User Guide

SM-Encoder Plus

Solutions Module for
Unidrive SP

General Information

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

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

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Drive software version

The SM-Encoder Plus can only be used with drive software version 01.02.00 onwards.

Contents

1 How to use this guide

1.1 Intended personnel

This guide is intended for personnel who have the necessary training and experience in system design, installation, commissioning and maintenance.

1.2 Information

This guide contains information covering the identification of the Solutions Module, terminal layout for installation, fitting of the Solutions Module to the drive, parameter details and diagnosis information. Additional to the aforementioned are the specifications of the Solutions Module.

2 Safety information

2.1 Warnings, Cautions and Notes

⚠ **WARNING** A **Warning** contains information, which is essential for avoiding a safety hazard.

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

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

2.2 Electrical safety - general warning

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.

Specific warnings are given at the relevant places in this User Guide.

2.3 System design and safety of personnel

The drive is intended as a component for professional incorporation into complete equipment or a system. If installed incorrectly, the drive may present a safety hazard.

The drive uses high voltages and currents, carries a high level of stored electrical energy, and is used to control equipment which can cause injury.

Close attention is required to the electrical installation and the system design to avoid hazards either in normal operation or in the event of equipment malfunction. System design, installation, commissioning and maintenance must be carried out by personnel who have the necessary training and experience. They must read this safety information and this User Guide carefully.

The STOP and SECURE DISABLE functions of the drive do not isolate dangerous voltages from the output of the drive or from any external option unit. The supply must be disconnected by an approved electrical isolation device before gaining access to the electrical connections.

With the sole exception of the SECURE DISABLE 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.

Careful consideration must be given to the functions of the drive 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.

The SECURE DISABLE function has been approved[1] as meeting the requirements of EN954-1 category 3 for the prevention of unexpected starting of the drive. It 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.**

[1]Independent approval by BIA has been given for sizes 1 to 3.

2.4 Environmental limits

Instructions in the *Unidrive SP User Guide* regarding transport, storage, installation and use of the drive must be complied with, including the specified environmental limits. Drives must not be subjected to excessive physical force.

2.5 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 earth (ground) connections.

The *Unidrive SP User Guide* contains instruction for achieving compliance with specific EMC standards.

Within the European Union, all machinery in which this product is used must comply with the following directives:

98/37/EC: Safety of machinery.

89/336/EEC: Electromagnetic Compatibility.

2.6 Motor

Ensure the motor is installed in accordance with the manufacturer's recommendations. Ensure the motor shaft is not exposed.

Standard squirrel cage induction motors are designed for single speed operation. If it is intended to use the capability of the drive to run a motor at speeds above its designed maximum, it is strongly recommended that the manufacturer is consulted first.

Low speeds may cause the motor to overheat because the cooling fan becomes less effective. The motor should be fitted 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 should not be relied upon.

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

2.7 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.

3   Introduction

3.1   Features

The SM-Encoder Plus provides an interface for an additional encoder to be connected to the Unidrive SP, to be used as position and speed feedback for the drive. Typical uses for the SM-Encoder Plus would be to input a speed/position reference from a line speed encoder, or to digitally lock the drive to a master reference using the position controller in drive menu 13.

All three Solutions Module slots can be fitted with SM-Encoder Plus modules.

NOTE The SM-Encoder Plus does not have any simulated encoder outputs available.

Figure 3-1 SM-Encoder Plus
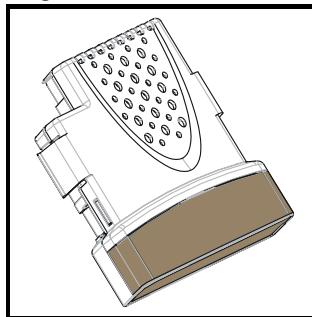
3.2   Solutions Module identification

The SM-Encoder Plus can be identified by:

1. The label located on the underside of the Solutions Module.
2. The colour coding across the front of the Solutions Module. All Unidrive SP Solutions Modules are colour coded, with the SM-Encoder Plus being brown.

Figure 3-2 SM-Encoder Plus label
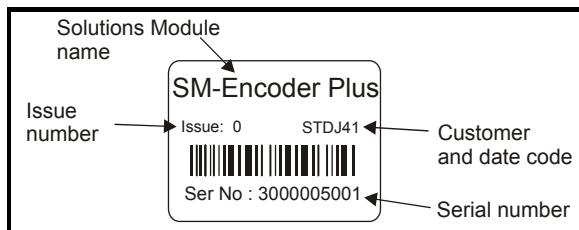
3.2.1   Date code format

The date code is split into two sections: a letter followed by a number.

The letter indicates the year, and the number indicates the week number (within the year) in which the Solutions Module was built.

The letters go in alphabetical order, starting with A in 1990 (B in 1991, C in 1992 etc.).

Example:
A date code of L35 would correspond to week 35 of year 2002.

3.3 Set-up parameters

All parameters associated to the SM-Encoder Plus can be found in either menu 15, 16, or 17. Each of menus 15, 16, and 17 refer to one of the available slots into which the SM-Encoder Plus can be fitted. Slot 1 = Menu 15, Slot 2 = Menu 16, Slot 3 = Menu 17.

3.4 Compatible with encoder types

The SM-Encoder Plus will allow for the following encoders to be used with Unidrive SP:

Incremental encoders Ab, Fd, and Fr

This type of encoder gives incremental position and can only be used for control in Closed Loop Vector and not Servo mode.

Type	Encoder	Description	Pr x.15
Incremental	Ab	Quadrature incremental encoder. With or without marker pulse.	0
	Fd	Incremental encoder with frequency and direction outputs. With or without marker pulse.	1
	Fr	Incremental encoder with forward and reverse outputs. With or without marker pulse.	2

Ab, Fd, Fr

Quadrature detection logic determines rotation from the phase relationship of the two channels. These encoders are available with a marker pulse, which identifies each individual rotation of the disc, and is also used to reset the drive position parameter. The incremental encoder can be used when operating in Closed Loop Vector mode, with the optional marker pulse not being required for correct operation.

