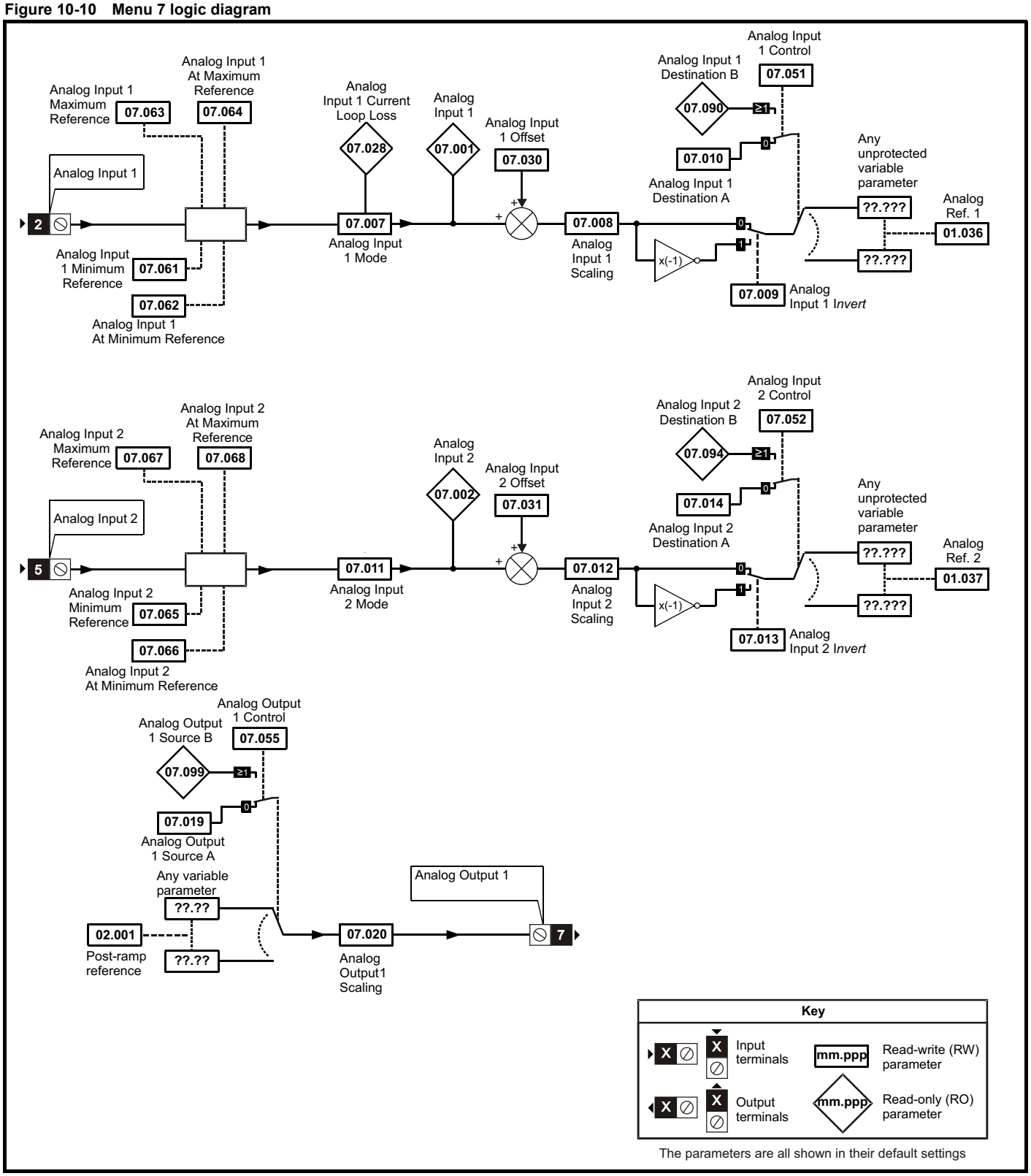
Parameter		Range	Default	Type					
P06.001	Stop Mode	Coast (CoASt) (0), Ramp (rP) (1), Ramp+dc injection (rP.dcl) (2), dc injection (dc I) (3), Timed dc injection (td.dcl) (4), Disable (dis) (5), No Ramp (no.rP) (6), Distance (7)	Ramp (rP) (1)	RW	Txt				US
P06.002	Limit Switch Stop Mode	Stop (0), Ramp (rp) (1)	Ramp (rp) (1)	RW	Txt				US
P06.003	Supply Loss Mode	Disable (dis) (0), Ramp (rP.StoP) (1), Ride Through (ridE.th) (2), Limit Stop (Lt.Stop) (3)	Disable (dis) (0)	RW	Txt				US
P06.004	Start/Stop Logic Select	Run Forward + Run Reverse (3 Wire)(rF.rr.3) (1), Enable + Run + Reverse(run.rEu) (2), Run + Reverse (3 Wire)(run.r.3) (3), Run + Jog (3 Wire)(run.Jo9) (4), Run Forward + Run Reverse(rF.rr.2) (5), Custom (CuSt) (6)	Run Forward + Run Reverse(rF.rr.2) (5)	RW	Num				US
P06.006	D.C. Braking Current Level	0.0 to 150.0 %	100.0 %	RW	Num		RA		US
P06.007	D.C. Braking Time	0.0 to 100.0 s	1.0 s	RW	Num				US
P06.008	Hold Zero Frequency	Off (0) or On (1)	Off (0)	RW	Bit				US
P06.009	Catch A Spinning Motor	Disable(dis)(0), Enable(EnAbLE)(1), Forward Only (Fr.OnLY)(2), Reverse Only (ru.OnLY)(3)	Disable(dis)(0)	RW	Txt				US
P06.010	Enable Indicators	000000000000 to 111111111111 (0 to 4095)		RO	Bin	ND	NC	PT	
P06.011	Sequencer Input and Output Indicators	0000000 to 1111111 (0 to 127)		RO	Bin	ND	NC	PT	
P06.012	Enable Stop Key	Off (0) or On (1)	Off (0)	RW	Bit				US
P06.013	Enable Auxiliary Key	Disable(dIS)(0), Forward Reverse(Fd.ru)(1), Run Reverse(r.rEu)(2	Disable(dIS)(0)	RW	Txt				US
P06.014	Disable Reset On Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
P06.015	Drive Enable	Off (0) or On (1)	On (1)	RW	Bit				US
P06.016	Date	00-00-00 to 31-12-99	00-00-00	RW	Date	ND	NC	PT	
P06.017	Time	00:00:00 to 23:59:59	00:00:00	RW	Time	ND	NC	PT	
P06.018	Day Of Week	Sunday (0), Monday (1), Tuesday (2), Wednesday (3), Thursday (4), Friday (5), Saturday (6)		RO	Txt	ND	NC	PT	
P06.019	Date/Time Selector	Set (SEt)(0), Since Power-Up(Po.uP) (1), Running (run) (2), Power-Up (Acc.Po) (3), RTC Keypad (rE.PAd)(5), Option Module (SLot.1)(6)	Since Power-Up(Po.uP) (1)	RW	Txt				US
P06.020	Date Format	Standard(Std) (0), US (1)	Standard(Std) (0)	RW	Txt				US
P06.021	Time Between Filter Changes	0 to 30000 h	0 h	RW	Num				US
P06.022	Filter Change Required	Off (0) or On (1)	Off (0)	RW	Bit	ND	NC		
P06.023	Time Before Filter Change Due	0 to 30000 h		RO	Num	ND	NC	PT	PS
P06.024	Reset Energy Meter	Off (0) or On (1)	Off (0)	RW	Bit				
P06.025	Energy Meter: MWh	±999.9 MWh		RO	Num	ND	NC	PT	PS
P06.026	Energy Meter: kWh	±99.99 kWh		RO	Num	ND	NC	PT	PS
P06.027	Energy Cost Per kWh	0.0 to 600.0	0.0	RW	Num				US
P06.028	Running Cost	±32000		RO	Num	ND	NC	PT	
P06.029	Hardware Enable	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P06.030	Run Forward	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P06.031	Jog Forward	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P06.032	Run Reverse	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P06.033	Forward/Reverse	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P06.034	Run	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P06.035	Forward Limit Switch	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P06.036	Reverse Limit Switch	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P06.037	Jog Reverse	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P06.038	User Enable	Off (0) or On (1)	On (1)	RW	Bit		NC		
P06.039	Not Stop	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P06.040	Enable Sequencer Latching	Off (0) or On (1)	Off (0)	RW	Bit				US
P06.041	Drive Event Flags	00 to 11 (0 to 3)	1	RW	Bin		NC		
P06.042	Control Word	0 to 32767	0	RW	Bin		NC		
P06.043	Control Word Enable	Off (0) or On (1)	Off (0)	RW	Num				US
P06.045	Cooling Fan control	Always Off (0), Full Speed (1), Default (2), Never Off (3), Always Low (4), Theatre Mode (5)	Default (2)	RW	Num				US
P06.047	Supply Phase Loss Detection Mode	Full (FuLL)(0), Ripple(rIPPLE)(1), Disable (diS)(2)	Full (FuLL)(0)	RW	Txt				US
P06.048	Supply Loss Detection Level	0 to Supply Loss Level V (See defaults)	110 V drive: 205 V, 200 V drive: 205 V 400 V drive: 410 V, 575 V drive: 540 V 690 V drive: 540 V	RW	Num		RA		US
P06.051	Hold Supply Loss Active	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P06.052	Motor Pre-heat Current Magnitude	0 to 100 %	0 %	RW	Num				US
P06.059	Motor Phase Loss Detection Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
P06.060	Standby Mode Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
P06.061	Standby Mode Mask	0 to 15	0	RW	Bin				US
P06.071	Slow Rectifier Charge Rate Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
P06.073	Braking IGBT Lower Threshold	Drive Rating Dependent V	110 V drive: 390 V, 200 V drive: 390 V 400 V drive: 780 V, 575 V drive: 930 V 690 V drive: 1120 V	RW	Num		RA		US

Parameter		Range	Default	Type					
P06.074	Braking IGBT Upper Threshold	Drive Rating Dependent V	110 V drive: 390 V, 200 V drive: 390 V 400 V drive: 780 V, 575 V drive: 930 V 690 V drive: 1120 V	RW	Num		RA		US
P06.075	Low Voltage Braking IGBT Threshold	0 to DC voltage set Drive Voltage Rating 100 V / 200 V= 400 V 400 V = 800 V 575V = 955 V 690 V = 1150 V	0 V	RW	Num		RA		US
P06.076	Low Voltage Braking IGBT Threshold Select	Off (0) or On (1)	Off (0)	RW	Bit				
P06.077	Low DC Link Operation	Off (0) or On (1)	Off (0)	RW	Bit				
P06.084	UTC Offset	±24.00 Hours	0.00 Hours	RW	Num				US
P06.089	D.C. Injection Active	Off (0) or On (1)		RO	Bit	ND	NC	PT	US

RW	Read / Write	RO	Read only	Num	Number parameter	Bit	Bit parameter	Txt	Text string	Bin	Binary parameter	FI	Filtered
ND	No default value	NC	Not copied	PT	Protected parameter	RA	Rating dependent	US	User save	PS	Power-down save	DE	Destination
IP	IP address	Mac	Mac address	Date	Date parameter	Time	Time parameter	SMP	Slot,menu,parameter	Chr	Character parameter	Ver	Version number

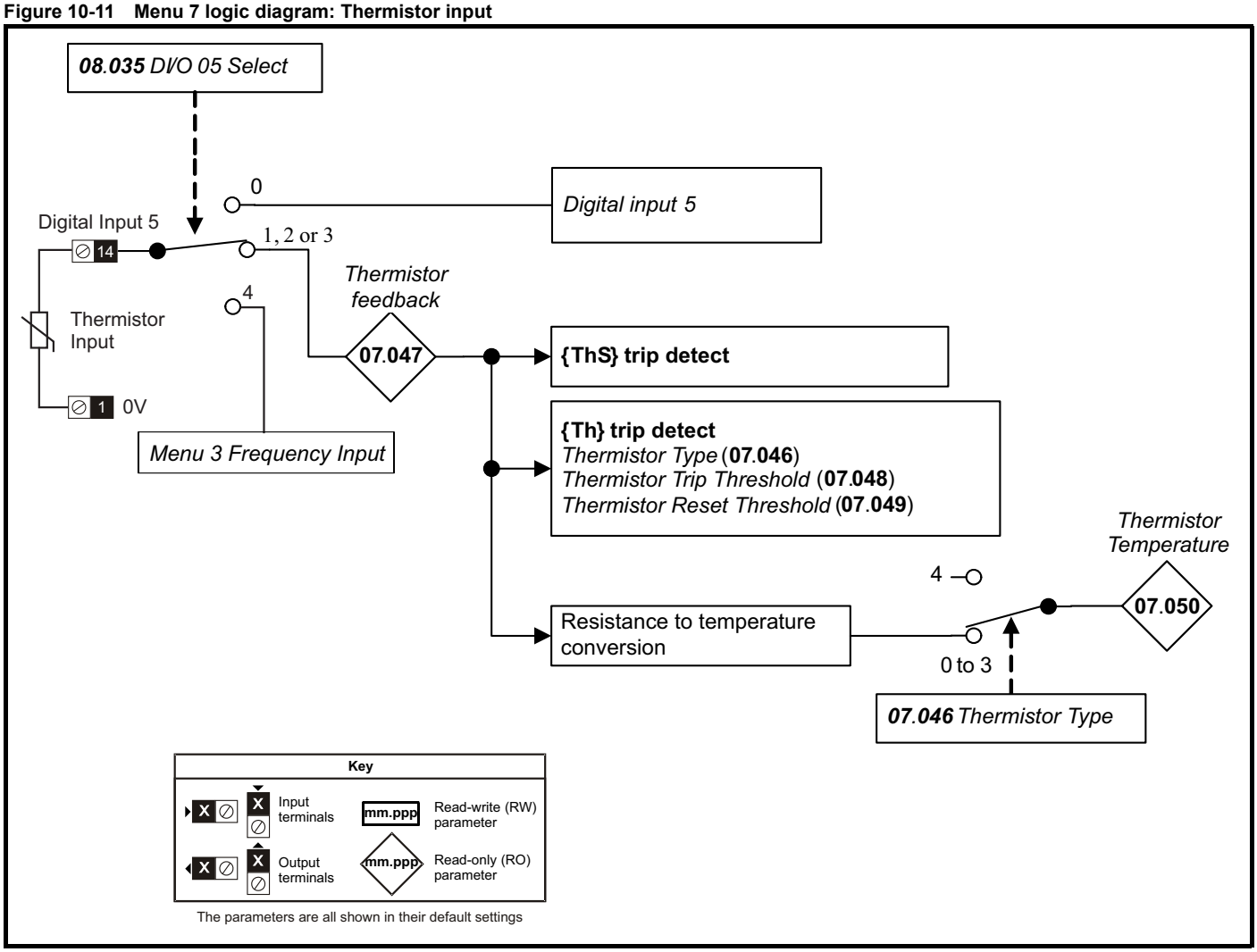
10.7 Menu 7: Analog I/O

Figure 10-10 Menu 7 logic diagram



The parameters are all shown in their default settings

Figure 10-11 Menu 7 logic diagram: Thermistor input

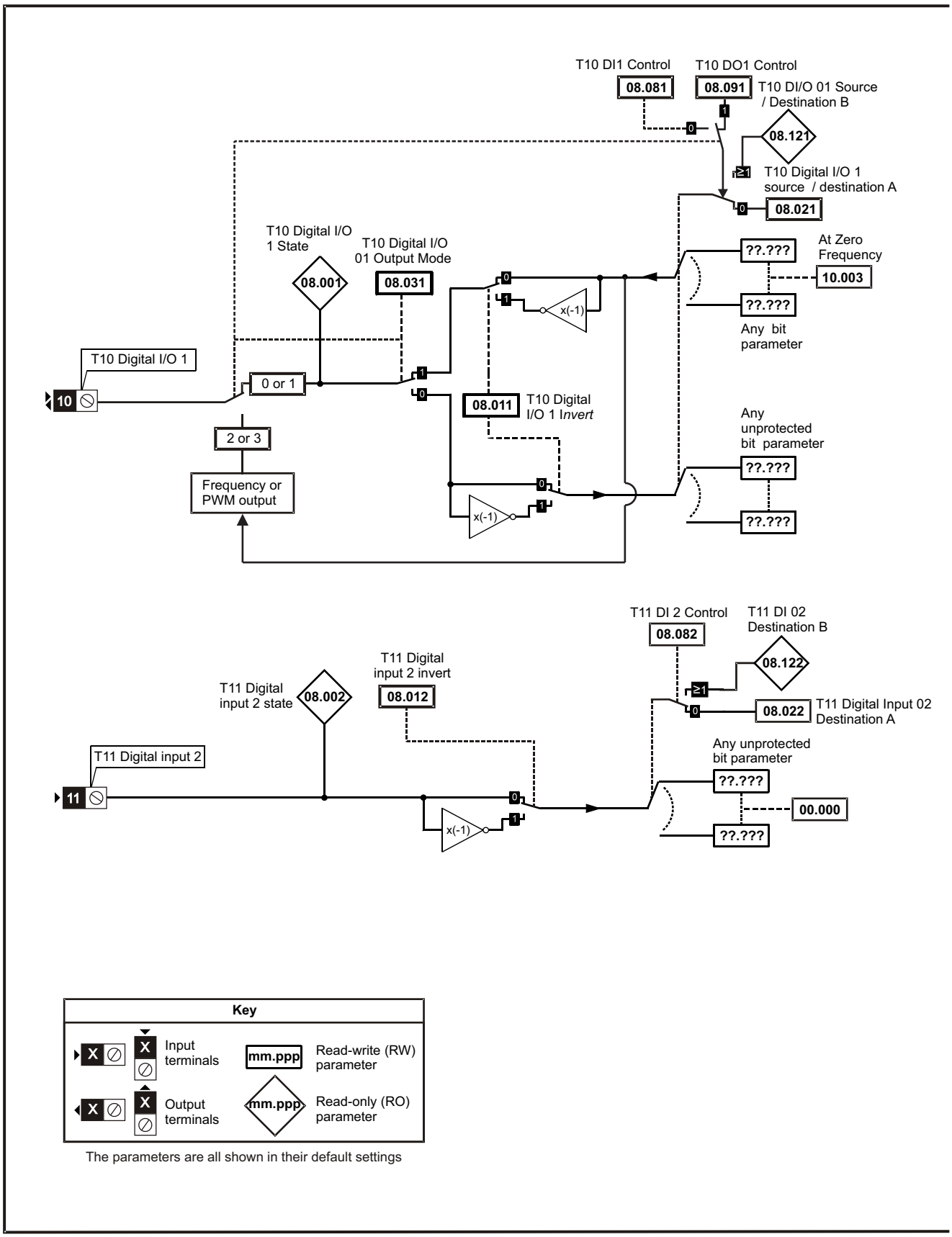


Parameter		Range	Default	Type					
P07.001	T2 Analog Input 1 Percentage	0.00 to 100.00 %		RO	Num	ND	NC	PT	FI
P07.002	T5 Analog Input 2 Percentage	0.00 to 100.00 %		RO	Num	ND	NC	PT	FI
P07.004	Stack Temperature	± 250 °C		RO	Num	ND	NC	PT	
P07.005	Auxiliary Temperature	± 250 °C		RO	Num	ND	NC	PT	
P07.007	T2 Analog Input 1 Type	4-20 mA Stop (4-20.S) (-6), 20-4 mA Stop (20-4.S)(-5), 4-20 mA Low (4-20.P)(-4), 20-4 mA Low (20-4.P)(-3), 4-20 mA Hold (4-20.H)(-2), 20-4 mA Hold (20-4H)(-1), 0-20 mA (0), 20-0 mA (1), 4-20 mA Error (4-20.E) (2), 20-4 mA Error (20-4.E) (3), 4-20 mA No Alarm (4-20)(4), 20-4 mA No Alarm (20-4)(5), 0-10 V (UoLt)(6)	0-10 V (UoLt)(6)	RW	Txt				US
P07.008	T2 Analog Input 1 Scaling	0.000 to 10.000	1.000	RW	Num				US
P07.009	T2 Analog Input 1 Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
P07.010	T2 Analog Input 1 Destination A	0.000 to 30.999	1.036 (Analog Reference 1)	RW	Num	DE		PT	US
P07.011	T5 Analog Input 2 Type	0-10 V (UoLt) (6), Digital (di9) (7)	0-10 V (UoLt) (6)	RW	Txt				US
P07.012	T5 Analog Input 2 Scaling	0.000 to 10.000	1.000	RW	Num				US
P07.013	T5 Analog Input 2 Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
P07.014	T5 Analog Input 2 Destination A	0.000 to 30.999	1.037 (Analog Reference 2)	RW	Num	DE		PT	US
P07.019	T7 Analog Output 1 Source A	0.000 to 30.999	2.001 (Ramp Output)	RW	Num			PT	US
P07.020	T7 Analog Output 1 Scaling	0.000 to 40.000	1.000	RW	Num				US
P07.026	T2 Analog Input 1 Preset on Current Loss	4.00 to 20.00 mA	4.00 mA	RW	Num				US
P07.028	T2 Analog Input 1 Current Loop Loss	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P07.030	T2 Analog Input 1 Offset	± 100.00 %	0.00 %	RW	Num				US
P07.031	T5 Analog Input 2 Offset	± 100.00 %	0.00 %	RW	Num				US
P07.034	Inverter Temperature	± 250 °C		RO	Num	ND	NC	PT	
P07.035	D.C. Bus Thermal Percentage	0 to 100 %		RO	Num	ND	NC	PT	
P07.036	Drive Thermal Percentage	0 to 100 %		RO	Num	ND	NC	PT	
P07.037	Temperature Nearest To Error Level	0 to 29999		RO	Num	ND	NC	PT	
P07.046	Thermistor Type	DIN44081(d44081) (0), KTY84(84) (1), PT1000 (Pt1000) (2), PT2000 (Pt2000) (3), OthEr (4)	DIN44081(d44081) (0)	RW	Txt				US
P07.047	Thermistor Feedback	0 to 4000 Ω		RO	Num	ND	NC	PT	FI
P07.048	Thermistor Error Threshold	0 to 4000 Ω	3300 Ω	RW	Num				US
P07.049	Thermistor Reset Threshold	0 to 4000 Ω	1800 Ω	RW	Num				US
P07.050	Thermistor Temperature	-50 to 300 °C		RO	Num	ND	NC	PT	FI
P07.051	T2 Analog Input 1 Function Select	User Defined (0), Analog Ref 1 (1), Analog Ref 2 (2), Max Ref Clamp (3), Current Limit (4), Torque Reference (5)	Analog Ref 1 (1)	RW	Num				US
P07.052	T5 Analog Input 2 Function Select	User Defined (0), Analog Ref 1 (1), Analog Ref 2 (2), Max Ref Clamp (3), Current Limit (4), Torque Reference (5), Preset Switch b0 (6), Preset Switch b1 (7), Preset Switch b2 (8), Up/Down % Up (9), Up/Down % Down (10)	Analog Ref 2 (2)	RW	Num				US
P07.055	T7 Analog Output 1 Control	User Defined (0), Post Ramp Ref (1), Pre Ramp Ref (2), Motor RPM (3), Current Output (4), Percentage Load (6), Torque Current (7), Voltage Output (8), DC Bus Voltage (9), Analog Input 1 (10), Analog Input 2 (11), Power Output (12), Current Limit (13), Torque Reference (14)	Post Ramp Ref (1)	RW	Num				US
P07.061	T2 Analog Input 1 Minimum Reference	0.00 to 100.00 %	0.00 %	RW	Num				US
P07.062	T2 Analog Input 1 At Minimum Reference	± 100.00 %	0.00 %	RW	Num				US
P07.063	T2 Analog Input 1 Maximum Reference	0.00 to 100.00 %	100.00 %	RW	Num				US
P07.064	T2 Analog Input 1 At Maximum Reference	± 100.00 %	100.00 %	RW	Num				US
P07.065	T5 Analog Input 2 Minimum Reference	0.00 to 100.00 %	0.00 %	RW	Num				US
P07.066	T5 Analog Input 2 At Minimum Reference	± 100.00 %	0.00 %	RW	Num				US
P07.067	T5 Analog Input 2 Maximum Reference	0.00 to 100.00 %	100.00 %	RW	Num				US
P07.068	T5 Analog Input 2 At Maximum Reference	± 100.00 %	100.00 %	RW	Num				US

