



## *Installation Guide*



# ***Adaptor***

Part Number: 0437-0007-01

Issue Number: 1

## **General Information**

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

This module is intended for use only with Control Techniques products. Any other use invalidates the warranty and may cause a safety hazard.

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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# Contents

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<b>1</b>	<b>How to use this guide .....</b>	<b>4</b>
1.1	Intended personnel .....	4
1.2	Information .....	4
<b>2</b>	<b>Safety Information .....</b>	<b>5</b>
2.1	Warnings, Cautions and Notes .....	5
2.2	Electrical safety - general warning .....	5
2.3	System design and safety of personnel .....	5
2.4	Environmental limits .....	5
2.5	Compliance with regulations .....	6
2.6	Motor .....	6
2.7	Adjusting parameters .....	6
<b>3</b>	<b>Introduction .....</b>	<b>7</b>
3.1	Features .....	7
3.2	Solutions Module identification .....	8
3.3	Compatible with encoder types .....	8
<b>4</b>	<b>Wiring and hardware set up .....</b>	<b>9</b>
4.1	Installation .....	9
4.2	Terminal and switch locations .....	9
4.3	Switch settings .....	10
4.4	Terminal descriptions .....	10
4.5	Drivelink connector (SK4) .....	11
4.6	Wiring, Shield connections .....	12
<b>5</b>	<b>Set-up and commissioning .....</b>	<b>17</b>
5.1	Rotary encoders (single cycle) .....	17
5.2	Linear Encoders .....	19
<b>6</b>	<b>Troubleshooting .....</b>	<b>20</b>
<b>7</b>	<b>EMC Data .....</b>	<b>21</b>
7.1	Installation .....	21
<b>8</b>	<b>Technical data .....</b>	<b>22</b>
<b>9</b>	<b>Encoder types compatible with SLMA .....</b>	<b>24</b>
9.1	Stegmann .....	24
9.2	Heidenhain .....	25
9.3	Tamagawa .....	26
<b>10</b>	<b>Determining connections for unspecified rotary encoders .....</b>	<b>27</b>
<b>11</b>	<b>Thermistor input .....</b>	<b>28</b>
11.1	Thermistor input .....	28

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# 1 How to use this guide

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## 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  Adaptor module, terminal layout for installation, fitting of the  Adaptor to the drive and motor.

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## 2 Safety Information

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### 2.1 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.

### 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 Installation 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 the drives User Guide carefully.

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.

### 2.4 Environmental limits

Instructions in the <sup>(SLM)</sup> *Adaptor Installation Guide* regarding transport, storage, installation and use of the <sup>(SLM)</sup> Adaptor must be complied with, including the specified environmental limits. <sup>(SLM)</sup> Adaptor 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 *Drives documentation* 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.

**Servo motors** are designed to operate at elevated temperatures which may exceed 100°C. Where necessary, precautions to prevent human contact should be taken.

**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  $\text{SLM}$  Adaptor affect the protection of the motor. Ensure the correct details are entered into the  $\text{SLM}$  Adaptor on set up.

## 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.

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## 3 Introduction

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### 3.1 Features

The <sup>(SLM)</sup> Adaptor is an interface that allows the MultiAx, M'Ax and Unidrive SP (with <sup>(SLM)</sup> feedback option) platforms to operate with off the shelf sin/cos encoders (Linear and Rotary). This removes the need to replace motors with CT Dynamics SL Motors when retro fitting existing applications. It also allows induction motors with sin/cos encoders to benefit from the higher resolution feedback available from the <sup>(SLM)</sup> technology, when using Unidrive SP.

The <sup>(SLM)</sup> Adaptor needs to be mounted close to the motor to reduce the signal degradation from the sin/cos Encoder (Max 2m).

- Selectable Encoder supply voltages (5V,8V, 9V &12V)
- Digital signal processor
- High-speed, two-wire EIA485 serial communications interface operating with the DrivelinK protocol for data transfer to and from the drive and motion controller
- Serial communication to the encoder
- EEPROM for motor/ encoder data storage.
- PTC thermistor input (See Chapter 11 *Thermistor input* on page 28)

**Figure 3-1** <sup>(SLM)</sup> Adaptor module



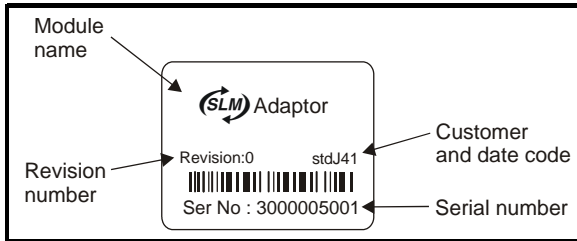
The <sup>(SLM)</sup> Adaptor samples the shaft speed and position every 125 $\mu$ s to a resolution of one eight-millionth of a revolution. The following information is then transmitted over the serial communications link:

- Position and speed demand from a motion controller
- Position feedback to the motion controller
- Current/torque demand to the drive
- Parameter values

## 3.2 Solutions Module identification

The  $(\text{SLM})$  Adaptor module can be identified by the module name printed on the serial number label, for example  $(\text{SLM})$  Adaptor (EnDat solution)

Figure 3-2  $(\text{SLM})$  Adaptor module 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 N35 would correspond to week 35 of year 2004.

## 3.3 Compatible with encoder types

The  $(\text{SLM})$  Adaptor is designed to be used with sin/cos encoders only. Dependant on part number the  $(\text{SLM})$  Adaptor will work with Linear and Rotary sin/cos encoders that achieve initial position via the hyperface or EnDat serial comms protocol. The  $(\text{SLM})$  Adaptor is also compatible with sin/cos encoders that provide a single cycle sin/cos signal and marker pulse for initial position derivation at power up.

