Nidec

All for dreams

User Guide

SI-I/O 24 Plus

Part Number: 0478-0704-04
Issue: 4

Contents

Compliance Information

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 Manual constitutes the original instructions. Manuals published in other languages are translations of the original instructions and the English language version of this Manual prevails over any other language version in the event of inconsistency.

Documentation and user software tools

Manuals, datasheets and software that we make available to users of our products can be downloaded from: **http://www.drive-setup.com**

Warranty and liability

The contents of this Manual 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: **http://www.drive-setup.com/environment**.

Restriction and control of hazardous substances

The products covered by this Manual 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
UK REACH etc. (Amendment etc.) (EU Exit) Regulations 2020, European Union REACH Regulation EC 1907/2006
EU restriction of the Use of certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) - Directive 2011/65/EU
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 Manual 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 Manual fall within the scope of the UK Waste Electrical and Electronic Equipment Regulations 2013, EU Directive 2012/19/EU amended by EU Directive 2018/849 (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.

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 DC 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 Introduction

2.1 Module information

The SI-I/O 24 Plus module provides an encoder input and digital I/O with the following features:

- **Encoder input**
  - Quadrature AB encoder with marker pulse
  - Quadrature AB encoder with marker pulse and UVW commutation signals for absolute position with permanent magnet motors.
  - Time capture/freeze system
  - Motor thermistor input
- **Digital I/O**
  - 16 optically isolated digital inputs, 8 of which support high speed time capture capability.
  - 8 optically isolated digital outputs.

The SI-I/O 24 Plus module has been designed to work alongside the PTi210 Motion Made Easy option module to provide the same digital I/O and main motor encoder input as the Epsilon EP servo drives. A 44-way high density D-type connector is used to provide both the encoder input and digital I/O connections.

An optional breakout board is available which provides screw terminal connections for interfacing to the SI-I/O 24 Plus module. See section 4.6 *Optional breakout board* on page 12 for more information.

2.2 Compatible drive models

The module can be used with following drive models:

- Unidrive M600 & M70x
- Digitax HD

2.3 Setup menus and parameters

All parameters associated with the option module are contained within two menus on the drive depending into which option slot on the drive the module has been fitted to. The first menu contains all parameters associated with the encoder input (menu 15, 16 or 17) and the second menu contains all parameters associated with the digital I/O (menu 25, 26 or 27).

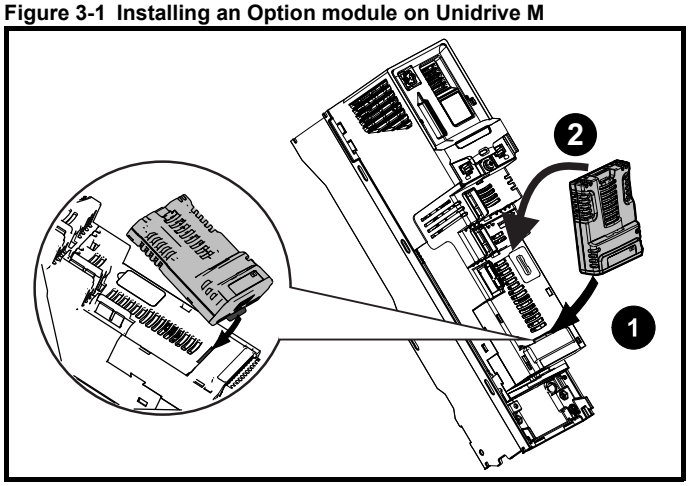
Slot	Encoder input menu	Digital I/O menu
1	15	25
2	16	26
3	17	27

3 Installing the Option Module

WARNING

Before installing or removing an option module from any drive, ensure the AC supply has been disconnected for at least 10 minutes and refer to Chapter 1 Safety Information on page 3. If using a DC bus supply ensure this is fully discharged before working on any drive or option module.

Figure 3-1 Installing an Option module on Unidrive M

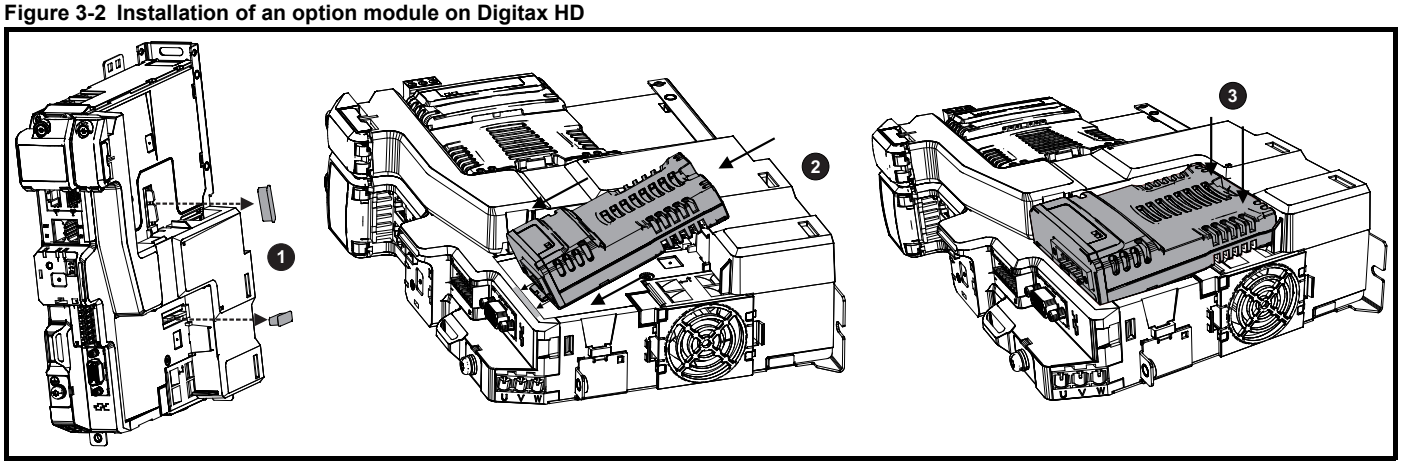


- Move the option module in direction shown (1/2).
- Align and insert the option module tab in to the slot provided, this is highlighted in the detailed view (A).
- Press down on the option module until it clicks into place.

NOTE

Option module slots must be used in the following order: Slot 3 (lower), Slot 2 (middle) and then Slot 1 (upper).

Figure 3-2 Installation of an option module on Digitax HD



1. Remove the protective interface card covers.
2. Align and insert the option module tab into the slot on the drive plastic.
3. Once the option module tab is located into the slot on the drive, push down at the rear of the option module until it clicks into place.

NOTE

To fit SI option modules to a Digitax HD M75X series drive an additional SI option mounting kit is required if not already supplied with the drive.

The SI option mounting kit can be ordered from the supplier of the drive. Refer to the Digitax HD M75X Series Installation and Technical Guide for further information.

NOTE

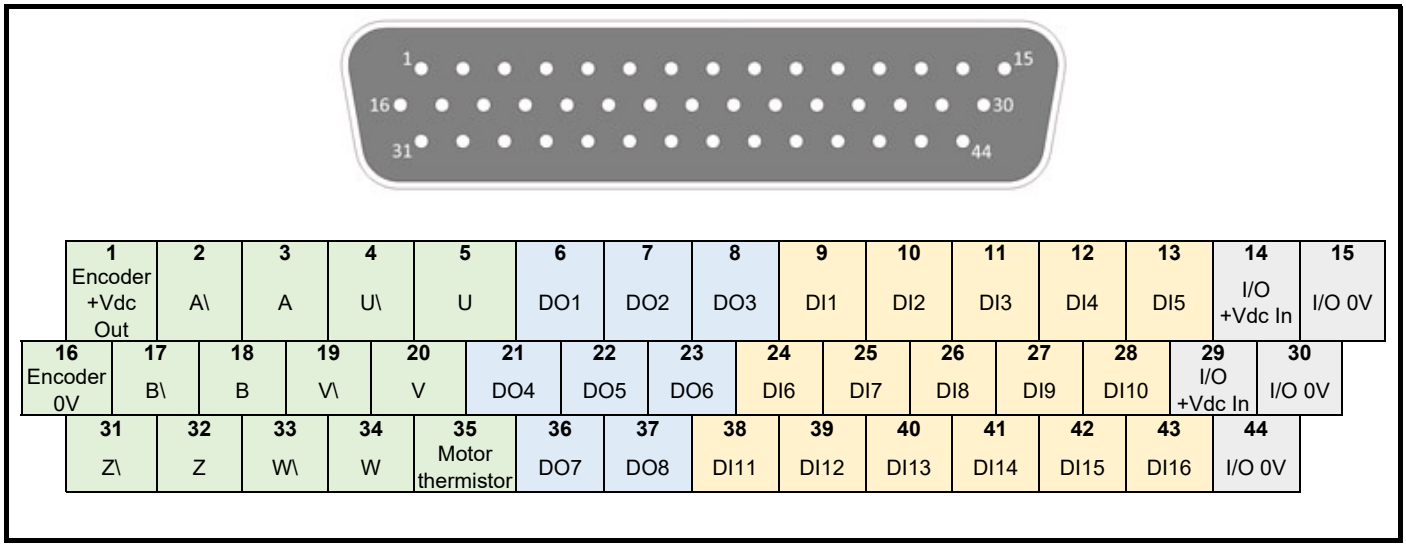
Once fitted, the option module remains at an angle with respect to the drive.

4 Electrical installation

4.1 Terminal descriptions

The module uses a single 44-pin male high density D-type connector for the encoder input and the digital I/O connections.