RW	Read / Write	RO	Read only	Num	Number parameter	Bit	Bit parameter	Txt	Text string	Bin	Binary parameter	FI	Filtered
ND	No default value	NC	Not copied	PT	Protected parameter	RA	Rating dependent	US	User save	PS	Power-down save	DE	Destination

10.8 Menu 8: Digital I/O

Figure 10-12 Menu 8 logic diagram



The parameters are all shown in their default settings

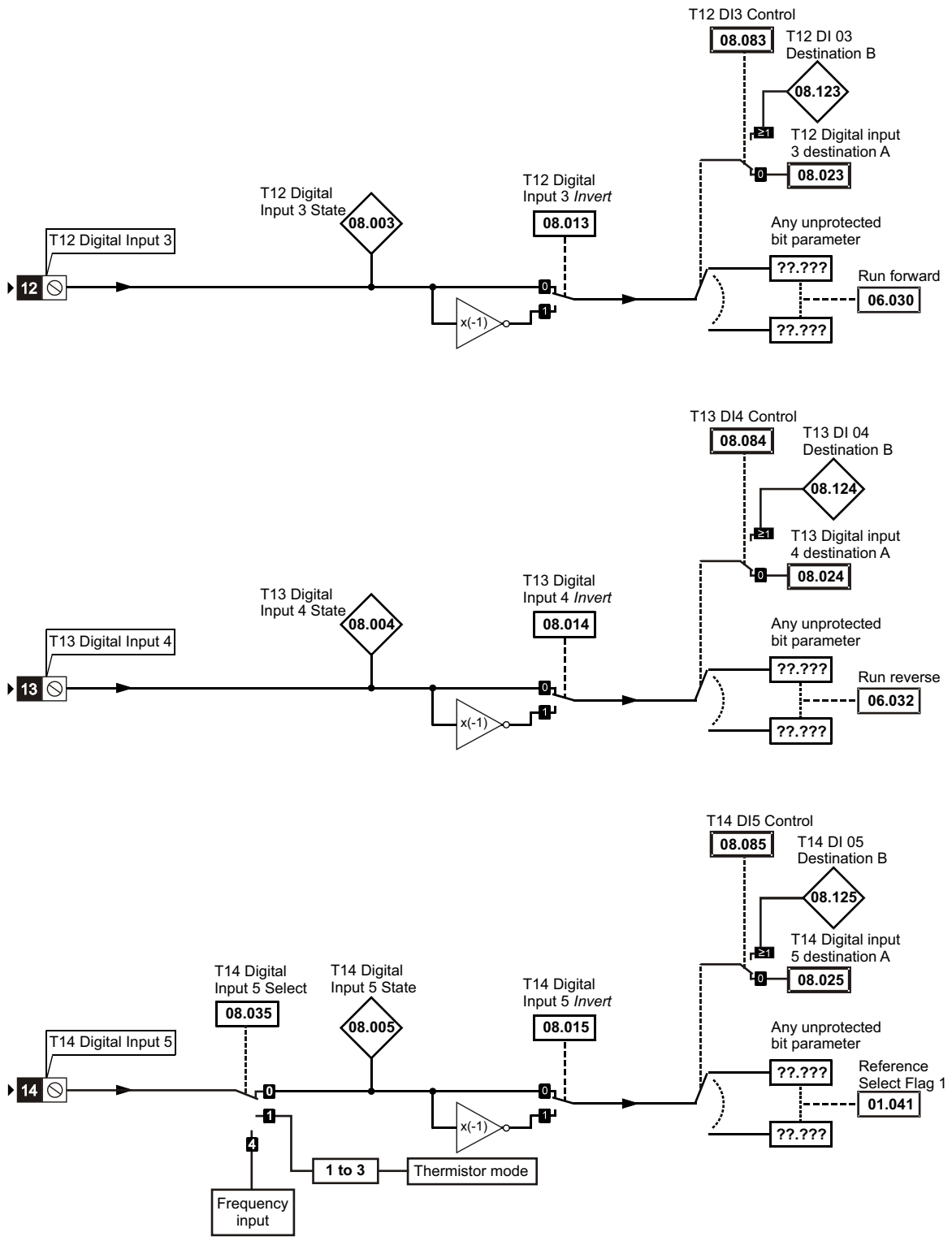

T12 DI3 Control
08.083
T12 DI 03 Destination B
08.123
≥1
T12 Digital input 3 destination A
0
08.023
T12 Digital Input 3 State
08.003
T12 Digital Input 3 Invert
08.013
T12 Digital Input 3
12
0
1
x(-1)
Any unprotected bit parameter
??.???
Run forward
06.030
??.???
T13 DI4 Control
08.084
T13 DI 04 Destination B
08.124
≥1
T13 Digital input 4 destination A
0
08.024
T13 Digital Input 4 State
08.004
T13 Digital Input 4 Invert
08.014
T13 Digital Input 4
13
0
1
x(-1)
Any unprotected bit parameter
??.???
Run reverse
06.032
??.???
T14 DI5 Control
08.085
T14 DI 05 Destination B
08.125
≥1
T14 Digital input 5 destination A
0
08.025
T14 Digital Input 5 Select
08.035
T14 Digital Input 5 State
08.005
T14 Digital Input 5 Invert
08.015
T14 Digital Input 5
14
0
1
4
1 to 3
Thermistor mode
Frequency input
0
1
x(-1)
Any unprotected bit parameter
??.???
Reference Select Flag 1
01.041
??.???

Figure 10-13 Menu 8 logic (relay)

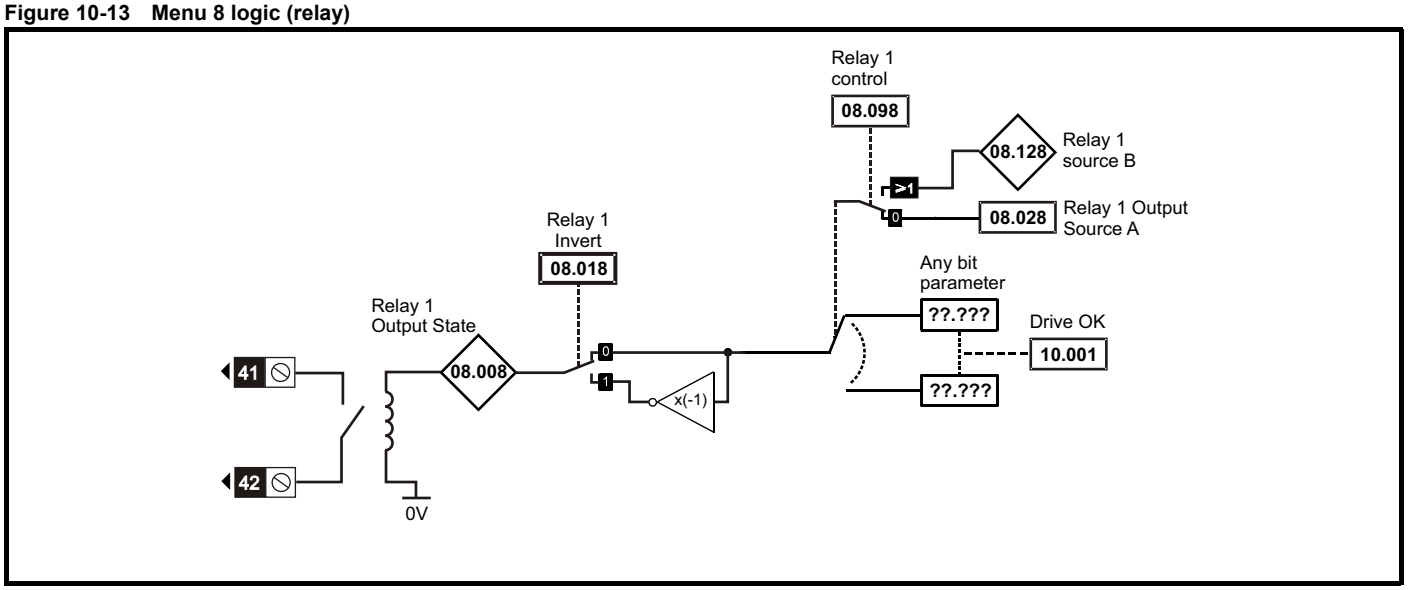


Figure 10-14 Safe Torque Off Logic diagram (frame 1 to 4)

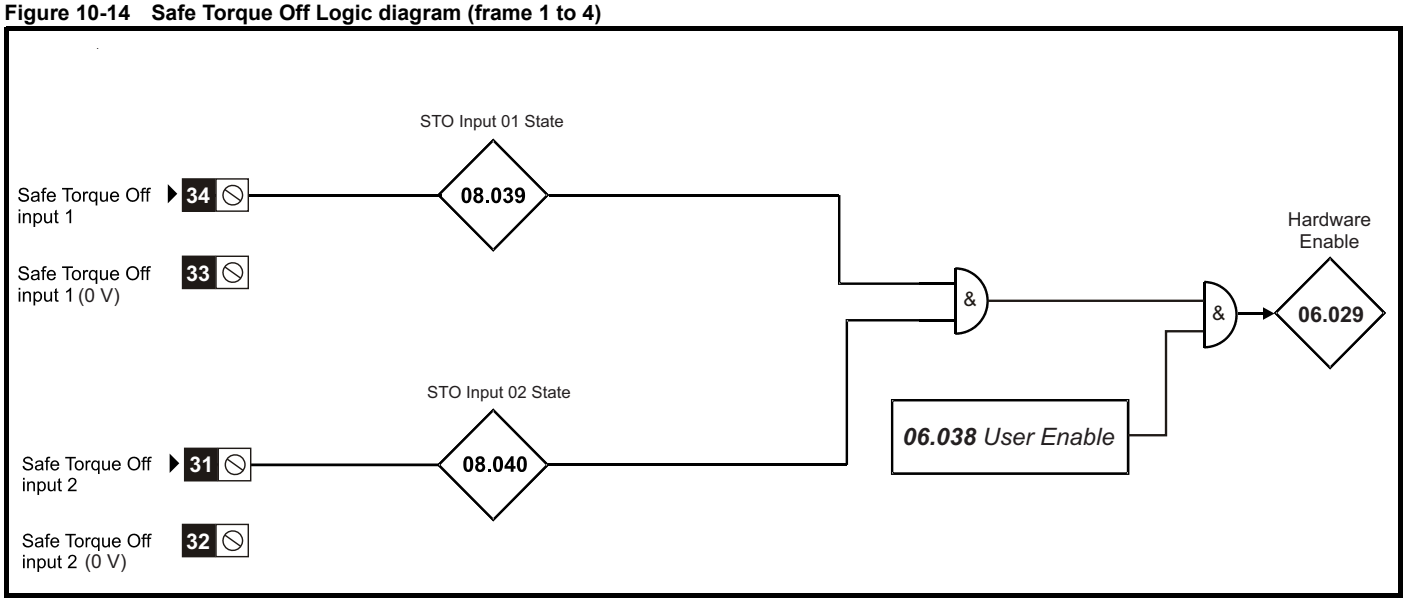


Figure 10-15 Safe Torque Off Logic diagram (frame 5 to 9)

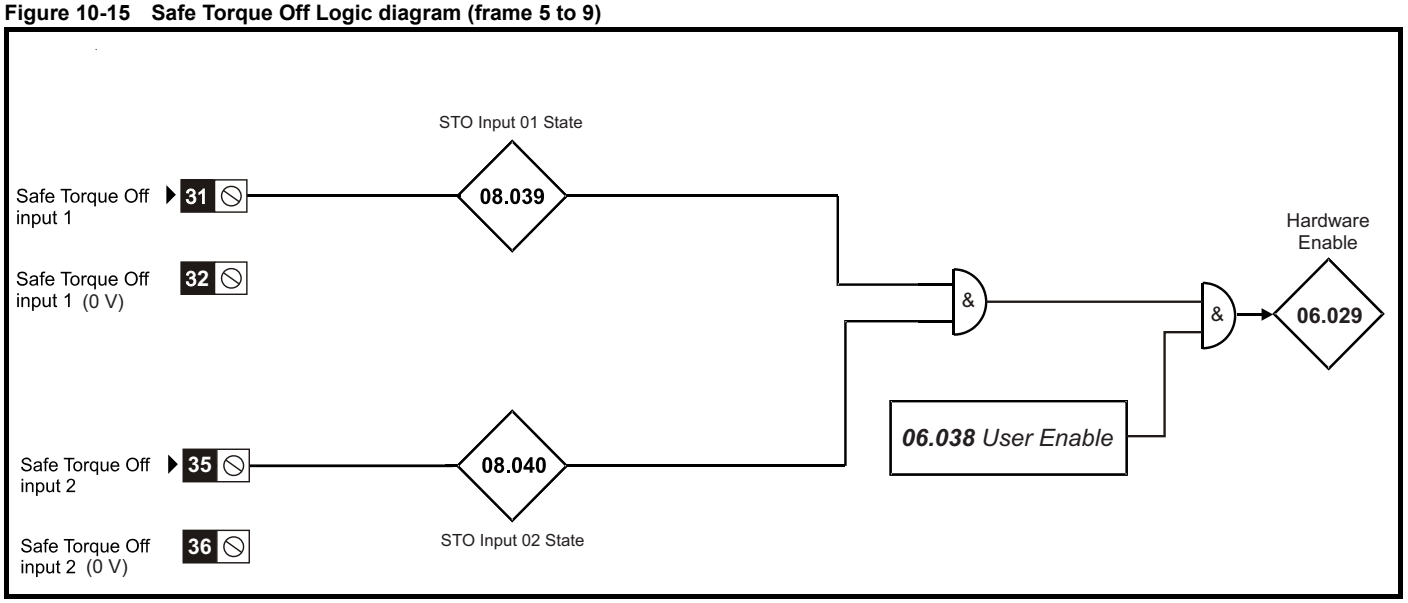
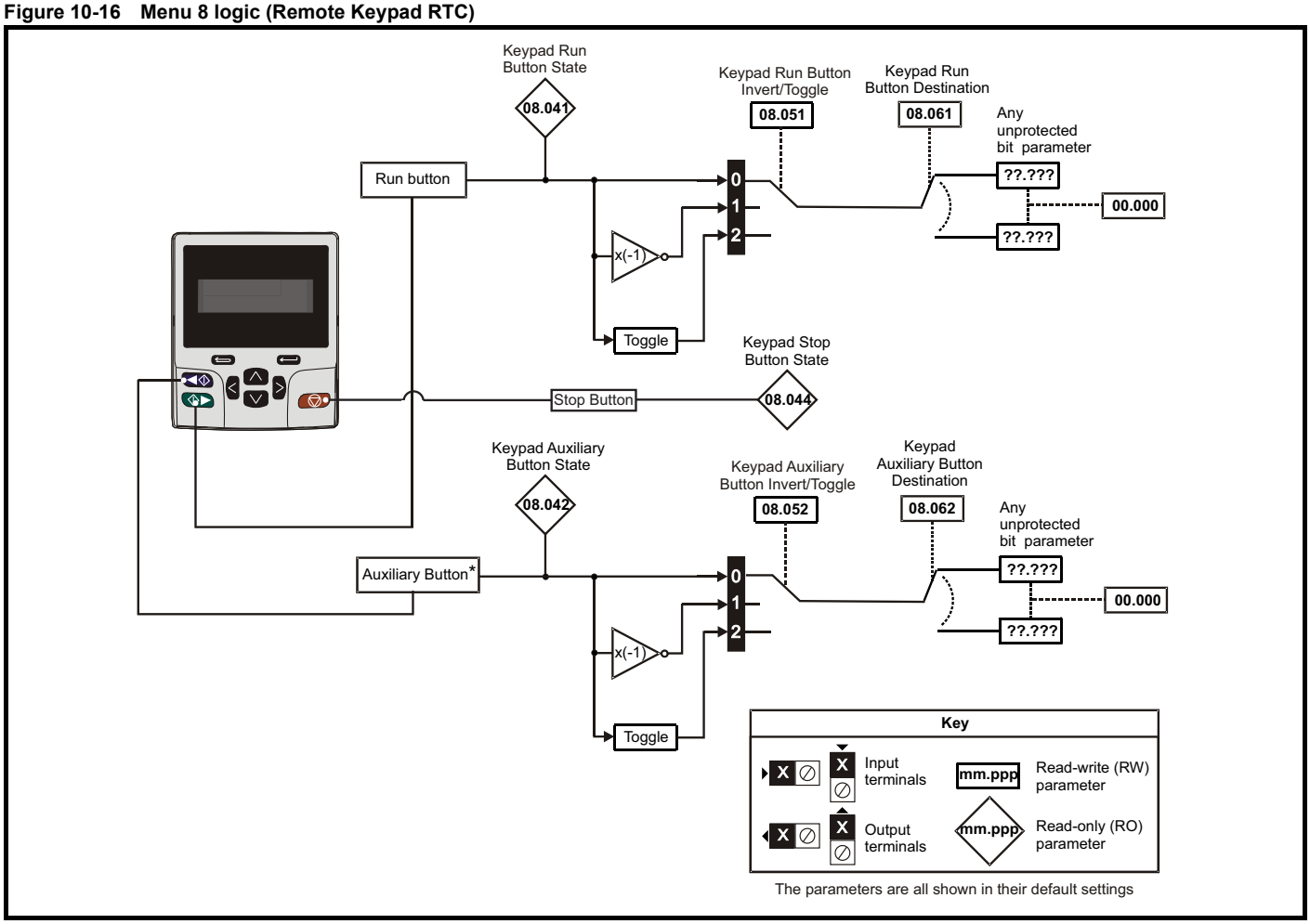


Figure 10-16 Menu 8 logic (Remote Keypad RTC)



* The auxiliary button is available with Remote Keypad RTC.

Parameter		Range	Default	Type					
P08.001	T10 Digital I/O 1 State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P08.002	T11 Digital Input 2 State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P08.003	T12 Digital Input 3 State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P08.004	T13 Digital Input 4 State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P08.005	T14 Digital Input 5 State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P08.008	T41-T42 Relay Output State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P08.011	T10 Digital I/O 1 Invert	Not Invert (not.Inu) (0), Invert (InuErt)(1)	Not Invert (not.Inu) (0)	RW	Txt				US
P08.012	T11 Digital Input 2 Invert	Not Invert (not.Inu) (0), Invert (InuErt)(1)	Not Invert (not.Inu) (0)	RW	Txt				US
P08.013	T12 Digital Input 3 Invert	Not Invert (not.Inu) (0), Invert (InuErt)(1)	Not Invert (not.Inu) (0)	RW	Txt				US
P08.014	T13 Digital Input 4 Invert	Not Invert (not.Inu) (0), Invert (InuErt)(1)	Not Invert (not.Inu) (0)	RW	Txt				US
P08.015	T14 Digital Input 5 Invert	Not Invert (not.Inu) (0), Invert (InuErt)(1)	Not Invert (not.Inu) (0)	RW	Txt				US
P08.018	T41-T42 Relay 1 Invert	Not Invert (not.Inu) (0), Invert (InuErt)(1)	Not Invert (not.Inu) (0)	RW	Txt				US
P08.020	Digital I/O Indicators	bit 0 - T10 Digital I/O 1 bit 1 - T11 Digital Input 2 bit 2 - T12 Digital Input 3 bit 3 - T13 Digital Input 4 bit 4 - T14 Digital Input 5 bit 7 & 8 - STO bit 9 - Relay		RO	Num	ND	NC	PT	
P08.021	T10 Digital I/O 1 Source / Destination	0.000 to 30.999	10.003 (Zero Frequency)	RW	Num	DE		PT	US
P08.022	T11 Digital Input 2 Destination	0.000 to 30.999	00.000 (No default function)	RW	Num	DE		PT	US
P08.023	T12 Digital Input 3 Destination	0.000 to 30.999	6.030 (Run Forward)	RW	Num	DE		PT	US
P08.024	T13 Digital Input 4 Destination	0.000 to 30.999	6.032 (Run Reverse)	RW	Num	DE		PT	US
P08.025	T14 Digital Input 5 Destination	0.000 to 30.999	1.041 (Reference Switch bit 0)	RW	Num	DE		PT	US
P08.028	T41-T42 Relay Output Source	0.000 to 30.999	10.001 (Drive Healthy)	RW	Num			PT	US
P08.031	T10 Digital I/O 1 Type	Digital Input (InPut)(0) Digital Output(OutPut) (1), Frequency Output (Fr) (2), PWM Output (PuLSE) (3)	Digital Output(OutPut) (1)	RW	Txt				US
P08.035	T14 Digital Input 5 Type	Digital Input (InPut) (0), ThermShortDetect (th.Sct)(1), Thermistor (th)(2), Therm.NoError (th.noEr) (3), Frequency input(Fr) (4)	Digital Input (InPut) (0)	RW	Txt				US
P08.039	STO State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P08.041	Keypad Run Button State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P08.042	Keypad Auxiliary Button State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P08.043	User 24 V Monitor	Off (0) or On (1)		RO	Bit	ND	NC		
P08.044	Keypad Stop Button State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P08.051	Keypad Run Button Invert / Toggle	Not Invert (not.Inu) (0), Invert (InuErt)(1), Toggle (to99LE) (2)	Not Invert (not.Inu) (0)	RW	Txt				US
P08.052	Keypad Auxiliary Button Invert / Toggle	Not Invert (not.Inu) (0), Invert (InuErt)(1), Toggle (to99LE) (2)	Not Invert (not.Inu) (0)	RW	Txt				US
P08.061	Keypad Run Button Destination	0.000 to 30.999	0.000	RW	Num	DE		PT	US
P08.062	Keypad Auxiliary Button Destination	0.000 to 30.999	0.000	RW	Num	DE		PT	US
P08.081	T10 Digital Input 1 Function Select	User defined (0), Preset Switch bit 0 (1), Preset Switch bit 1 (2), Preset Switch bit 2 (3), Run Permit (4), Ramp Switch bit 0 (5), Ramp Switch bit 1 (6), Ramp Switch bit 2 (7), Torque Mode (8), External Error (Et) (9), Drive Reset (rESEt)(10), Jog Forward (11), Jog Reverse (12), Drive Enable (13), Ramp Hold (14), Run Forward (15), Run Reverse (r.rEu) (16), Enable Latching (17), Forward Limit Switch (18), Reverse Limit Switch (19), Ref Select 3 (20), Ref Select 2 (21), Ref Select 1 (22), PID Enable (23), Up/Down % Up (25), Up/Down % Down (26), Run (run) (27), Reverse(rEu) (28)	User defined (0)	RW	Num				US
P08.082	T11 Digital Input 2 Function Select		User defined (0)	RW	Num				US
P08.083	T12 Digital Input 3 Function Select		Run Forward (15)	RW	Num				US
P08.084	T13 Digital Input 4 Function Select		Run Reverse (r.rEu) (16)	RW	Num				US
P08.085	T14 Digital Input 5 Function Select		Ref Select 1 (22)	RW	Num				US
P08.091	T10 Digital Output 1 Control	User Defined (0), Drive Active (1), At Frequency (2), Motor Overload (5), Under Voltage (UU) (6), External Error (Et) (7), Above Frequency (8), Below Frequency (9), At Zero (10), Drive Ready (14), Drive Healthy (15), Brake Release (18), In Current Limit (19), Reverse Running (20)	At Zero (10)	RW	Num				US
P08.098	T41-T42 Relay Control		Drive Healthy (15)	RW	Num				US

RW	Read / Write	RO	Read only	Num	Number parameter	Bit	Bit parameter	Txt	Text string	Bin	Binary parameter	FI	Filtered
ND	No default value	NC	Not copied	PT	Protected parameter	RA	Rating dependent	US	User save	PS	Power-down save	DE	Destination