### 3.3.1 sin/cos encoder feedback signals

For the sin/cos encoder to be compatible with the  $(\text{SLM})$  Adaptor, the output signals from the encoder must be a 1V or 2V peak to peak differential voltage (across sinref to sin and cosref to cos). See Chapter 9 *Encoder types compatible with SLMA* on page 24 for more details.

# 4 Wiring and hardware set up

## 4.1 Installation



Before installing the (SLM) Adaptor, refer to Chapter 2 *Safety Information* on page 5.

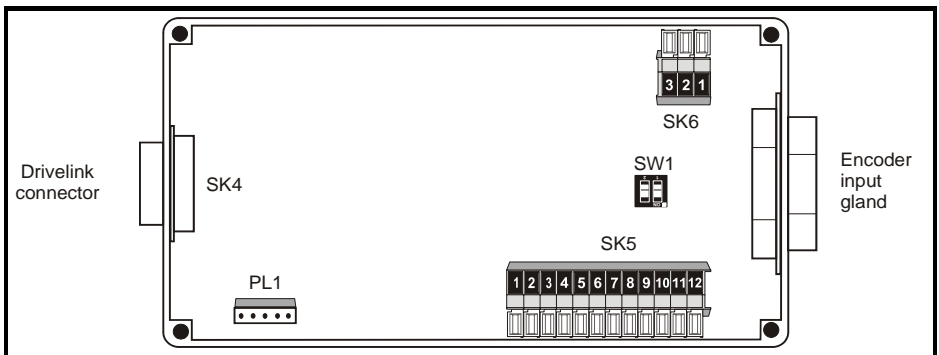


When connected to the drive the control circuits are isolated from the power circuits in the drive by basic insulation only, as specified in IEC60664-1. The installer must ensure that the external control circuits are insulated from human contact by at least one layer of insulation rated for use at the 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.

1. Check that the (SLM) Adaptor is the correct version for the encoder (single cycle sin/cos, EnDat or Hyperface, linear).
2. Set switch SW1 for correct encoder voltage (See section 4.3 *Switch settings* on page 10).
3. Connect thermistor (if fitted) to connector SK6 pins 2 & 3 (See section 4.4.1 *Thermistor Connector (SK6)* on page 10)
4. Connect encoder to connector SK5 (See section on page 10).
5. Refer to section 5 for setup and commissioning.

## 4.2 Terminal and switch locations

Figure 4-1 Plan view of (SLM) Adaptor



## 4.3 Switch settings

Figure 4-2 SW1 - Encoder supply selection switch

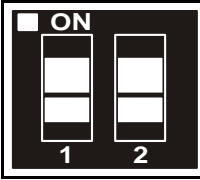


Table 4.1 Encoder supply switch settings

Switch Position		Supply
1	2	
Off	Off	5V
Off	On	8V
On	Off	9V
On	On	12V

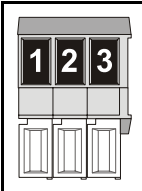


Ensure that the correct switch setting is selected, to ensure the correct voltage is supplied to the encoder.

## 4.4 Terminal descriptions

### 4.4.1 Thermistor Connector (SK6)

Figure 4-3 SK6 Terminal



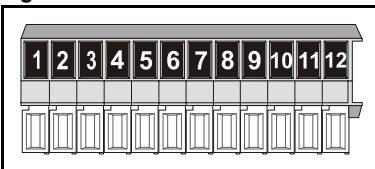
Connect the motor thermistor (if fitted) between pins 2 & 3 of SK6 and encoder shield to pin 1, as indicated in table 4.2 below.

Table 4.2 Functions of SK6 terminals

Connector	Location	Function
SK6	1	0V_Thermistor Shield
SK6	2	Thermistor 0V
SK6	3	Thermistor

### 4.4.2 Encoder connector (SK5)

Figure 4-4 SK5 Terminal



**Table 4.3 Functions of SK5 terminals**

Pin Number	Pin Name	Description	Tamagawa TS6058N50 Connections	Heidenhein ERN1185 Connections	Heidenhein with EnDat
1	1024 Cos	Multi sin/cos per rev input	B\	B\	B\
2	1024 Cos\	Multi sin/cos per rev input	B	B	B
3	1024 Sin\	Multi sin/cos per rev input	A	A\	A\
4	1024 Sin	Multi sin/cos per rev input	A\	A	A
5	Z	Marker pulse input	Z	R	
6	Z\	Marker pulse input	Z\	R\	
7	1Sin\, CLK\	Single cycle sin/cos I/P or Endat CLK O/P	Cos	C	CLK\
8	1Sin, CLK	Single cycle sin/cos I/P or Endat CLK O/P	Cos\	C\	CLK
9	1Cos\, Data	Single cycle sin/cos I/P or 485 Data I/O	Sin	D\	DATA\
10	1Cos, Data	Single cycle sin/cos I/P or 485 Data I/O	Sin\	D	DATA
11	Encoder supply	Encoder supply	DC+5V	5V Sensor & 5V Up	5V Sensor & 5V Up
12	0V	Encoder supply 0V	GND (0V)	0V Sensor & 0V Un	0V sensor & 0V Un



Incorrect encoder wiring can lead to loss of motor control.