Figure 4-1 SI-I/O 24 Plus connector



4.1.1 44-way D-type connector

Table 4-1 44-way D-type connector pinout

Pin	Function	Pin	Function	Pin	Function
1	Encoder +5Vdc Output	16	Encoder 0V	31	Encoder Input Z\
2	Encoder Input A\	17	Encoder Input B\	32	Encoder Input Z
3	Encoder Input A	18	Encoder Input B	33	Encoder Input W\
4	Encoder Input U\	19	Encoder Input V\	34	Encoder Input W
5	Encoder Input U	20	Encoder Input V	35	Motor Thermistor Input
6	Digital Output 1	21	Digital Output 4	36	Digital Output 7
7	Digital Output 2	22	Digital Output 5	37	Digital Output 8
8	Digital Output 3	23	Digital Output 6	38	Digital Input 11
9	Digital Input 1 (with time capture)	24	Digital Input 6 (with time capture)	39	Digital Input 12
10	Digital Input 2 (with time capture)	25	Digital Input 7 (with time capture)	40	Digital Input 13
11	Digital Input 3 (with time capture)	26	Digital Input 8 (with time capture)	41	Digital Input 14
12	Digital Input 4 (with time capture)	27	Digital Input 9	42	Digital Input 15
13	Digital Input 5 (with time capture)	28	Digital Input 10	43	Digital Input 16
14	I/O +Vdc Input	29	I/O +Vdc Input	44	I/O 0V Common
15	I/O 0V Common	30	I/O 0V Common		

An external 24 Vdc power supply is required to use the digital outputs on the module. See section 4.3 *External 24 V power supply requirements* on page 10 for more information.

All digital outputs are configured as sourcing (positive logic) such that the outputs "source" current from the positive side of the I/O supply when ON. The inputs on the module are compatible with a sourcing output returning current to the grounded negative side of the I/O supply.

Optical isolation of the I/O is functional only and does not provide safety rated isolation. For UL installations, I/O wiring must be from a limited voltage/ limited energy or limited voltage/limited current supply.

4.2 Electrical specifications

4.2.1 Encoder input

1	Encoder +5Vdc Output Power Supply
Supply voltage	5.15 Vdc ±4 %
Maximum output current	300 mA
0 V reference connection	Pin 16 Encoder 0V

2 to 5, 17 to 20, 31 to 34	Channel A, B, Z, U, V and W
Type	EIA 485 differential receivers
Maximum frequency	500 kHz
Line loading	<2 unit loads
Line termination components	None. See section 4.4 *Encoder terminations* for more information.
Working common mode range	-7 Vdc to +12 Vdc
Absolute maximum applied voltage relative to 0 V	-9 V to +14 V
Absolute maximum applied differential voltage	-9 V to +14 V

16	Encoder 0V
Function	0V for encoder power supply and motor thermistor This cannot be used as a 0V common for the digital I/O

The Encoder 0V pin is referenced to the drive's 0V. The housing/shield of the D-type is also referenced to the Encoder 0V pin and the drive's 0V.

35	Motor Thermistor Input
Supported thermistor types	DIN44082
Trip threshold resistance	User defined in Pr **1x.120**. Default is 3300 Ω
Trip reset threshold resistance	User defined in Pr **1x.121**. Default is 1800 Ω
Short-circuit detection resistance	50 Ω ±40 %
0 V reference connection	Encoder 0V on pin 16

4.2.2 Digital I/O electrical specifications

9 to 13, 24 to 26	Digital Inputs 1 to 8 with time capture
Type	Positive logic digital input
Isolation	Optically isolated
Typical input current @ 24V	2.9 mA
Logic high	> 15 Vdc with an input current of > 2 mA
Logic low	< 5 V or an input current of < 0.5 mA
Absolute maximum voltage range	-3 V to +30 V
Compliance	IEC61131-2 Type 1 24 Vdc digital input
Update rate	250 µs
High-speed time capture accuracy	Rising edge: <±1 µs Falling edge: <±3 µs
0 V reference connection	I/O 0V Common on pins 15, 30 and 44

27 to 28, 38 to 43	Digital Inputs 9 to 16
Type	Positive logic digital input
Isolation	Optically isolated
Typical input current @ 24V	2.9 mA
Logic high	> 15 Vdc with an input current of > 2 mA
Logic low	< 5 V or an input current of < 0.5 mA
Absolute maximum voltage range	-3 V to +30 V
Compliance	IEC61131-2 Type 1 24 Vdc digital input
Update rate	250 µs
0 V reference connection	I/O 0V Common on pins 15, 30 and 44

6 to 8, 21 to 23, 36 to 37	Digital Outputs 1 to 8
Type	Positive logic digital output (source only)
Isolation	Optically isolated
Output voltage	I/O power supply voltage - 1.5 Vdc
Maximum output current	150 mA
Short-circuit protection	From I/O 0V Common to any voltage up to the I/O power supply voltage.
Update rate	250 µs
0 V reference connection	I/O 0V Common on pins 15, 30 and 44

If a digital output is used to drive an inductive load such as a relay, a suitable freewheeling diode should be fitted.

14, 29	I/O Power Supply Input +Vdc
Function	User supplied power for digital output circuits
Nominal voltage	+24 Vdc
Minimum operating voltage	+19 Vdc
Maximum operating voltage	+30 Vdc
Current consumption with all digital outputs loaded	1.2 A
Recommended fuse	3 A

4.3 External 24 V power supply requirements

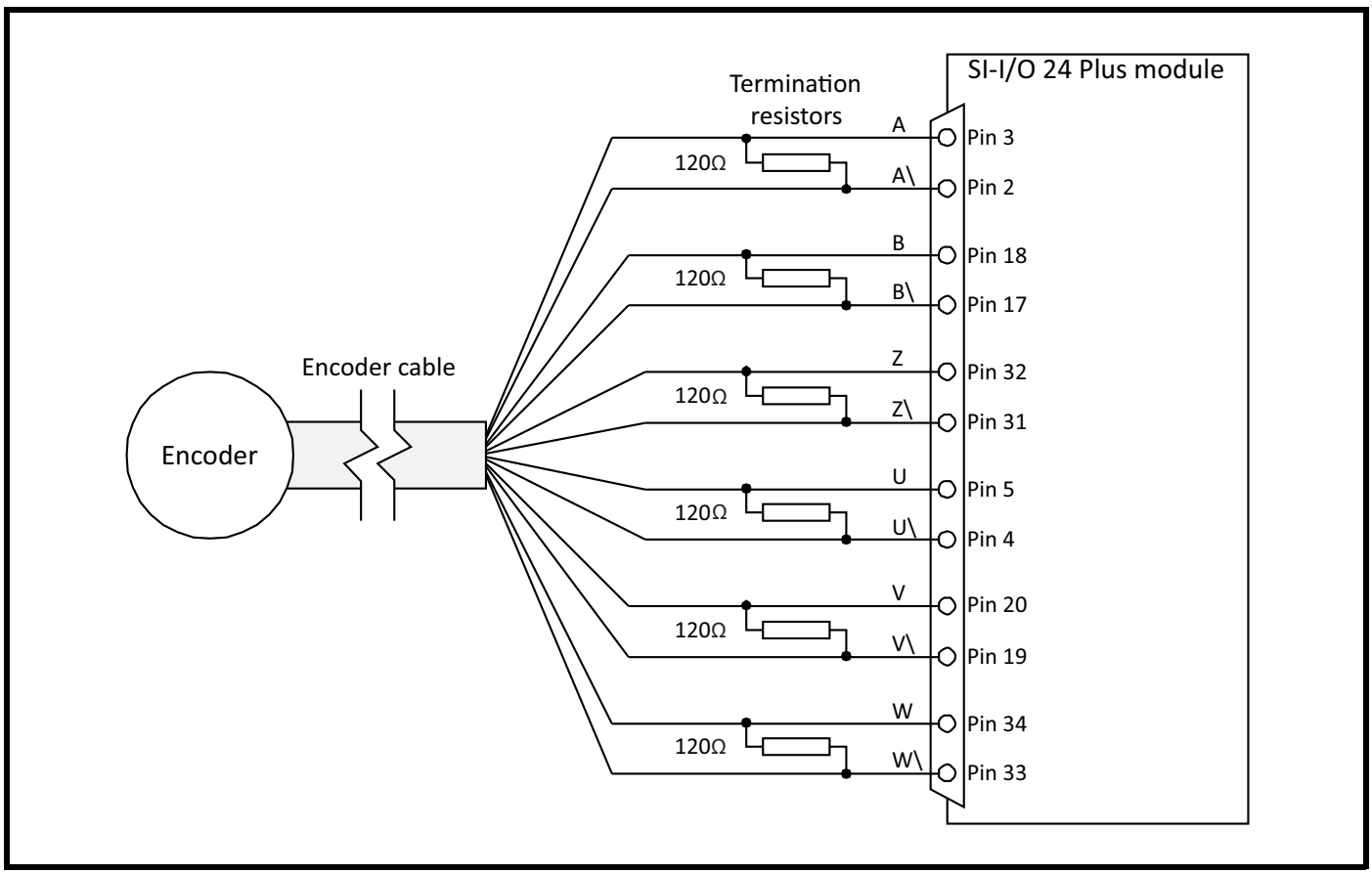
The digital outputs require an external 24 V power to be connected to the module. It is recommended that the power supply is able to supply at least 1.2 A. With a larger power supply the recommended fuse is 3A.

For UL installations, the I/O power supply must be from a limited voltage/limited energy or limited voltage/limited current supply.

4.4 Encoder terminations

The module does not provide termination resistors. 120 Ω, 0.25 W termination resistors will need to be fitted externally to each of the encoder input channels being used. These should ideally be located as close as possible to the encoder input on the module.