Limitations			
Type	**Encoder**	**Max Input Frequency**	**Max no. of Lines (LPR)**
Incremental	Ab	600kHz*	16,384
	Fd		
	Fr		

*   Max input frequency = LPR x rpm / 60

NOTE   The maximum speed in rpm which an encoder connected to the SM-Encoder Plus can reach can be calculated from :

Max rpm = (60 x Max input frequency) / Encoder LPR

e.g. For a 4096 line encoder the maximum rpm would be:

$(60 \times 600 \times 10^3) / 4096 = 8789$rpm

Figure 3-3 Encoder feedback signals

Figure showing encoder waveforms with labels: 360° electrical (encoder), A, /A, B, /B (Incremental signals), 90° separation of A and B, Z, /Z (Marker signals), min, max, Index alignment reference.
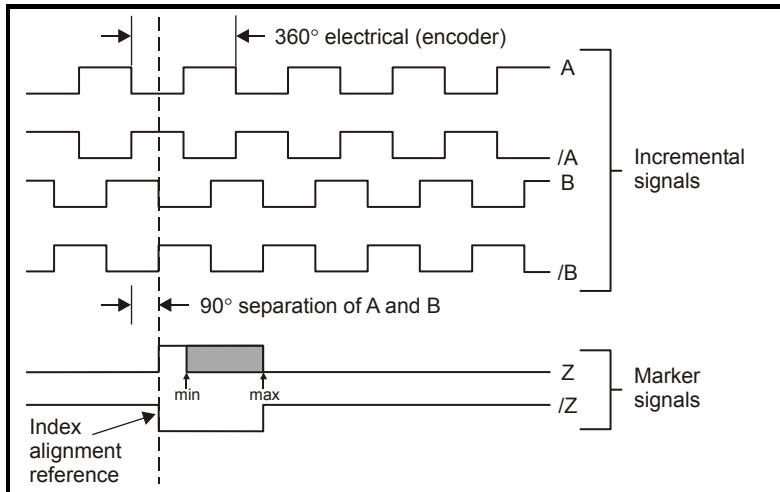
NOTE	Only encoders with lines per revolution that are a power of 2 can be used with the SM-Encoder Plus, e.g. 256, 512, 1024 etc.

The marker pulse duration must be between 45° to 360° electrical (encoder).

4 Installing the SM-Encoder Plus

4.1 Solutions Module slots

⚠️ **WARNING**

Before installing the SM-Encoder Plus, refer to Chapter 2 *Safety information* on page 5.

There are three slots available, which the Solutions Module can be plugged into as shown in Figure 4-1. The Solutions Module can be plugged into either one of these, but it is recommended that slot 3 be used for the first Solutions Module then slot 2 and slot 1. This ensures maximum mechanical support for the Solutions Module once fitted.

Figure 4-1 Location of slots 1, 2 and 3 on the Unidrive SP
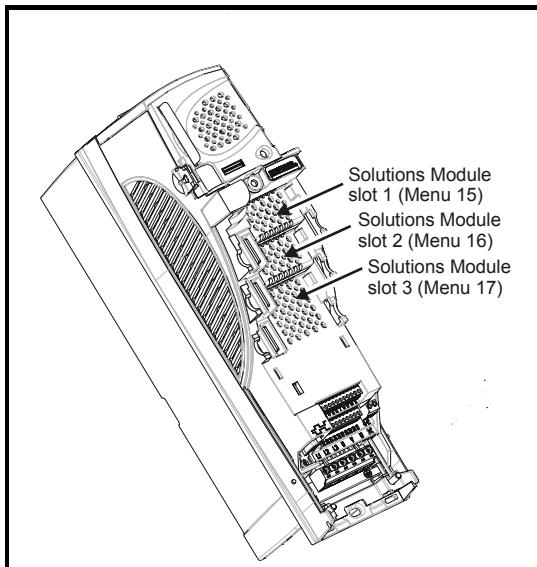
4.2 Installation

1. Before installing the SM-Encoder Plus in the Unidrive SP, ensure the AC supply has been disconnected from the drive for at least 10 minutes.
2. Ensure that both the +24V, and +48V backup power supplies are disconnected from the drive for at least 10 minutes if used.
3. Check that the exterior of the SM-Encoder Plus is not damaged, and that the multi-way connector is free from dirt and debris.
4. Do not install a damaged or dirty SM-Encoder Plus in the drive.
5. Remove the terminal cover from the drive. (For removal / re-fitting instructions, see *Unidrive SP Solutions Module Installation Sheet* provided with the Solutions Module.)
6. Position the drive connector of the SM-Encoder Plus over the connector of the appropriate slot in the drive and push downwards until it locks into place.

Figure 4-2 Fitting the SM-Encoder Plus
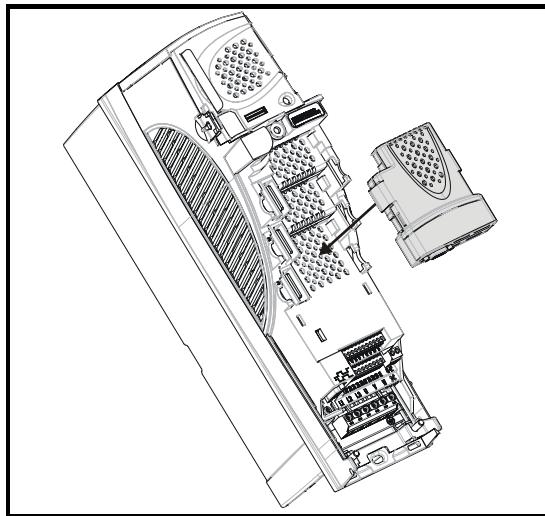
7.   Re-fit the terminal cover to the drive. (For removal / re-fitting instructions, see *Unidrive SP Solutions Module Installation Sheet* provided with the Solutions Module.)

8.   Connect the AC supply to the drive.

9.   Set Pr **0.49** to L2 to unlock read only security.

10. Check that Menu 15 (slot 1), 16 (slot 2), or 17 (slot 3) parameters are now available.

11. Check that Pr **15.01**, Pr **16.01** or Pr **17.01** shows the correct code for the SM-Encoder Plus (code = 104).

12. If the checks in steps 10 and 11 fail, either the SM-Encoder Plus is not fully inserted, or the Solutions Module is faulty.

13. If a trip code is now present refer to Chapter 7 *Diagnostics* on page 32.

4.3   Terminal descriptions

Figure 4-3 SM-Encoder Plus terminals

PL1

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
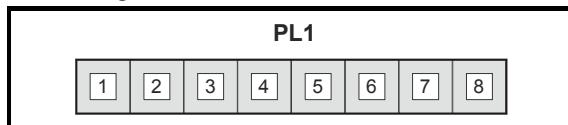
Table 4.1 SM-Encoder Plus terminal descriptions

Term	Encoder		
	Ab	**Fd**	**Fr**
1	A	F	F
2	A\	F\	F\
3	B	D	R
4	B\	D\	R\
5	Z		
6	Z\		
7	0V		
8	External power supply decoupling		

NOTE Terminal 8 should be used to join the external encoder power supply to the encoder as shown in Figure 4-4. If the drive encoder supply is to be used for two encoders, the user must ensure the total load does not exceed 300mA for 5V and 8V encoders and 200mA for 15V encoders.