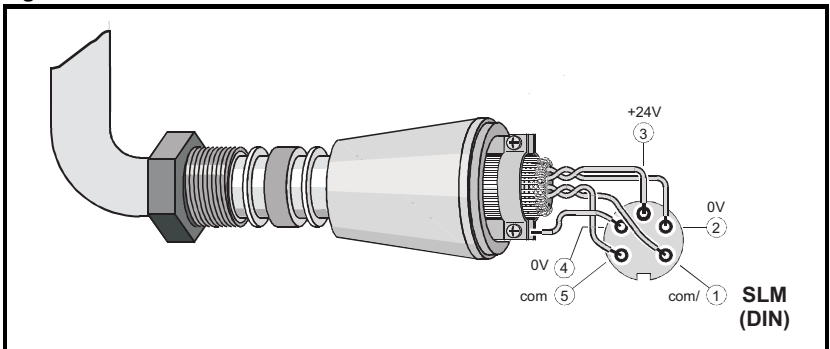
To determine connections for unspecified rotary encoders (sin/cos with single cycle only), see section 10 *Determining connections for unspecified rotary encoders* on page 27.

**NOTE**

The only serial interfaces supported are EnDat & Hyperface (not available at present). SSI is not supported.

## 4.5 Drivelink connector (SK4)

**Figure 4-5 SK4 Drivelink connector**



The above Drivelink connector is the same as the existing SLM. The existing wiring is

therefore compatible.

**Table 4.4 Functions of Drivelink Connector**

Name	Location	Function	Specification
Com\	1	<i>(SLM)</i> technology port for bi-directional communications with a drive	2-wire EIA 485 connecting cable: shielded twisted pair.
0V Common	2	For use with: <i>(SLM)</i> technology com and com\	0V common must not be interchanged with 0V
+24V	3	24Volt supply input for Adaptor	See drives 24volt specification or external power supply data
0V common	4	For use with: <i>(SLM)</i> technology com & com\	0V common must not be interchanged with 0V
Com	5	<i>(SLM)</i> technology port for bi-directional communications with a drive	2-wire EIA 485connecting cable: Shielded twisted pair

## 4.6 Wiring, Shield connections

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

### Encoder mounting methods

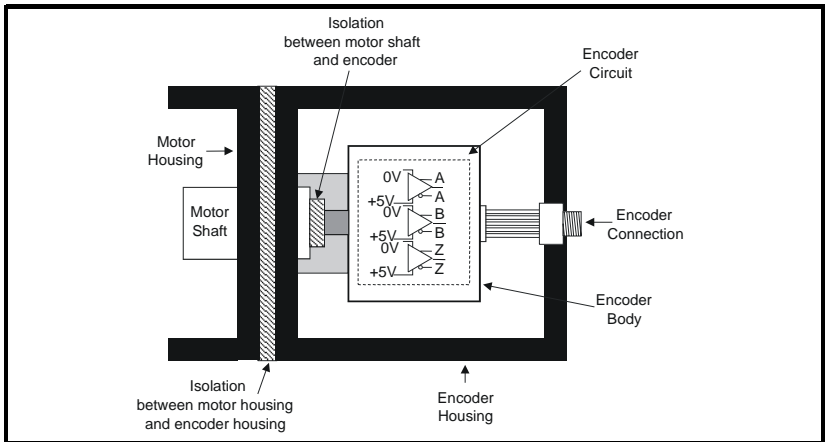
There are three methods for mounting an encoder onto a motor:

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

#### 4.6.1 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 4-6.

**Figure 4-6 Galvanic Isolation from Motor**

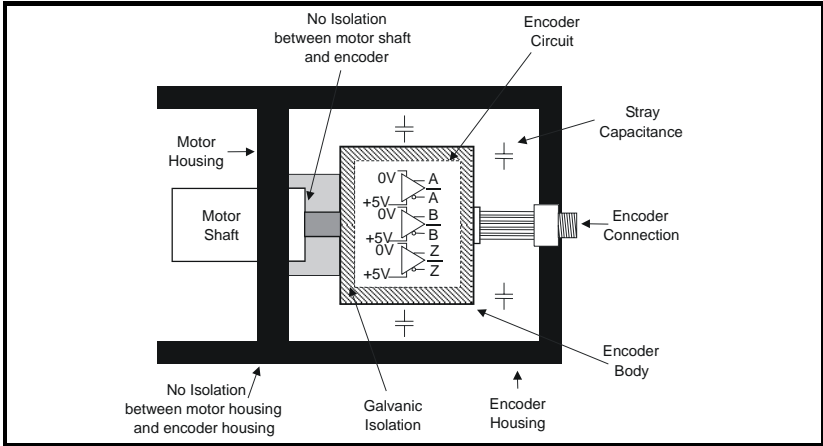


An example of this is the Unimotor where isolation from the motor is achieved by inserting a plastic mounting plate between the motor housing and encoder housing and a plastic insert fitted in the motor shaft for encoder mounting to the motor shaft. With this preferred method of mounting noise current 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.