10.9 Menu 9: Programmable logic, motorized pot, binary sum and timers

Figure 10-17 Menu 9 logic diagram: Programmable logic

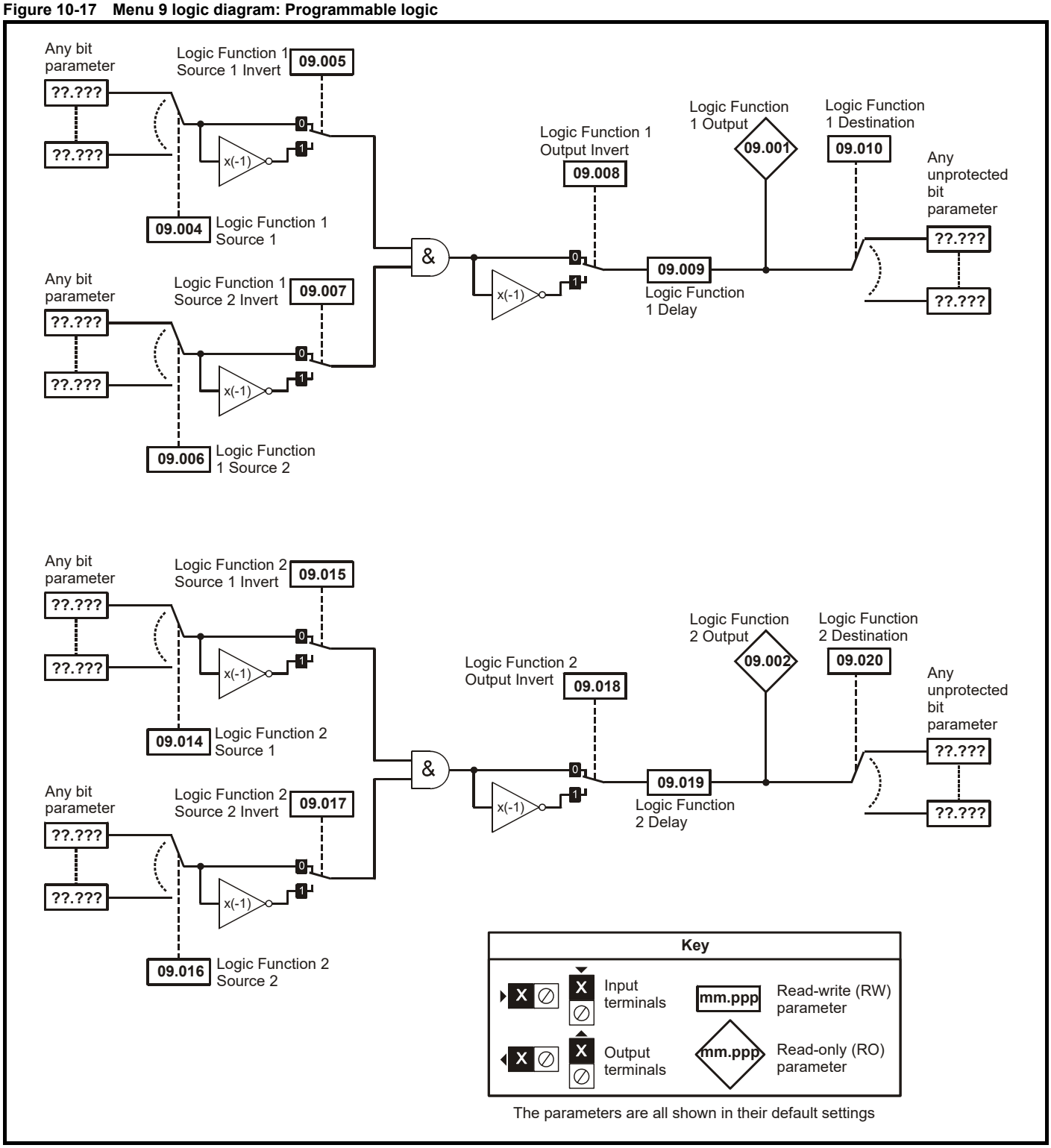


Figure 10-18 Menu 9 logic diagram: Motorized pot and binary sum

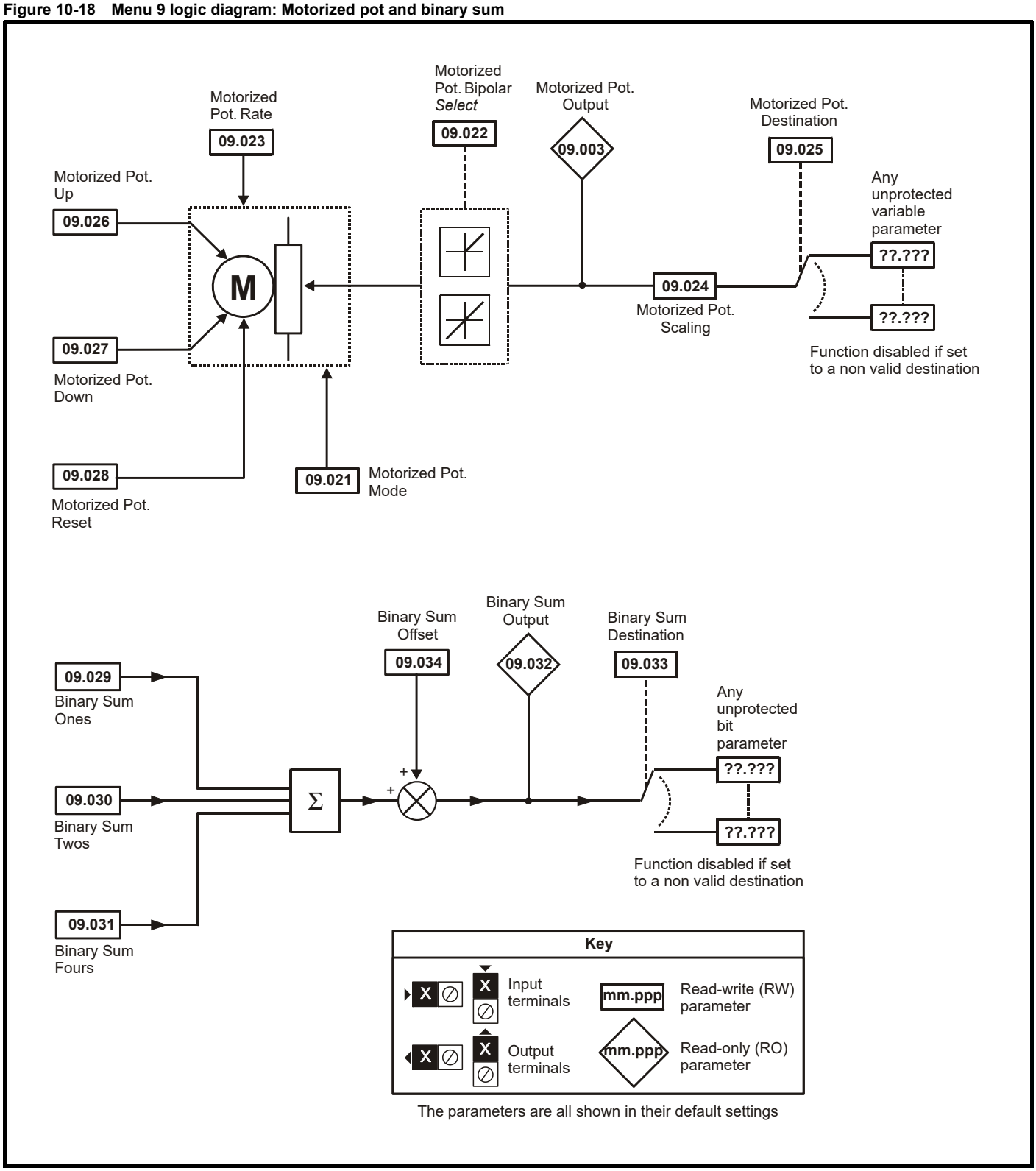
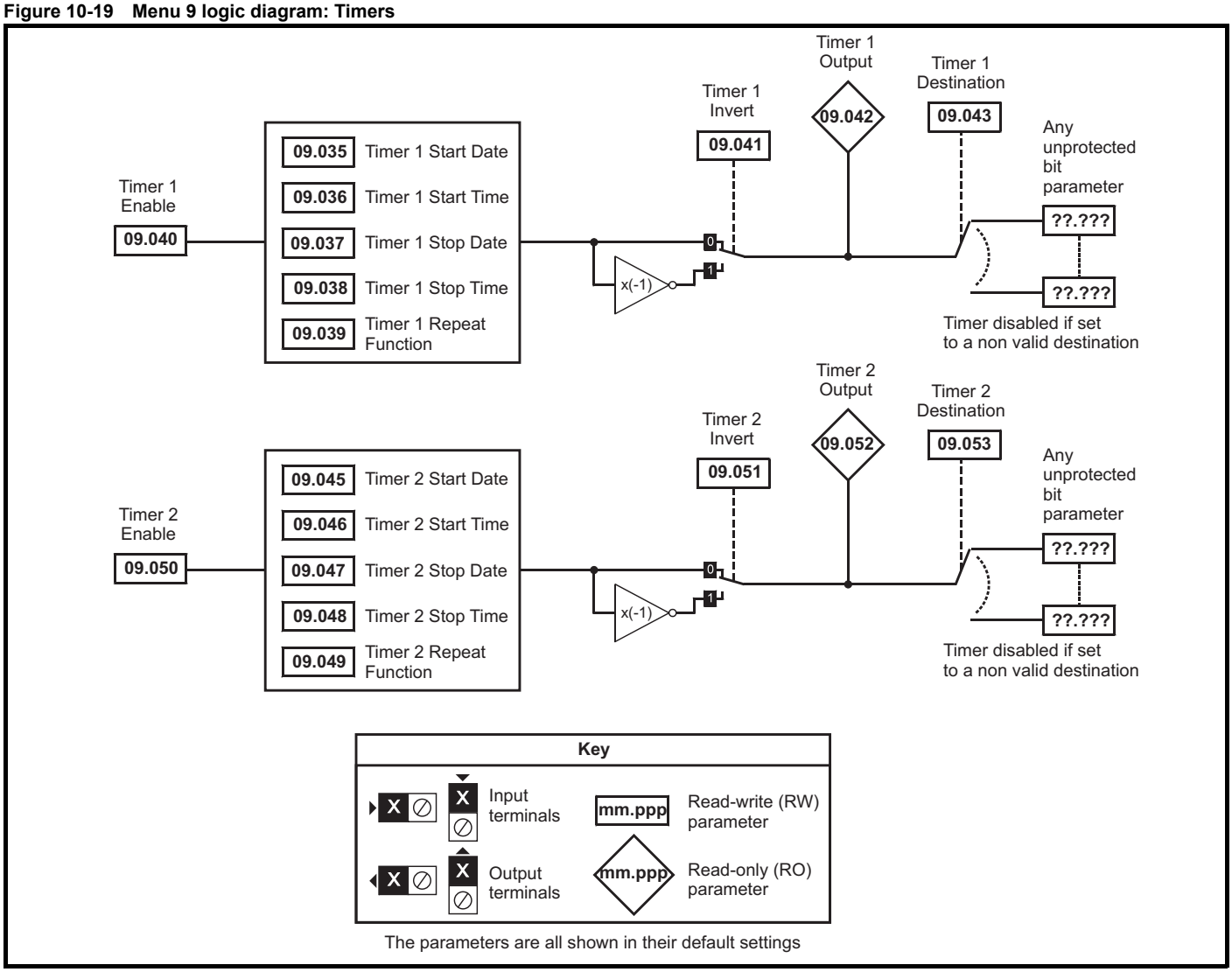


Figure 10-19 Menu 9 logic diagram: Timers



The parameters are all shown in their default settings

Parameter		Range	Default	Type					
P09.001	Logic Function 1 Output	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P09.002	Logic Function 2 Output	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P09.003	Up/Down Percentage	±100.00 %		RO	Num	ND	NC	PT	PS
P09.004	Logic Function 1 Source 1	0.000 to 30.999	0.000	RW	Num			PT	US
P09.005	Logic Function 1 Source 1 Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
P09.006	Logic Function 1 Source 2	0.000 to 30.999	0.000	RW	Num			PT	US
P09.007	Logic Function 1 Source 2 Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
P09.008	Logic Function 1 Output Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
P09.009	Logic Function 1 Delay	±25.0 s	0.0 s	RW	Num				US
P09.010	Logic Function 1 Destination	0.000 to 30.999	0.000	RW	Num	DE		PT	US
P09.014	Logic Function 2 Source 1	0.000 to 30.999	0.000	RW	Num			PT	US
P09.015	Logic Function 2 Source 1 Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
P09.016	Logic Function 2 Source 2	0.000 to 30.999	0.000	RW	Num			PT	US
P09.017	Logic Function 2 Source 2 Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
P09.018	Logic Function 2 Output Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
P09.019	Logic Function 2 Delay	±25.0 s	0.0 s	RW	Num				US
P09.020	Logic Function 2 Destination	0.000 to 30.999	0.000	RW	Num	DE		PT	US
P09.021	Up/Down % Configuration	Reset (rESEt) (0), Last (LASt) (1), Reset + Running Only (2), Last + Running Only (3) Reset after Run (4)	Reset (rESEt) (0)	RW	Num				US
P09.022	Up/Down % Bipolar Select	Off (0) or On (1)	Off (0)	RW	Bit				US
P09.023	Up/Down % Time to Max	0 to 250 s	20 s	RW	Num				US
P09.024	Up/Down % Scaling	0.000 to 4.000	1.000	RW	Num				US
P09.025	Up/Down % Destination	0.000 to 30.999	0.000	RW	Num	DE		PT	US
P09.026	Up/Down % Increase	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P09.027	Up/Down % Decrease	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P09.028	Up/Down % Reset	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P09.029	Binary Sum Ones	Off (0) or On (1)	Off (0)	RW	Bit				
P09.030	Binary Sum Twos	Off (0) or On (1)	Off (0)	RW	Bit				
P09.031	Binary Sum Fours	Off (0) or On (1)	Off (0)	RW	Bit				
P09.032	Binary Sum Output	0 to 255		RO	Num	ND	NC	PT	
P09.033	Binary Sum Destination	0.000 to 30.999	0.000	RW	Num	DE		PT	US
P09.034	Binary Sum Offset	0 to 248	0	RW	Num				US
P09.035	Timer 1 Start Date	00-00-00 to 31-12-99	00-00-00	RW	Date				US
P09.036	Timer 1 Start Time	00:00:00 to 23:59:59	00:00:00	RW	Time				US
P09.037	Timer 1 Stop Date	00-00-00 to 31-12-99	00-00-00	RW	Date				US
P09.038	Timer 1 Stop Time	00:00:00 to 23:59:59	00:00:00	RW	Time				US
P09.039	Timer 1 Repeat Function	None (nonE) (0), Hour (1), Day (2), Week (3), Month (4), Year (5), One Off (6), Minute (7)	None (nonE) (0)	RW	Txt				US
P09.040	Timer 1 Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
P09.041	Timer 1 Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
P09.042	Timer 1 Output	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P09.043	Timer 1 Destination	0.000 to 30.999	0.000	RW	Num	DE		PT	US
P09.045	Timer 2 Start Date	00-00-00 to 31-12-99	00-00-00	RW	Date				US
P09.046	Timer 2 Start Time	00:00:00 to 23:59:59	00:00:00	RW	Time				US
P09.047	Timer 2 Stop Date	00-00-00 to 31-12-99	00-00-00	RW	Date				US
P09.048	Timer 2 Stop Time	00:00:00 to 23:59:59	00:00:00	RW	Time				US
P09.049	Timer 2 Repeat Function	None (nonE) (0), Hour (1), Day (2), Week (3), Month (4), Year (5), One Off (6), Minute (7)	None (nonE) (0)	RW	Txt				US
P09.050	Timer 2 Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
P09.051	Timer 2 Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
P09.052	Timer 2 Output	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P09.053	Timer 2 Destination	0.000 to 30.999	0.000	RW	Num	DE		PT	US
P09.055	Scope Trace 1 Source	0.000 to 30.999	0.000	RW	Num			PT	US
P09.056	Scope Trace 2 Source	0.000 to 30.999	0.000	RW	Num			PT	US
P09.057	Scope Trace 3 Source	0.000 to 30.999	0.000	RW	Num			PT	US
P09.058	Scope Trace 4 Source	0.000 to 30.999	0.000	RW	Num			PT	US
P09.059	Scope Trigger	Off (0) or On (1)	Off (0)	RW	Bit				
P09.060	Scope Trigger Source	0.000 to 30.999	0.000	RW	Num			PT	US
P09.061	Scope Trigger Threshold	-2147483648 to 2147483647	0	RW	Num				US
P09.062	Scope Trigger Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
P09.063	Scope Mode	Single (Sin9LE) (0), Normal (norNAL) (1), Auto (Auto) (2)	Single (Sin9LE) (0)	RW	Txt				US
P09.064	Scope Arm	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P09.065	Scope Data Not Ready	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P09.066	Scope Saving Data	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P09.067	Scope Sample Tme	1 to 200 ms	1 ms	RW	Num				US
P09.068	Scope Trigger Delay	0 to 100 %	0 %	RW	Num				US
P09.069	Scope Time Period	0.00 to 200000.00 ms		RO	Num	ND	NC	PT	

RW	Read / Write	RO	Read only	Num	Number parameter	Bit	Bit parameter	Txt	Text string	Bin	Binary parameter	FI	Filtered
ND	No default value	NC	Not copied	PT	Protected parameter	RA	Rating dependent	US	User save	PS	Power-down save	DE	Destination
IP	IP address	Mac	Mac address	Date	Date parameter	Time	Time parameter	SMP	Slot,menu,parameter	Chr	Character parameter	Ver	Version number

10.10 Menu 10: Status and errors

Parameter		Range	Default	Type					
P10.001	Drive OK	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.002	Drive Running	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.003	Zero Frequency	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.004	Running At Or Below Minimum Frequency	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.005	Below Set Frequency	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.006	At Frequency	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.007	Above Set Frequency	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.008	Rated Load Reached	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.009	Current Limit Active	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.010	Regenerating	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.011	Braking IGBT Active	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.012	Braking Resistor Alarm	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.013	Reverse Direction Commanded	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.014	Reverse Direction Running	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.015	Supply Loss	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.016	Under Voltage Active	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.017	Motor Overload Alarm	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.018	Drive Over-temperature Alarm	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.019	Drive Warning	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.020	Error	0 to 255		RO	Txt	ND	NC	PT	PS
P10.021	Error History 1	0 to 255		RO	Txt	ND	NC	PT	PS
P10.022	Error History 2	0 to 255		RO	Txt	ND	NC	PT	PS
P10.023	Error History 3	0 to 255		RO	Txt	ND	NC	PT	PS
P10.024	Error History 4	0 to 255		RO	Txt	ND	NC	PT	PS
P10.025	Error History 5	0 to 255		RO	Txt	ND	NC	PT	PS
P10.026	Error History 6	0 to 255		RO	Txt	ND	NC	PT	PS
P10.027	Error History 7	0 to 255		RO	Txt	ND	NC	PT	PS
P10.028	Error History 8	0 to 255		RO	Txt	ND	NC	PT	PS
P10.029	Error History 9	0 to 255		RO	Txt	ND	NC	PT	PS
P10.030	Braking Resistor Rated Power	0.0 to 99999.9 kW	0.0 kW	RW	Num				US
P10.031	Braking Resistor Thermal Time Constant	0.00 to 1500.00 s	0.00 s	RW	Num				US
P10.032	External Error	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P10.033	Drive Reset	Off (0) or On (1)	Off (0)	RW	Bit		NC		
P10.034	Number Of Auto Reset Attempts	None (nonE) (0), 1 (1), 2 (2), 3 (3), 4 (4), 5 (5), Unlimited (inF)(6)	None (0)	RW	Txt				US
P10.035	Auto Reset Delay	0.0 to 600.0 s	1.0 s	RW	Num				US
P10.036	Hold Drive Healthy on Auto Reset Attempts	Off (0) or On (1)	Off (0)	RW	Bit				US
P10.037	Action On Error Detection	00000 to 11111 (0 to 31)	0	RW	Num				US
P10.038	User Error **	None (nonE) (0) to (255)	None (nonE) (0)	RW	Num	ND	NC		
P10.039	Braking Resistor Thermal Percentage	0.0 to 100.0 %		RO	Num	ND	NC	PT	
P10.040	Status Word	0 to 32767		RO	Num	ND	NC	PT	
P10.041	Error Date	00-00-00 to 31-12-99		RO	Date	ND	NC	PT	PS
P10.042	Error Time	00:00:00 to 23:59:59		RO	Time	ND	NC	PT	PS
P10.043	Error History 1 Date	00-00-00 to 31-12-99		RO	Date	ND	NC	PT	PS
P10.044	Error History 1 Time	00:00:00 to 23:59:59		RO	Time	ND	NC	PT	PS
P10.045	Error History 2 Date	00-00-00 to 31-12-99		RO	Date	ND	NC	PT	PS
P10.046	Error History 2 Time	00:00:00 to 23:59:59		RO	Time	ND	NC	PT	PS
P10.047	Error History 3 Date	00-00-00 to 31-12-99		RO	Date	ND	NC	PT	PS
P10.048	Error History 3 Time	00:00:00 to 23:59:59		RO	Time	ND	NC	PT	PS
P10.049	Error History 4 Date	00-00-00 to 31-12-99		RO	Date	ND	NC	PT	PS
P10.050	Error History 4 Time	00:00:00 to 23:59:59		RO	Time	ND	NC	PT	PS
P10.051	Error History 5 Date	00-00-00 to 31-12-99		RO	Date	ND	NC	PT	PS
P10.052	Error History 5 Time	00:00:00 to 23:59:59		RO	Time	ND	NC	PT	PS
P10.053	Error History 6 Date	00-00-00 to 31-12-99		RO	Date	ND	NC	PT	PS
P10.054	Error History 6 Time	00:00:00 to 23:59:59		RO	Time	ND	NC	PT	PS
P10.055	Error History 7 Date	00-00-00 to 31-12-99		RO	Date	ND	NC	PT	PS
P10.056	Error History 7 Time	00:00:00 to 23:59:59		RO	Time	ND	NC	PT	PS
P10.057	Error History 8 Date	00-00-00 to 31-12-99		RO	Date	ND	NC	PT	PS
P10.058	Error History 8 Time	00:00:00 to 23:59:59		RO	Time	ND	NC	PT	PS
P10.059	Error History 9 Date	00-00-00 to 31-12-99		RO	Date	ND	NC	PT	PS
P10.060	Error History 9 Time	00:00:00 to 23:59:59		RO	Time	ND	NC	PT	PS
P10.061	Braking Resistor Resistance	0.00 to 10000.00 Ω	0.00 Ω	RW	Num				US
P10.064	Remote Keypad Battery Low	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.065	Auto-tune Active	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.066	Limit Switch Active	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.067	Fire Mode Active	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.068	Hold Drive Healthy On Under Voltage	Off (0) or On (1)	Off (0)	RW	Bit				US