Figure 4-4

Screen connection

External encoder power supply

0V +V
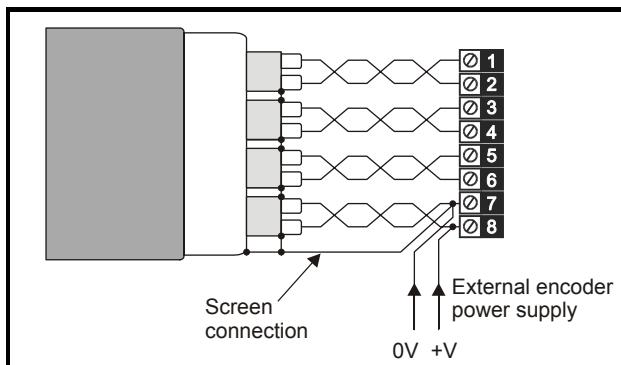
4.4   Wiring, Shield connections

Shielding considerations are important for PWM drive installations due to the high voltages and currents present in the output 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.

Encoder mounting methods

There are three methods for mounting an encoder onto a motor:

1.   Galvanic isolation between encoder and motor
2.   Galvanic isolation between encoder circuit and encoder body
3.   No Isolation

4.4.1 Encoder with galvanic isolation from motor

When galvanically isolated the encoder device is mounted to the motor with isolation fitted between the motor housing / shaft and encoder as shown in Figure 4-5.

**Figure 4-5 Galvanic Isolation from motor**
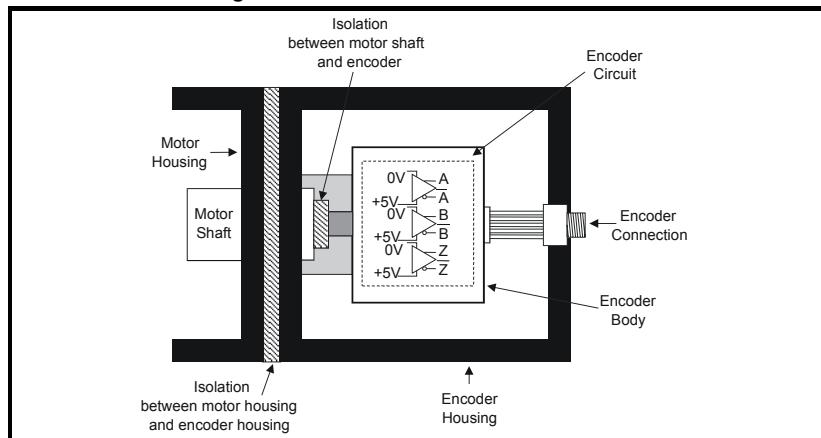
An example of this is the Unimotor where isolation from the motor is achieved by inserting a plastic mounting plate between the motor housing and encoder housing and a plastic insert fitted in the motor shaft for encoder mounting to the motor shaft. With this preferred method of mounting noise current is prevented from passing from the motor housing into the encoder housing, and hence into the encoder cable. The ground connection of the cable shield is optional, this may be required to comply with safety measures or to reduce radiated radio frequency emissions from either the drive or encoder.

4.4.2 Encoder circuit with galvanic isolation from encoder body

In this case the encoder device is mounted directly on the motor housing with contact being made between the motor housing/shaft and encoder. With this mounting method the encoder internal circuits are exposed to electrical noise from the motor housing through the stray capacitance, and they must be designed to withstand this situation. However this arrangement still prevents large noise currents from flowing from the motor body into the encoder cable. The ground connection of the cable shield is optional, this may be required to comply with safety measures or to reduce radiated radio frequency emissions from either the drive or encoder.

Figure 4-6 Encoder galvanically isolated from encoder body
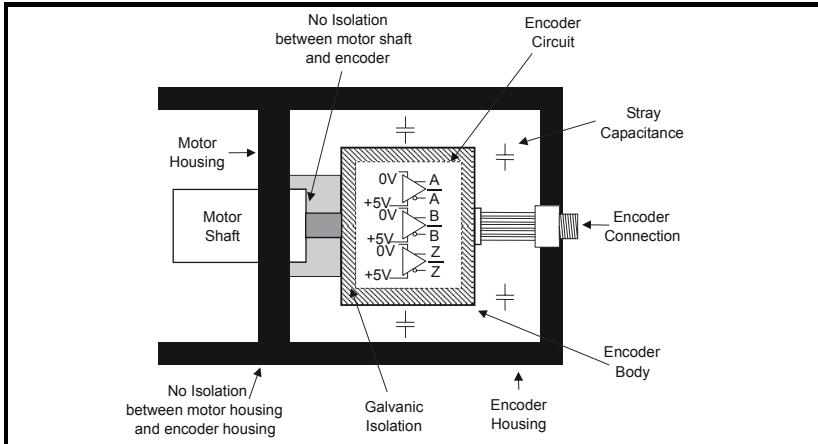
4.4.3 No isolation

As shown in Figure 4-7 the encoder 0V connection may be permanently connected to the housing. This has the advantage that the encoder body can form a shield for its internal circuits. However it permits noise current from the motor body to flow into the encoder cable shield. A good quality shielded cable correctly terminated protects the data against this noise current, but much more care is needed in ensuring correct cable management than for the isolated cases.