#### **4.6.2 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.

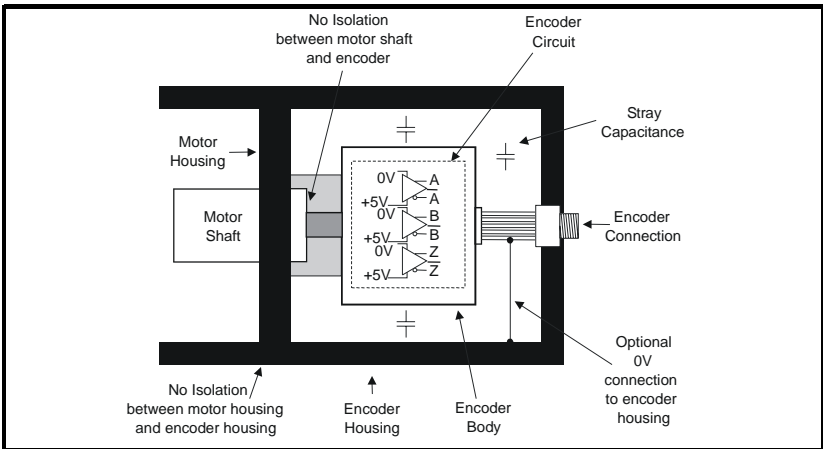
**Figure 4-7 Encoder Galvanically Isolated from Encoder Body**



**4.6.3 No isolation**

As shown in Figure 4-8 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 4-8 No Isolation**



## 4.6.4 Cable requirements

### All mounting methods:

- Shield connection at (SLM) Adaptor 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 "pigtailed" and to maximise the shielding benefit.
- The shield connections ("pigtailed") to the (SLM) Adaptor 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 (SLM) Adaptor grounding bracket, see Figure 4-7. "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 (SLM) Adaptor 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 "pigtailed" and to maximise the shielding benefit.



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 (SLM) Adaptor.

### Cable shield ground connection

For all mounting methods, grounding of the feedback cable shield has added benefits. It can protect the (SLM) Adaptor 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 4-10.

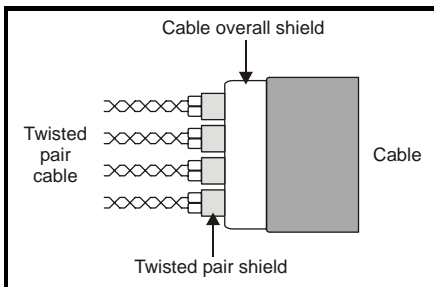


Connecting the cable shield to ground at both ends carries the risk that an electrical fault might cause excessive power current to flow in the cable shield and overheat the cable. There must be an adequately rated safety ground connection between the motor/encoder and the (SLM) Adaptor.

### Recommended Cable

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

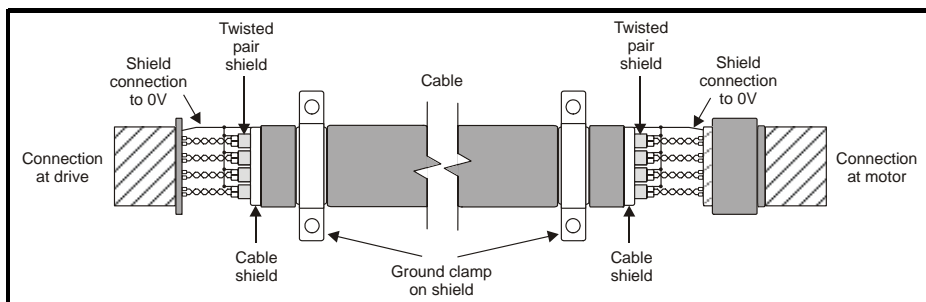
Figure 4-9 Feedback Cable, Twisted Pair



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 (SLM) Adaptor and encoder end, when required.

**NOTE** Ensure that feedback cables are kept as far away as possible from power cables and avoid parallel routing.

**Figure 4-10 Feedback cable connections**



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# 5 Set-up and commissioning

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In order to enable identical operation to SLM-based systems, the SLMA contains an EEPROM in which the necessary set-up parameters are stored (encoder & motor object). These objects need to be characterised for the encoder / motor using a M'Ax drive and M'AxLink commissioning software (contact drive supplier for further information).

## 5.1 Rotary encoders (single cycle)

### 5.1.1 SLA set-up summary

A summary of the procedure for setting up a new SLA is shown below:

1. SLMA driveline connections are compatible with SLM i.e. same cable can be used for both. See Figure 4.5 on page 11.
2. Connect SLMA and motor to M'Ax with V01.50.15 firmware or greater. Connect a pc loaded with M'AxLink commissioning software to the M'Ax, and power up the drive (ensure the drive is in a disabled state). M'Ax will power up with 'Sl.Er' trip
3. Write encoder object to SLMA (refer to section 5.1.2).
4. Write motor object to SLMA (refer to section 5.1.3).
5. Power cycle the M'Ax and M'Ax will power up without any trip.
6. Check encoder is connected properly. See Figure 5.1.4 on page 18.
7. Flux align the motor. See Figure 5.1.5 on page 19.
8. Perform encoder offset and amplitude calibration routine. See Figure 5.1.5 on page 19.
9. Motor is ready to use with any SLM-based application.

### 5.1.2 Encoder object creation using M'Ax and M'AxLink

Select 'Encoder Object' tab on M'AxLink and press 'Load Defaults' to load default values. Press 'Configure' (Encoder set-up) to set up number of encoder lines and encoder type e.g. 'Heidenhain with EnDat', and press 'Update Encoder Obj' to load the corresponding values into the encoder object table. To write these values to the EEPROM, press 'Write Object' on the 'Encoder Object' tab (this overwrites all the encoder object on the SLMA with the values in the table).

A list of encoder objects that should be written to is shown below:

- Object 9 should be set to  $2^n$  (min  $2^4$  up to  $2^{14}$  i.e. 16 to 16384), which corresponds to the number of encoder lines.
- Object 10 should be set as follows:

Rotary Encoder Type	Value (Object 10)
CT-Coder (not compatible with SLA)	0
Single cycle sin/cos, differential voltage = 2V (Tamagawa)	1
Single cycle sin/cos, differential voltage = 1V (e.g. Heidenhain ERN1185 series)	2
Heidenhain with EnDat	3
Hyperface (not available at present)	4

- Objects 14 to 18 (serial numbers) can be set to any meaningful value (0 - 65535).