Parameter		Range	Default	Type					
P10.069	Additional Status Bits	0 to 2047		RO	Num	ND	NC	PT	
P10.070	Error Sub-error Number	0 to 65535		RO	Num	ND	NC	PT	PS
P10.071	Error History 1 Sub-error Number	0 to 65535		RO	Num	ND	NC	PT	PS
P10.072	Error History 2 Sub-error Number	0 to 65535		RO	Num	ND	NC	PT	PS
P10.073	Error History 3 Sub-error Number	0 to 65535		RO	Num	ND	NC	PT	PS
P10.074	Error History 4 Sub-error Number	0 to 65535		RO	Num	ND	NC	PT	PS
P10.075	Error History 5 Sub-error Number	0 to 65535		RO	Num	ND	NC	PT	PS
P10.076	Error History 6 Sub-error Number	0 to 65535		RO	Num	ND	NC	PT	PS
P10.077	Error History 7 Sub-error Number	0 to 65535		RO	Num	ND	NC	PT	PS
P10.078	Error History 8 Sub-error Number	0 to 65535		RO	Num	ND	NC	PT	PS
P10.079	Error History 9 Sub-error Number	0 to 65535		RO	Num	ND	NC	PT	PS
P10.080	Stop Motor	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.081	Phase Loss	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.082	Motor Torque Limit Active	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.090	Drive Ready	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.101	Drive State	Inhibit (0), Ready (1), Stop (2), Run (4), Supply Loss (5), Deceleration (6) DC Injection (7), Error (9), Heat (14), Under Voltage (15), Initialising (17)		RO	Txt	ND	NC	PT	
P10.102	Error Reset Log	0 to 1023		RO	Num	ND	NC	PT	PS
P10.103	Error Time Identifier	-2147483648 to 2147483647 ms		RO	Num	ND	NC	PT	
P10.104	Active Alarm	None (0), Brake Resistor (1), Motor Overload (2), Drive Overload (4), Auto Tune (5), Limit Switch (6), Fire Mode (7), Option Slot 1 (9), Low Voltage (13), Current Limit (14), 24 V Lost (15), Fan (16)		RO	Txt	ND	NC	PT	
P10.106	Potential Drive Damage Conditions	0 to 3		RO	Bin	ND	NC	PT	PS
P10.107	Low AC Alarm	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P10.108	Reversed cooling fan detected	Off (0) or On (1)		RO	Bit	ND	NC	PT	

* Refer to section 12.4 *Displaying the error history*

** For full list of errors refer to Table 12-2 *Error codes*

RW	Read / Write	RO	Read only	Num	Number parameter	Bit	Bit parameter	Txt	Text string	Bin	Binary parameter	FI	Filtered
ND	No default value	NC	Not copied	PT	Protected parameter	RA	Rating dependent	US	User save	PS	Power-down save	DE	Destination
IP	IP address	Mac	Mac address	Date	Date parameter	Time	Time parameter	SMP	Slot,menu,parameter	Chr	Character parameter	Ver	Version number

10.11 Menu 11: General drive set-up

Parameter		Range	Default	Type					
P11.018	Status Display Parameter 1	0.000 to 30.999	2.001	RW	Num			PT	US
P11.019	Status Display Parameter 2	0.000 to 30.999	4.020	RW	Num			PT	US
P11.021	Status Display Parameter 1 Scaling	0.000 to 10.000	1.000	RW	Num				US
P11.022	Parameter Displayed At Power-up	0.000 to 0.095	0.010	RW	Num			PT	US
P11.023	Serial Node Address	1 to 247	1	RW	Num				US
P11.024	Serial Mode	8.2NP (0), 8.1NP (1), 8.1EP (2), 8.1OP (3), 8.2NP E (4), 8.1NP E (5), 8.1EP E (6), 8.1OP E (7), 7.1EP (8), 7.1OP (9), 7.1EP E (10), 7.1OP E (11)	8.2NP (0)	RW	Txt				US
P11.025	Serial Baud Rate	600 (1), 1200 (2), 2400 (3), 4800 (4), 9600 (5), 19200 (6), 38400 (7), 57600 (8), 76800 (9), 115200 (10) Baud	115200 (10) Baud	RW	Txt				US
P11.026	Minimum Serial Comms Transmit Delay	0 to 250 ms	2 ms	RW	Num				US
P11.027	Silent Period	0 to 250 ms	0 ms	RW	Num				US
P11.028	Drive Derivative	0 to 255		RO	Num	ND	NC	PT	
P11.029	Software Version	00.00.00.00 to 99.99.99.99		RO	Ver	ND	NC	PT	
P11.030	Security PIN	0 to 9999	0000	RW	Num	ND		PT	US
P11.032	Maximum Heavy Duty Rating	0.00 to Drive HD Current Rating A		RO	Num	ND	NC	PT	
P11.033	Drive Rated Voltage	110 V (0), 200 V (1), 400 V (2), 575 V (3) 690 V (4)		RO	Txt	ND	NC	PT	
P11.034	Drive Configuration	Voltage (AU) (0), Local/Remote (A1)(1), Voltage Input or Presets (AU.Pr)(2), Current Input or Presets(AI.Pr) (3), Presets (PrESEt)(4), Keypad (PAd)(5), Keypad Reference Only (PAd.rEF)(6), Terminal Up/Down (E.Pot) (7), Torque Control (tor9uE) (8), PID (PId)(9) Custom (CuSt) (10)	Voltage (AU) (0)	RW	Txt			PT	US
P11.035	Power Software Version	00.00.00 to 99.99.99		RO	Ver	ND	NC	PT	
P11.043	Load Defaults	None (0), 50 Hz (Std)(1), 60 Hz (US) (2)	None (0)	RW	Txt		NC		
P11.044	Menu Access Level	Basic Menu 0(LEUEL.1) (0), Menu 0 (LEUEL.2) (1), All Menus (ALL)(2), Status (StAtuS)(3), No Access (no.Acc) (4)	All Menus (ALL)(2)	RW	Txt	ND		PT	
P11.046	Defaults Previously Loaded	0 to 2000		RO	Num	ND	NC	PT	US
P11.047	Onboard User Program: Enable	Stop (0), Run (1)	Run (1)	RW	Txt				US
P11.048	Onboard User Program: Status	Stop (0), Run (1), Not Present (3)		RO	Num	ND	NC	PT	
P11.050	Onboard User Program: Freewheeling Tasks Per Second	0 to 65535		RO	Num	ND	NC	PT	
P11.051	Onboard User Program: Clock Task Time Used	0.0 to 100.0 %		RO	Num	ND	NC	PT	
P11.052	Serial Number LS	0 to 999999		RO	Num	ND	NC	PT	
P11.053	Serial Number MS	0 to 999999		RO	Num	ND	NC	PT	
P11.054	Drive Date Code	0 to 9999		RO	Num	ND	NC	PT	
P11.055	Onboard User Program: Clock Task Schedule Rate	0 to 262128 ms		RO	Num	ND	NC	PT	
P11.060	Maximum Rated Current	0.0 to 266.0 A		RO	Num	ND	NC	PT	
P11.061	Full Scale Current Kc	0.0 to 498.0 A		RO	Num	ND	NC	PT	
P11.063	Product Type	0 to 255		RO	Num	ND	NC	PT	
P11.064	Product Identifier Characters	C300		RO	Chr	ND	NC	PT	
P11.065	Frame size and voltage code	000 to 999		RO	Num	ND	NC	PT	
P11.066	Power Stage Identifier	0 to 255		RO	Num	ND	NC	PT	
P11.067	Control Board Identifier	0 to 18	16	RO	Num	ND	NC	PT	
P11.068	Drive current rating	0 to 2240		RO	Num	ND	NC	PT	
P11.070	Core Parameter Database Version	0.00 to 99.99		RO	Num	ND	NC	PT	
P11.079	Drive Name Characters 1-4	(-2147483648) to (2147483647) *	- - - - (757935405)	RW	Chr			PT	US
P11.080	Drive Name Characters 5-8	(-2147483648) to (2147483647) *	- - - - (757935405)	RW	Chr			PT	US
P11.081	Drive Name Characters 9-12	(-2147483648) to (2147483647) *	- - - - (757935405)	RW	Chr			PT	US
P11.082	Drive Name Characters 13-16	(-2147483648) to (2147483647) *	- - - - (757935405)	RW	Chr			PT	US
P11.091	Additional Identifier Characters 1	(-2147483648) to (2147483647) *		RO	Chr	ND	NC	PT	
P11.092	Additional Identifier Characters 2	(-2147483648) to (2147483647) *		RO	Chr	ND	NC	PT	
P11.093	Additional Identifier Characters 3	(-2147483648) to (2147483647) *		RO	Chr	ND	NC	PT	
P11.094	Disable String Mode	Off (0) or On (1)	Off (0)	RW	Bit			PT	US
P11.097	AI Adaptor TYpe	None (0), SD Card (1), RS-485 (2), Reserved (3), Reserved (4), Reserved (5), Reserved (6), Reserved (7)		RO	Txt	ND	NC	PT	
P11.099	Modbus Parameter Conversion	0000 to 1111	0000	RW	Bin				US

* All displayable ASCII characters are available put not all are able to be displayed on the drive LED keypad.

RW	Read / Write	RO	Read only	Num	Number parameter	Bit	Bit parameter	Txt	Text string	Bin	Binary parameter	FI	Filtered
ND	No default value	NC	Not copied	PT	Protected parameter	RA	Rating dependent	US	User save	PS	Power-down save	DE	Destination
IP	IP address	Mac	Mac address	Date	Date parameter	Time	Time parameter	SMP	Slot,menu,parameter	Chr	Character parameter	Ver	Version number

10.12 Menu 12: Threshold detectors, variable selectors and brake control function

Figure 10-20 Menu 12 logic diagram

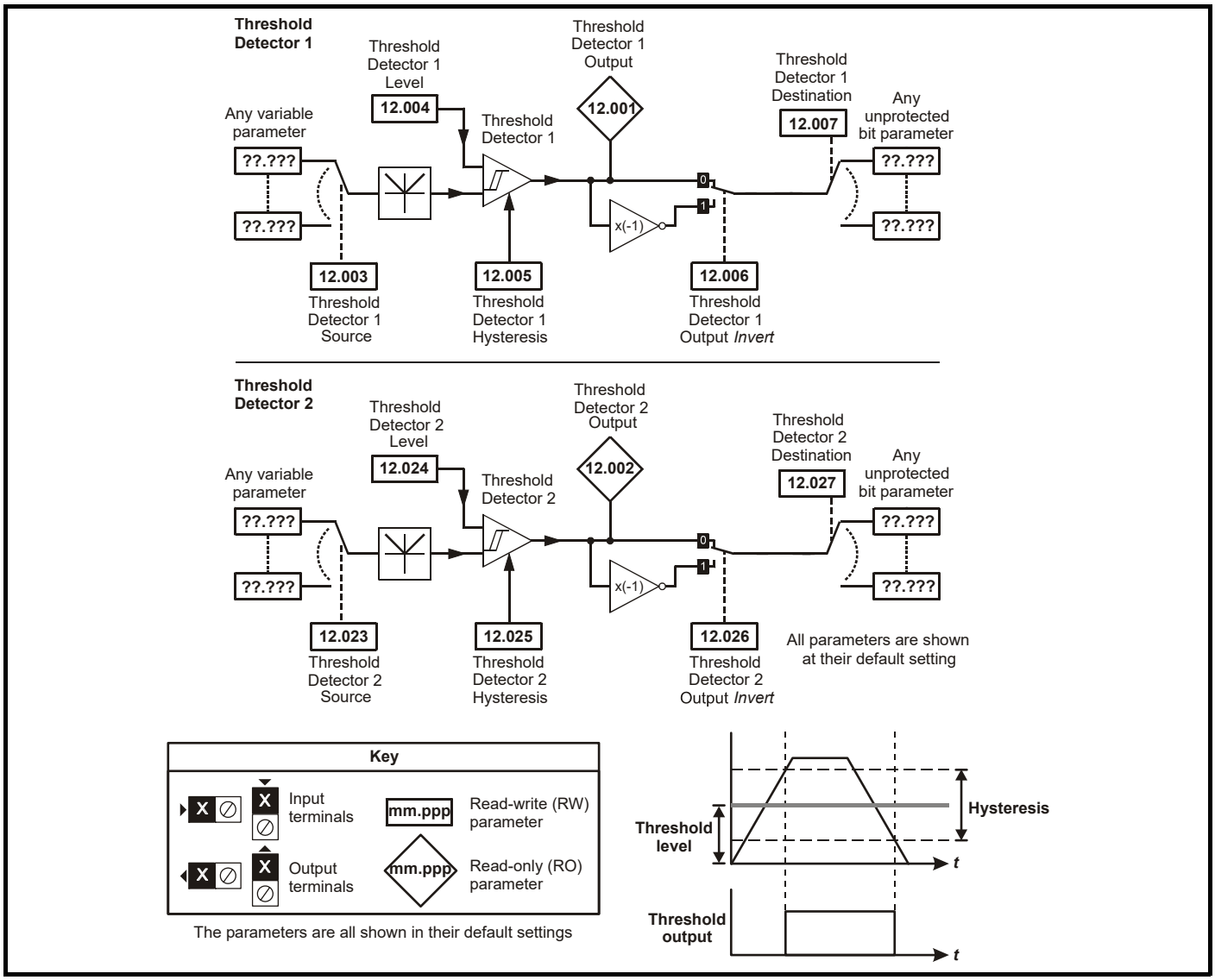
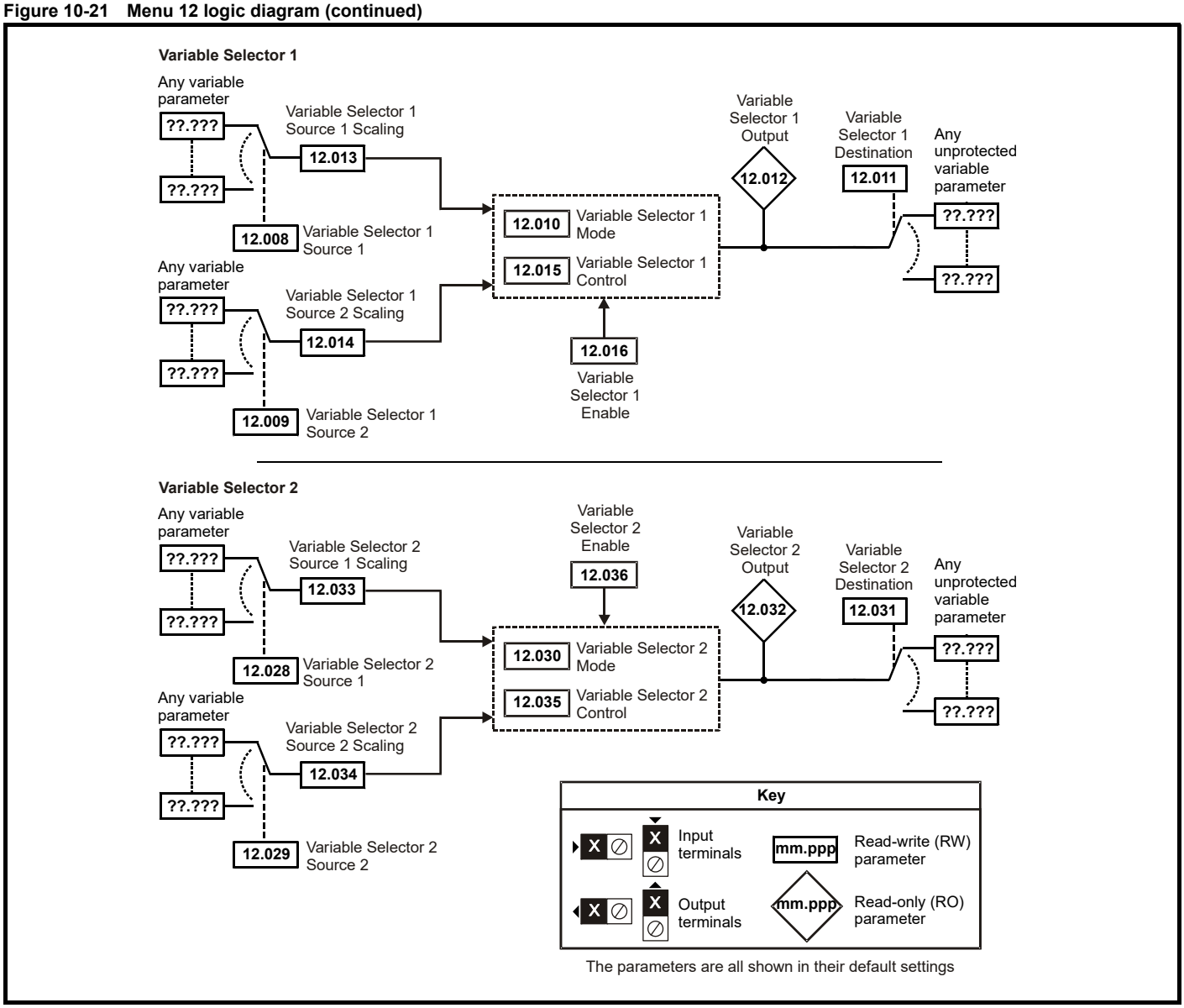


Figure 10-21 Menu 12 logic diagram (continued)



The parameters are all shown in their default settings

WARNING

The brake control functions are provided to allow well co-ordinated operation of an external brake with the drive. While both hardware and software are designed to high standards of quality and robustness, they are not intended for use as safety functions, i.e. where a fault or failure would result in a risk of injury. In any application where the incorrect operation of the brake release mechanism could result in injury, independent protection devices of proven integrity must also be incorporated.

WARNING

The control terminal relay can be selected as an output to release a brake. If a drive is set up in this manner and a drive replacement takes place, prior to programming the drive on initial power up, the brake may be released.
When drive terminals are programmed to non default settings the result of incorrect or delayed programming must be considered.

Figure 10-22 Brake sequence

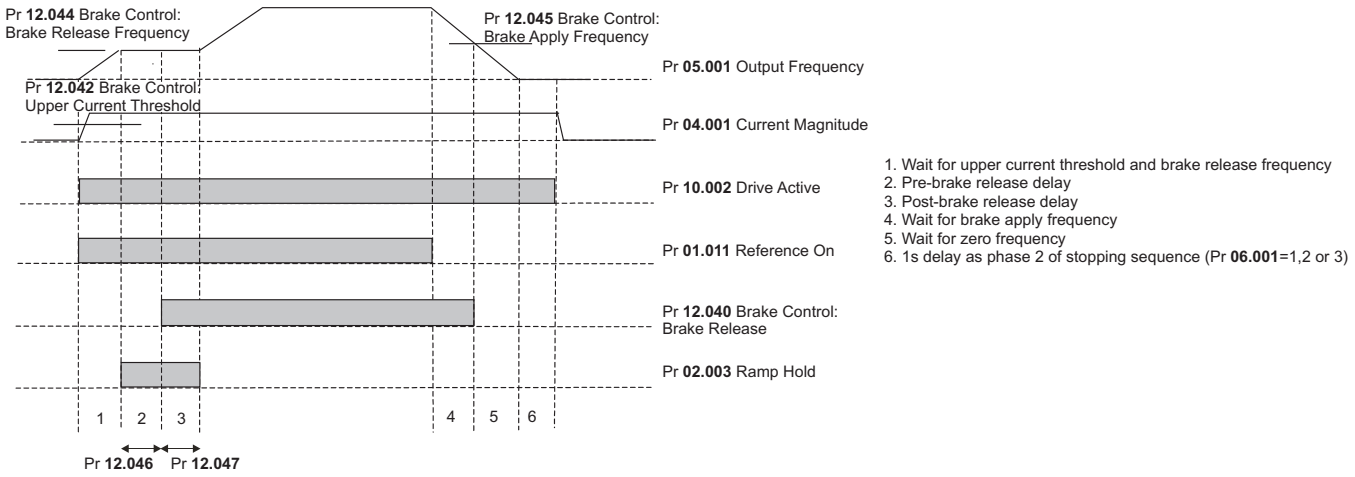
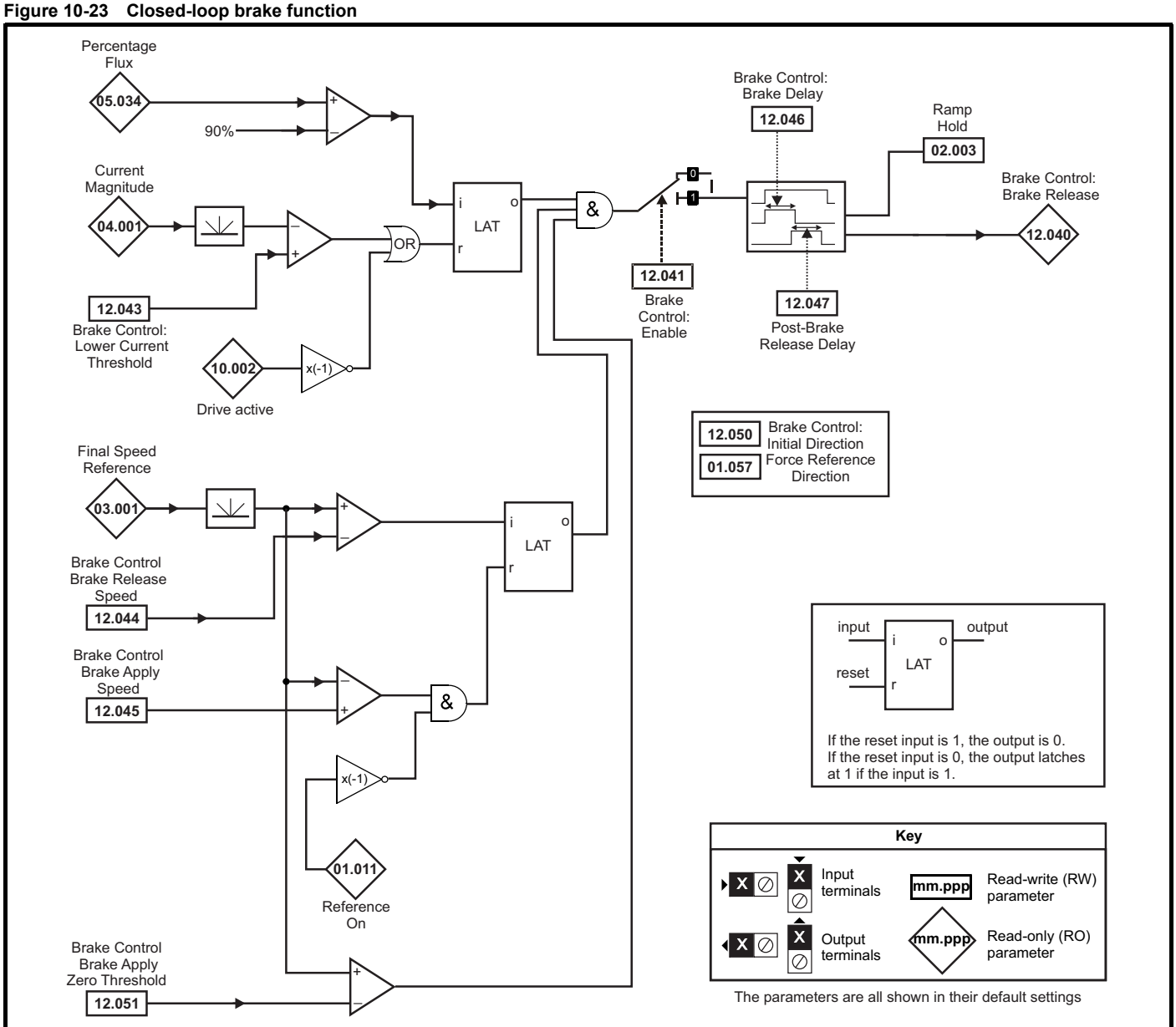