Figure 4-7 No isolation
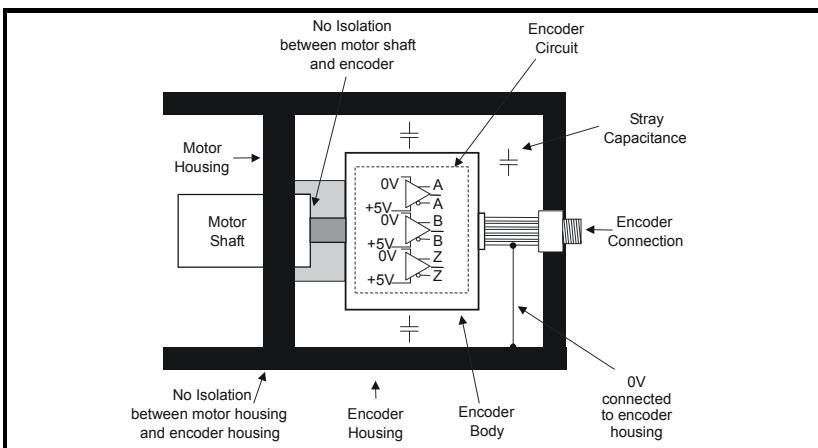
4.4.4   Cable requirements

All mounting methods:
- Shield connection at drive terminal to 0V
- Shield connection at encoder to 0V
- It is recommended that the shielded cable should be run in a continuous length to the terminal, to avoid the injection of noise at intermediate pigtails and to maximise the shielding benefit.
- The shield connections ("pigtails") to the drive and encoder should be kept as short as possible

Mounting with no isolation:
- Shield connected to ground at both ends. The connection must be made by direct fixing of the cable to the grounded metal parts, i.e. to the encoder body and the drive grounding bracket, as illustrated in Figure 4.9. "Pigtails" must be avoided. The outer sheath of the cable should be stripped back enough to allow for the ground clamp to be fitted. The shield connection should not be broken. The ground clamps should be located as close as possible to the drive and encoder.
- It is essential that the shielded cable should be run in a continuous length to the terminal, to avoid the injection of noise at intermediate "pigtails" and to maximise the shielding benefit.

> ⚠ **CAUTION**
>
> In this case under no circumstances must the cable shield connection be omitted at either end of the cable in this case, since the noise voltage may well be sufficient to destroy the line driver and receiver chips in the encoder and the drive.

Cable shield ground connection
For all mounting methods, grounding of the feedback cable shield has added benefits. It can protect the drive and encoder from induced fast electrical transients, and prevent radiated radio-frequency emission. However it is essential that it be carried out in the correct manner as explained above and shown in Figure 4-9.

> ⚠ **WARNING**
>
> Connecting the cable shield to ground at both ends carries the risk that an electrical fault might cause excessive power current to flow in the cable shield and overheat the cable. There must be an adequately rated safety ground connection between the motor/encoder and the drive.

Recommended Cable
The recommended cable for feedback signals is a twisted pair, shielded with an overall shield as shown below.

Figure 4-8 Feedback cable, twisted pair
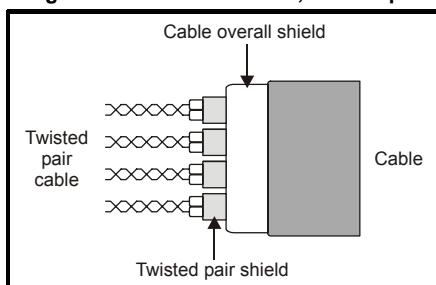
Using this type of cable also allows for the connection of the outer shield to ground and the inner shields to 0V alone at both drive and encoder end, when required.

Figure 4-9 Feedback cable connections
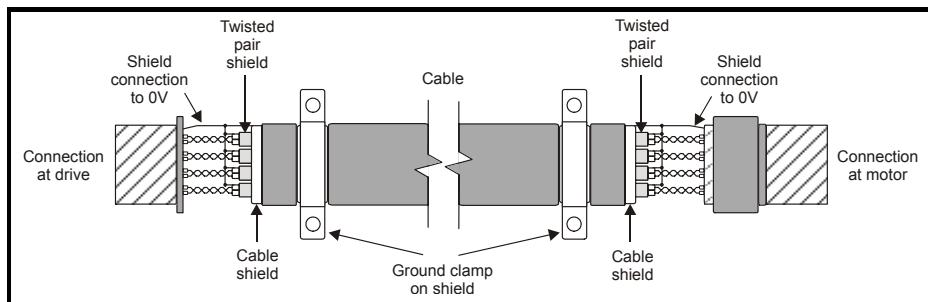
5 Getting started

5.1 Installation

> ⚠️ **WARNING**
>
> The control circuits are isolated from the power circuits in the drive by basic insulation only, as specified in IEC60664-1. The installer must ensure that the external control circuits are insulated from human contact by at least one layer of insulation rated for use at the AC supply voltage.
>
> 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.

Encoder feedback and communications data is transmitted from an encoder as low voltage analog or digital signals. Ensure that electrical noise from the drive or motor does not adversely affect the encoder feedback. Ensure that the drive and motor are connected as per the instructions given in Chapter 4 *Electrical Installation* in the *Unidrive SP User Guide*, and that the encoder feedback wiring and shielding recommendations are followed in section 4.4 *Wiring, Shield connections* on page 12.

5.2   SM-Encoder Plus set-up

The following parameter set-up should be followed when operating with an Incremental Encoder.

Incremental encoders, Ab, Fd and Fr	
Action	**Detail**
Before power-up	Ensure: • Drive enable signal is not given (terminal 31) • Run signal is not given • Solutions Module is fitted in appropriate slot • Feedback device is connected
Power up drive	Ensure: • Drive displays 'inh' If the drive trips see Chapter 7 *Diagnostics* on page 32
Error detection	Ensure: • When operating with an SM-Encoder Plus in slot 1,2 or 3, the error detection for the drive encoder is disabled. Pr **3.40** = 0 when no drive encoder is connected.
Slot identification	Identify which Solutions Module slot and menu are being used • Slot 1 – Menu 15 • Slot 2 – Menu 16 • Slot 3 – Menu 17

Select Solutions Module	Enter:
	• Speed feedback selector Pr **13.04**
	  0: Drive encoder
	  1: Slot 1 encoder
	  2: Slot 2 encoder
	  3: Slot 3 encoder
	  4: Local reference

Set-up encoder parameters	Enter: • Encoder type Pr **x.15** **0** (Ab) **1** (Fd) **2** (Fr)
Set-up encoder lines per revolution	• Equivalent lines per revolution Pr **x.10** Set according to encoder, see below for restrictions **Encoder** / **Pr x.10 Equivalent lines per revolution** Ab / Number of lines per revolution Fd, Fr / Number of lines per revolution / 2
Initialisation	Ensure: Position feedback is initialised Pr **x.45**

5.3   Freeze function

The SM-Encoder Plus has a freeze function, but does not have freeze inputs. The freeze function can be activated using either the SM-Applications or SM-Universal Encoder Plus. When a freeze signal is applied, the freeze flag (Pr **x.39**) is set to "ON". When activated, the non-marker position data (Pr **x.29** and Pr **x.30**) is transferred into Pr **x.35** and Pr **x.36**.