Figure 4-2 Encoder termination resistors



4.5 Encoder wiring and shield connections

Shielding considerations are important for PWM drive installations due to the high voltages and currents present in the output (motor) circuit with a very wide frequency spectrum, typically from 0 to 20 MHz. Encoder inputs are liable to be disturbed if careful attention is not given to managing the cable shields.

The following guidance is divided into two parts:

1. Ensuring correct transfer of data without disturbance from electrical noise originating either within the drive or from outside.
2. Additional measures to prevent unwanted emission of radio frequency noise. These are optional and only required where the installation is subject to specific requirements for radio frequency emission control.

To ensure correct transfer of data, observe the following

Use a cable with the correct impedance

- Use a cable with individually shielded twisted pairs
- Connect the cable shields to 0V at both the drive and the encoder, using the shortest possible links ("pigtails")
- The cable should preferably not be interrupted. If interruptions are unavoidable, ensure the absolute minimum length of "pigtail" in the shield connections at each interruption. Preferably, use a connection method which provides substantial metallic clamps for the cable shield terminations.

The above applies where the encoder body is isolated from the motor and where the encoder circuit is isolated from the encoder body. Where there is no isolation between the encoder circuits and the motor body, and in case of doubt, the following additional requirement must be observed. This gives the best possible noise immunity.

- The shields must be directly clamped to the encoder body (no pigtail) and to the drive grounding bracket. This may be achieved by clamping of the individual shields or by providing an additional overall shield which is clamped.

NOTE

The recommendations of the encoder manufacturer must also be adhered to for the encoder connections.

NOTE

In order to guarantee maximum noise immunity for any application double shielded cable as shown should be used.

In some cases, single shielding of each pair of differential signals cables, or a single overall shield with individual shield on the thermistor connections is sufficient. In these cases, all the shields should be connected to ground and 0 V at both ends.

If the 0 V is required to be left floating, a cable with individual shields and an overall shield must be used.

Figure 4-3 and Figure 4-4 illustrate the preferred construction of cable and the method of clamping. The outer sheath of the cable should be stripped back enough to allow the clamp to be installed. The shield must not be broken or opened at this point. The clamps should be installed close to the drive or encoder, with the ground connections made to a ground plate or similar metallic ground surface.

Figure 4-3 Encoder cable, twisted pair

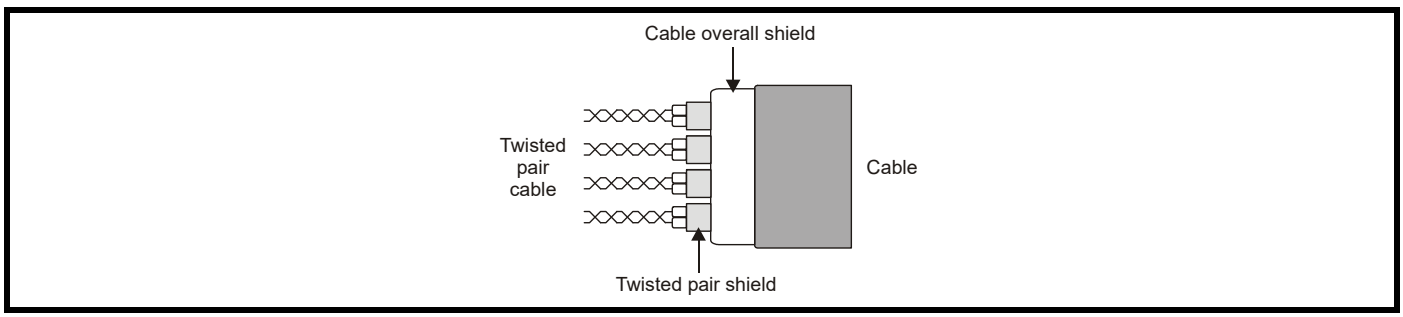
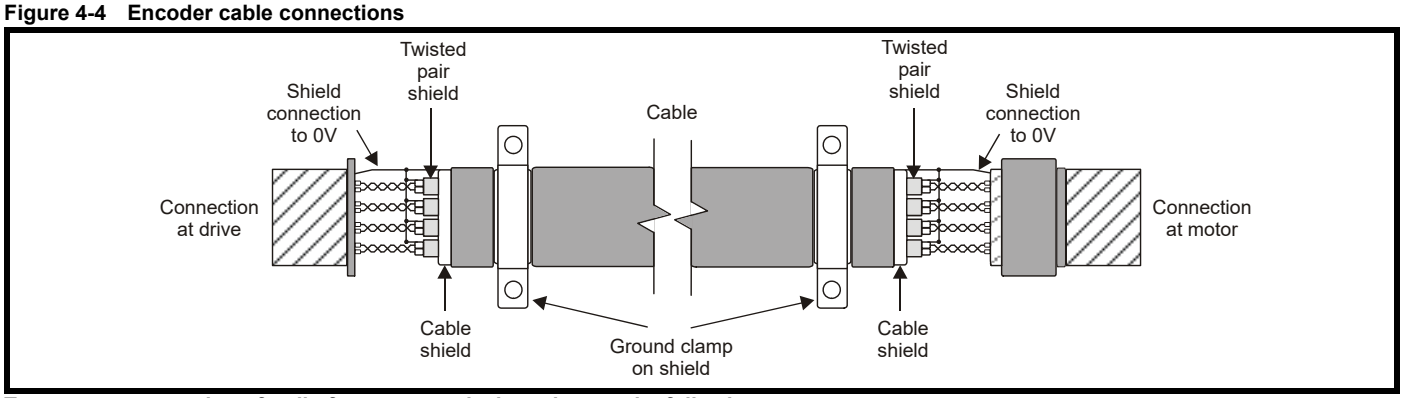


Figure 4-4 Encoder cable connections



To ensure suppression of radio frequency emission, observe the following:

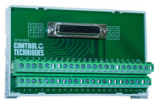
- Use a cable with an overall shield
- Clamp the overall shield to grounded metallic surfaces at both the encoder and the drive, as illustrated in Figure 4-4.

4.6 Optional breakout board

An optional breakout board is available which provides screw terminal connections for interfacing to the SI-I/O 24 Plus module. This provides 46 screw terminals for the encoder input and digital I/O connections.

The numbering of the screw terminals on the breakout board matches the numbering of the 44-way D-type on the module as detailed in section 4.1 *Terminal descriptions* on page 8.

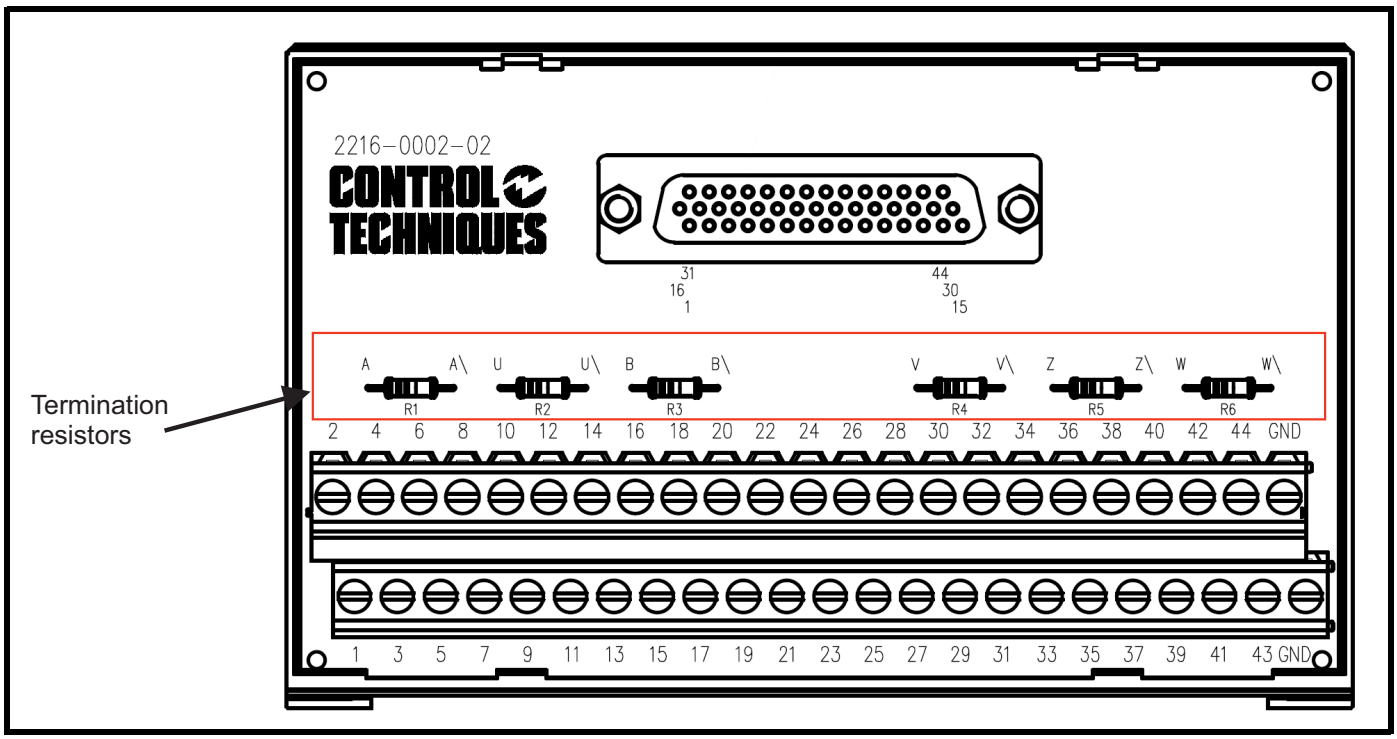
Table 4-2 Breakout board and cable

	Part number	Name	Description
	2216-0002-02	44-way high density D-type breakout PCB	DIN rail mountable breakout board providing 46 screw terminal connections for the encoder input and digital I/O.
	3471-0002	D-sub cable HD44 male to female cable	760 mm (30 in) 44-way cable to connect the breakout board to the SI-I/O 24 Plus module.