Figure 10-23 Closed-loop brake function

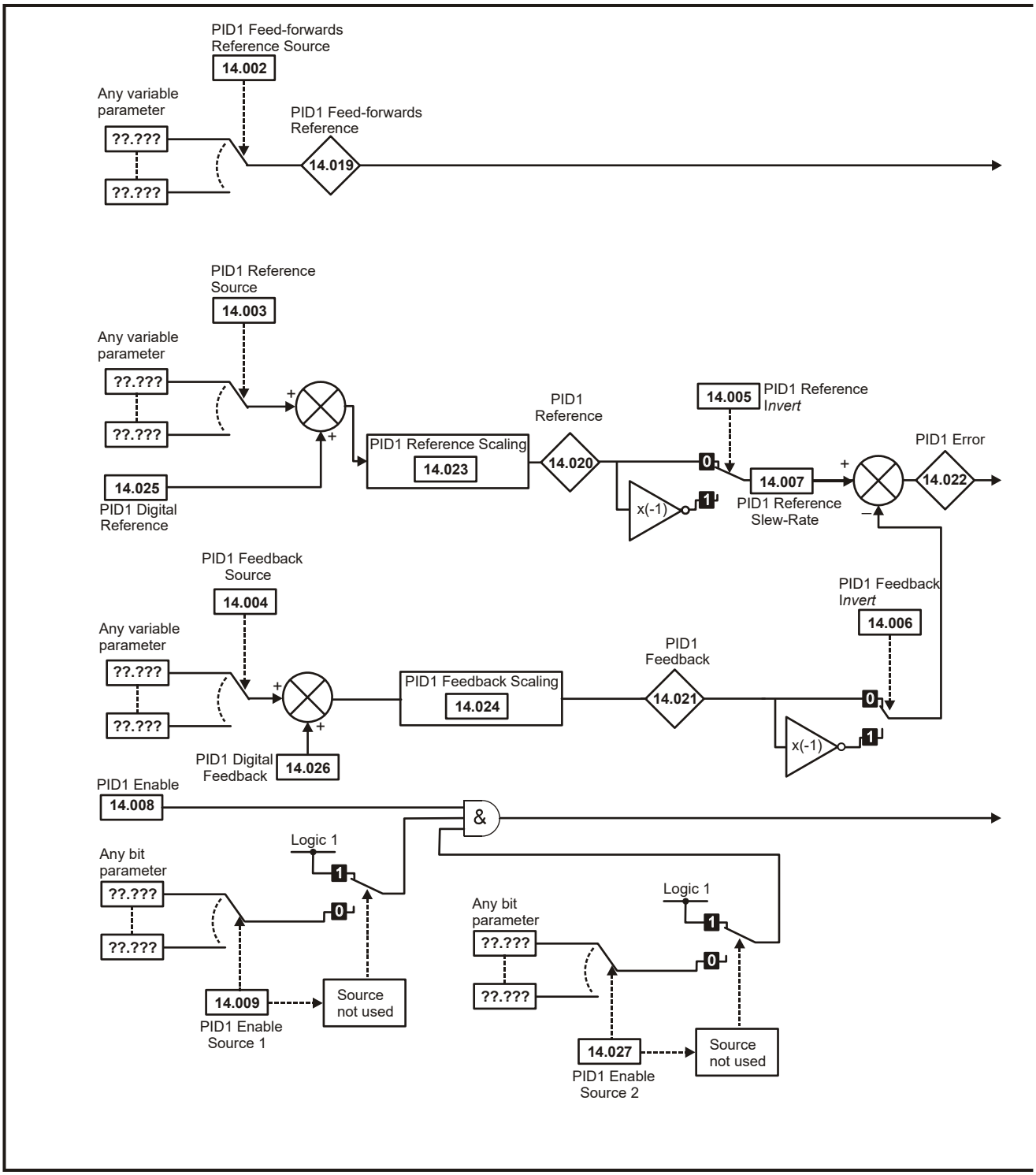


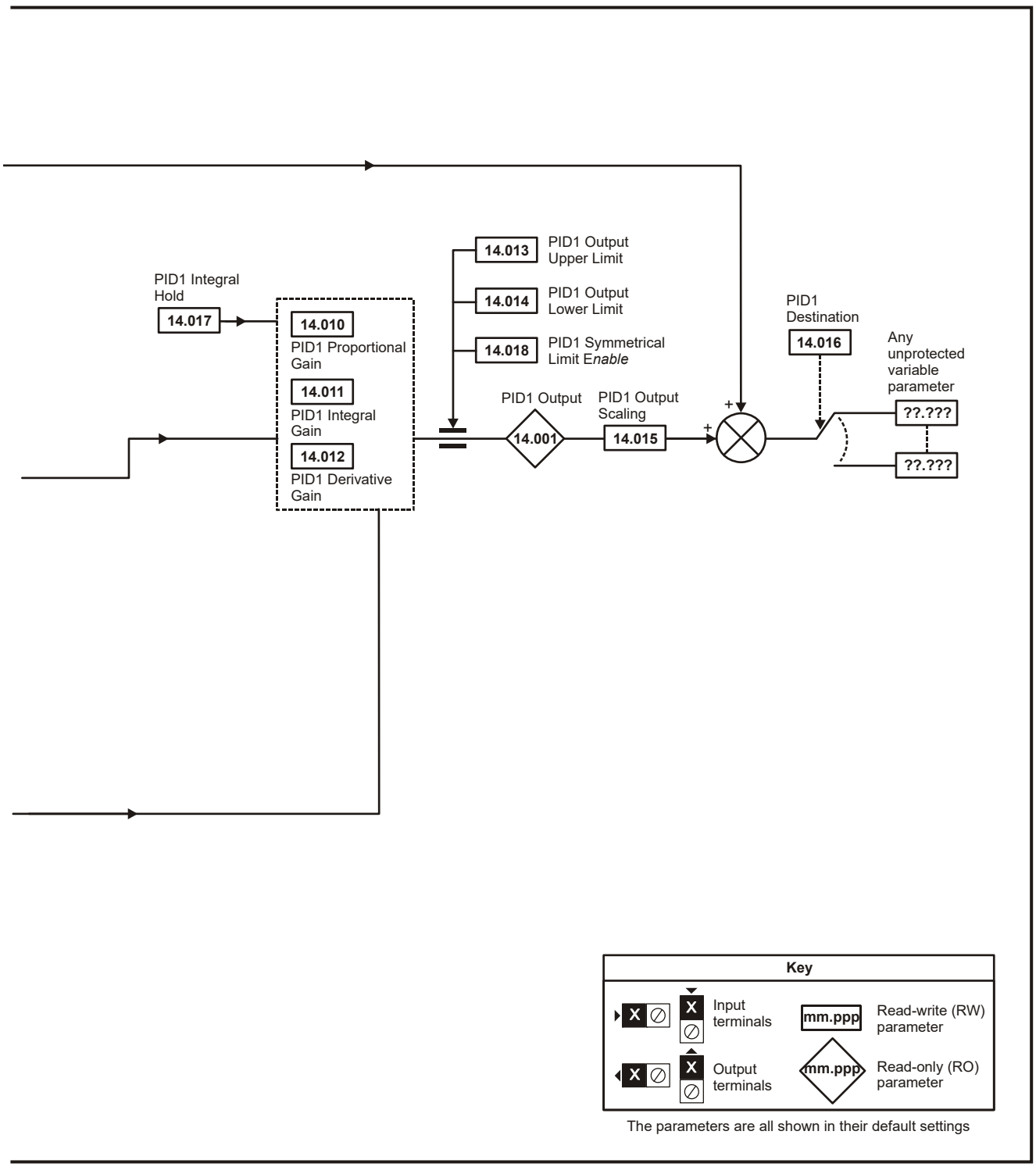
Parameter		Range	Default	Type					
P12.001	Threshold Detector 1 Output	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P12.002	Threshold Detector 2 Output	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P12.003	Threshold Detector 1 Source	0.000 to 30.999	0.000	RW	Num			PT	US
P12.004	Threshold Detector 1 Level	0.00 to 100.00 %	0.00 %	RW	Num				US
P12.005	Threshold Detector 1 Hysteresis	0.00 to 25.00 %	0.00 %	RW	Num				US
P12.006	Threshold Detector 1 Output Invert	Off (0), On (1)	Off (0)	RW	Bit				US
P12.007	Threshold Detector 1 Destination	0.000 to 30.999	0.000	RW	Num	DE		PT	US
P12.008	Variable Selector 1 Source 1	0.000 to 30.999	0.000	RW	Num			PT	US
P12.009	Variable Selector 1 Source 2	0.000 to 30.999	0.000	RW	Num			PT	US
P12.010	Variable Selector 1 Mode	Input 1 (0), Input 2 (1), Add (2), Subtract (3), Multiply (4), Divide (5), Time Constant (6), Ramp (7), Modulus (8), Powers (9)	Input 1 (0)	RW	Txt				US
P12.011	Variable Selector 1 Destination	0.000 to 30.999	0.000	RW	Num	DE		PT	US
P12.012	Variable Selector 1 Output	±100.00 %		RO	Num	ND	NC	PT	
P12.013	Variable Selector 1 Source 1 Scaling	±4.000	1.000	RW	Num				US
P12.014	Variable Selector 1 Source 2 Scaling	±4.000	1.000	RW	Num				US
P12.015	Variable Selector 1 Control	0.00 to 100.00	0.00	RW	Num				US
P12.016	Variable Selector 1 Enable	Off (0) or On (1)	On (1)	RW	Bit				US
P12.023	Threshold Detector 2 Source	0.000 to 30.999	0.000	RW	Num			PT	US
P12.024	Threshold Detector 2 Level	0.00 to 100.00 %	0.00 %	RW	Num				US
P12.025	Threshold Detector 2 Hysteresis	0.00 to 25.00 %	0.00 %	RW	Num				US
P12.026	Threshold Detector 2 Output Invert	Off (0), On (1)	Off (0)	RW	Bit				US
P12.027	Threshold Detector 2 Destination	0.000 to 30.999	0.000	RW	Num	DE		PT	US
P12.028	Variable Selector 2 Source 1	0.000 to 30.999	0.000	RW	Num			PT	US
P12.029	Variable Selector 2 Source 2	0.000 to 30.999	0.000	RW	Num			PT	US
P12.030	Variable Selector 2 Mode	Input 1 (0), Input 2 (1), Add (2), Subtract (3), Multiply (4), Divide (5), Time Constant (6), Ramp (7), Modulus (8), Powers (9)	Input 1 (0)	RW	Txt				US
P12.031	Variable Selector 2 Destination	0.000 to 30.999	0.000	RW	Num	DE		PT	US
P12.032	Variable Selector 2 Output	±100.00 %		RO	Num	ND	NC	PT	
P12.033	Variable Selector 2 Source 1 Scaling	±4.000	1.000	RW	Num				US
P12.034	Variable Selector 2 Source 2 Scaling	±4.000	1.000	RW	Num				US
P12.035	Variable Selector 2 Control	0.00 to 100.00	0.00	RW	Num				US
P12.036	Variable Selector 2 Enable	Off (0) or On (1)	On (1)	RW	Bit				US
P12.040	BC Brake Release	Off (0) or On (1)		RO	Bit	ND	NC	PT	
P12.041	BC Enable	Disable (diS) (0), Relay (rELAY) (1), Digital Output (di9 10) (2), Custom (USEr) (3)	Disable (diS) (0)	RW	Txt				US
P12.042	BC Upper Current Threshold	0 to 200 %	50 %	RW	Num				US
P12.043	BC Lower Current Threshold	0 to 200 %	10 %	RW	Num				US
P12.044	BC Brake Release Frequency	0.00 to 20.00 Hz	1.00 Hz	RW	Num				US
P12.045	BC Brake Apply Frequency	0.00 to 20.00 Hz	2.00 Hz	RW	Num				US
P12.046	BC Brake Delay	0.0 to 25.0 s	1.0 s	RW	Num				US
P12.047	BC Post-brake Release Delay	0.0 to 25.0 s	1.0 s	RW	Num				US
P12.050	BC Initial Direction	Reference (rEF)(0), Forward (For)(1), Reverse (rEu) (2)	Reference (rEF)(0)	RW	Txt				US
P12.051	BC Brake Apply Through Zero Threshold	0.00 to 20.00 Hz	1.00 Hz	RW	Num				US

RW	Read / Write	RO	Read only	Num	Number parameter	Bit	Bit parameter	Txt	Text string	Bin	Binary parameter	FI	Filtered
ND	No default value	NC	Not copied	PT	Protected parameter	RA	Rating dependent	US	User save	PS	Power-down save	DE	Destination

10.13 Menu 14: User PID controller

Figure 10-24 Menu 14 Logic diagram





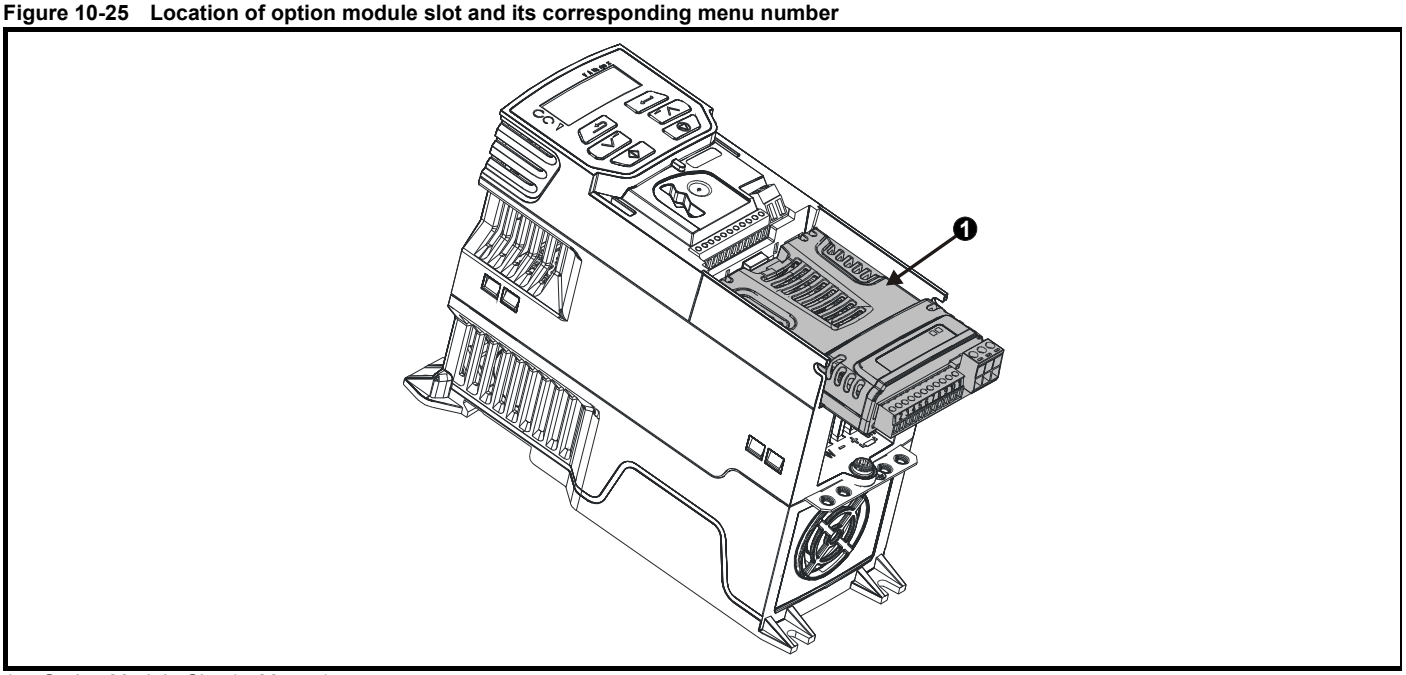
The parameters are all shown in their default settings

Parameter		Range	Default	Type					
P14.001	PID Output Percentage	±100.00 %		RO	Num	ND	NC	PT	
P14.002	PID Feed-forwards Reference Source	0.000 to 30.999	0.000	RW	Num			PT	US
P14.003	PID Reference Source	0.000 to 30.999	0.000	RW	Num			PT	US
P14.004	PID Feedback Source	0.000 to 30.999	0.000	RW	Num			PT	US
P14.005	PID Reference Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
P14.006	PID Feedback Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
P14.007	PID Reference Slew Rate Limit	0.0 to 3200.0 s	0.0 s	RW	Num				US
P14.008	PID Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
P14.009	PID Enable Source 1	0.000 to 30.999	0.000	RW	Num			PT	US
P14.010	PID Proportional Gain	0.000 to 4.000	1.000	RW	Num				US
P14.011	PID Integral Gain	0.000 to 4.000	0.500	RW	Num				US
P14.012	PID Differential Gain	0.000 to 4.000	0.000	RW	Num				US
P14.013	PID Output Upper Limit	0.00 to 100.00 %	100.00 %	RW	Num				US
P14.014	PID Output Lower Limit	±100.00 %	-100.00 %	RW	Num				US
P14.015	PID Output Scaling	0.000 to 4.000	1.000	RW	Num				US
P14.016	PID Destination	0.000 to 30.999	0.000	RW	Num	DE		PT	US
P14.017	PID Integral Hold	Off (0) or On (1)	Off (0)	RW	Bit				
P14.018	PID Symmetrical Limit Enable	Off (0) or On (1)	Off (0)	RW	Bit				US
P14.019	PID Feed Forward	±100.00 %		RO	Num	ND	NC	PT	
P14.020	PID Reference	±100.00 %		RO	Num	ND	NC	PT	
P14.021	PID Feedback	±100.00 %		RO	Num	ND	NC	PT	
P14.022	PID Error	±100.00 %		RO	Num	ND	NC	PT	
P14.023	PID Reference Scaling	0.000 to 4.000	1.000	RW	Num				US
P14.024	PID Feedback Scaling	0.000 to 4.000	1.000	RW	Num				US
P14.025	PID Fixed Reference Set-Point	±100.00 %	0.00 %	RW	Num				US
P14.026	PID Fixed Feedback Set-Point	±100.00 %	0.00 %	RW	Num				US
P14.027	PID Enable Source 2	0.000 to 30.999	0.000	RW	Num			PT	US

RW	Read / Write	RO	Read only	Num	Number parameter	Bit	Bit parameter	Txt	Text string	Bin	Binary parameter	FI	Filtered
ND	No default value	NC	Not copied	PT	Protected parameter	RA	Rating dependent	US	User save	PS	Power-down save	DE	Destination

10.14 Menu 15: Option module set-up

Figure 10-25 Location of option module slot and its corresponding menu number



1. Option Module Slot 1 - Menu 15

10.14.1 Parameters common to all categories

Parameter		Range	Default	Type					
P15.001	Module ID	0 to 65535		RO	Num	ND	NC	PT	
P15.002	Software Version	00.00.00 to 99.99.99		RO	Ver	ND	NC	PT	
P15.003	Hardware Version	0.00 to 99.99		RO	Num	ND	NC	PT	
P15.004	Serial Number LS	0 to 999999		RO	Num	ND	NC	PT	
P15.005	Serial Number MS			RO	Num	ND	NC	PT	
P15.006	Module Status	Boot Update (-2), Boot Idle (-1), Initializing (0), OK (1), Config Error (2), Error (3)		RO	Txt	ND	NC	PT	
P15.007	Module Reset	Off (0) or On (1)	Off (0)	RW	Bit		NC		

The option module ID indicates the type of module that is installed in the corresponding slot. See Table 2-1 for the module ID or the relevant option module user guide for more information regarding the module.

10.15 Menu 18: Application menu 1

Parameter		Range	Default	Type					
P18.001	Application Menu 1 Power-down Save Integer	-32768 to 32767	0	RW	Num				PS
P18.002	Application Menu 1 Read-only Integer 2			RO	Num	ND	NC		
P18.003	Application Menu 1 Read-only Integer 3			RO	Num	ND	NC		
P18.004	Application Menu 1 Read-only Integer 4			RO	Num	ND	NC		
P18.005	Application Menu 1 Read-only Integer 5			RO	Num	ND	NC		
P18.006	Application Menu 1 Read-only Integer 6			RO	Num	ND	NC		
P18.007	Application Menu 1 Read-only Integer 7			RO	Num	ND	NC		
P18.008	Application Menu 1 Read-only Integer 8			RO	Num	ND	NC		
P18.009	Application Menu 1 Read-only Integer 9			RO	Num	ND	NC		
P18.010	Application Menu 1 Read-only Integer 10			RO	Num	ND	NC		
P18.011	Application Menu 1 Read-write Integer 11		0	RW	Num				US
P18.012	Application Menu 1 Read-write Integer 12			RW	Num				US
P18.013	Application Menu 1 Read-write Integer 13			RW	Num				US
P18.014	Application Menu 1 Read-write Integer 14			RW	Num				US
P18.015	Application Menu 1 Read-write Integer 15			RW	Num				US
P18.016	Application Menu 1 Read-write Integer 16			RW	Num				US
P18.017	Application Menu 1 Read-write Integer 17			RW	Num				US
P18.018	Application Menu 1 Read-write Integer 18			RW	Num				US
P18.019	Application Menu 1 Read-write Integer 19			RW	Num				US
P18.020	Application Menu 1 Read-write Integer 20			RW	Num				US
P18.021	Application Menu 1 Read-write Integer 21			RW	Num				US
P18.022	Application Menu 1 Read-write Integer 22			RW	Num				US
P18.023	Application Menu 1 Read-write Integer 23			RW	Num				US
P18.024	Application Menu 1 Read-write Integer 24			RW	Num				US
P18.025	Application Menu 1 Read-write Integer 25			RW	Num				US
P18.026	Application Menu 1 Read-write Integer 26			RW	Num				US
P18.027	Application Menu 1 Read-write Integer 27			RW	Num				US
P18.028	Application Menu 1 Read-write Integer 28			RW	Num				US
P18.029	Application Menu 1 Read-write Integer 29			RW	Num				US
P18.030	Application Menu 1 Read-write Integer 30			RW	Num				US
P18.031	Application Menu 1 Read-write bit 31	Off (0) or On (1)	Off (0)	RW	Bit				US
P18.032	Application Menu 1 Read-write bit 32			RW	Bit				US
P18.033	Application Menu 1 Read-write bit 33			RW	Bit				US
P18.034	Application Menu 1 Read-write bit 34			RW	Bit				US
P18.035	Application Menu 1 Read-write bit 35			RW	Bit				US
P18.036	Application Menu 1 Read-write bit 36			RW	Bit				US
P18.037	Application Menu 1 Read-write bit 37			RW	Bit				US
P18.038	Application Menu 1 Read-write bit 38			RW	Bit				US
P18.039	Application Menu 1 Read-write bit 39			RW	Bit				US
P18.040	Application Menu 1 Read-write bit 40			RW	Bit				US
P18.041	Application Menu 1 Read-write bit 41			RW	Bit				US
P18.042	Application Menu 1 Read-write bit 42			RW	Bit				US
P18.043	Application Menu 1 Read-write bit 43			RW	Bit				US
P18.044	Application Menu 1 Read-write bit 44			RW	Bit				US
P18.045	Application Menu 1 Read-write bit 45			RW	Bit				US
P18.046	Application Menu 1 Read-write bit 46			RW	Bit				US
P18.047	Application Menu 1 Read-write bit 47			RW	Bit				US
P18.048	Application Menu 1 Read-write bit 48			RW	Bit				US
P18.049	Application Menu 1 Read-write bit 49			RW	Bit				US
P18.050	Application Menu 1 Read-write bit 50			RW	Bit				US
P18.051	Application Menu 1 Power-down Save long Integer	-2147483648 to 2147483647	0	RW	Num				PS
P18.052	Application Menu 1 Power-down Save long Integer			RW	Num				PS
P18.053	Application Menu 1 Power-down Save long Integer			RW	Num				PS
P18.054	Application Menu 1 Power-down Save long Integer			RW	Num				PS

RW	Read / Write	RO	Read only	Num	Number parameter	Bit	Bit parameter	Txt	Text string	Bin	Binary parameter	FI	Filtered
ND	No default value	NC	Not copied	PT	Protected parameter	RA	Rating dependent	US	User save	PS	Power-down save	DE	Destination

10.16 Menu 20: Application menu 2

Parameter		Range	Default	Type					
P20.021	Application Menu 2 Read-write Long Integer 21	-2147483648 to 2147483647	0	RW	Num				
P20.022	Application Menu 2 Read-write Long Integer 22			RW	Num				
P20.023	Application Menu 2 Read-write Long Integer 23			RW	Num				
P20.024	Application Menu 2 Read write Long Integer 24			RW	Num				
P20.025	Application Menu 2 Read-write Long Integer 25			RW	Num				
P20.026	Application Menu 2 Read-write Long Integer 26			RW	Num				
P20.027	Application Menu 2 Read-write Long Integer 27			RW	Num				
P20.028	Application Menu 2 Read-write Long Integer 28			RW	Num				
P20.029	Application Menu 2 Read-write Long Integer 29			RW	Num				
P20.030	Application Menu 2 Read-write Long Integer 30			RW	Num				