The freeze flag does not reset itself. Before carrying out consecutive freeze functions, the SM-Encoder Plus freeze flag must be cleared by the user (Pr **x.39** = "OFF").

NOTE   If a SM-Universal Encoder Plus is used as a freeze input, it must be set to freeze the drive position by setting Pr **x.40** to "On". Also, before consecutive freeze operations can be performed in the SM-Encoder Plus, the SM-Universal Encoder Plus freeze flag (Pr **x.39**) must be cleared together with the SM-Encoder Plus freeze flag (Pr **x.39**).
E.g. If slot 3 has a SM-Universal Encoder Plus fitted and slot 2 has an SM-Encoder Plus fitted, Pr **16.39** and Pr **17.39** need to be set to "OFF" before another freeze function can be performed on the SM-Encoder Plus.

6   Parameters

6.1   Introduction

The parameters listed in this chapter are used for programming and monitoring the SM-Encoder Plus.

The SM-Encoder Plus is classed as a dumb module as it does not have its own processor and as a result all parameters are updated by the drive processor.

The SM-Encoder Plus parameters are read/written by the drive background task or at the combined update time for time critical parameters. The combined update time depends on the number and type of dumb modules fitted to the drive. For each dumb module the update rate of these parameters is specified as either 4 or 8ms. The combined update time is the total of the update times for all dumb modules fitted. (E.g. if two modules with 4ms and 8ms update times are fitted to the drive, then the combined update time for the time critical parameters of each module will be 12ms.)

Dumb module	Update time
SM-I/O Plus	8ms
SM-Encoder Plus	4ms
SM-Resolver	4ms

NOTE   The same parameter structure is available in menu 15, 16 and 17 referring to slots 1, 2 and 3.

WARNING   Before attempting to adjust any parameters, refer to Chapter 2 *Safety information* on page 5.

Table 6.1 Key to parameter coding

| Coding	Attribute
RW	Read/write: can be written by the user
RO	Read only: can only be read by the user
Bit	1 bit parameter
Bi	Bipolar parameter
Uni	Unipolar parameter
Txt	Text: the parameter uses text strings instead of numbers.
FI	Filtered: some parameters which can have rapidly changing values are filtered when displayed on the drive keypad for easy viewing.
DE	Destination: indicates that this parameter can be a destination parameter.
RA	Rating dependant: this parameter is likely to have different values and ranges with drives of different voltage and current ratings. This parameters is not transferred by smart cards when the rating of the destination drive is different from the source drive.
NC	Not cloned: not transferred to or from smart cards during cloning.
PT	Protected: cannot be used as a destination.
US	User save: saved in drive EEPROM when the user initiates a parameter save.
PS	Power-down save: automatically saved in drive EEPROM at power-down.

6.2 Single line descriptions

Parameter		Range(⇕) OL	Range(⇕) CL	Default(⇨) OL	Default(⇨) VT	Default(⇨) SV	Type					
x.01	Solutions Module ID	0 to 599		104			RO	Uni			PT	US
x.02	Solutions Module software version	00.00 to 99.99					RO	Uni		NC	PT	
x.03	Speed feedback	±40,000.0 rpm					RO	Bi	FI	NC	PT	
x.04	Revolution counter	0 to 65,535 revolutions					RO	Uni	FI	NC	PT	
x.05	Position	0 to 65,535 (1/2^{16}ths of a revolution)					RO	Uni	FI	NC	PT	
x.06	No function											
x.07	Marker position reset disable	OFF (0) or On (1)		OFF (0)			RW	Bit				US
x.08	Marker flag	OFF (0) or On (1)		OFF (0)			RW	Bit		NC		
x.09	No function											
x.10	Equivalent lines per revolution	0 to 50,000		4,096			RW	Uni				US
x.11	No function											
x.12	No function											
x.13	No function											
x.14	No function											
x.15	Encoder type	Ab (0), Fd (1), Fr (2)		Ab (0)			RW	Uni				US
x.16	Encoder termination	0 to 2		1			RW	Bit				US
x.17	No function											
x.18	No function											
x.19	Feedback filter	0 to 5 (0 to 16 ms)		0			RW	Uni				US
x.20	No function											
x.21	No function											
x.22	No function											
x.23	No function											
x.24	No function											
x.25	No function											
x.26	No function											
x.27	No function											
x.28	No function											
x.29	Non-marker reset revolution counter	0 to 65,535 revolutions					RO	Uni		NC	PT	
x.30	Non-marker reset position	0 to 65,535 (1/2^{16}ths of a revolution)					RO	Uni		NC	PT	
x.31	No function											
x.32	Marker revolution counter	0 to 65,535 revolutions					RO	Uni		NC	PT	
x.33	Marker position	0 to 65,535 (1/2^{16}ths of a revolution)					RO	Uni		NC	PT	
x.34	No function											
x.35	Freeze revolution counter	0 to 65,535 revolutions					RO	Uni		NC	PT	
x.36	Freeze position	0 to 65,535 (1/2^{16}ths of a revolution)					RO	Uni		NC	PT	
x.37	No function											
x.38	No function											
x.39	Freeze flag	OFF (0) or On (1)		OFF (0)			RW	Bit		NC		
x.40	No function											
x.41	No function											
x.42	No function											
x.43	No function											

Parameter		Range($\updownarrow$)		Default($\Rightarrow$)			Type						
		OL	CL	OL	VT	SV							
x.44	No function												
x.45	Position feedback initialised	OFF (0) or On (1)					RO	Bit			NC	PT	
x.46	No function												
x.47	No function												
x.48	No function												
x.49	Lock position feedback	OFF (0) or On (1)					RW	Bit					
x.50	Solutions Module error status	0 to 255					RO	Uni			NC	PT	
x.51	No function												

RW	Read / Write	RO	Read only	Uni	Unipolar	Bi	Bi-polar
Bit	Bit parameter	Txt	Text string	FI	Filtered	DE	Destination
NC	Not cloned	RA	Rating dependent	PT	Protected	US	User save
PS	Power down save						

NOTE   Not all parameters available in menus 15, 16 and 17 (Pr **x.01** to Pr **x.50**) are used when operating with the SM-Encoder Plus.