The ground connections on terminals 45 and 46 of the breakout board are connected to the shell of the 44-way high density D-type connector. When the breakout board is connected to the SI-I/O 24 Plus module, terminals 45 and 46 will be connected to the encoder 0 V on terminal 16 of the breakout board, and to 0 V on the drive. The ground connections on terminals 45 and 46 are not connected to I/O 0V common on terminals 15, 30 and 44.

The breakout board with part number 2216-0002-02 includes termination resistors for the encoder input. Conventional 120Ω resistors are used for the termination resistors. If it is necessary to disconnect the termination resistors, then this can be done by cutting out the relevant resistors. The termination resistors are labelled on the breakout board as shown in Figure 4-5 below.

Figure 4-5 Breakout board



5 Getting Started

This module is intended to be used in combination with the PTi210 module and configured via the PowerTools Studio PC tool. The information below is provided for when the encoder interface is to be setup manually via the module parameters. No setup is required for the digital I/O as the inputs are read and the outputs are set via registers.

5.1 Encoder setup

Follow the steps below to set up an encoder.

<table>
<tr><th colspan="2">Quadrature AB incremental encoder (A, B, Z)
Quadrature AB incremental encoder with commutation signals (A, B, Z, U, V, W)</th></tr>
<tr><td>Device Type (1x.038)</td><td>AB (0) for a quadrature encoder without commutation signals *
AB Servo (1) for a quadrature encoder with commutation signals</td></tr>
<tr><td>Lines Per Revolution (1x.034)</td><td>Set to the number of lines or pulses per revolution of the encoder</td></tr>
<tr><td>Marker Mode (1x.031)</td><td>Configure the marker mode required. The selection in bold indicates the default condition.
<table>
<tr><th colspan="3">Bit</th><th rowspan="2">Description</th></tr>
<tr><th>2</th><th>1</th><th>0</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>Position (1x.029) and Fine Position (1x.030) are reset to zero. The bits in Normalised Position (1x.058) related to Position (1x.029) and Fine Position (1x.030) are reset to zero. Marker Flag (1x.032) is set to one.</td></tr>
<tr><td>X</td><td>X</td><td>1</td><td>No action is taken unless the marker flag is zero before the marker event occurs</td></tr>
<tr><td>0</td><td>1</td><td>X</td><td>Revolution Counter (1x.028) and the whole of Normalised Position (1x.058) are also set to zero on a marker event</td></tr>
<tr><td>1</td><td>X</td><td>X</td><td>Revolution Counter (1x.028), Position (1x.029), Fine Position (1x.030) and the related part of Normalised Position (1x.058) are not reset. (This overrides bit 1.) Normalised Position (1x.058) is transferred to Normalised Marker Position (1x.059) and Marker Flag (1x.032) is set to one.</td></tr>
</table></td></tr>
</table>

* A device type of AB should only be used in RFC-A mode with an induction motor. If used in RFC-S mode, a phase offset test must be performed after every power up.

If the encoder does not provide UVW commutation signals then ensure that *Device Type* (**1x.038**) is set to AB.

5.2 Selecting the module for motor control feedback

If the module is required to be the source of control feedback for the drive then *Motor Control Feedback Select* (**03.026**) on the drive should be set to one of the following settings depending on which option slot the module is installed in.

Option Slot	Setting for *Motor Control Feedback Select* (03.026) on the drive
1	P1 Slot 1 (2)
2	P1 Slot 2 (4)
3	P1 Slot 3 (6)

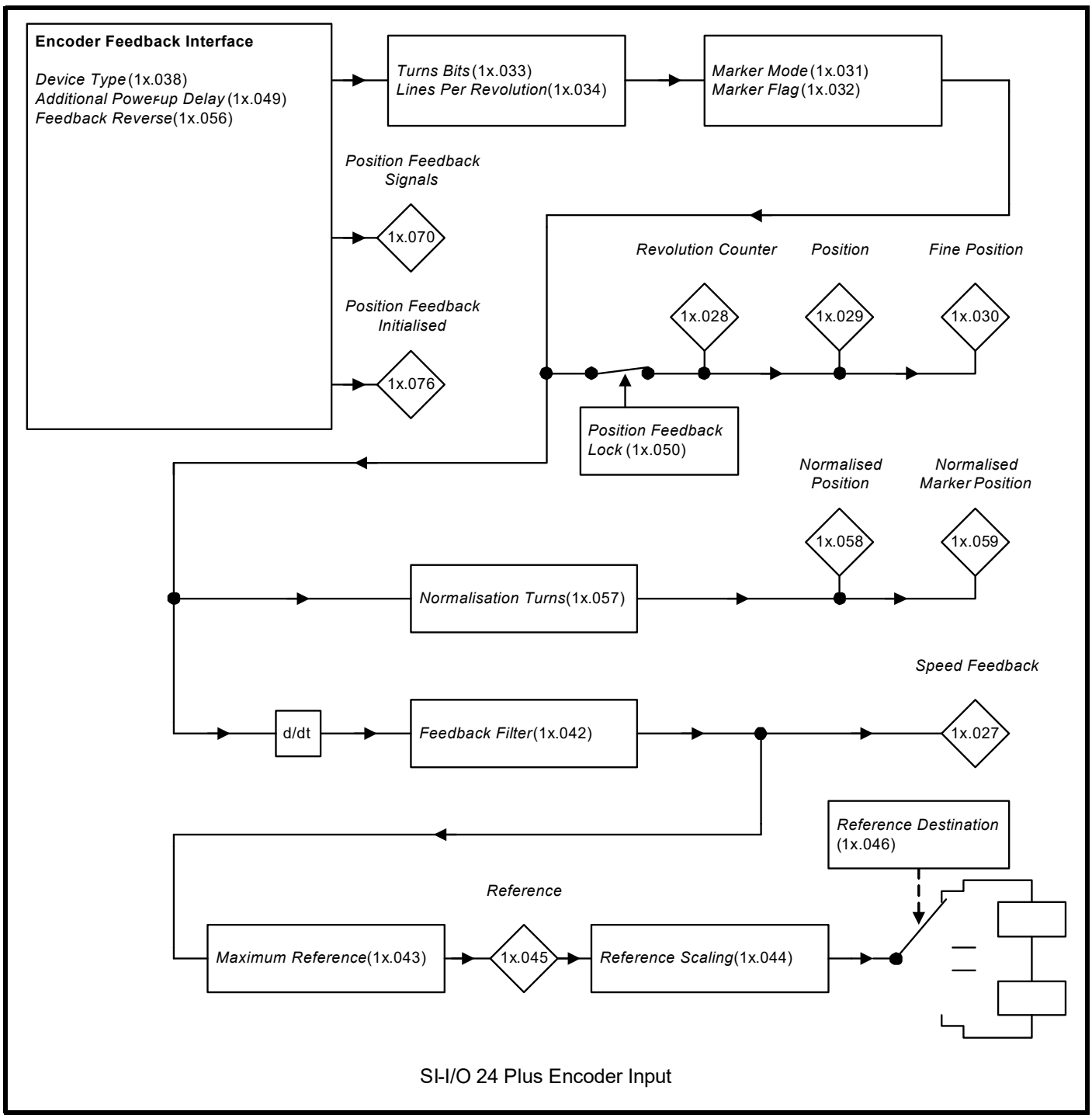
6 Parameters

The module contains two menus with the menu numbers dependent on which option slot the module it fitted to.