RW	Read / Write	RO	Read only	Num	Number parameter	Bit	Bit parameter	Txt	Text string	Bin	Binary parameter	FI	Filtered
ND	No default value	NC	Not copied	PT	Protected parameter	RA	Rating dependent	US	User save	PS	Power-down save	DE	Destination

10.17 Menu 22: Additional Menu 0 set-up

Parameter		Range	Default	Type					
P22.001	Parameter P00.001 Set-up	0.000 to 30.999	1.007	RW	Num			PT	US
P22.002	Parameter P00.002 Set-up	0.000 to 30.999	1.006	RW	Num			PT	US
P22.003	Parameter P00.003 Set-up	0.000 to 30.999	2.011	RW	Num			PT	US
P22.004	Parameter P00.004 Set-up	0.000 to 30.999	2.021	RW	Num			PT	US
P22.005	Parameter P00.005 Set-up	0.000 to 30.999	11.034	RW	Num			PT	US
P22.006	Parameter P00.006 Set-up	0.000 to 30.999	5.007	RW	Num			PT	US
P22.007	Parameter P00.007 Set-up	0.000 to 30.999	5.008	RW	Num			PT	US
P22.008	Parameter P00.008 Set-up	0.000 to 30.999	5.009	RW	Num			PT	US
P22.009	Parameter P00.009 Set-up	0.000 to 30.999	5.010	RW	Num			PT	US
P22.010	Parameter P00.010 Set-up	0.000 to 30.999	11.044	RW	Num			PT	US
P22.011	Parameter P00.011 Set-up	0.000 to 30.999	6.004	RW	Num			PT	US
P22.012	Parameter P00.012 Set-up	0.000 to 30.999	5.014	RW	Num			PT	US
P22.013	Parameter P00.013 Set-up	0.000 to 30.999	5.012	RW	Num			PT	US
P22.014	Parameter P00.014 Set-up	0.000 to 30.999	0.000	RW	Num			PT	US
P22.015	Parameter P00.015 Set-up	0.000 to 30.999	1.005	RW	Num			PT	US
P22.016	Parameter P00.016 Set-up	0.000 to 30.999	7.007	RW	Num			PT	US
P22.017	Parameter P00.017 Set-up	0.000 to 30.999	1.010	RW	Num			PT	US
P22.018	Parameter P00.018 Set-up	0.000 to 30.999	1.021	RW	Num			PT	US
P22.019	Parameter P00.019 Set-up	0.000 to 30.999	1.022	RW	Num			PT	US
P22.020	Parameter P00.020 Set-up	0.000 to 30.999	1.023	RW	Num			PT	US
P22.021	Parameter P00.021 Set-up	0.000 to 30.999	1.024	RW	Num			PT	US
P22.022	Parameter P00.022 Set-up	0.000 to 30.999	11.019	RW	Num			PT	US
P22.023	Parameter P00.023 Set-up	0.000 to 30.999	11.018	RW	Num			PT	US
P22.024	Parameter P00.024 Set-up	0.000 to 30.999	11.021	RW	Num			PT	US
P22.025	Parameter P00.025 Set-up	0.000 to 30.999	11.030	RW	Num			PT	US
P22.026	Parameter P00.026 Set-up	0.000 to 30.999	0.000	RW	Num			PT	US
P22.027	Parameter P00.027 Set-up	0.000 to 30.999	1.051	RW	Num			PT	US
P22.028	Parameter P00.028 Set-up	0.000 to 30.999	2.004	RW	Num			PT	US
P22.029	Parameter P00.029 Set-up	0.000 to 30.999	2.002	RW	Num			PT	US
P22.030	Parameter P00.030 Set-up	0.000 to 30.999	11.042	RW	Num			PT	US
P22.031	Parameter P00.031 Set-up	0.000 to 30.999	6.001	RW	Num			PT	US
P22.032	Parameter P00.032 Set-up	0.000 to 30.999	5.013	RW	Num			PT	US
P22.033	Parameter P00.033 Set-up	0.000 to 30.999	6.009	RW	Num			PT	US
P22.034	Parameter P00.034 Set-up	0.000 to 30.999	8.035	RW	Num			PT	US
P22.035	Parameter P00.035 Set-up	0.000 to 30.999	8.091	RW	Num			PT	US
P22.036	Parameter P00.036 Set-up	0.000 to 30.999	7.055	RW	Num			PT	US
P22.037	Parameter P00.037 Set-up	0.000 to 30.999	5.018	RW	Num			PT	US
P22.038	Parameter P00.038 Set-up	0.000 to 30.999	0.000	RW	Num			PT	US
P22.039	Parameter P00.039 Set-up	0.000 to 30.999	5.006	RW	Num			PT	US
P22.040	Parameter P00.040 Set-up	0.000 to 30.999	5.011	RW	Num			PT	US
P22.041	Parameter P00.041 Set-up	0.000 to 30.999	0.000	RW	Num			PT	US
P22.042	Parameter P00.042 Set-up	0.000 to 30.999	5.015	RW	Num			PT	US
P22.043	Parameter P00.043 Set-up	0.000 to 30.999	11.025	RW	Num			PT	US
P22.044	Parameter P00.044 Set-up	0.000 to 30.999	11.023	RW	Num			PT	US
P22.045	Parameter P00.045 Set-up	0.000 to 30.999	11.020	RW	Num			PT	US
P22.046	Parameter P00.046 Set-up	0.000 to 30.999	12.042	RW	Num			PT	US
P22.047	Parameter P00.047 Set-up	0.000 to 30.999	12.043	RW	Num			PT	US
P22.048	Parameter P00.048 Set-up	0.000 to 30.999	12.044	RW	Num			PT	US
P22.049	Parameter P00.049 Set-up	0.000 to 30.999	12.045	RW	Num			PT	US
P22.050	Parameter P00.050 Set-up	0.000 to 30.999	12.046	RW	Num			PT	US
P22.051	Parameter P00.051 Set-up	0.000 to 30.999	12.047	RW	Num			PT	US
P22.052	Parameter P00.052 Set-up	0.000 to 30.999	0.000	RW	Num			PT	US
P22.053	Parameter P00.053 Set-up	0.000 to 30.999	12.050	RW	Num			PT	US
P22.054	Parameter P00.054 Set-up	0.000 to 30.999	12.051	RW	Num			PT	US
P22.055	Parameter P00.055 Set-up	0.000 to 30.999	12.041	RW	Num			PT	US
P22.056	Parameter P00.056 Set-up	0.000 to 30.999	10.020	RW	Num			PT	US
P22.057	Parameter P00.057 Set-up	0.000 to 30.999	10.021	RW	Num			PT	US
P22.058	Parameter P00.058 Set-up	0.000 to 30.999	10.022	RW	Num			PT	US

Parameter		Range	Default	Type					
P22.059	Parameter P00.059 Set-up	0.000 to 30.999	11.047	RW	Num			PT	US
P22.060	Parameter P00.060 Set-up	0.000 to 30.999	11.048	RW	Num			PT	US
P22.061	Parameter P00.061 Set-up	0.000 to 30.999	0.000	RW	Num			PT	US
P22.062	Parameter P00.062 Set-up	0.000 to 30.999	0.000	RW	Num			PT	US
P22.063	Parameter P00.063 Set-up	0.000 to 30.999	0.000	RW	Num			PT	US
P22.064	Parameter P00.064 Set-up	0.000 to 30.999	2.039	RW	Num			PT	US
P22.065	Parameter P00.065 Set-up	0.000 to 30.999	3.010	RW	Num			PT	US
P22.066	Parameter P00.066 Set-up	0.000 to 30.999	3.011	RW	Num			PT	US
P22.067	Parameter P00.067 Set-up	0.000 to 30.999	3.079	RW	Num			PT	US
P22.068	Parameter P00.068 Set-up	0.000 to 30.999	0.000	RW	Num			PT	US
P22.069	Parameter P00.069 Set-up	0.000 to 30.999	5.040	RW	Num			PT	US
P22.070	Parameter P00.070 Set-up	0.000 to 30.999	14.001	RW	Num			PT	US
P22.071	Parameter P00.071 Set-up	0.000 to 30.999	14.010	RW	Num			PT	US
P22.072	Parameter P00.072 Set-up	0.000 to 30.999	14.011	RW	Num			PT	US
P22.073	Parameter P00.073 Set-up	0.000 to 30.999	14.006	RW	Num			PT	US
P22.074	Parameter P00.074 Set-up	0.000 to 30.999	14.013	RW	Num			PT	US
P22.075	Parameter P00.075 Set-up	0.000 to 30.999	14.014	RW	Num			PT	US
P22.076	Parameter P00.076 Set-up	0.000 to 30.999	10.037	RW	Num			PT	US
P22.077	Parameter P00.077 Set-up	0.000 to 30.999	11.032	RW	Num			PT	US
P22.078	Parameter P00.078 Set-up	0.000 to 30.999	11.029	RW	Num			PT	US
P22.079	Parameter P00.079 Set-up	0.000 to 30.999	0.000	RW	Num			PT	US
P22.080	Parameter P00.080 Set-up	0.000 to 30.999	0.000	RW	Num			PT	US

RW	Read / Write	RO	Read only	Num	Number parameter	Bit	Bit parameter	Txt	Text string	Bin	Binary parameter	FI	Filtered
ND	No default value	NC	Not copied	PT	Protected parameter	RA	Rating dependent	US	User save	PS	Power-down save	DE	Destination

11 Communications

Installing an AI-485 Adaptor provides the drive with a 2 wire EIA 485 serial communications interface. This enables the drive set-up, operation and monitoring to be carried out with a PC or controller as required.

11.1 EIA 485 Serial communications

Communication is via the RJ45 connector or screw terminals (parallel connection). The drive only supports Modbus RTU protocol.

The communications port applies a 1.25 unit load to the communications network.

USB to EIA485 Communications

An external USB hardware interface such as a PC cannot be used directly with the 2-wire EIA485 interface of the drive. Therefore a suitable converter is required.

A suitable USB to EIA485 isolated converter is available from Control Techniques as follows:

- CT USB Comms cable (CT Part No. 4500-0096)

When using the above converter or any other suitable converter with the drive, it is recommended that no terminating resistors be connected on the network. It may be necessary to 'link out' the terminating resistor within the converter depending on which type is used. The information on how to link out the terminating resistor will normally be contained in the user information supplied with the converter.

Serial communications set-up parameters

The following parameters need to be set according to the system requirements.

Serial communications set-up parameters		
Serial Mode (**P11.024**)	8 2 NP (0), 8 1 NP (1), 8 1 EP (2), 8 1 OP (3), 8 2 NP M (4), 8 1 NP M (5), 8 1 EP M (6), 8 1 OP M (7), 7 1 EP (8), 7 1 OP (9), 7 1 EP M (10), 7 1 OP M (11)	The drive only supports the Modbus RTU protocol and is always a slave. This parameter defines the supported data formats used by the 485 comms port (if installed) on the drive. This parameter can be changed via the drive keypad, via a option module or via the comms interface itself.
Serial Baud Rate (**P11.025**)	600 (1), 1200 (2), 2400 (3), 4800 (4), 9600 (5),19200 (6), 38400 (7), 57600(8), 76800(9), 115200 (10)	This parameter can be changed via the drive keypad, via a option module or via the comms interface itself. If it is changed via the comms interface, the response to the command uses the original baud rate. The master should wait at least 20 ms before sending a new message using the new baud rate.
Serial Address (**P11.023**)	1 to 247	This parameter defines the serial address and an addresses between 1 and 247 are permitted.

11.2 CT Modbus RTU specification

This section describes the adaptation of the MODBUS RTU protocol offered on Control Techniques' products. The portable software class which implements this protocol is also defined.

MODBUS RTU is a master slave system with half-duplex message exchange. The Control Techniques (CT) implementation supports the core function codes to read and write registers. A scheme to map between MODBUS registers and CT parameters is defined. The CT implementation also defines a 32 bit extension to the standard 16 bit register data format.

11.2.1 MODBUS RTU

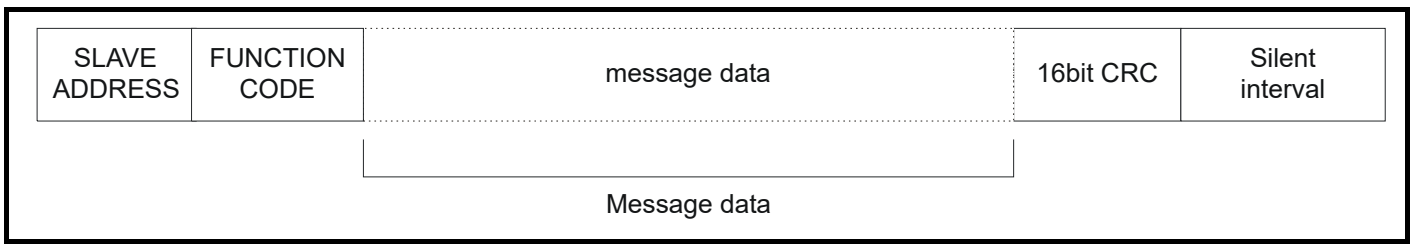
Physical layer

Attribute	Description
Normal physical layer for multi-drop operation	EIA485 2 wire
Bit stream	Standard UART asynchronous symbols with Non Return to Zero (NRZ)
Symbol	Each symbol consists of:- 1 start bit 8 data bits (transmitted least significant bit first) 2 stop bits*
Baud rates	600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 76800, 115200

* The drive will accept a packet with 1 or 2 stop bits but will always transmit 2 stop bits

RTU framing

The frame has the following basic format

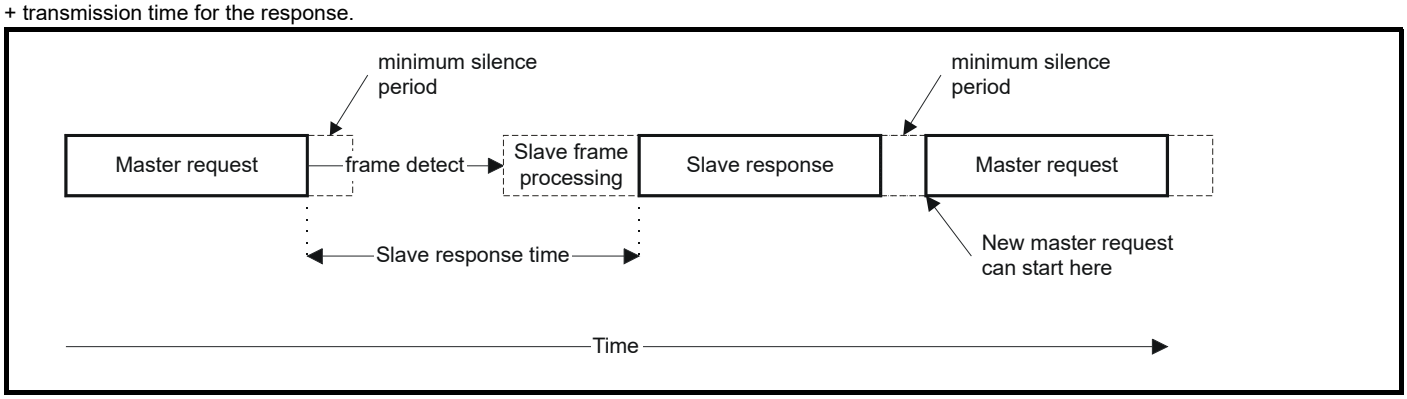


The frame is terminated with a minimum silent period of 3.5 character times (for example, at 19200 baud the minimum silent period is 2 ms). Nodes use the terminating silence period to detect the end of frame and begin frame processing. All frames must therefore be transmitted as a continuous stream without any gaps greater or equal to the silence period. If an erroneous gap is inserted then receiving nodes may start frame processing early in which case the CRC will fail and the frame will be discarded.

MODBUS RTU is a master slave system. All master requests, except broadcast requests, will lead to a response from an individual slave. The slave will respond (i.e. start transmitting the response) within the quoted maximum slave response time (this time is quoted in the data sheet for all Control Techniques products). The minimum slave response time is also quoted but will never be less that the minimum silent period defined by 3.5 character times.

If the master request was a broadcast request then the master may transmit a new request once the maximum slave response time has expired.

The master must implement a message time out to handle transmission errors. This time out period must be set to the maximum slave response time + transmission time for the response.



11.2.2 Slave address

The first byte of the frame is the slave node address. Valid slave node addresses are 1 through 247 decimal. In the master request this byte indicates the target slave node; in the slave response this byte indicates the address of the slave sending the response.

Global addressing

Address zero addresses all slave nodes on the network. Slave nodes suppress the response messages for broadcast requests.

11.2.3 MODBUS registers

The MODBUS register address range is 16 bit (65536 registers) which at the protocol level is represented by indexes 0 through 65535.

PLC registers

Modicon PLCs typically define 4 register 'files' each containing 65536 registers. Traditionally, the registers are referenced 1 through 65536 rather than 0 through 65535. The register address is therefore decremented on the master device before passing to the protocol.

File type	Description
1	Read only bits ("coil")
2	Read / write bits ("coil")
3	Read only 16bit register
4	Read / write 16bit register

The register file type code is NOT transmitted by MODBUS and all register files can be considered to map onto a single register address space. However, specific function codes are defined in MODBUS to support access to the "coil" registers.

All standard CT drive parameters are mapped to register file '4' and the coil function codes are not required.

CT parameter mapping

The Modbus register address is 16 bits in size, of which the upper two bits are used for data type selection leaving 14 bits to represent the parameter address, taking into account the slave increments the address value by 1, this results in a theoretical maximum parameter address of 163.84 (limited to 162.99 in software) when the default standard addressing mode (see *Serial Mode* (**P11.024**)) is used.

To access a parameter number above 99 in any drive menu then the modified addressing mode must be used (see *Serial Mode* (**P11.024**)), this will allow access to parameter numbers up to 255 but also limit the maximum menu number to 63.

The Modbus slave device increments the register address by 1 before processing the command, this effectively prevents access to parameter **P00.000** in the drive or option module.

The table below shows how the start register address is calculated for both addressing modes.

Parameter	Addressing mode	Protocol register			
0.mm.ppp	Standard	mm x 100 + ppp - 1			
	Modified	mm x 256 + ppp - 1			
Examples					
		16-bit		**32-bit**	
		Decimal	**Hex (0x)**	**Decimal**	**Hex (0x)**
0.01.021	Standard	120	00 78	16504	40 78
	Modified	276	01 14	16660	41 14
0.01.000	Standard	99	00 63	16483	40 63
	Modified	255	00 FF	16639	40 FF
0.03.161	Standard	N/A	N/A	N/A	N/A
	Modified	928	03 A0	17312	43 A0

Data types

The MODBUS protocol specification defines registers as 16 bit signed integers. All CT devices support this data size.

Refer to the section 11.2.7 *Extended data types* on page 132 for detail on accessing 32 bit register data.

11.2.4 Data consistency

All CT devices support a minimum data consistency of one parameter (16 bit or 32 bit data). Some devices support consistency for a complete multiple register transaction.

11.2.5 Data encoding

MODBUS RTU uses a 'big-endian' representation for addresses and data items (except the CRC, which is 'little-endian'). This means that when a numerical quantity larger than a single byte is transmitted, the MOST significant byte is sent first. So for example

16 - bits	0x1234	would be	0x12	0x34		
32 - bits	0x12345678	would be	0x12	0x34	0x56	0x78

11.2.6 Function codes

The function code determines the context and format of the message data. Bit 7 of the function code is used in the slave response to indicate an exception.

The following function codes are supported:

Code	Description
3	Read multiple 16 bit registers
6	Write single register
16	Write multiple 16 bit registers
23	Read and write multiple 16 bit registers
43	Read device indentification (MEI type 14)

FC03 Read multiple

Read a contiguous array of registers. The slave imposes an upper limit on the number of registers, which can be read. If this is exceeded the slave will issue an exception code 2.

Table 11-1 Master request

Byte	Description
0	Slave destination node address 1 through 247, 0 is global
1	Function code 0x03
2	Start register address MSB
3	Start register address LSB
4	Number of 16 bit registers MSB
5	Number of 16 bit registers LSB
6	CRC LSB
7	CRC MSB

Table 11-2 Slave response

Byte	Description
0	Slave source node address
1	Function code 0x03
2	Length of register data in read block (in bytes)
3	Register data 0 MSB
4	Register data 0 LSB
3+byte count	CRC LSB
4+byte count	CRC MSB

FC06 Write single register

Writes a value to a single 16 bit register. The normal response is an echo of the request, returned after the register contents have been written. The register address can correspond to a 32 bit parameter but only 16 bits of data can be sent.

Table 11-3 Master request

Byte	Description
0	Slave node address 1 through 247, 0 is global
1	Function code 0x06
2	Register address MSB
3	Register address LSB
4	Register data MSB
5	Register data LSB
6	CRC LSB
7	CRC MSB

Table 11-4 Slave response

Byte	Description
0	Slave source node address
1	Function code 0x06
2	Register address MSB
3	Register address LSB
4	Register data MSB
5	Register data LSB
6	CRC LSB
7	CRC MSB

FC16 Write multiple

Writes a contiguous array of registers. The slave imposes an upper limit on the number of registers which can be written. If this is exceeded the slave will discard the request and the master will time out.

Table 11-5 Master request

Byte	Description
0	Slave node address 1 through 247, 0 is global
1	Function code 0x10
2	Start register address MSB
3	Start register address LSB
4	Number of 16 bit registers MSB
5	Number of 16 bit registers LSB
6	Length of register data to write (in bytes)
7	Register data 0 MSB
8	Register data 0 LSB
7+byte count	CRC LSB
8+byte count	CRC MSB

Table 11-6 Slave response

Byte	Description
0	Slave source node address
1	Function code 0x10
2	Start register address MSB
3	Start register address LSB
4	Number of 16 bit registers written MSB
5	Number of 16 bit registers written LSB
6	CRC LSB
7	CRC MSB

FC23 Read/Write multiple

Writes and reads two contiguous arrays of registers. The slave imposes an upper limit on the number of registers which can be written. If this is exceeded the slave will discard the request and the master will time out.

Table 11-7 Master request

Byte	Description
0	Slave node address 1 through 247, 0 is global
1	Function code 0x17
2	Start register address to read MSB
3	Start register address to read LSB
4	Number of 16 bit registers to read MSB
5	Number of 16 bit registers to read LSB
6	Start register address to write MSB
7	Start register address to write LSB
8	Number of 16 bit registers to write MSB
9	Number of 16 bit registers to write LSB
10	Length of register data to write (in bytes)
11	Register data 0 MSB
12	Register data 0 LSB
11+byte count	CRC LSB
12+byte count	CRC MSB

Table 11-8 Slave response

Byte	Description
0	Slave source node address
1	Function code 0x17
2	Length of register data in read block (in bytes)
3	Register data 0 MSB
4	Register data 0 LSB
3+byte count	CRC LSB
4+byte count	CRC MSB

FC43 Read Device Identification

Modbus function code FC43 (0x2B) is now supported on Commander C300 drives with user firmware V01.11.00.04 or later. This function code allows the user to read drive identification and additional information relative to the physical and functional description of a remote drive over the RTU serial interface.

This function code uses the MEI (Modbus Encapsulated Interface) transport mechanism type 14 (0x0E), reserved for Device Identification.

Both the mandatory (Basic) and optional (Regular) identification modes (0x01 and 0x02 respectively) are supported, the Basic mode returns the first three identification objects, Vendor name, Product code and Major/minor revision; and the optional (Regular) mode returns the identification objects Vendor URL, Product name, Model name and Application name.

The supported identification objects and values are shown in the following table.