Figure 6-1 SM-Encoder Plus logic diagram

Feedback
filter

Speed

| x.19 | x.03 |

x.49

Lock position
feedback

Revolution
counter

Position

| x.04 | x.05 |

Positional information

Key

| X ⊘ X ⊘ | Input terminals | 0.XX | Read-write (RW) parameter |
| X ⊘ X ⊘ | Output terminals | 0.XX | Read-only (RO) parameter |
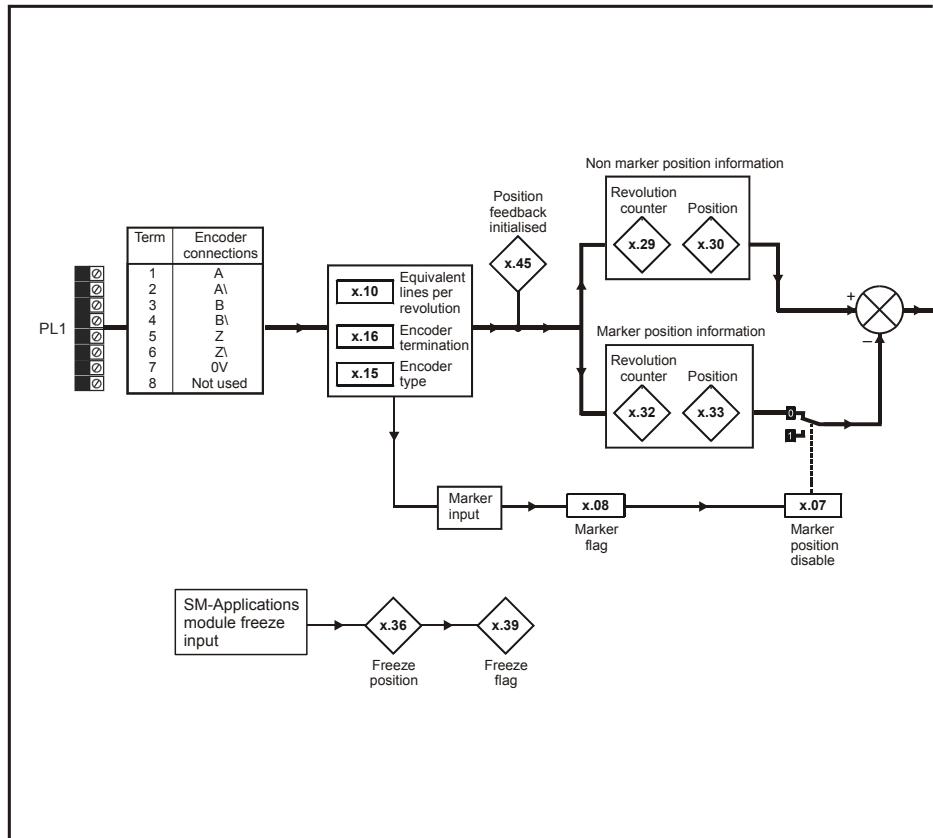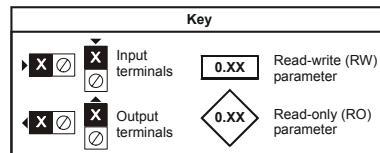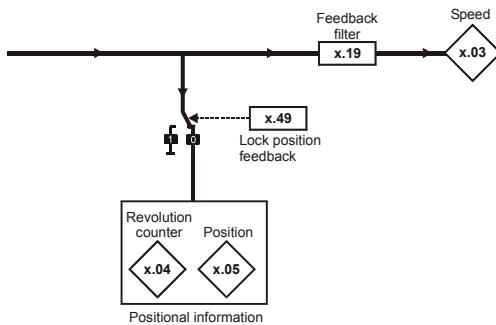
The parameters are all shown at their default settings

6.3   Parameter descriptions

x.01		Solutions Module ID code							
RO	Uni						PT	US	
⇕		0 to 599		⇨		104			
Update rate: Write on power-up									

The menu for the relevant slot appears for the new Solutions Module category with the default parameter values for the new category. When no Solutions Module is fitted in the relevant slot this parameter is zero. When a Solutions Module is fitted this parameter displays the identification code as shown below.

Code	Solutions Module	Category	Dumb module
0	No Solutions Module fitted		
101	SM-Resolver	Feedback	✓
102	SM-Universal Encoder Plus	Feedback	
104	SM-Encoder Plus	Feedback	✓
201	SM-I/O Plus	Automation	✓
301	SM-Applications	Automation	
302	SM-Application Lite	Automation	
401	reserved	Fieldbus	
402	reserved	Fieldbus	
403	SM-Profibus DP	Fieldbus	
404	SM-Interbus	Fieldbus	
405	reserved	Fieldbus	
406	SM-CAN	Fieldbus	
407	SM-DeviceNet	Fieldbus	
408	SM-CANopen	Fieldbus	
501	SM-SLM	SLM	

The new parameters values are not stored in EEPROM until the user performs a parameter save. When parameters are saved by the user in the drive EEPROM the option code of the currently fitted Solutions Module is saved in EEPROM. If the drive is subsequently powered-up with a different Solutions Module fitted, or no Solutions Module fitted where one was previously fitted, the drive gives a Slot.dF or SLot.nf trip.

x.02		Solutions Module software version							
RO	Uni					NC	PT		
⇕		00.00 to 99.99		⇨					
Update rate: Write on power-up									

The SM-Encoder Plus is a dumb module and contains no software. This parameter is therefore non-applicable.

x.03		**Speed feedback**							
RO	Bi	FI				NC	PT		
⇕	±40,000.0 rpm		⇨						
Update rate: 4ms x number of dumb modules									

Provided the set-up parameters for the position feedback are correct this parameter shows the speed in rpm.

x.04		**Revolution counter**							
RO	Uni	FI				NC	PT		
⇕	0 to 65,535 revolutions		⇨						
Update rate: 4ms x number of dumb modules									

x.05		**Position**							
RO	Uni	FI				NC	PT		
⇕	0 to 65,535 (1/2^{16}ths revolutions)		⇨						
Update rate: 4ms x number of dumb modules									

Pr **x.04** and Pr **x.05** give the position with a resolution of 1/2^{16}ths of a revolution as a 32 bit number as shown below.

31	16 15	0
Revolutions	Position	

Provided the set-up parameters are correct, the position is always converted to units of 1/2^{16}ths of a revolution, but some parts of the value may not be relevant depending on the resolution of the feedback device. For example if 10 bit resolution is selected the resolver produces 4,096 counts per revolution, and so the position is represented by the bits in the shaded area only.