### 5.1.3 Motor object creation usin M'Ax and M'AxLink

Select 'Motor Object' tab on M'AxLink and press 'Load Defaults' to load default values. Enter all relevant motor information, and press 'Configure' (Thermistor trip) to set up motor thermistor trip level (if no motor thermistor is fitted, ensure 'Enable Thermistor' check box is NOT ticked). Press 'Update Trip Level' to load the corresponding value into the motor object table. To write these values to the EEPROM, press 'Write Object' on the 'Motor Object' tab (this overwrites all the motor object on the SLMA with the values in the table).

A list of motor objects that should be written to is shown below:

- Objects 23 to 28 (motor type, manufacturer & serial numbers) can be set to any meaningful value (0-65535).
- Object 30 (rated current x 10) e.g. for 6.5A motor, set object 30 to 65.
- Object 31 (poles)
- Object 32 (winding time constant x 10) e.g. for winding time constant of 217 secs, set object 32 to 2170.
- Object 33 (phase advance). For motors <6000 rpm, set object 33 to 60000; for motors >= 6000 rpm, set object 33 to 30000.
- Object 34 (maximum speed) in rpm.
- Object 36 (inertia x multiplication factor). See exceptions field below for multiplication factor and units, e.g. for inertia of 7.8kg cm<sup>2</sup>, set object 36 to 780 and object 44 to 3.
- Object 37 (base speed) in rpm.
- Object 38 (Kt x 10) e.g. for 1.6Nm/A, set object 38 to 16.
- Object 44 (exceptions)

Bit 1	Bit 0	Multiplication factor	Inertia units	Range
1	1	100	Kg cm <sup>2</sup>	300.00 to 0.00
0	1	10	Kg cm <sup>2</sup>	3000.0 to 300.00
1	0	100	Kg m <sup>2</sup>	300.00 to 0.00
0	0	10	Kg m <sup>2</sup>	3000.0 to 300.00

- Object 47 (Thermistor Trip Level) should be set using the Thermistor Trip Configurator on M'AxLink. If not the set up correctly, the motor may not be protected properly.

#### NOTE

For multiple SLMA set ups with the same encoder / motor, power down the drive and swap the SLMA. The previous encoder / motor object will remain in M'AxLink, so when power is re-applied to the drive you just need to press 'Write Object' on the 'Encoder Object' and 'Motor Object' tabs to overwrite the EEPROM objects on the new SLMA. The object values may also be saved to a file by selecting 'File, Save Objects, Save ALL Objects...' from the M'AxLink menu. To retrieve the saved values at a later date, press 'Load From File' on the relevant object tab and select the required file.

#### NOTE

Writing the encoder and motor objects to the SLMA EEPROM may be done without wiring the encoder or thermistor.

### 5.1.4 Checking rotary encoder is connected properly

Before the motor is enabled, a check should be done to ensure the encoder is connected correctly.

## Incremental

Using a M'Ax (in a disabled state), the motor shaft should be turned by hand a quarter of a turn whilst monitoring M'Ax Pr **3.29** (position within a revolution). If the shaft was turned in a clockwise direction (looking into the motor shaft), the count should have incremented by approx 16000 (1 revolution = 65535 counts); if the shaft was turned in an anti-clockwise direction, the count should decrement by the same amount. Repeat the above procedure several times, remembering that when Pr **3.29** reaches 65535, it will roll over to zero.

## Single cycle initial position

Move the shaft to a position and note M'Ax Pr **3.29**. Power cycle the drive and then read Pr **3.29**. The values before and after power cycling should be equal to within  $\pm 300$  counts. Move the shaft to different positions and repeat the above procedure.

## Marker pulse check

Power up drive and check M'Ax Pr **3.32**. If it is set to 1, turn shaft a quarter of a turn and power cycle drive. If Pr **3.32** is still set to 1, the marker pulse is connected incorrectly. Therefore swap Z and Z\ connections.

If Pr **3.32** is not set to 1, turn the shaft 1 revolution. At some point in the revolution Pr **3.32** should get set to 1. If not, check wiring for an open circuit and repeat the above.

**NOTE** The marker pulse should coincide with 0 position  $\pm 300$  counts i.e. M'Ax Pr **3.29** should be  $0 \pm 300$ .

### 5.1.5 Flux Alignment & Offset Calibration

Ensure the following is done with a motor not connected to any mechanical load. After the encoder and motor objects have been created, power cycle the drive and perform the flux alignment routine by selecting the 'Configuration' tab on M'AxLink, press 'Flux Alignment' and follow the on screen instructions. To perform the encoder offset and amplitude calibration routine, press 'Encoder Calibration' on the 'Configuration' tab and follow the on screen instructions.

Alternatively, to perform the flux alignment routine, set M'Ax Pr **6.08** to 0, close hardware enable and set Pr **5.12** to 1. When the flux alignment has finished (Pr **5.12** returned to 0), open hardware enable and power cycle the drive. To perform the encoder offset and amplitude calibration routine, set Pr **5.55** to 1. When the routine has finished (Pr **5.55** returned to 0), the drive and motor with SLMA are ready to use.

Use the gain calculator macro or load the default values to set appropriate speed loop gains values.

## 5.2 Linear Encoders

Not available at present.