Table 11-9 Supported identification objects

Object Number	Object name	Object ID	Value
1	Vendor name	0x00	Control Techniques
2	Product code	0x01	(see below)
3	Major/minor revision	0x02	(**P11.029** Vaabbccdd)
4	Vendor URL	0x03	controltechniques.com
5	Product name	0x04	Commander
6	Model name	0x05	(**P11.064**)
7	Application name	0x06	(**P11.079** to **11.082**)

Product code

The product code information is comprised as:

[Model name]-[FVCA]

Where:

- Model name is derived from parameter **P11.064**
- F is the frame size (2 digits)
- V is the voltage rating (1 digit)
- C is the current rating (5 digits)
- A is an additional product identifier (12 digits) - Not used on Commander drives

For example, a frame 2, 200 Volt, 2.4 Amp C300 product code will be:

C300-02200024

The format of the master request is shown in the following table.

Table 11-10 Master request

Byte	Description	
0	Slave node address	
1	Modbus Function Code (0x2B)	
2	MEI Type (0x0E)	
3	Read Device ID Code	(0x01): Basic identification (mandatory) (0x02): Regular identification (optional)
4	Starting Object ID (0x00)	
5	CRC LSB	(0x70): Basic identification (0x70): Regular identification
6	CRC MSB	(0x77): Basic identification (0x87): Regular identification

If the master request is valid, the slave will respond with the requested information using the following format.

Table 11-11 Slave response

Byte	Description	
0	Slave node address	
1	Modbus Function Code (0x2B)	
2	MEI Type (0x0E)	
3	Read Device ID Code	(0x01): Basic identification (mandatory) (0x02): Regular identification (optional)
4	Conformity level	(0x01): Basic identification (mandatory) (0x02): Regular identification (optional)
5	More follows (0x00)	
6	Next object ID (0x00	
7	Number of objects in list	(0x03): Basic identification (mandatory) (0x04): Regular identification (optional)
	List of enumerated objects	
n[1]	Object ID	
n[1]+1	Object length (bytes)	
n[1]+2	Object value start byte	
66	CRC LSB	
67	CRC MSB	

The Object ID, length and value are returned for each object in the list.

[1] - The value of n is dependent on the number of the object in the list and the previous object length, with the first object numbered 1.

The byte number, n (starting at 0) for each object is shown in the following table.

Table 11-12 Returned object's attributes bytes

Object			Return Byte		
Number	**Name**	**ID**	**ID**	**Length**	**Value**
Basic identification (mandatory)					
1	Vendor name	0x00	8	9	10
2	Product code	0x01	28	29	30
3	Major/minor revision	0x02	55	56	57
Regular identification (optional)					
4	Vendor URL	0x03	8	9	10
5	Product name	0x04	31	32	33
6	Model name	0x05	42	43	44
7	Application name	0x06	48	49	50

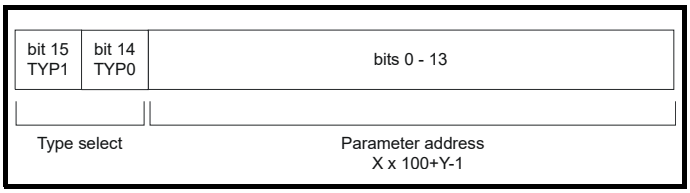
11.2.7 Extended data types

Standard MODBUS registers are 16bit and the standard mapping maps a single #X.Y parameter to a single MODBUS register. To support 32 bit data types (integer and float) the MODBUS multiple read and write services are used to transfer a contiguous array of 16 bit registers.

Slave devices typically contain a mixed set of 16 bit and 32 bit registers. To permit the master to select the desired 16 bit or 32 bit access the top two bits of the register address are used to indicate the selected data type.

NOTE

The selection is applied for the whole block access.



The 2bit type field selects the data type according to the table below:

Type field bits 15-14	Selected data type	Comments
00	INT16	backward compatible
01	INT32	
10	Float32	IEEE754 standard Not supported on all slaves
11	Reserved	

If a 32 bit data type is selected then the slave uses two consecutive 16 bit MODBUS registers (in 'big endian'). The master must also set the correct 'number of 16 bit registers'.

Example, read **P20.021** through **P20.024** as 32 bit parameters using FC03 from node 8:

Table 11-13 Master request

Byte	Value	Description
0	0x08	Slave destination node address
1	0x03	FC03 multiple read
2	0x47	Start register address **P20.021** (16384 + 2021 - 1) = 18404 = 0x47E4
3	0xE4	
4	0x00	Number of 16 bit registers to read **P20.021** through **P20.024** is 4x32 bit registers = 8x16 bit registers
5	0x08	
6	CRC LSB	
7	CRC MSB	

Table 11-14 Slave response

Byte	Value	Description
0	0x08	Slave destination node address
1	0x03	FC03 multiple read
2	0x10	Length of data (bytes) = 4x32 bit registers = 16 bytes
3-6		**P20.021** data
7-10		**P20.022** data
11-14		**P20.023** data
15-18		**P20.024** data
19	CRC LSB	
20	CRC MSB	

Reads when actual parameter type is different from selected

The slave will send the least significant word of a 32 bit parameter if that parameter is read as part of a 16 bit access.

The slave will sign extend the least significant word if a 16 bit parameter is accessed as a 32 bit parameter. The number of 16 bit registers must be even during a 32 bit access.

Example, If **P01.028** is a 32 bit parameter with a value of 0x12345678, **P01.029** is a signed 16 bit parameter with a value of 0xABCD, and **P01.030** is a signed 16 bit parameter with a value of 0x0123.

Read	Start register address	Number of 16 bit registers	Response	Comments
P01.028	127	1	0x5678	Standard 16 bit access to a 32 bit register will return low 16 bit word of truncated data
P01.028	16511*	2	0x12345678	Full 32 bit access
P01.028	16511*	1	Exception 2	Number of words must be even for 32 bit access
P01.029	128	1	0xABCD	Standard 16 bit access to a 32 bit register will return low 16 bit word of data
P01.029	16512*	2	0xFFFFABCD	32 bit access to a 16 bit register will return 32 bit sign extended data
P01.030	16513*	2	0x00000123	32 bit access to a 16 bit register will return 32 bit sign extended data
P01.028 to P01.029	127	2	0x5678, 0xABCD	Standard 16 bit access to a 32 bit register will return low 16 bit word of truncated data
P01.028 to P01.029	16511*	4	0x12345678, 0xFFFFABCD	Full 32 bit access

* Bit 14 is set to allow 32 bit access.

Writes when actual parameter type is different from selected

The slave will allow writing a 32 bit value to a 16 bit parameter as long as the 32 bit value is within the normal range of the 16 bit parameter.

The slave will allow a 16 bit write to a 32 bit parameter. The slave will sign extend the written value, therefore the effective range of this type of write will be -32768 to +32767.

Examples, if **P01.028** has a range of ±100000, and **P01.029** has a range of ±10000.

Write	Start register address	Number of 16 bit registers	Data	Comments
P01.028	127	1	0x1234	Standard 16 bit write to a 32bit register. Value written = 0x00001234
P01.028	127	1	0xABCD	Standard 16 bit write to a 32 bit register. Value written = 0xFFFFABCD
P01.028	16511	2	0x00001234	Value written = 0x00001234
P01.029	128	1	0x0123	Value written = 0x0123
P01.029	16512	2	0x00000123	Value written = 0x00000123

* Bit 14 is set to allow 32 bit access

11.2.8 Exceptions

The slave will respond with an exception response if an error is detected in the master request. If a message is corrupted and the frame is not received or the CRC fails then the slave will not issue an exception. In this case the master device will time out. If a write multiple (FC16 or FC23) request exceeds the slave maximum buffer size then the slave will discard the message. No exception will be transmitted in this case and the master will time out.

Exception message format

The slave exception message has the following format.

Byte	Description
0	Slave source node address
1	Original function code with bit 7 set
2	Exception code
3	CRC LSB
4	CRC MSB

Exception codes

The following exception codes are supported.

Code	Description
1	Function code not supported
2	Register address out of range, or request to read too many registers

Parameter over range during block write FC16

The slave processes the write block in the order the data is received. If a write fails due to an out of range value then the write block is terminated. However, the slave does not raise an exception response, rather the error condition is signalled to the master by the number of successful writes field in the response.

Parameter over range during block read/write FC23

There will be no indication that there has been a value out of range during a FC23 access.

11.2.9 CRC

The CRC is a 16 bit cyclic redundancy check using the standard CRC-16 polynomial x16 + x15 + x2 + 1. The 16 bit CRC is appended to the message and transmitted LSB first.

The CRC is calculated on ALL the bytes in the frame.

11.2.10 Device compatibility parameters

All devices have the following compatibility parameters defined:

Parameter	Description
Device ID	Unique device identification code
Minimum slave response time	The minimum delay between the end of a message from the master and the time at which the master is ready to receive a response from the slave. Refer to **P11.026**
Maximum slave response time	When global addressing, the master must wait for this time before issuing a new message. In a network of devices, the slowest time must be used
Maximum baud rate	115200
32 bit float data type supported	If this data type is not supported then an over range error will be raised if this data type is used
Maximum buffer size	Determines the maximum block size.

12 Diagnostics

The keypad display on the drive gives various information about the status of the drive. The keypad display provides information on the following categories:

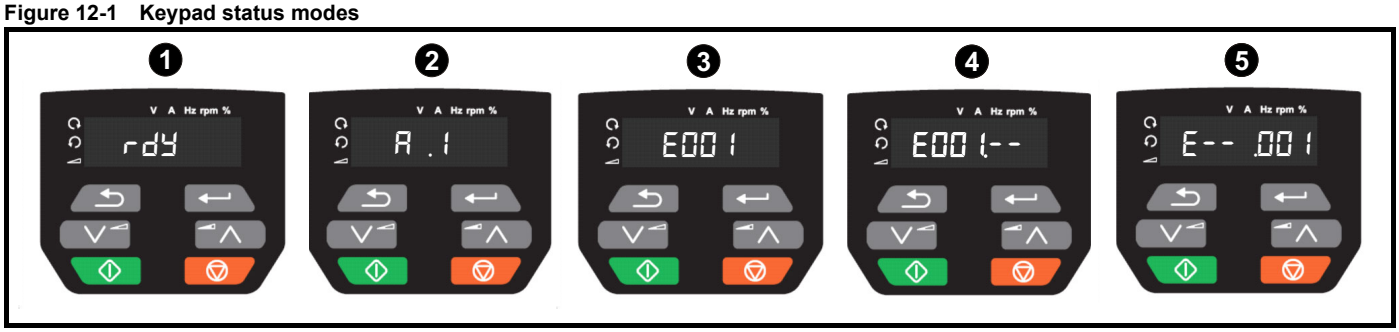
- Error indicators
- Alarm indicators
- Status indicators

A full list of status indicators can be found in section 5.2.

WARNING

Users must not attempt to repair a drive if it is faulty, nor carry out fault diagnosis other than through the use of the diagnostic features described in this chapter.
If a drive is faulty, it must be returned to an authorized Control Techniques distributor for repair.

Figure 12-1 Keypad status modes



1 Drive Ready status

2 Alarm status

3 Error status

4 Error status with sub-error (Error code)

5 Error status with sub-error (Sub-error code)

12.1 Alarms

The drive will produce an alarm under certain conditions to warn the user of a potential fault condition. The drive will continue to run in an alarm condition, but some alarms will advance to an error if the cause is not removed

Table 12-1 Drive Alarms

Alarm number	Alarm string	Description
A.1	**A.br.rES**	Brake resistor overload. *Braking Resistor Thermal Percentage* (**P10.039**) has reached 75.0 % of the value at which the drive will generate the error.
A.2	**A.OV.Ld**	*Motor Thermal Percentage* (**P04.019**) has reached 75.0 % of the value at which the drive will generate an error and the load on the drive is >100 %.
A.4	**A.D.OV.Ld**	Drive over temperature. *Drive Thermal Percentage* (**P07.036**) in the drive is greater than 90 %.
A.5	**A.Tune**	The auto-tune procedure has been initialized and an auto-tune is in progress.
A.6	**A.LS**	Limit switch active. Indicates that a limit switch is active and that is causing the motor to be stopped.
A.7	**A.FIrE**	Fire mode is active.
A.9	**A.OPt.AI**	Option slot alarm.
A.13	**A.Lo.AC**	Low voltage mode. See *Low AC Alarm* (**P10.107**).
A.14	**A.I.AC.Lt**	Current limit active. See *Current Limit Active* (**P10.009**).
A.15	**24V**	24 V Backup not present. See *24 V Alarm Loss Enable* (**P11.098**)
A.16	**A.Fan.r**	Fan reversed or failed

12.2 Errors

An error is produced as a response to certain conditions detected by the drive either to protect the motor or protect the drive. When an error does occur, it is shown on the display by an error code. Certain errors will have an additional sub-error code that provides a specific reason for the error. The main error code is stored in **P10.020** and the sub-error code is stored in **P10.070**. If the sub-error is >99 the display will alternate between the error code and sub-error code shown in (4) and (5) of Figure 12-1.

Table 12-2 Error codes

<table>
<tr><th>Error</th><th>Sub-error</th><th>Diagnosis</th></tr>
<tr><td>E002</td><td></td><td>D.C. Over Voltage (OV)</td></tr>
<tr><td></td><td></td><td>The D.C. bus voltage has exceeded the maximum D.C. bus voltage. The error is caused when either the instant threshold has been exceeded or the delay threshold has been exceeded for 15 s. These thresholds vary depending on the voltage rating of the drive as shown below.
<table>
<tr><th>Drive Voltage Rating</th><th>Instant Threshold</th><th>Delay Threshold</th></tr>
<tr><td>110 V</td><td>415 V</td><td>400 V</td></tr>
<tr><td>200 V</td><td>415 V</td><td>400 V</td></tr>
<tr><td>400 V</td><td>830 V</td><td>800 V</td></tr>
<tr><td>575 V</td><td>990 V</td><td>955 V</td></tr>
<tr><td>690 V</td><td>1192 V</td><td>1150 V</td></tr>
</table>
Recommended actions:
• Increase deceleration ramp rate parameter values, see Deceleration Rate 1 (P02.021)
• Consider enabling S-Ramps (P02.006) if the problem occurs at the start of deceleration
• Consider reducing Standard Ramp Voltage (P02.008) if seen during deceleration
• Check nominal A.C. supply level
• Check for supply disturbances which could cause the D.C. bus level to rise
• Check motor insulation using an insulation tester
• The inertia tune test will use the Fast Ramp (0) setting in Deceleration Ramp Type (P02.004). Ensure the correct braking resistor is fitted to absorb the energy during the deceleration part of the test.</td></tr>
<tr><td></td><td>.001</td><td>The D.C. bus voltage exceeded the instant threshold.</td></tr>
<tr><td></td><td>.002</td><td>The D.C. bus voltage exceeded the delay threshold for 15 seconds.</td></tr>
<tr><td>E003</td><td></td><td>Over Current (OI.aC)</td></tr>
<tr><td></td><td></td><td>The instantaneous drive output current has exceeded the over current threshold of the drive defined by Full Scale Current Kc (P11.061) and Over-Current Error Level (P05.069)
This error cannot be reset until 10 s after it was initiated.
Recommended Actions:
• Increase time taken for the drive to accelerate/decelerate
• Check for short circuit on the output cabling
• Check integrity of the motor insulation using an insulation tester
• Check the motor cable length is within limits of the drive
• Reduce the current loop gains, see Current Controller Kp Gain (P04.013)</td></tr>
<tr><td>E004</td><td></td><td>Brake Resistor Over Current (OI.br)</td></tr>
<tr><td></td><td></td><td>An over-current has been detected in the braking IGBT.
This error cannot be reset until 10 s after it was initiated.
Recommended actions:
• Check brake resistor wiring
• Check braking resistor value is greater than or equal to the minimum resistance value specified in the Power Installation Guide
• Check braking resistor insulation</td></tr>
<tr><td>E005</td><td></td><td>Power Supply Fault (PSU)</td></tr>
<tr><td></td><td></td><td>One or more internal power supply rails are outside limits or overloaded.
Recommended Actions:
• Remove option modules if installed. Ensure the drive supply is disconnected first
• Hardware fault - Contact the supplier of the drive</td></tr>
<tr><td>E006</td><td></td><td>External Error (Et)</td></tr>
<tr><td></td><td></td><td>An external error has been generated by a user function setting External Error (P10.032) to On (1).
Recommended actions if not configured deliberately:
• Digital input destination or functions are not set to trigger External Error
• Check user program or controller is not setting P10.032</td></tr>
</table>

Error	Sub-error	Diagnosis
E007		**Motor Over Speed (O.SPd)**
		Ramp Output (**P02.001**) or *Estimated Frequency* (**P03.002**), has exceeded the *Over Frequency Threshold* (**P03.008**). If *Over Frequency Threshold* (**P03.008**) is set to 0, the threshold is equal to 1.2 x *Maximum Frequency Limit* (**P01.006**). **Recommended actions:** • Check that the motor is not being driven by another part of the system • If using closed-loop control, reduce the *Frequency Controller Proportional Gain Kp1* (**P03.010**) to reduce the frequency overshoot
E011		**Auto-tune 1 (Tun.1)**
	.001	The auto-tune test to measure the motor stator resistance has failed because the output current failed to rise to the correct level to produce an accurate measurement. **Recommended actions:** • Check the motor cable / connections • Check the integrity of the motor stator windings using an insulation tester • Check the motor phase to phase resistance at the drive terminals • Check the motor phase to phase resistance at the motor terminals • If using an induction motor select *Linear V to F* in *Motor Control Mode* (**P05.014**) and verify the output current waveforms with an oscilloscope • Replace the motor
	.002	The current did not attain a high enough level during the auto-tune for the drive to determine the dead-time compensation of the inverter, or the calculation has provided an invalid result. **Recommended actions:** • Refer to sub-error .001
E013		**Auto-tune 3 (Tun.3)**
	.002	The motor speed did not reach 20 % of its rated speed in the test while running at a higher switching frequency. **Recommended Actions:** • Ensure that the motor is free to turn and that the static load plus inertia is not too large for the drive to accelerate within the test time • Ensure *Maximum Frequency Limit* (**P01.006**) is high enough for the test to run correctly • Reduce the switching frequency used for the test in *Maximum Switching Frequency* (**P05.018**)
	.003	The inertia auto-tune has been unable to identify the motor and load inertia. **Recommended Actions:** • Increase *Mechanical Load Test Level* (**P05.021**) • Increase *PM Start Boost* (**P05.071**) • Ensure the selected acceleration rate allows the motor to reach 20 % of it's rated speed within 60 s or the auto-tune will timeout.
E018		**Tune Interrupted (Tun.S)**
		The drive was prevented from completing an auto-tune, because either the drive enable, or the drive run signals were removed. **Recommended actions:** • Ensure the drive enable signal is active for the entire auto-tune. This can be checked using *Enable Indicators* (**P06.010**) • Ensure the drive run signal is active for the entire auto-tune • If these signals are supplied by a digital input, check the states using *Digital I/O Indicators* (**P08.020**)
E019		**Brake Resistor Temp (It.br)**
		The drive has estimated that the brake resistor has become too hot based on the values of *Braking Resistor Rated Power* (**P10.030**), *Braking Resistor Thermal Time Constant* (**P10.031**) and *Braking Resistor Resistance* (**P10.061**). The error occurs when *Braking Resistor Thermal Percentage* (**P10.039**) reaches 100 %. **Recommended actions:** • Reduce deceleration duty cycle • Increase the deceleration time, see *Deceleration Rate 1* (**P02.021**) • Reduce motor load • Ensure the values entered in *Braking Resistor Rated Power* (**P10.030**), *Braking Resistor Thermal Time Constant* (**P10.031**) and *Braking Resistor Resistance* (**P10.061**) are correct • If an external thermal protection device is being used, this error can be disabled by setting *Braking Resistor Rated Power* (**P10.030**), *Braking Resistor Thermal Time Constant* (**P10.031**) or *Braking Resistor Resistance* (**P10.061**) to 0

Error	Sub-error	Diagnosis
E020		**Motor Temp (It.AC)**
		The drive has estimated that the motor has become too hot based on the *Motor Rated Current* (**P05.007**) and *Motor Thermal Time Constant* (**P04.015**). The error occurs when *Motor Thermal Percentage* (**P04.019**) reaches 100 %. **Recommended actions:** • Ensure the load is not jammed / sticking • Check the load on the motor has not changed • Ensure the *Motor Rated Current* (**P05.007**) is correct • Ensure *Low Frequency Thermal Protection Enable* (**P04.025**) is set correctly for the motor type • If external motor thermal protection is used this error can be disabled using *Thermal Protection Action* (**P04.019**)
E021		**Drive Temp 1 (Oht.I)**
		An IGBT junction over-temperature has been detected. **Recommended actions:** • Check enclosure temperature • Check enclosure / drive fans are still functioning correctly • Clean the fan filter if being used • Check enclosure ventilation paths • Check enclosure door filters • Ensure all three supply phases are present and balanced • Increase ventilation • Reduce *Maximum Switching Frequency* (**P05.018)** • Ensure *Hold Switching Frequency* (**P05.035**) is set to Off (0). • Reduce duty cycle • Increase the acceleration / deceleration time, see *Deceleration Rate 1* (**P02.021**) • Reduce motor load • Confirm the drive is correctly sized for the application • Use a drive with larger current / power rating
E022		**Drive Temp 2 (Oht.P)**
		A power stage over-temperature has been detected. Sub-errors are for internal use only. **Recommended actions:** • See *Drive Temp 1* (**E021**)
E024		**Motor Thermistor Temp (th)**
		The motor thermistor has reached the motor over-temperature threshold defined by *Thermistor Error Threshold* (**P07.048**). **Recommended actions:** • Ensure the load is not jammed / sticking • Check the load on the motor has not changed • Check motor temperature • Check thermistor continuity
E025		**Motor Thermistor Short (thS)**
		The motor thermistor is short circuited or has a low impedance. The resistance of the thermistor connected to Terminal 14 (DI 5) is less than 50 ohms. **Recommended Actions:** • Check thermistor continuity • Replace motor / motor thermistor
E026		**I/O Overload (O.Ld1)**
		The current demand on the drive 24 V circuit has exceeded 100 mA. **Recommended Actions:** • Check control wiring is correct • Check 24 V output, digital output and 485 port for a current overload condition or potential short
E027		**Drive Temp 3 (Oh.dc)**
		A D.C. bus component over-temperature has been detected. **Recommended actions:** • *See Drive Temp 1* (**E021**)

Error	Sub-error	Diagnosis
E028		**Analog Input 1 Current Loss (cL.A1)**
		Indicates that a current loss was detected on terminal 2 analog input 1 and the input type is set to *4-20mA Error* (2) or *20-4mA Error* (3). Loss of input is detected if the current falls below 3 mA. **Recommended actions:** • Check control wiring is correct • Check control wiring is undamaged • Check that the current signal is present and greater than 3 mA • This error can be disabled in *T2 Analog Input 1 Type* (**P07.007**)
E030		**Watchdog Timeout (SCL)**
		Once the watchdog enable (bit 14) of *Binary Control Word* (**P06.042**) has been set to 0, it must continue to be written to at least once a second to prevent a Watchdog Timeout error from being generated.
E031		**Defaults Loaded (EEF)**
		The parameters have been set to their default values because the parameter set has been corrupted. This can occur if power was removed during a save. Sub-errors are for internal use only. **Recommended actions:** • Restore application settings and perform a save by selecting *Save* (1) in *Parameter 0* (**Pmm.000**) and pressing the reset button • Hardware fault - Contact the supplier of the drive
E032		**Supply Phase (PH.Lo)**
		The drive has detected a supply phase loss or large supply imbalance. **Recommended actions:** • Check the A.C. supply voltage balance and level at full load • Check the output current stability • Reduce the duty cycle • Reduce the motor load • If drive is supplied by the D.C. bus, this error should be disabled by setting Supply *Phase Loss Detection Mode* (**P06.047**) to *Disabled* (2)
E033		**Motor Resistance (rS)**
		The value set in *Stator Resistance* (**P05.017**) exceeds (V_{FS} / sqrt(2)) / *Full Scale Current Kc* (**P11.061**). V_{FS} is the full-scale D.C. bus voltage that is set as follows: Drive Voltage Rating: **100 V and 200 V** | **400 V** | **575 V** | **690 V** Frame size 5+: 415 | 830 | 990 | 1190 **Recommended actions:** • Check that the value entered in *Stator Resistance* (**P05.017**) does not exceed the allowed range.
E034		**Keypad Removed (Pad)**
		The keypad has been disconnected whilst being used to provide the drive reference (i.e. *Reference Selected Indicator* (**P01.049**) = *Keypad* (4) or *Keypad Ref* (6)). **Recommended actions:** • Check cable connection • Select another reference source in *Reference Selector* (**P01.014**)
E035		**Control Word (CL.bt)**
		Bit 12 (Control Word Error) in *Binary Control Word* (**P06.042**) has been set to 1 and *Binary Control Word Enable* (**P06.043**) is set to On (1).
E036		**User Save (U.S)**
		The user save parameters have been corrupted. Sub-errors are for internal use only. **Recommended actions:** • Perform a save by selecting *Save* (1) in *Parameter 0* (**Pmm.000**) and pressing the reset button • Ensure that the drive has enough time to complete the save before removing the power to the drive • If the problem persists, restore factory defaults by selecting *50 dEF* (7) or *60 dEF* (8) in *Parameter 0* (**Pmm.000)** and pressing the reset button
E037		**Power Down Save (Pd.S)**
		The power down save parameters have been corrupted. Sub-errors are for internal use only. **Recommended actions:** • Perform a save by selecting *Save* (1) in *Parameter 0* (**Pmm.000**) and pressing the reset button • If the problem persists, restore factory defaults by selecting *50 dEF* (7) or *60 dEF* (8) in *Parameter 0* (**Pmm.000**) and pressing the reset button