31	16 15	4 3	0
Revolutions	Position		

When the feedback device rotates by more than one revolution, the revolutions in Pr **x.04** increment or decrement in the form of a sixteen bit roll-over counter.

x.07		**Marker position reset disable**							
RW	Bit							US	
⇕	OFF (0) or On (1)		⇨		OFF (0)				
Update rate: Background read									

x.08		Marker flag							
RW	Bit					NC			
⇕	OFF (0) or On (1)			⇨	OFF (0)				
Update rate: 4ms x number of dumb modules									

An incremental digital encoder may have a marker channel and when this channel becomes active (rising edge in the forward direction and falling edge in reverse) it may be used to reset the encoder position and set the marker flag (Pr **x.07** = 0), or just to set the marker flag (Pr **x.07** = 1). When the position is reset by the marker, Pr **x.05** is reset to zero.

The marker flag is set each time the marker input becomes active, but it is not reset by the drive, and so this must be done by the user.

x.10		Equivalent lines per revolution							
RW	Uni							US	
⇕	0 to 50,000			⇨	4,096				
Update rate: Background read (only has any effect when the drive is disabled)									

When Ab, Fd, or Fr signals are used the equivalent number of encoder lines per revolution must be set-up correctly in Pr **x.10** to give the correct speed and position feedback. The equivalent number of encoder lines per revolution (ELPR) is defined as follows:

Position feedback device	ELPR
Ab	number of lines per revolution
Fd, Fr	number of lines per revolution / 2

Although Pr **x.10** can be set to any value from 0 to 50,000, there are restrictions on the values actually used as follows:

If Pr **x.10** < 2, ELPR = 2. If Pr **x.10** > 16,384, ELPR = 16,384. Otherwise, Pr **x.10** is rounded down to the nearest value that is a power of 2, e.g. if 5,000 is set in Pr **x.10**, the drive actually uses 4,096.

x.15		Encoder type							
RW	Uni							US	
⇕	Ab (0), Fd (1), Fr (2)			⇨	Ab (0)				
Update rate: 4ms x number of dumb modules									

The following encoders can be connected to the SM-Encoder Plus.

0, Ab: Quadrature incremental encoder, with or without marker pulse

1, Fd: Incremental encoder with frequency and direction outputs, with or without marker pulse

2, Fr: Incremental encoder with forward and reverse outputs, with or without marker pulse

x.16		Encoder termination							
RW	Txt							US	
↕		0 to 2			⇨		1		
Update rate: Background read									

The terminations may be enabled/disabled by this parameter as follows:

Encoder input	x.16=0	x.16=1	x.16=2
A-A\	Disabled	Enabled	Enabled
B-B\	Disabled	Enabled	Enabled
Z-Z\	Disabled	Disabled	Enabled

x.19		Feedback filter							
RW	Uni							US	
↕		0 to 5 (0 to 16 ms)			⇨		0		
Update rate: Background read									

A sliding window filter may be applied to the feedback. This is particularly useful in applications where the feedback 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. The filter is not active if the parameter value is 0 or 1ms, but operates over the defined window for parameter values of 2, 4, 8 and 16ms.

Value in Pr x.19	Filter window
0	Not active
1	Not active
2	2ms
4	4ms
8	8ms
16	16ms

x.29		Non-marker reset revolution counter							
RO	Uni					NC	PT		
↕		0 to 65,535 revolutions			⇨				
Update rate: 4ms x number of dumb modules									

x.30		Non-marker reset position							
RO	Uni					NC	PT		
↕		0 to 65,535 (1/2^{16}ths of a revolution)			⇨				
Update rate: 4ms x number of dumb modules									

Pr **x.29** and Pr **x.30** are duplicates of Pr **x.04** and Pr **x.05** respectively and not affected by the marker or freeze inputs.

x.32		**Marker revolution counter**								
RO	Uni					NC	PT			
⇕	0 to 65,535 revolutions			⇨						
Update rate: 4ms x number of dumb modules										

x.33		**Marker position**								
RO	Uni					NC	PT			
⇕	0 to 65,535 (1/2^{16}ths of a revolution)			⇨						
Update rate: 4ms x number of dumb modules										

Each time the marker becomes active, the non-marker position values (Pr **x.29** and Pr **x.30**) are sampled and stored in Pr **x.32** and Pr **x.33**.

x.35		**Freeze revolution counter**								
RO	Uni					NC	PT			
⇕	0 to 65535 revolutions			⇨						
Update rate: 4ms x number of dumb modules										

x.36		**Freeze position**								
RO	Uni					NC	PT			
⇕	0 to 65535 (1/2^{16}ths of a revolution)			⇨						
Update rate: 4ms x number of dumb modules										

x.39		**Freeze flag**								
RW	Bit					NC				
⇕	OFF (0) or On (1)			⇨		OFF (0)				
Update rate: 4ms x number of dumb modules										

This Solutions Module does not have its own freeze input, therefore the freeze input must come from a SM-Applications or SM-Universal Encoder Plus. The freeze data is processed every 4ms x number of dumb modules fitted. If a freeze has occurred and the freeze flag (Pr **x.39**) is zero, the position data is stored in Pr **x.35** and Pr **x.36** and the freeze flag is set. The freeze flag must be reset by the user before the next freeze event is stored.

x.45		**Position feedback initialised**								
RO	Bit					NC	PT			
⇕	OFF (0) or On (1)			⇨						
Update rate: 4ms x number of dumb modules										

At power-up Pr **x.45** is initially OFF (0), but is set to On (1) when the SM-Encoder Plus

can provide position feedback. Pr **x.45** then remains at On (1) whilst the drive is powered-up.

x.49	**Lock position feedback**							
RW	Bit							
⇕	OFF (0) or On (1)	⇨						
Update rate: Background write								

If Pr **x.49** is set to one, Pr **x.04** and Pr **x.05** are not updated. If this parameter is zero, Pr **x.04** and Pr **x.05** are updated normally.

x.50	**Solutions Module error status**							
RO	Uni				NC	PT		
⇕	0 to 255	⇨						

The error status is provided so that the only one option error trip is required for each Solutions Module slot. If an error occurs, the reason for the error is written to this parameter and the drive may produce a 'SLX.er' trip, where X is the slot number. A value of zero indicates the Solutions Module has not detected an error, a non-zero value indicates that an error has been detected. (See Table 7.1 *Trip codes* on page 33 for the meaning of the values in this parameter.) When the drive is reset, this parameter is cleared.

The Solutions Module includes a temperature monitoring circuit. If the PCB temperature exceeds 90°C, the drive fan is forced to operate at full speed (for a minimum of 10s). If the temperature falls below 90°C, the fan can operate normally again. If the PCB temperature exceeds 100°C, the drive is tripped and the error status is set to 74.