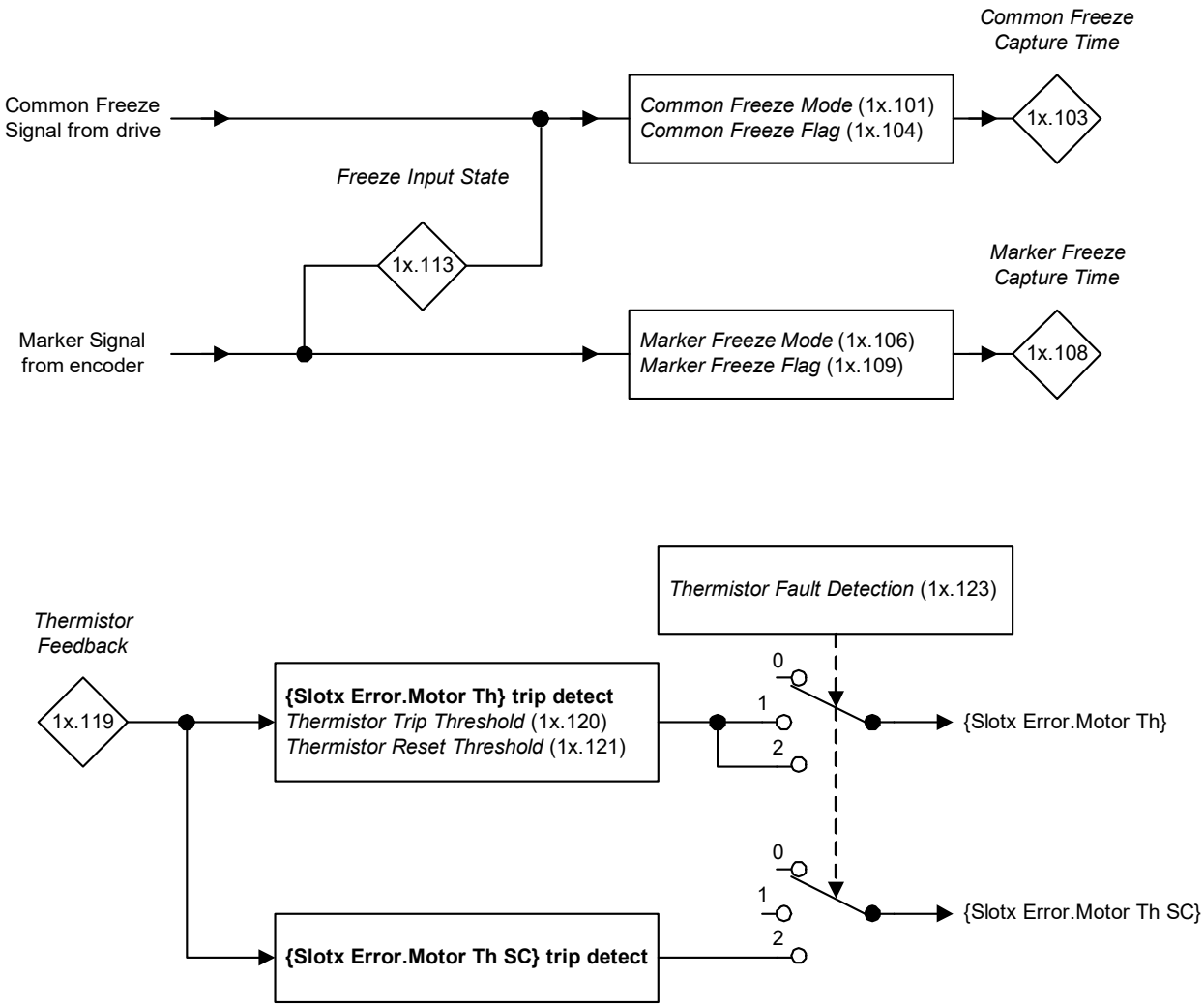
Function	Slot 1	Slot 2	Slot 3
Menu 1x - Encoder input, freeze system and thermistor input setup	Menu 15	Menu 16	Menu 17
Menu 2x - Digital I/O setup	Menu 25	Menu 26	Menu 27

6.1 Menu 1x - Encoder interface, freeze system and thermistor input

6.1.1 Menu 1x block diagram



SI-I/O 24 Plus Encoder Input



SI-I/O 24 Plus Freeze System and Thermistor Input

6.1.2 Menu 1x single line descriptions

Parameter		Range (⇳)	Default (⇨)	Type					
1x.001	Module ID	0 to 999	108	RO	Num	ND	NC	PT	
1x.002	Firmware Version	0 to 99999999		RO	Num	ND	NC	PT	
1x.027	Speed Feedback	±60000.0 rpm		RO	Num	ND	NC	PT	FI
1x.028	Revolution Counter	0 to 65535		RO	Num	ND	NC	PT	
1x.029	Position	0 to 65535		RO	Num	ND	NC	PT	
1x.030	Fine Position	0 to 65535		RO	Num	ND	NC	PT	
1x.031	Marker Mode	000 to 111	100	RW	Bin				US
1x.032	Marker Flag	Off (0) or On (1)	Off (0)	RW	Bit		NC		
1x.033	Turns Bits	0 to 16	16	RW	Num				US
1x.034	Lines Per Revolution	1 to 100000	4096	RW	Num				US
1x.038	Device Type	AB (0), AB Servo (1)	AB Servo (1)	RW	Txt				US
1x.042	Feedback Filter	Disabled (0), 1ms (1), 2ms (2), 4ms (3), 8ms (4), 16ms (5)	Disabled (0)	RW	Txt				US
1x.043	Maximum Reference	0 to 60000 rpm	3000	RW	Num				US
1x.044	Reference Scaling	0.000 to 4.000	1.000	RW	Num				US
1x.045	Reference	±100.0 %		RO	Num	ND	NC	PT	FI
1x.046	Reference Destination	0.000 to 59.999	0.000	RW	Num	DE		PT	US
1x.049	Additional Power-up Delay	0.0 to 25.0 s	0.0 s	RW	Num				US
1x.050	Position Feedback Lock	Off (0) or On (1)	Off (0)	RW	Bit				US
1x.056	Feedback Reverse	Off (0) or On (1)	Off (0)	RW	Bit				US
1x.057	Normalisation Turns	0 to 16	16	RW	Num				US
1x.058	Normalised Position	-2147483648 to 2147483647		RO	Num	ND	NC	PT	
1x.059	Normalised Marker Position	-2147483648 to 2147483647		RO	Num	ND	NC	PT	
1x.070	Position Feedback Signals	000000 to 111111		RO	Bin	ND	NC	PT	
1x.076	Position Feedback Initialised	Off (0) or On (1)		RO	Bit	ND	NC	PT	
1x.101	Common Freeze Mode	Rising 1st (0), Falling 1st (1), Rising all (2), Falling all (3)	Rising 1st (0)	RW	Txt				US
1x.103	Common Freeze Capture Time	0 to 65535		RO	Num	ND	NC	PT	
1x.104	Common Freeze Flag	Off (0) or On (1)		RO	Bit	ND	NC	PT	
1x.106	Marker Freeze Mode	Rising 1st (0), Falling 1st (1), Rising all (2), Falling all (3)	Rising 1st (0)	RW	Txt				US
1x.108	Marker Freeze Capture Time	0 to 65535		RO	Num	ND	NC	PT	
1x.109	Marker Freeze Flag	Off (0) or On (1)		RW	Bit	ND	NC	PT	
1x.113	Freeze Input States	00 to 11		RO	Bin	ND	NC	PT	
1x.119	Thermistor Feedback	0 to 5000 Ω		RO	Num	ND	NC	PT	
1x.120	Thermistor Trip Threshold	0 to 5000 Ω	3300 Ω	RW	Num				US
1x.121	Thermistor Reset Threshold	0 to 5000 Ω	1800 Ω	RW	Num				US
1x.123	Thermistor Fault Detection	None (0), Temperature (1), Temp or Short (2)	None (0)	RW	Txt				US

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string
Num	Number parameter	Bin	Binary parameter	DE	Destination	ND	No default value
NC	Not cloneable	PT	Protected	FI	Filtered	US	User save

6.1.3 Menu 1x parameter descriptions

1x.001	**Module ID**				
Minimum	0	**Maximum**	999	**Default**	108
Decimal places	0	**Units**		**Update rate**	Power-up write
Type	16 Bit Volatile	**Display format**	Standard	**Coding**	RO, ND, NC, PT, BU

This parameter displays the ID number for the option module. For the SI-I/O 24 Plus module this is 108.

1x.002	**Firmware Version**				
Minimum	0	**Maximum**	99999999	**Default**	
Decimal places	0	**Units**		**Update rate**	Power-up write
Type	32 Bit Volatile	**Display format**	Version	**Coding**	RO, ND, NC, PT

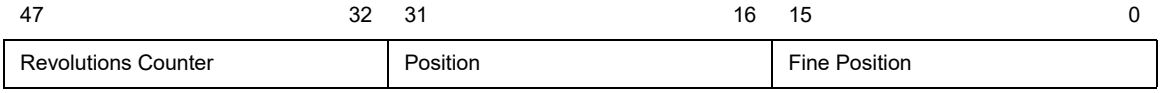
Shows the firmware in the module in version format ww.xx.yy.zz.

1x.027	**Speed Feedback**				
Minimum	-60000.0	**Maximum**	60000.0	**Default**	
Decimal places	1	**Units**	rpm	**Update rate**	4 ms write
Type	32 Bit Volatile	**Display format**	Standard	**Coding**	RO, FI, ND, NC, PT

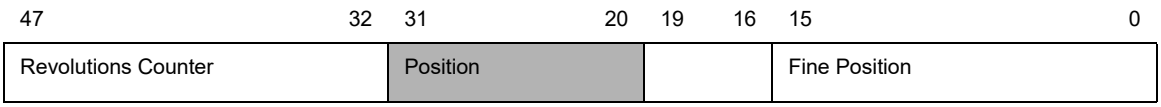
Provided the set-up parameters for the encoder connected to this module are correct, this parameter shows the speed derived from the feedback in rpm. The value shown is measured over a 16 ms sliding window period.

1x.028	**Revolution Counter**				
1x.029	**Position**				
1x.030	**Fine Position**				
Minimum	0	**Maximum**	65535	**Default**	
Decimal places	0	**Units**		**Update rate**	4 ms write
Type	16 Bit Volatile	**Display format**	Standard	**Coding**	RO, ND, NC, PT, BU

Revolution Counter (**1x.028**), *Position* (**1x.029**) and *Fine Position* (**1x.030**) combined give the encoder position with a resolution of $1/2^{32}$ of a revolution as a 48 bit number.



Provided the encoder set-up parameters are correct, the position is always converted to units of $1/2^{32}$ of a revolution, but some parts of the value may not be relevant depending on the resolution of the feedback device. For example, a 1024 line quadrature encoder produces 4096 counts per revolution. This is represented by 12 bits of information shown in the shaded area below.



At power-up and each time the encoder is subsequently initialised the whole position represented by these three parameters is reset to zero. When the position feedback moves by more than one revolution the *Revolution Counter* (**1x.028**) increments or decrements in the form of a sixteen bit roll-over counter. If required the *Revolution Counter* (**1x.028**) can be masked to remove the most significant part by defining the number of turns with *Turns Bits* (**1x.033**).