Error	Sub-error	Diagnosis
E090		**Firmware Fault 1 (LF.Er)**
		Communications loss between processors in the power stage on frame sizes 5 and above. **Recommended actions:** • Hardware fault - Contact the supplier of the drive
E093		**Inter-Processor (Pb.Er)**
		Communication between the control board processor and the power stage processor has been lost. This can be caused by extreme levels of noise on the system, follow guidance on *Electromagnetic compatibility (EMC)* in the *Power Installation Guide.* Sub-errors are for internal use only.
E096		**User Program 1 (UP.us)**
		A user program error has been generated by a function call in the onboard user program. The function call can be used to define the sub-error. **Recommended actions:** • Check user program
E098		**Motor Phase (Out.P)**
		Motor Phase Loss Detection (**P06.059**) is enabled and a motor phase loss has been detected.
	.001	Phase U has been disconnected
	.002	Phase V has been disconnected
	.003	Phase W has been disconnected
		Recommended actions: • Check motor and drive connections • Check cable integrity
E110		**Firmware Fault 2 (dcct)**
		D.C. current transformer failure **Recommended actions:** • Hardware fault - Contact the supplier of the drive
E172		**Fire Mode Error (FIrE)**
		Fire mode has been deactivated and errors were suppressed while the drive was in fire mode. See *Error History 1* (**P10.021**) to *Error History 9* (**P10.029**)
E173		**Fan Failure (FAn.F)**
		The drive has detected a fault with the cooling fan. **Recommended actions:** • Check that the fan is fitted and connected correctly • Contact the supplier of the drive to replace the fan
E189		**Analog Input 1 Overload**
		The input current on T2 analog input 1 has exceeded 24 mA. **Recommended actions:** • Check the control wiring is correct • Check the control wiring is undamaged • Check *T2 Analog Input 1 Type* (**P07.007**)
E200		**Option Module Fault 1 (SL.HF)**
		There is a fault with the option module in slot 1. This error can only be cleared by restarting the drive. Sub-errors are for internal use only. **Recommended actions:** • Ensure the option module is installed correctly • Ensure the supply is disconnected and the drive keypad is off before removing or installing option modules • Hardware fault - Contact the supplier of the drive or option module
E201		**Option Module Fault 2 (SL.tO)**
		Hardware fault - Contact the supplier of the drive or option module
E202		**Option Module Error (SL.Er)**
		The sub-error indicates the option module error. **Recommended actions:** • See the relevant Option Module User Guide for details on the error

Error	Sub-error	Diagnosis
E203		**Option Module Not Fitted (SL.nF)**
		The drive can no longer detect the option module that was installed when the drive was last powered down. The sub-error indicates the previous module fitted. See Table 2-1 to identify the option module from the module ID. **Recommended actions:** • Ensure the supply is disconnected and the drive keypad is off before removing or installing option modules • Ensure the option module is installed correctly • To confirm the option module is no longer required perform a save by selecting *Save* (1) in *Parameter 0* (**Pmm.000**) and pressing the reset button
E204		**Option Module Different (SL.dF)**
		The drive has detected a new or changed option module. The sub-error indicates the previous module fitted. See Table 2-1 to identify the option module from the module ID. **Recommended actions:** • Confirm that the currently installed option module is correct, ensure option module parameters are set correctly and perform a save by selecting *Save* (1) in *Parameter 0* (**Pmm.000**) and pressing the reset button • Turn off the power, ensure the correct option module is installed and re-apply the power. Sub-errors below provide more detail:
	.001	No option module was previously installed.
	.002	The option module setup parameters are different from the values when the drive was last powered down and so these parameters have all been set to their factory defaults.
	.>99	Sub-error >99 indicates the identifier of the option module previously installed. See value in *Error 0 Sub Error* (**P10.070**).
E218		**Firmware Fault 3 (tH.fb)**
		Thermistor failure. **Recommended actions:** • Hardware fault - Contact the supplier of the drive
E219		**Drive Temp 4 (Oht.C)**
		A control board over-temperature has been detected. This error can only be cleared by restarting the drive. **Recommended actions:** • See *Drive Temp 1* (**E021**)
E220		**Firmware Fault 4 (P.dAt)**
		Drive configuration data mismatch. **Recommended actions:** • Ensure the drive has been powered with the full rated voltage (enough to come out of the under voltage state) • Perform a save by setting *Parameter 0* (**Pmm.000**) to 1 and pressing the reset button • Restart the drive • If still failing then this could be a hardware fault, please contact the supplier of the drive
E221		**Stored HF (St.HF)**
		The drive had a hardware fault (HF) on the last power down. The sub-error indicates the HF code. **Recommended actions:** • Enter 1299 into *Parameter 0* (**Pmm.000**) and press the reset button to clear the error • If the problem persists contact the supplier of the drive
E226		**Firmware Fault 5 (So.St)**
		Soft start failure. **Recommended actions:** • Hardware fault - Contact the supplier of the drive
E228		**Phase U Fault (OI.E1)**
		The drive has detected a ground (earth) fault on the U phase of the motor cable/windings. This error can only be cleared by restarting the drive. **Recommended actions:** • Check for short circuit to ground (earth) on the output cables • Check the integrity of the motor insulation using an insulation tester **NOTE** This trip is not active during power up
E229		**Phase V Fault (OI.E2)**
		The drive has detected a ground (earth) fault on the V phase of the motor cable/windings. This error can only be cleared by restarting the drive. **Recommended actions:** • Check for short circuit to ground (earth) on the output cables • Check the integrity of the motor insulation using an insulation tester **NOTE** This trip is not active during power up

Error	Sub-error	Diagnosis
E230		**Phase W Fault (OI.E3)**
		The drive has detected a ground (earth) fault on the W phase of the motor cable/windings. This error can only be cleared by restarting the drive. **Recommended actions:** • Check for short circuit to ground (earth) on the output cables • Check the integrity of the motor insulation using an insulation tester **NOTE** This trip is not active during power up
E232		**Firmware Fault 6 (Dr.CF)**
		Hardware Fault - Contact the supplier of the drive
E234		**STO (STO)**
		No STO board fitted **Recommended actions:** • Hardware Fault - Contact the supplier of the drive
E235		**Firmware Fault 7 (Pb.HF)**
		A hardware fault has occurred in the power stage processor. The sub-error indicates the HF code. **Recommended actions:** • Enter 1299 into *Parameter 0* (**Pmm.000**) and press the reset button to clear the error • Hardware fault - Contact the supplier of the drive
E237		**Firmware Incompatible (FI.In)**
		The power firmware and control firmware are not compatible. This error can only be cleared by restarting the drive. Compatible firmware types will have matching "ww.xx" version numbers of the "ww.xx.yy" firmware version format in *Control Firmware Version* (**P11.039**) and *Power Firmware Version* (**P11.035**) **Recommended actions:** • Use Connect to install compatible firmware versions
E245		**Firmware Fault 8 (Pb.bt)**
		A firmware update has been interrupted. **Recommended actions:** • Restart the drive • Re-download drive firmware and ensure the drive does not lose power • Hardware Fault - Contact the supplier of the drive
E246		**Firmware Fault 9 (DEr.E)**
		The drive has a derivative image error. **Recommended actions:** Hardware Fault - Contact the supplier of the drive
E248		**Firmware Fault 10 (DEr.I)**
		The drive has a derivative program error. **Recommended actions:** Hardware Fault - Contact the supplier of the drive

Error	Sub-error	Diagnosis
E249		**User Program 2 (UPrG)**
		There is an error in the onboard user program. The sub-error will give additional detail and specific recommended actions. **Recommended actions:** • Check onboard user program with Machine Control Studio
	.002	Attempted to use a drive function that doesn't exist
	.003	Attempted fast parameter access set-up with non-existent parameter
	.004	Attempted access to non-existent parameter
	.005	Attempted write to read-only parameter
	.006	Attempted an over-range write
	.007	Attempted read from write-only parameter
	.030	The user program's associated image file is corrupt. **Recommended actions:** • Re-download the user program to the drive
	.031	The user program requires more RAM than can be provided by the drive
	.032	The user program requires an OS function call that is higher than the maximum allowed
	.033	The user program is not compatible with this drive **Recommended actions:** • Re-build the user program for this type of drive
	.040	The timed task has not completed in time and has been suspended **Recommended actions:** • Reduce code in timed task • Reduce the task repeat rate in *OUP: Clock Task Schedule Rate* (**P11.035**)
	.041	Undefined function called
	.051	The core menu customization is corrupt. **Recommended actions:** • Re-download the user program to the drive
	.052	The custom menu is corrupt. **Recommended actions:** • Re-download the customized menu to the drive
	.053	The custom menu has been changed **Recommended actions:** • Perform a save by selecting *Save* (1) in *Parameter 0* (**Pmm.000**) and pressing the reset button
	.1xx	Internal use only, please check Machine Control Studio and the drive firmware are both up to date and if the problem persists contact the supplier of the drive.
	.200	The user program has attempted to divide by zero
	.201	Parameter access is not supported. An attempt to read database other than the host drive
	.202	Parameter does not exist
	.203	Attempted write to a read-only parameter
	.204	Parameter is write-only
	.205	Unknown parameter error
	.206	Invalid bit present in parameter. The parameter does not contain the specified bit
	.207	Parameter format lookup failed. Failed to get parameter information data
	.208	An over-range write has been attempted
E250		**Drive Temp 5 (R.b.ht)**
		The input rectifier or braking IGBT is too hot. **Recommended actions:** • Check the A.C. supply voltage balance and levels • Check the D.C. bus ripple level • Reduce duty cycle • Reduce motor load • If fitted, check the braking resistor value is greater than or equal to the minimum resistance value stated in the Power Installation Guide

The errors can be grouped into the following categories. It should be noted that only error with the highest priority will be shown on the display.

Table 12-3 Error priorities

Priority	Category	Errors	Comments
1	Internal faults	HFxx	These errors indicate an internal fault. To clear the fault, restart the drive. All drive features are inactive after any of these errors occur.
1	Stored HF error	(E221)	Enter 1299 into *Parameter 0* (**Pmm.000**) and press the reset button to clear this error.
2	Non-resettable errors	Error numbers E200, E218 to E247	To clear a non-resettable error restart the drive.
3	Volatile memory failure	(E031)	This can only be reset if Parameter **00** is set to 1233 or 1244, or if *Load Defaults* (**P11.043**) is set to a non-zero value.
4	Internal 24 V	(E005)	Rectifier 24 V
5	Errors with extended reset times	(E003), (E004) and (E173)	These errors cannot be reset until 10 s after the error was initiated.
5	Phase loss and d.c. link power circuit protection	(E027) and (E032)	The drive will attempt to stop the motor before a (**E032**) error occurs unless this feature has been disabled (see *Action On Error Detection* (**P10.037**). The drive will always attempt to stop the motor before an error (**E027**) occurs.
5	Standard errors	All other errors	

12.3 Internal / Hardware faults

Errors (HF01) to (HF23) are internal faults that do not have error numbers except HF08, HF11, HF12 & HF18. If one of these errors occurs, the main drive processor has detected an irrecoverable error. All drive functions are stopped and the error message will be displayed on the drive keypad. If a non permanent error occurs this may be reset by power cycling the drive. On power up after it has been power cycled the drive will have an St.HF error (the sub-error number indicates the HF fault code). Enter 1299 in **P00.000** to clear the Stored HF error.

12.4 Displaying the error history

The drive retains a log of the last ten error that have occurred. *Error* (**P10.020**) to *Error History 9* (**P10.029**) store the most recent 10 errors that have occurred where *Error* (**P10.020**) is the most recent and *Error History 9* (**P10.029**) is the oldest. When a new error occurs it is written to *Error* (**P10.020**) and all the other errors move down the log, with oldest being lost. The date and time when each error occurs are also stored in the date and time log, i.e. *Error Date* (**P10.041**) to *Error 9 Time* (**P10.060**). The date and time are taken from *Date* (**P06.016**) and *Time* (**P06.017**). Some errors have sub-error numbers which give more detail about the reason for the error. If an error has a sub-error number its value is stored in the sub-error log, i.e. *Error Sub-error Number* (**P10.070**) to *Error 9 Sub-error Number* (**P10.079**). If the error does not have a sub-error number then zero is stored in the sub-error log.

If any parameter between **P10.020** and **P10.029** inclusive is read by serial communication, then the error number in Table 12-2 is the value transmitted.

NOTE

The error logs can be reset by writing a value of 255 in **P10.038** (via serial communications only).

12.5 Behavior of the drive with an error

If the drive has an error, the output of the drive is disabled so the load coasts to a stop and the following read only parameters are frozen until the error is cleared. This is to help diagnose the cause of the error.

Table 12-4 Parameters frozen on error

Parameter	Description
P01.001	Frequency reference
P01.002	Pre-skip filter reference
P01.003	Ramp input
P01.069	Reference in rpm
P01.070	Clamped reference
P02.001	Ramp output
P03.001	Final demand reference
P03.002	Estimated frequency
P03.003	Frequency error
P03.004	Frequency controller output
P03.045	Frequency reference
P04.001	Current magnitude
P04.002	Torque producing current
P04.017	Magnetizing current
P05.001	Output frequency
P05.002	Output voltage
P05.003	Output power
P05.005	D.C. bus voltage
P07.001	T2 Analog input 1 percentage
P07.002	T5 Analog input 2 percentage

If the parameters are not required to be frozen then this can be disabled by setting bit 4 of **P10.037**.

12.6 Drive status

The bits in *Additional Status Bits* (**P10.069**) mirror the status bits parameters as shown below. Where the parameters do not exist in any mode the bit remains at zero.

Table 12-5 Additional Status Bits

Bit	Status Parameter
0	*Under Voltage Active* (**P10.016**)
1	*Motor Overload Alarm* (**P10.017**)
2	*Drive Over-temperature Alarm* (**P10.018**)
3	*Drive Warning* (**P10.019**)
4	Reserved
5	Reserved
6	*Remote Keypad Battery Low* (**P10.064**)
7	*Auto-tune Active* (**P10.065**)
8	*Limit Switch Active* (**P10.066**)
9	*Fire Mode Active* (**P10.067**)
10	*Low AC Alarm* (**P10.107**)
11	*Current Limit Active* (**P10.009**)

13 UL Listing

13.1 UL file reference

All models are UL Listed to both Canadian and US requirements. The UL file reference is: NMMS/7.E171230.

Products that incorporate the Safe Torque Off function have been investigated by UL. The UL file reference is: FSPC.E171230.

13.2 Option modules, kits and accessories

Option Modules, Control Pods, Installation Kits and other accessories for use with these drives are UL Listed.

13.3 Enclosure ratings

All models are Open Type as supplied.

The drive enclosure is not classified as a fire enclosure. A separate fire enclosure must be provided. A UL/ NEMA Type 12 enclosure is suitable.

When fitted with a conduit box the drives meet the requirements for UL Type 1. Type 1 enclosures are intended for indoor use, primarily to provide a degree of protection against limited amounts of falling dirt.

The drives meet the requirements for UL Type 12 when installed inside a Type 12 enclosure and through-hole mounted using the sealing kit and the high-IP insert (where provided).

When through-hole mounted, the drives have been evaluated as suitable for use in surrounding air temperatures up to 40 °C.

Remote Keypads are UL Type 12 when installed with the sealing washer and fixing kit provided.

When installed in a Type 1 or Type 12 enclosure, the drives may be operated in a compartment handling conditioned air.

13.4 Mounting

Drives may be surface, through-panel or tile mounted using the appropriate brackets. Drives may be mounted singly or side by side with suitable space between them (bookcase mounting).

13.5 Environment

Drives must be installed in a Pollution Degree 2 environment or better (dry, non-conductive pollution only).

The drives have been evaluated for use at ambient temperatures up to 40 °C. The drives have additionally been evaluated for 50 °C and 55 °C ambient air temperatures with a derated output.

13.6 Electrical Installation

OVERVOLTAGE CATEGORY

OVC III

SUPPLY

(Frame 1 to 4 drives)

The drives are suitable for use on a circuit capable of delivering not more than 10,000 RMS Symmetrical Amperes, at rated voltage when protected by fuses as specified in the Installation Instructions.

Some smaller drives are suitable for use on a circuit capable of delivering not more than 10,000 RMS Symmetrical Amperes, at rated voltage when protected by circuit breakers.

(Frame 5 to 9 drives)

The drives are suitable for use on a circuit capable of delivering not more than 100,000 RMS Symmetrical Amperes, at rated voltage when protected by fuses as specified in the Installation Instructions.

TERMINAL TORQUE

Terminals must be tightened to the rated torque as specified in the Installation Instructions.

WIRING TERMINALS

Drives must be installed using cables rated for 75 °C operation, copper wire only.

Where possible, UL Listed closed-loop connectors sized according to the field wiring shall be used for all field power wiring connections.

GROUND CONNECTION INSTRUCTIONS

UL Listed closed-loop connectors sized according to the field wiring shall be used for grounding connections.

BRANCH CIRCUIT PROTECTION

The fuses and circuit breakers required for branch circuit protection are specified in the Installation Instructions.

OPENING OF BRANCH CIRCUIT

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.

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.

DYNAMIC BRAKING

Frame sizes 1 to 4 have been evaluated for dynamic braking applications. Other drive models have not been evaluated for dynamic braking.

13.7 Motor overload protection and thermal memory retention

All drives incorporate internal overload protection for the motor load that does not require the use of an external or remote overload protection device.

The protection level is adjustable and the method of adjustment is provided in section 8.9 *Motor thermal protection* on page 70. Maximum current overload is dependent on the values entered into the current limit parameters (motoring current limit, regenerative current limit and symmetrical current limit entered as percentage) and the motor rated current parameter (entered in amperes).

The duration of the overload is dependent on motor thermal time constant. The maximum programmable time constant depends on the drive model. The method of adjustment of the overload protection is provided.

The drives are provided with user terminals that can be connected to a motor thermistor to protect the motor from high temperature, in the event of a motor cooling fan failure.

13.8 External Class 2 supply

The external power supply used to power the 24 V control circuit shall be marked: “UL Class 2”. The power supply voltage shall not exceed 24 Vdc.

13.9 Modular Drive Systems

Drives with DC+ and DC- supply connections, rated 230 V or 480 V have been investigated for use in Modular Drive Systems as inverters when supplied by the converter sections from the Commander range. In these applications the inverters are required to be additionally protected by supplemental fuses.

Alternatively, the inverters may be supplied by converter models: Mentor MP25A, 45A, 75A, 105A, 155A or 210A.

Contact the supplier of the drive for more information.

13.10 Requirement for Transient Surge Suppression

This requirement only applies to Frame Size 7 drives with rated input voltage = 575 V.

TRANSIENT SURGE SUPPRESSION SHALL BE INSTALLED ON THE LINE SIDE OF THIS EQUIPMENT AND SHALL BE RATED 575 Vac (PHASE TO GROUND), 575 Vac (PHASE TO PHASE), SUITABLE FOR OVERVOLTAGE CATEGORY III, AND SHALL PROVIDE PROTECTION FOR A RATED IMPULSE VOLTAGE TO WITHSTAND VOLTAGE PEAK OF 6 kV AND A CLAMPING VOLTAGE OF MAXIMUM 2400 V.

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CONTROL TECHNIQUES

KB

0478-0699-04

EU Declaration of Conformity (Machinery Directive)

1. Product model

Commander C300 incorporating a Safe Torque Off (STO) function when used as a safety component of a machine.

Only the Safe Torque Off function may be used as a safety function of a machine.

2. Name and address of the manufacturer and authorised representative

Manufacturer**:**

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

Authorised representative:

Nidec Netherlands B.V.
Kubus 155
3364 DG Sliedrecht
Netherlands.

3. Responsibility

This declaration is issued under the sole responsibility of the manufacturer.

4. Object of the declaration

Model number	Interpretation	Nomenclature aaaa - bbc ddddde
aaaa	Basic series	C300
bb	Frame size	01, 02, 03, 04, 05, 06, 07, 08, 09
c	Voltage rating	1 = 100 V, 2 = 200 V, 4 = 400 V, 5 = 575 V
ddddd	Current rating	Example 01000 = 100 A
e	Drive format	A = 6P Rectifier + Inverter with internal choke

The model number may be followed by additional characters that do not affect the ratings.

5. Declaration

The object of the declaration is in conformity with the following European Union harmonisation legislation:

Machinery Directive (2006/42/EC)

Electromagnetic Compatibility Directive (2014/30/EU)

Type examination has been carried out by the following notified body:

TUV Rheinland Industrie Service GmbH, Am Grauen Stein, D-51105 Köln, Germany

Notified body identification number: 0035

EC type-examination certificate numbers:

Frame sizes 1 to 4: 01/205/5383.04/20 dated 2020-06-23

Frame sizes 5 to 9: 01/205/5387.03/20 dated 2020-06-23

6. References to the relevant harmonised standards used

The variable speed drive products listed above have been designed and manufactured in accordance with the following European harmonised standards:

EN 61800-5-2:2016	Adjustable speed electrical power drive systems - Part 5-2: Safety requirements - Functional
EN 61800-5-1:2016 (in extracts)	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy
EN 61800-3: 2004 + A1: 2012	Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods
EN ISO 13849-1:2015	Safety of Machinery, Safety-related parts of control systems, General principles for design
EN 62061:2005 + AC: 2010 + A1: 2013 + A2: 2015	Safety of machinery, Functional safety of safety related electrical, electronic and programmable electronic control systems
EN 61508 Parts 1 - 7:2010	Functional safety of electrical/ electronic/programmable electronic safety-related systems

7. Signed for and on behalf of:

Person authorised to complete the technical file: Authorised representative (see detail above)

DoC authorised by:

Jon Holman-White, Vice President, Research and Development.

Date: **1st January 2021, Newtown, Powys, UK**

IMPORTANT NOTICE

These electronic drive products are intended to be used with appropriate motors, controllers, electrical protection components and other equipment to form complete power drive system (PDS).

It is the responsibility of the installer to ensure that the design of the system and machine, including its safety-related control system, is carried out in accordance with the requirements of the Machinery Directive and any other relevant legislation.

The use of a safety component does not ensure the safety of the machine.

Compliance with safety and EMC regulations depends upon installing and configuring drives correctly, including using the specified input filters.

The drive must be installed only by professional installers who are familiar with requirements for safety and EMC.

The assembler is responsible for ensuring that the final product or system complies with all relevant laws in the country where it is to be used. For more information regarding Safe Torque Off, refer to the Product Documentation.