7 Diagnostics

If the drive trips, the output is disabled so that the drive stops controlling the motor. The lower display indicates that a trip has occurred and the upper display shows the trip.

Trips are listed alphabetically in Table 7.1 based on the trip indication shown on the drive display. Refer to Figure 7-1.

If a display is not used, the drive LED Status indicator will flash if the drive has tripped. Refer to Figure 7-2.

The trip indication can be read in Pr **10.20** providing a trip number.

7.1 Displaying the trip history

The drive retains a log of the last 10 trips that have occurred in Pr **10.20** to Pr **10.29** and the corresponding time for each trip in Pr **10.43** to Pr **10.51**. The time of the trip is recorded from the powered-up clock (if Pr **6.28** = 0) or from the run time clock (if Pr **6.28** = 1).

Pr **10.20** is the most recent trip, or the current trip if the drive is in a trip condition (with the time of the trip stored in Pr **10.43**). Pr **10.29** is the oldest trip (with the time of the trip stored in Pr **10.51**). Each time a new trip occurs, all the parameters move down one, such that the current trip (and time) is stored in Pr **10.20** (and Pr **10.43**) and the oldest trip (and time) is lost out of the bottom of the log.

If any parameter between Pr **10.20** and Pr **10.29** inclusive is read by serial communications, then the trip number in Table 7-1 is the value transmitted.

Figure 7-1 Keypad status modes
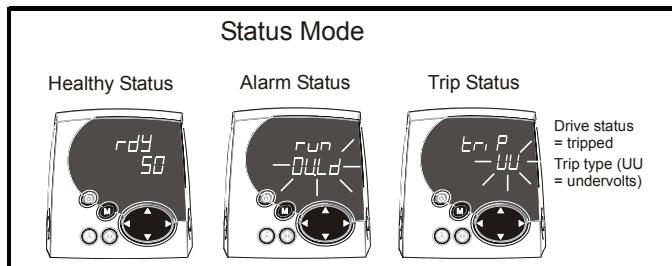
Figure 7-2 Location of the status LED
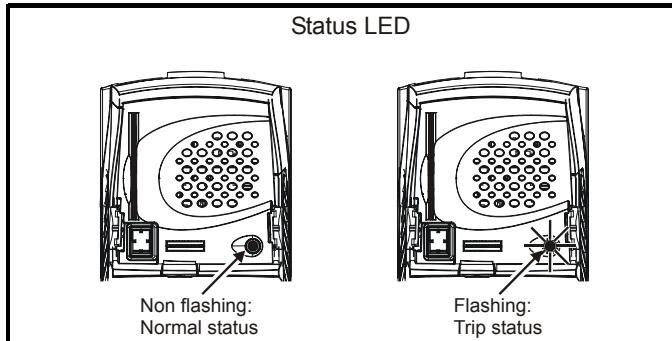
Any trip can be initiated by writing the relevant trip number to Pr **10.38**. If any trips shown as user trips are initiated the trip string is "txxx", where xxx is the trip number.

Trips can be reset after 1.0s if the cause of the trip has been rectified.

A full list of drive trips can be found in the *Unidrive SP User Guide.*

Table 7.1 Trip codes

Trip	Diagnosis
C.Optn	**SMARTCARD trip: Solutions Modules fitted are different between source drive and destination drive**
180	Ensure correct Solutions Modules are fitted Ensure Solutions Modules are in the same Solutions Module slot Press the red ⊘ reset button
Enc1	**Drive encoder trip: Encoder power supply overload**
189	Check encoder power supply wiring and encoder current requirement Maximum current = 200mA @ 15V or 300mA @ 8V and 5V
PS.24V	**24V internal power supply overload**
9	The total user load of the drive and Solutions Modules has exceeded the internal 24V power supply limit. The user load consists of the drive's digital outputs plus the SM-I/O Plus digital outputs, or the drive's main encoder supply plus the SM-Universal Encoder Plus encoder supply. • Reduce load and reset • Provide an external 24V >50W power supply • Remove any Solutions Modules and reset
SLX.dF	**Solutions Module slot X trip: Solutions Module type fitted in slot X changed**
204,209, 214	Save parameters and reset
SLX.Er	**Solutions Module slot X trip: Error detected with Solutions Module, where X is the slot number**
202 207 212	(see table below)

Pr x.50	Fault description
0	No errors
1	Power supply short circuit
2	Hardware detectors on the A(F), B(D,R) and Z signal detect a wire break.
9	Thermistor trip
10	Thermistor short circuit
74	Solutions Module over-temperature

- If the terminations are not enabled on the A, B or Z inputs the wire break system will not operate. (Note that as default the Z input terminations are disabled to disable wire break detection on this input.)

Encoder initialisation will occur when trips 1 to 8 are reset.

It is important that a break in the connections between the drive and the position feedback device can be detected. This feature is provided either directly or indirectly as listed.

When the drive is reset this parameter is cleared for the relevant Solutions Module

Trip	Diagnosis
SLX.HF	**Solutions Module slot X trip: Solutions Module X hardware fault**
200,205, 210	Ensure Solutions Module is fitted correctly Return Solutions Module to supplier
SLX.nF	**Solutions Module slot X trip: Solutions Module has been removed**
203,208, 213	Ensure Solutions Module is fitted correctly Replace Solutions Module Save parameters and reset drive
SLX.tO	**Solutions Module slot X trip: Solutions Module watchdog time-out**
203,208, 211	Press reset. If the trip persists, contact the supplier of the drive.
SL.rtd	**Solutions Module trip: Drive mode has changed and Solutions Module parameter routing is now incorrect**
215	Press reset. If the trip persists, contact the supplier of the drive.

8   Terminal data

8.1   Encoder inputs

Ab, Fd, and Fr encoders

1	Channel A, Frequency or Forward inputs
2	Channel A\, Frequency\ or Forward\ inputs
3	Channel B, Direction or Reverse inputs
4	Channel B\, Direction\ or Reverse\ inputs
5	Marker pulse channel Z
6	Marker pulse channel Z\

Type	EIA 485 differential receivers
Maximum frequency	600kHz
Line loading	<2 unit loads (for terminals 1 to 4) 32 unit loads (for terminals 5 and 6)
Line termination components	120Ω
Working common mode range	+12Vdc to –7Vdc
Absolute maximum applied voltage relative to 0V	±25V
Absolute maximum applied differential voltage	±25V

7	0V Common

8	External power supply decoupling
Maximum voltage	±50Vdc

Index

0471-0026-03