## 6 Troubleshooting

Problem	Potential reasons
Get more (or less) than 65535 for 1 turn of the motor shaft.	<ul style="list-style-type: none"> <li>Encoder lines set incorrectly in object 9.</li> </ul>
For a clockwise turn (looking into the motor shaft), the count in M'Ax Pr 3.29 decrements (should increment).	<ul style="list-style-type: none"> <li>Incremental sin/cos signals are connected incorrectly (SK5 pins 1 to 4). See section on page 10</li> </ul>
Initial position doesn't match incremental position (+/-300 counts).	<ul style="list-style-type: none"> <li>Single cycle sin/cos signals are connected incorrectly (SK5 pins 7 to 10). See section on page 10</li> </ul>
Motor turns but vibrates, and is verging on instability.	<ul style="list-style-type: none"> <li>Check speed loop gains.</li> <li>Check inertia settings in motor object. If incorrect, change and perform M'Ax macro 3000 to automatically calculate new speed loop gains.</li> </ul>
Minimal or no torque.	<ul style="list-style-type: none"> <li>Check motor current is set correctly in object 30.</li> </ul>
Motor speed is clamped.	<ul style="list-style-type: none"> <li>Check base speed and maximum speed have been set correctly in objects 34 &amp; 37.</li> </ul>
M'Ax Pr 3.29 doesn't change when motor shaft is rotated.	<ul style="list-style-type: none"> <li>Ensure encoder power supply is connected correctly.</li> <li>Ensure encoder sin/cos signals are connected correctly. See section on page 10</li> </ul>
Motor spins off when enabled.	<ul style="list-style-type: none"> <li>Ensure motor has been flux aligned.</li> <li>Check speed loop gains.</li> <li>Check encoder connections.</li> <li>Check encoder object has been set up correctly.</li> <li>Check motor object has been set up correctly.</li> <li>Check initial position and incremental position match.</li> </ul>
M'Ax trips O.ht3	<ul style="list-style-type: none"> <li>Motor object 47 (thermistor trip threshold) incorrectly set.</li> <li>Thermistor not connected / open circuit.</li> <li>Thermistor short circuit.</li> <li>If no thermistor fitted, ensure motor object 47 is set to 4096 so thermistor input is disabled.</li> </ul>

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# 7 EMC Data

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## 7.1 Installation



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 the *Electrical Installation* of the drives, and that the encoder feedback wiring and shielding recommendations are followed in section 4.6 *Wiring, Shield connections* on page 12.

### 7.1.1 Electromagnetic compatibility (EMC)

It is the responsibility of the installer to ensure that the equipment or system complies with the relevant EMC legislation in the country of use. Within the European Union, equipment into which this product is incorporated must comply with 89/336/EEC Electromagnetic Compatibility.

EMC immunity	
EN50082-2	Industrial
EN61000-4-3 Electromagnetic field	Level 3
EN61000-4-6 Conducted RF	Level 3
EN61000-4-4 Fast transient burst	Level 3
EMC emission	

**NOTE** EMC compliance depends on the use of the correct cable connected as shown in Chapter 4 *Wiring and hardware set up* on page 9

## 8 Technical data

<b>Mechanical</b>	
Maximum dimensions (excluding encoder shaft and signal connector)	Length 150mm, Depth 40mm, Width 65mm
Weight	260gm (92oz)
<b>Environmental</b>	
Maximum ambient temperature	40°C (104°F)
Maximum relative humidity	90% non-condensing
Ingress protection (when the <sup>(6LM)</sup> is fitted in accordance with instructions)	IP65
<b>Vibration and shock</b>	
<b>Supply requirements</b>	
Supply voltage	24V ± 20%
Absolute maximum supply voltage	30V
Current consumption	60mA
<b>DrivelinK communications</b>	
Physical layer	RS485
Baud rate	2.5Mb/s
Data integrity	Hardware CRC check with error monitor
Connecting cable (minimum requirements)	Twin twisted-pair RS485 cable with screen
Maximum cable length	50m (165 ft)
<b>Sampling and update times</b>	
Type	PID
Sampling frequency (period)	8.3kHz (125µs)
Position update rate (for acceleration feedback)	15µs
<b>Repeatability and resolution of position feedback</b>	
Resolution	8 million counts per rev.
Synchronization accuracy of position loop	±50ns
<b>Motor thermal-protection</b>	
Motor protection via thermistor	
EN50081-2	Industrial

### Sin/Cos & Z (marker pulse Input) specification

Type	Differential voltage
Max signal level	1.2V Pk-Pk
Max common Mode voltage	3V
Min Common Mode voltage	2V
Max Freq	115kHz

### Encoder supply specification

Supply Voltage	5V, 8V, 9V & 12V±10%
Maximum output current	250mA @ 5V 200mA @ 8, 9 & 12V (if a larger current is required, contact CT Technical Support)

### Motor thermistor specification

Hot trip detection level	PTC
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### Data I/O and Clock specification

Type	EIA 485 differential trceivers
Max Frequency	1MHz
Line termination (fitted)	120Ω
Common mode voltage range	12V to -7V
Loading	2

### SLM Adaptor power supply requirement

Supply Voltage	24V ± 20%
Nominal current demand (at 24V) (No Encoder connected)	60mA

To estimate the current demand for differing input voltages and encoder supplies the following formula can be used:

$$I_{in} = \frac{(1.45 + V_{enc} \times I_{enc} \times 1.3)}{V_{in}}$$

$I_{in}$  = Current demanded by <sup>(SLM)</sup> Adaptor.