1x.031	**Marker Mode**				
Minimum	000 (0)	**Maximum**	111 (7)	**Default**	100 (4)
Decimal places	0	**Units**		**Update rate**	Background read
Type	8 Bit User Save	**Display format**	Binary	**Coding**	RW

Each position feedback device produces incremental signals which are counted in hardware. If *Marker Mode* (**1x.031**) = 000 (0) the following occurs when a marker event is produced by the Z input:

1. *Position* (**1x.029**) and *Fine Position* (**1x.030**) are reset to zero.
2. The bits in *Normalised Position* (**1x.058**) related to *Position* (**1x.029**) and *Fine Position* (**1x.030**) are reset to zero
3. *Marker Flag* (**1x.032**) is set to one.

The marker is a hardware function, and so the position appears as though it is reset at the marker event time even if this is between control system sample points. It should be noted that unlike the drive, the marker event always occurs on the rising edge of the marker pulse regardless of the direction of rotation.

The action taken when a marker event occurs can be modified by setting the bits of *Marker Mode* (**1x.031**) as described in the table below.

Bit	Effect of setting bit to one
0	No action is taken unless the marker flag is zero before the marker event occurs
1	*Revolution Counter* (**1x.028**) and the whole of *Normalised Position* (**1x.058**) are also set to zero on a marker event
2	*Revolution Counter* (**1x.028**), *Position* (**1x.029**), *Fine Position* (**1x.030**) and the related part of *Normalised Position* (**1x.058**) are not reset. (This overrides bit 1.) *Normalised Position* (**1x.058**) is transferred to *Normalised Marker Position* (**1x.059**) and *Marker Flag* (**1x.032**) is set to one.

The marker input can be used for a standard type marker function and it can be also be used as a time freeze (see *Marker Freeze Capture Time* (**1x.108**)).

1x.032	**Marker Flag**				
Minimum	0	**Maximum**	1	**Default**	0
Decimal places	0	**Units**		**Update rate**	250 µs write
Type	1 Bit Volatile	**Display format**	Standard	**Coding**	RW, NC

The marker flag is set each time a marker event occurs. This flag can be cleared by writing zero to this parameter.

1x.033	**Turns Bits**				
Minimum	0	**Maximum**	16	**Default**	16
Decimal places	0	**Units**		**Update rate**	Background read
Type	8 Bit User Save	**Display format**	Standard	**Coding**	RW

It is sometimes desirable to mask off the most significant bits of *Revolution Counter* (**1x.028**), but this does not have to be done for the drive to function correctly. If *Turns Bits* (**1x.033**) = 0 the whole of *Revolution Counter* (**1x.028**) is held at zero. If *Turns Bits* (**1x.033**) has any other value it indicates the number of bits in *Revolution Counter* (**1x.028**) that are not held at zero. For example, if *Turns Bits* (**1x.033**) = 5, then *Revolution Counter* (**1x.028**) counts up to 31 before being reset.

1x.034	**Lines Per Revolution**				
Minimum	1	**Maximum**	100000	**Default**	4096
Decimal places	0	**Units**		**Update rate**	Background Read
Type	32 Bit User Save	**Display format**	Standard	**Coding**	RW

This parameter defines the number of lines per revolution for the AB quadrature encoder connected to the module encoder interface. The maximum permissible input frequency is 500 kHz.

1x.038	**Device Type**				
Minimum	AB (0)	**Maximum**	AB Servo (1)	**Default**	AB Servo (1)
Decimal places	0	**Units**		**Update rate**	Background Read
Type	8 Bit User Save	**Display format**	Standard	**Coding**	RW, TE

Value	Text
0	AB
1	AB Servo

Selects the type of encoder signals at the module position feedback input:

AB:

This is an incremental encoder, which uses differential A and B quadrature signals (and marker signal if present). The position is zero at power-up (or encoder re-initialisation) and accumulates the change of position from that point on, and so the position is incremental and not absolute. These devices are suitable for motor control in RFC-A mode. They can also be used for RFC-S mode, but some form of phasing auto-tune is required each time the position feedback is initialised. If the encoder does not provide commutation signals then this mode should be selected.

AB Servo:

Same as AB but with additional U, V and W commutation inputs to provide absolute positioning for motor control. This allows RFC-S mode to be used without requiring a phasing test when the position feedback is initialised. The control position will be provided by just the commutation signals until the required change of the V commutation signal is detected, where the higher resolution incremental feedback can then be used. It should be noted that only the internal motor control position is absolute, with the position user parameters always starting from zero on power-up (or encoder re-initialisation) as with a standard AB encoder. This mode should only be selected if the encoder does provide UVW commutation signals.

1x.042	**Maximum Reference**				
Minimum	Disabled (0)	**Maximum**	16ms (5)	**Default**	Disabled (0)
Decimal places	0	**Units**	rpm	**Update rate**	Background read
Type	8 Bit User Save	**Display format**	Standard	**Coding**	RW, TE

Value	Text
0	Disabled
1	1ms
2	2ms
3	4ms
4	8ms
5	16ms

This parameter defines the time period for a sliding window filter that can be applied to the feedback. This is particularly useful in applications where the encoder is used to give speed feedback for the speed controller and where the load includes a high inertia, and so the speed controller gains are very high. Under these conditions, without a filter on the feedback, it is possible for the speed loop output to change constantly from one current limit to the other and lock the integral term of the speed controller.

1x.043	**Maximum Reference**				
Minimum	0	**Maximum**	60000	**Default**	3000
Decimal places	0	**Units**	rpm	**Update rate**	Background read
Type	16 Bit User Save	**Display format**	Standard	**Coding**	RW, BU

The speed feedback from the position feedback interface can be used as a source to control a parameter. The speed feedback is scaled to give a value as a percentage of *Maximum Reference* (**1x.043**) in 0.1 % units which is displayed in *Reference* (**1x.045**). The value is then scaled by *Reference Scaling* (**1x.044**) and routed to the destination defined by *Reference Destination* (**1x.046**). The scaled destination target parameter is updated every 4 ms. Although *Reference Destination* (**1x.046)** can be changed at any time, the destination target is only updated on drive reset.

1x.044	**Reference Scaling**				
Minimum	0.000	**Maximum**	4.000	**Default**	1.000
Decimal places	3	**Units**		**Update rate**	Background read
Type	16 But User Save	**Display format**	Standard	**Coding**	RW

See *Maximum Reference* (**1x.043**).

1x.045	**Reference**				
Minimum	-100.0	**Maximum**	100.0	**Default**	
Decimal places	1	**Units**		**Update rate**	4 ms write
Type	16 Bit User Save	**Display format**	Standard	**Coding**	RO, FI, ND, NC, PT

See *Maximum Reference* (**1x.043**).

1x.046	**Reference Destination**				
Minimum	0.000	**Maximum**	59.999	**Default**	0.000
Decimal places	3	**Units**		**Update rate**	Read on drive reset
Type	16 Bit User Save	**Display format**	Standard	**Coding**	RW, DE, PT, BU

See *Maximum Reference* (**1x.043**).

1x.049	**Additional Power-up Delay**				
Minimum	0.0	**Maximum**	25.0	**Default**	0.0
Decimal places	1	**Units**	s	**Update rate**	Background read
Type	16 Bit User Save	**Display format**	Standard	**Coding**	RW, BU

When the position feedback is initialised, at power-up or at any other time, a 100 ms delay is included before the information from the feedback device is used. This parameter defines an additional delay that is added to the minimum 100 ms delay.

1x.050	**Position Feedback Lock**				
Minimum	0	**Maximum**	1	**Default**	0
Decimal places	0	**Units**		**Update rate**	Background read
Type	1 Bit User Save	**Display format**	Standard	**Coding**	RW

If *Position Feedback Lock* (**1x.050**) = 1 then *Revolution Counter* (**1x.028**), *Position* (**1x.029**) and *Fine Position* (**1x.030**) are not updated. If *Position Feedback Lock* (**1x.050**) = 0 then these parameters are updated normally.

1x.056	**Feedback Reverse**				
Minimum	0	**Maximum**	1	**Default**	0
Decimal places	0	**Units**		**Update rate**	Background read
Type	1 Bit User Save	**Display format**	Standard	**Coding**	RW

If *Feedback Reverse* (**1x.056**) = 1 the direction of the encoder feedback is reversed.

Reversing the position feedback will not compensate for the case where the direction of the incremental signals and the direction of the digital commutation signals are different for an AB Servo encoder.

1x.057	**Normalisation Turns**				
Minimum	0	**Maximum**	16	**Default**	16
Decimal places	0	**Units**		**Update rate**	Background read
Type	1 Bit User Save	**Display format**	Standard	**Coding**	RW

The combination of *Revolution Counter* (**1x.028**), *Position* (**1x.029**) and *Fine Position* (**1x.030**) give the position feedback as a 48 bit value. This position cannot be read atomically without locking the position feedback (*Position Feedback Lock* (**1x.050**) = 1) and it cannot be used directly by the Advanced Motion Controller in the drive. It is useful to be able to create 32 bit position values that can be held by a single parameter as this value can be accessed atomically and can be used directly by the Advanced Motion Controller. This parameter defines the number of turns bits included in the *Normalised Position* (**1x.058**) and *Normalised Marker Position* (**1x.059**).

1x.058	**Normalisation Position**				
Minimum	-2147483648	**Maximum**	217483647	**Default**	
Decimal places	0	**Units**		**Update rate**	250 µs write
Type	32 Bit Volatile	**Display format**	Standard	**Coding**	RO, ND, NC, PT

See *Normalisation Turns* (**1x.057**).

1x.059	**Normalisation Marker Position**				
Minimum	-2147483648	**Maximum**	2147483647	**Default**	
Decimal places	0	**Units**		**Update rate**	250 µs write
Type	32 Bit Volatile	**Display format**	Standard	**Coding**	RO, ND, NC, PT

Normalised Marker Position (**1x.059**) is the value *Normalised Position* (**1x.058**) at the last marker event provided bit 2 of *Marker Mode* (**1x.031**) is set to 1. See *Marker Mode* (**1x.031**) for more details.

1x.070	**Position Feedback Signals**				
Minimum	000000(0)	**Maximum**	111111 (63)	**Default**	
Decimal places	0	**Units**		**Update rate**	Background write
Type	16 Bit Volatile	**Display format**	Binary	**Coding**	RO, ND, NC, PT

This parameter shows the state of the signals from the position feedback device as given in the table below. This parameter is intended as a debugging aid.

Position Feedback Signals **(1x.070) Bits**	**Signals**
0	A
1	B
2	Z
3	U
4	V
5	W

1x.076	**Position Feedback Initialised**				
Minimum	0	**Maximum**	1	**Default**	
Decimal places	0	**Units**		**Update rate**	Background read
Type	1 Bit Volatile	**Display format**	Standard	**Coding**	RO, ND, NC, PT

This parameter contains a flag that represents the initialisation state of the encoder connected to the option module. When this parameter is "On" it indicates that any power-up sequence for the device has been completed and the device is operating normally and providing position feedback. This is also reflected in parameter *Position Feedback Initialised* (**03.076**) in the drive which shows the initialisation state of all available position feedback devices in the drive and option modules. The encoder is initialised at power-up, when the drive is reset and the encoder is uninitialised, and when position feedback initialisation is specifically requested. The encoder becomes uninitialised if the encoder configuration is changed or the module imitates a trip. However, if an encoder configuration change has caused the encoder to become uninitialised, it will automatically re-initialise without a configuration change trip occurring. Any changes to the following parameters on the module cause an automatic re-initialisation:

- *Lines Per Revolution* (**1x.034**)
- *Device Type* (**1x.038**)
- *Feedback Reverse* (**1x.056**)

In addition, if the *Device Type* (**1x.038**) is AB Servo, changing the number of motor poles in the drive will also trigger automatic re-initialisation as this is used with the commutation signals to calculate the control position.

Any encoder module trips (i.e. PSU overload) will not trigger an automatic initialisation and the encoder initialisation will have to be triggered manually (i.e. through a drive reset or setting the parameter Initialise *Position Feedback* (**03.075**) in the drive).

1x.101	**Common Freeze Mode**				
Minimum	Rising 1st (0)	**Maximum**	Falling all (3)	**Default**	Rising 1st (0)
Decimal places	0	**Units**		**Update rate**	Background read
Type	8 Bit User Save	**Display format**	Standard	**Coding**	RW, TE

The common freeze line (driven by the drive or other option modules) is routed into this freeze system and is used to capture the time with respect to the last datum of the position feedback system. This parameter defines the edges of the freeze signal used to trigger the timer capture:

0: Rising 1st

Freeze events are produced on the rising edge of the common freeze signal. If the *Common Freeze Flag* (**1x.104**) is 0 then the first rising edge produced by the trigger source causes a time to be stored in *Common Freeze Capture Time* (**1x.103**) and *Common Freeze Flag* (**1x.104**) to be set to 1. No further freeze events are possible until *Common Freeze Flag* (**1x.104**) has been cleared by the user.

1: Falling 1st

As for Rising 1st, but the falling edge is used to trigger freeze events.

2: Rising All

Freeze events are produced on the rising edge of the common freeze signal. If *Freeze Flag* (**1x.104**) is 0 then the first rising edge causes the freeze position to be stored and *Freeze Flag* (**1x.104**) to be set to 1. If further rising edges occur the freeze position is updated.

Freeze events are produced on the rising edge of the common freeze signal. If the *Common Freeze Flag* (**1x.104)** is 0 then the first rising edge produced by the trigger source causes a time to be stored in *Common Freeze Capture Time* (**1x.103**) and *Common Freeze Flag* (**1x.104**) to be set to 1. If further suitable edges are produced a new time is stored in *Common Freeze Capture Time* (**1x.103**).

3: Falling All
As for Rising All, but the falling edge is used to trigger freeze events.

1x.103	**Common Freeze Capture Time**				
Minimum	-2147483648	**Maximum**	2147483647	**Default**	
Decimal places	0	**Units**		**Update rate**	250 µs write
Type	32 Bit Volatile	**Display format**	Standard	**Coding**	RO, ND, NC, PT

The time of the freeze event is stored with respect to the last datum used by the position feedback system and other option modules fitted to the drive. These datum events occur at a nominal rate of 250 µs, but if the drive timing is being synchronised by the comms system in an option module then the actual timing may vary slightly depending on the accuracy of the clock providing the synchronisation. In addition this module uses a phase-locked loop (PLL) to synchronise with the drive which may have some small jitter between 250 µs events. The time stored in *Common Freeze Capture Time* (**1x.103**) is given as a proportion of the nominal 250 µs time period where 65536 corresponds to one nominal 250 µs time period. Note that the value may be positive or negative. Positive values give the time of an event that occurred after the last datum, but before the freeze information was processed. Negative values give the time of an event that occurred before the datum, but after the previous time when the freeze information was processed. The time of the freeze event could be used, for example, to determine the value of a virtual position being generated within an option module at the freeze event. The calculated value would only be meaningful if the freeze information is used during the period between the position datum before and after the freeze event because the time is related to the datum before the freeze information is made available. The capture time is only updated when the *Common Freeze Flag* (**1x.104**) is clear when the 250 µs task runs (unless *Common Freeze Mode* (**1x.101**) is set to 'Rising All' or 'Falling All').

1x.104	**Common Freeze Flag**				
Minimum	0	**Maximum**	1	**Default**	
Decimal places	0	**Units**		**Update rate**	250 µs write
Type	1 Bit Volatile	**Display format**	Standard	**Coding**	RW, ND, NC, PT

The freeze flag is set when a common freeze event occurs. If 0 is written to this parameter the freeze flag is cleared.

1x.106	**Marker Freeze Mode**				
Minimum	Rising 1st (0)	**Maximum**	Falling all (3)	**Default**	Rising 1st (0)
Decimal places	0	**Units**		**Update rate**	Background read
Type	8 Bit User Save	**Display format**	Standard	**Coding**	RW, TE

Value	**Text**
0	Rising 1st
1	Falling 1st
2	Rising all
3	Falling all

The connected encoder marker can be used to freeze the time on this channel. This parameter defines the edges of the freeze signal used to trigger freeze events (see *Common Freeze Mode* (**1x.101**) for more information).

1x.108	**Marker Freeze Capture Time**				
Minimum	-2147483648	**Maximum**	2147483647	**Default**	
Decimal places	0	**Units**		**Update rate**	250 µs write
Type	32 Bit Volatile	**Display format**	Standard	**Coding**	RO, ND, NC, PT

See *Common Freeze Capture Time* (**1x.103**).

1x.109	**Marker Freeze Flag**				
Minimum	0	**Maximum**	1	**Default**	
Decimal places	0	**Units**		**Update rate**	250 µs write
Type	1 Bit Volatile	**Display format**	Standard	**Coding**	RW, ND, DC, PT

The freeze flag is set when a marker freeze event occurs. If 0 is written to this parameter the freeze flag is cleared.

1x.113	**Freeze Input State**				
Minimum	00 (0)	**Maximum**	11 (3)	**Default**	
Decimal places	0	**Units**		**Update rate**	4 ms write
Type	1 bit Volatile	**Display format**	Binary	**Coding**	RO, ND, NC, PT

The bits in this parameter show the state of the freeze inputs. Bit 0 corresponds to common freeze input and bit 1 corresponds to marker freeze input.

1x.119	**Thermistor Feedback**				
Minimum	0	**Maximum**	5000	**Default**	
Decimal places	0	**Units**	Ω	**Update rate**	Background Write
Type	16 Bit Volatile	**Display format**	Standard	**Coding**	RO, ND, NC, PT

This parameter shows the resistance of the thermistor connected between pin 35 (Motor Thermistor Input) and pin 16 (Encoder 0V).

The measured resistance can be used to initiate an over-temperature or device short circuit trip. See *Thermistor Fault Detection* (**1x.123**) for details.

1x.120	**Thermistor Trip Threshold**				
Minimum	0	**Maximum**	5000	**Default**	3300
Decimal places	0	**Units**	Ω	**Update rate**	Background read
Type	16 Bit User Save	**Display format**	Standard	**Coding**	RW

See *Thermistor Fault Detection* (**1x.123**).

1x.121	**Reset Trip Threshold**				
Minimum	0	**Maximum**	5000	**Default**	1800
Decimal places	0	**Units**	Ω	**Update rate**	Background read
Type	16 Bit User Save	**Display format**	Standard	**Coding**	RW

See *Thermistor Fault Detection* (**1x.123**).

1x123	**Thermistor Fault Detection**				
Minimum	0	**Maximum**	2	**Default**	1
Decimal places	0	**Units**		**Update rate**	Background write
Type	16 Bit Volatile	**Display format**	Standard	**Coding**	RW, TE

Value	**Text**	**Description**
0	None	No detection active
1	Temperature	Over temperature detection
2	Temp or Short	Over temperature and short circuit detection

This parameter defines the fault detection for the thermistor input:

If over temperature detection is enabled a *Motor Th* trip is initiated if *Thermistor Feedback* (**1x.119**) is above the level defined by *Thermistor Trip Threshold* (**1x.120**). The trip cannot be reset until *Thermistor Feedback* (**1x.119**) is below *Thermistor Reset Threshold* (**1x.121)**.