$V_{enc}$  = Encoder Voltage (5, 8, 9 or 12V ± 10%)

$I_{enc}$  = Encoder Current demand (250mA @ 5V; 200mA @ 8, 9, & 12V max)

$V_{in}$  = SLM Adaptor supply voltage (24V ± 20%)

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## 9 Encoder types compatible with SLMA

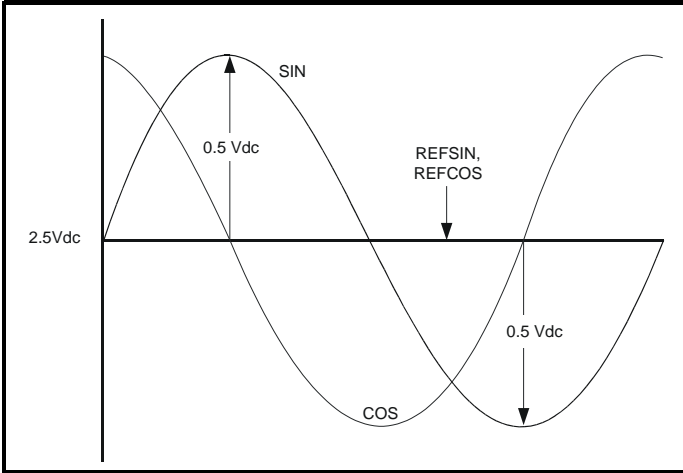
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### 9.1 Stegmann

Stegmann encoders typically have a 2.5Vdc offset. The sinref and cosref are a flat DC level at 2.5Vdc and the cos and sin signals have a 1V peak to peak waveform biased at 2.5Vdc.

The result is a 1V peak to peak differential voltage as show in Figure 9-1.

**Figure 9-1 Stegmann sin/cos encoder feedback signals**

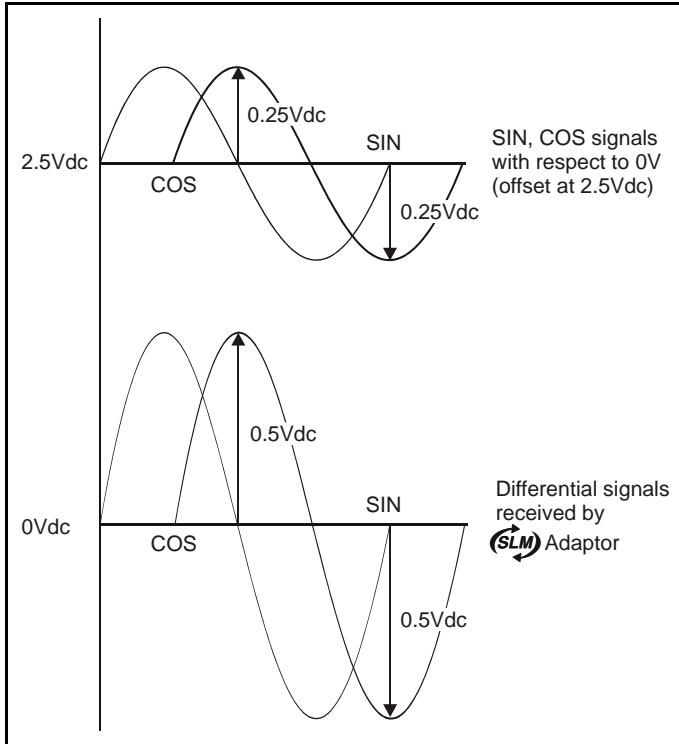


## 9.2 Heidenhain

The Heidenhain sin and cos signals with respect to 0V are offset at 2.5Vdc as shown in Figure 9-2.

The feedback signals which are seen by the (SLM) Adaptor are the differential signals Sin - Sin\ and Cos - Cos\ as in Figure 9-2, these being 90° phase shifted and at 1Vdc peak to peak.

**Figure 9-2 Heidenhain sin/cos encoder feedback signals**

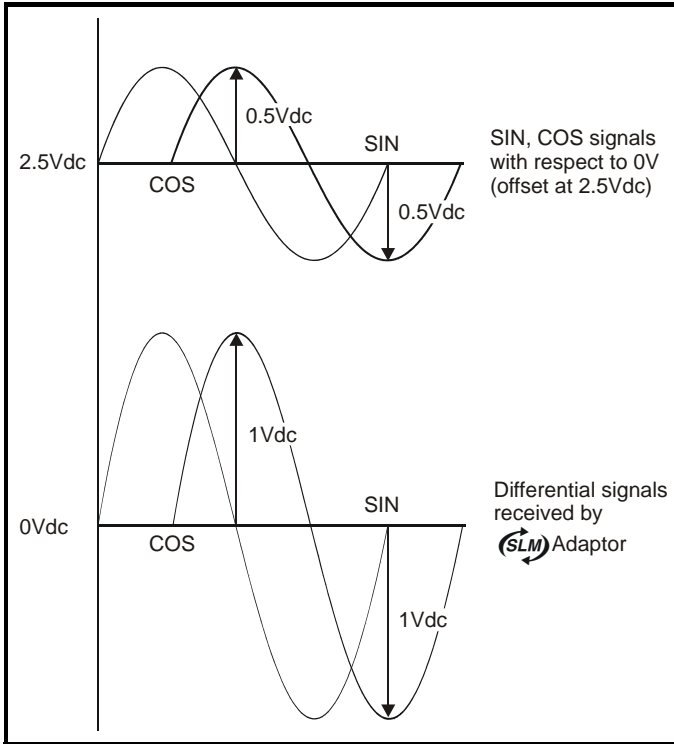


### 9.3 Tamagawa

The Tamagawa sin and cos signals with respect to zero volts are offset at 2.5Vdc as shown in Figure 9-3.