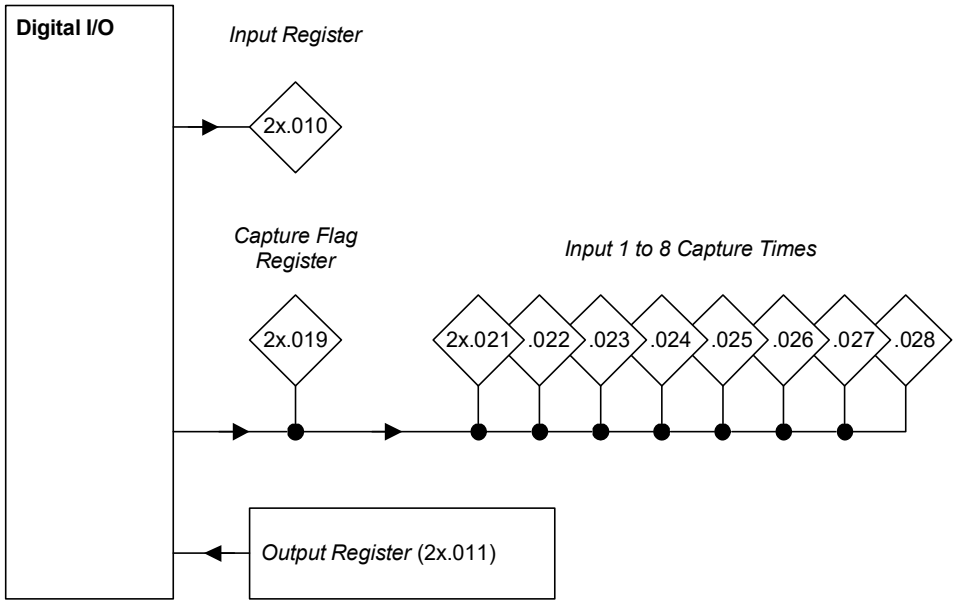
If short circuit detection is enabled then a *Motor Th SC* trip is initiated if *Thermistor Feedback* (**1x.119**) is below 50 ohms.

Key to parameter coding

RW	Read write	RO	Read-only	TE	Text string
ND	No default value	NC	Not cloneable	PT	Protected
BU	Unipolar or bit parameter with default of 1	RA	Voltage rating dependent	FI	Filtered
VM	Variable maximum	DE	Destination parameter	PR	Pseudo read-only

6.2 Menu 2x - Digital I/O

6.2.1 Menu 2x block diagram



SI-I/O 24 Plus Digital Inputs and Outputs

6.2.2 Menu 2x single line descriptions

Parameter		Range (⇳)	Default (⇨)	Type					
2x.010	Input Register	0000000000000000 to 1111111111111111		RO	Bin	ND	NC	PT	
2x.011	Output Register	00000000 to 11111111		RW	Bin	ND	NC	PT	
2x.019	Capture Flag Register	0000000000000000 to 1111111111111111		RW	Bin	ND	NC	PT	
2x.021	Input 1 Capture Time	-32768 to 32767		RO	Num	ND	NC	PT	
2x.022	Input 2 Capture Time	-32768 to 32767		RO	Num	ND	NC	PT	
2x.023	Input 3 Capture Time	-32768 to 32767		RO	Num	ND	NC	PT	
2x.024	Input 4 Capture Time	-32768 to 32767		RO	Num	ND	NC	PT	
2x.025	Input 5 Capture Time	-32768 to 32767		RO	Num	ND	NC	PT	
2x.026	Input 6 Capture Time	-32768 to 32767		RO	Num	ND	NC	PT	
2x.027	Input 7 Capture Time	-32768 to 32767		RO	Num	ND	NC	PT	
2x.028	Input 8 Capture Time	-32768 to 32767		RO	Num	ND	NC	PT	

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string
Num	Number parameter	Bin	Binary parameter	DE	Destination	ND	No default value
NC	Not cloneable	PT	Protected	FI	Filtered	US	User save

6.2.3 Menu 2x parameter descriptions

2x.010	**Input Register**				
Minimum	0	**Maximum**	65535	**Default**	
Decimal places	0	**Units**		**Update rate**	250 µs write
Type	16 Bit Volatile	**Display format**	Binary	**Coding**	RO, ND, NC, PT, BU

This parameter shows the state of each digital input: Bit 15 = Input 16, Bit 14 = Input 15, ... Bit 0 = Input 1.

2x.011	**Output Register**				
Minimum	0	**Maximum**	255	**Default**	
Decimal places	0	**Units**		**Update rate**	250 µs read
Type	8 Bit Volatile	**Display format**	Binary	**Coding**	RW, ND, NC, PT, BU

This parameter is used to set the state of the digital outputs. Bit 7 = Output 8, Bit 6 = Output 7, ... Bit 0 = Output 1.

2x.019	**Capture Flag Register**				
Minimum	0	**Maximum**	65535	**Default**	
Decimal places	0	**Units**		**Update rate**	250 µs write
Type	8 Bit Volatile	**Display format**	Binary	**Coding**	RW, ND, NC, PT, BU

A time capture function is provided on Inputs 1 to 8. The capture trigger edge is set every 250 µs based on the current signal state (i.e. if the signal is currently low then the system will be set-up to detect a rising edge in the next 250 µs sample period). If a capture event has been detected then this parameter is updated to indicate whether a rising or falling edge has been detected and the capture time is written to the corresponding input capture time parameter. See *Input 1 Capture Time* (**2x.021**) for more details on the capture time parameters format. Bits 0-7 of this capture flag register indicate whether a rising edge capture was detected since the previous datum on the corresponding channel (i.e. bit 0 = Input 1, bit 1 = Input 2, ..., bit 7 = Input 8), and bits 8-15 indicate a falling edge capture was detected following the same mapping pattern. This parameter is non-latching so must be processed before the next 250 µs task.

NOTE

Due to the 250 µs sampling rate, the minimum pulse width that can be guaranteed to be accurately captured is 500 µs. In addition, due to the automatic re-arming of the capture edge there should be a minimum of 500µs between repeat edges to ensure that the system is capturing the expected edge, and not the unwanted edge.

2x.021	**Input 1 Capture Time**				
2x.022	**Input 2 Capture Time**				
2x.023	**Input 3 Capture Time**				
2x.024	**Input 4 Capture Time**				
2x.025	**Input 5 Capture Time**				
2x.026	**Input 6 Capture Time**				
2x.027	**Input 7 Capture Time**				
2x.028	**Input 8 Capture Time**				
Minimum	-32768	**Maximum**	32767	**Default**	
Decimal places	0	**Units**		**Update rate**	250 µs write
Type	16 Bit Volatile	**Display format**	Standard	**Coding**	RO, ND, NC, PT

When a capture event has occurred on Input 1 to 8, the associated Input Capture Time parameter is updated with the capture time as a proportion of the latest 250 µs sampling period. Unity for the proportion value is 16384. The sampling period could be defined by synchronisation with another option module, and so the period may change from 250 µs by up to +/-0.6%. In addition this module uses a phase-locked loop to synchronise with the drive which can introduce a small amount of jitter (<500 ns). The value stored may be positive or negative. A negative value indicates that the capture event occurred before the last position datum and a positive value indicates that the capture event occurred after the last position datum but before the firmware task ran to record the value. Due to some delays in the input hardware that are adjusted for in the firmware, an event that actually occurred more than 250 µs ago may be detected in the current sample which is simply indicated by a time that is less than -16384.

NOTE

If more than one active edge change (i.e. multiple rising edges if the signal was low at the last 250 µs datum) have occurred in the previous 250 µs period then capture time will reflect the last change that was detected.

Key to parameter coding

RW	Read write	RO	Read-only	TE	Text string
ND	No default value	NC	Not cloneable	PT	Protected
BU	Unipolar or bit parameter with default of 1	RA	Voltage rating dependent	FI	Filtered
VM	Variable maximum	DE	Destination parameter	PR	Pseudo read-only

7 Diagnostics

7.1 Trips

The following trip can be initiated by this option module. The drive produces an SlotX Error trip, where X is the slot number the module is fitted, with a sub-trip which indicates the reason for the trip.

Sub-trip	Keypad String	Reason for trip	Solution
100	PSU Overload	Encoder power supply output current too high. The encoder power supply output supply a maximum current of 300 mA at 5 V, and this has been exceeded. The encoder power supply output has been disabled.	• Check encoder power supply wiring • Check the encoder specification to confirm it is compatible with the encoder power supply output current capability from the module • Replace the encoder • Use an external power supply with higher output current capability to supply the encoder
101	Output Overload	One or more of the digital outputs is overloaded. The maximum output current from a digital output is 150 mA. All the outputs have been disabled.	• Check total loads on digital outputs. • Check that the digital output wiring is correct and undamaged. • If the drive is being used at an elevated temperature then it is recommended that the maximum output current from the digital outputs is reduced to 100 mA or the air flow around the module is increased.
102	Motor Th	Motor thermistor too hot.	• Check motor temperature • Check thermistor continuity • If the motor is not fitted with a thermistor, set *Thermistor Fault Detection* (**1x.123**) to None (0).
103	Motor Th SC	Motor thermistor short circuit. The measured resistance of the thermistor is less than 50 Ω.	• Check temperature feedback connection and cabling. • Replace the thermistor.
104	Watchdog Error	The processor in the module has restarted due to a watchdog timeout or hard fault error.	• Ensure that the wiring and shield connections meet the recommendations given in this user guide. • Ensure that the EMC recommendations in the installation guide for the drive have been followed. • If this trip persists please consult the supplier of the module.

0478-0704-04