The feedback signals which are seen by the (SLM) Adaptor are the different signals Sin - Sin\ and Cos\ as in Figure 9-3, these being 90° phase shifted and 2V peak to peak.

**Figure 9-3 Tamagawa sin/cos encoder feedback signals**



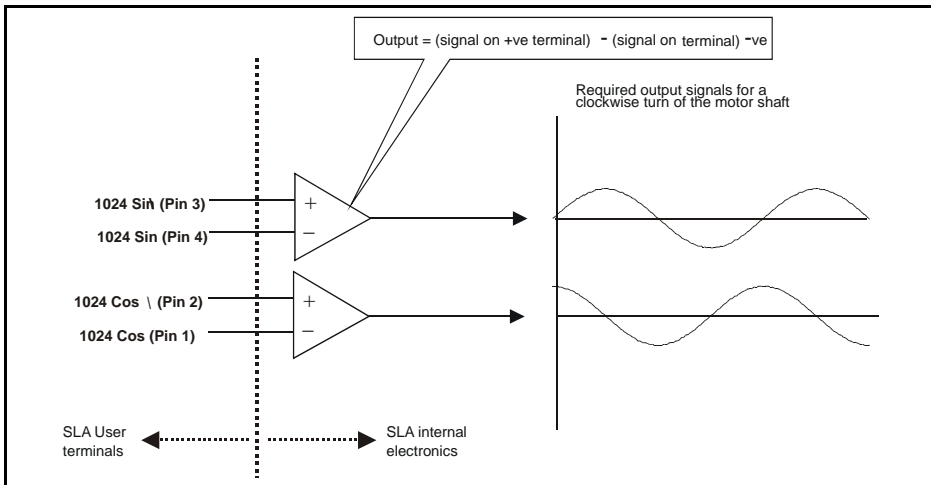
# 10 Determining connections for unspecified rotary encoders



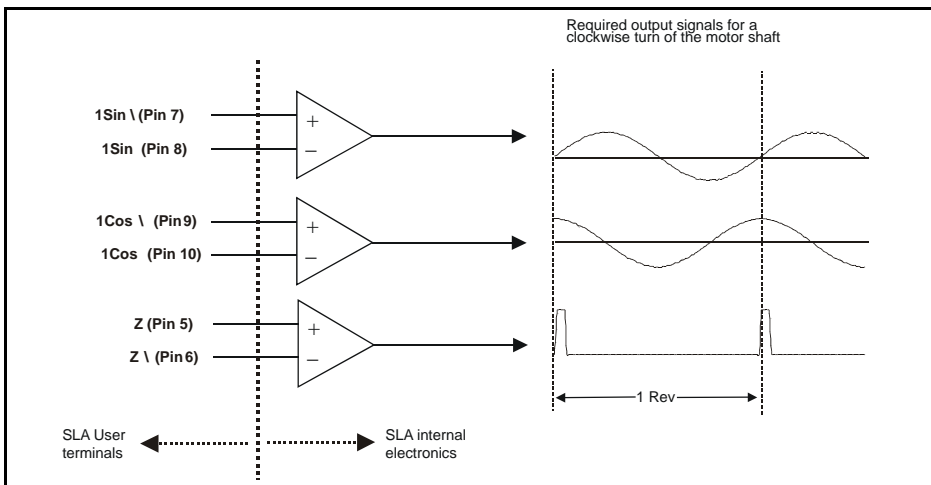
Incorrect encoder wiring can lead to loss of motor control.

It is important that when the encoder is connected, the following internal SLMA signals are generated for a clockwise turn of the motor shaft (looking into the shaft).

**Figure 10-1 Incremental sin/cos channels**



**Figure 10-2 Single cycle sin/cos and marker pulse**



# 11 Thermistor input

## 11.1 Thermistor input

The thermistor input has been designed to be used in conjunction with the basic individual PTC thermistor as defined below.

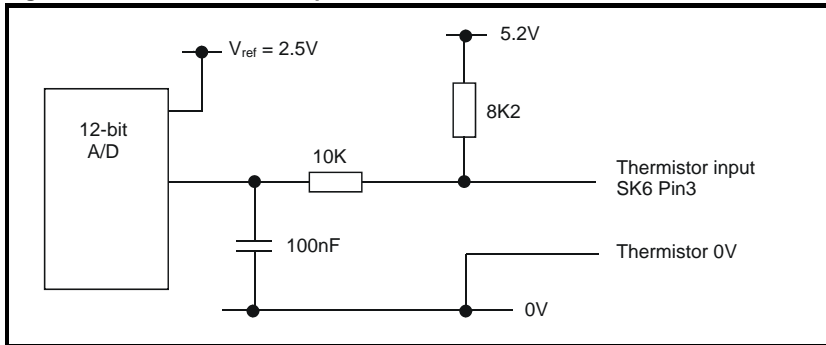
(Extract from British Standards BS4999 part III)

$T_r$  = reference temperature

**Table 11.1 Resistance variation with temperature**

Temperature	Resistance
-20 °C	$R < 250$ ohm
$(T_r - 5)$ °C	$R < 550$ ohm
$T_r$ °C	$R = 1000$ ohm nominal
$(T_r + 5)$ °C	$R > 1330$ ohm
$(T_r + 15)$ °C	$R > 4000$ ohm

**Figure 11-1 SLA Thermistor input circuit**



As can be seen, the maximum A/D input voltage is 2.5V, which corresponds to A/D units of 4095.





**0437-0007-01**