



Solartron
Metrology

Linear Encoders
with TTL output



User manual

AMETEK[®]
ULTRA PRECISION TECHNOLOGIES

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Return of Goods

1.0: Introduction

Introduction

The LE12/25 Linear Encoder with interpolation box and TTL square wave output provides a precision linear measurement system, when used with a suitable counter card. The Linear Encoder is available with a number of different pre-set resolutions.

Solartron also produce an Orbit digital version of the Linear Encoders, which can be used with Solartron DRO's or the Orbit network to create measuring systems.

This Manual

Describes the Linear Encoder types LE12/25 both pneumatic and spring version with TTL square wave output.

This manual details the handling, installation and operation of the encoder and describes the electrical interface.

2.0: Safety Summary

Terms in this Handbook

WARNING statements identify conditions or practices that could result in personal injury or loss of life.

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

Symbols in this manual

This symbol indicates where applicable cautionary or other information is to be found.



WARNINGS:

Do not operate in an explosive atmosphere

To avoid explosion, do not operate this equipment in an explosive atmosphere.

Air Pressure

On LE/12/P and LE/25/P under no circumstances should the recommended maximum overpressure of 1.0 bar be exceeded.

NOTES:

This equipment contains no user serviceable parts

This equipment must be returned to your Solartron dealer for all servicing and repair (see section 11.0).

Low Voltage

This equipment operates at below the SELV and is therefore outside the scope of the Low Voltage Directive.

3.0: Designation of Parts

Items Supplied

Linear Encoder Probe in packing case, with inline Digitising module and end connection.

Data sheet on connector details and pin out, if the Linear Encoder is supplied with a connector.

Standard tip (measuring contact) fitted.

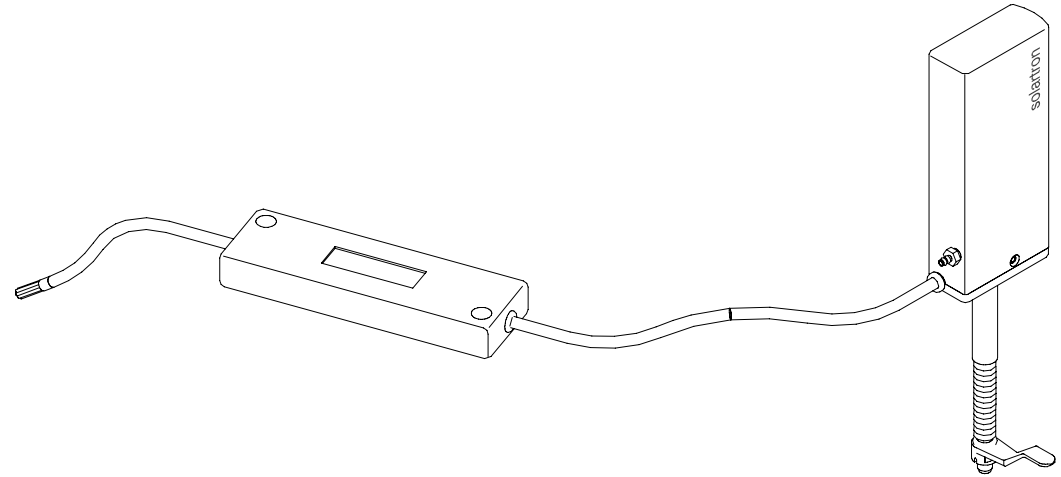
Finger lifter lever. (Spring probes only)

Locking tool.

Operating instructions.

Calibration chart.

Plus other accessories as ordered.

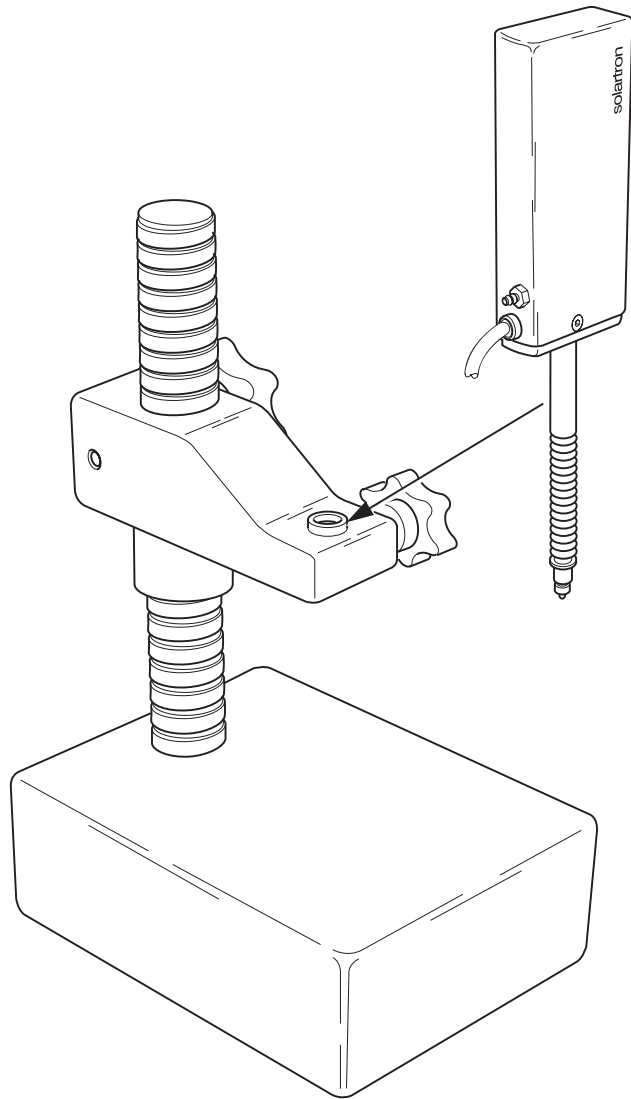


4.0: Handling & Maintenance

The Solartron range of Linear Encoders are precision instruments and should be handled with care. Where possible the Linear Encoder should be stored in its protective box when not being used.

These Linear Encoders are designed to be maintenance free, additional periodic lubrication is unnecessary. Contact with solvents should be avoided. Any attempt to dismantle the Linear Encoder will invalidate the warranty.

5.0: Mechanical Installation



CAUTIONS:

Ensure that the probe is not subjected to excessive over-travel, or side loading at the tip greater than that corresponding to a 0.5mm lift on a $\text{Ø}3$ ball.

When mounting the Linear Encoder avoid the risk of distortion of the bearing assembly by over-tightening of the mounting screws.

Notes:

It is important to ensure that the probe is perpendicular to measuring table to avoid introducing cosine errors.

Do not use excessive torque when tightening gauge stand clamp screws.

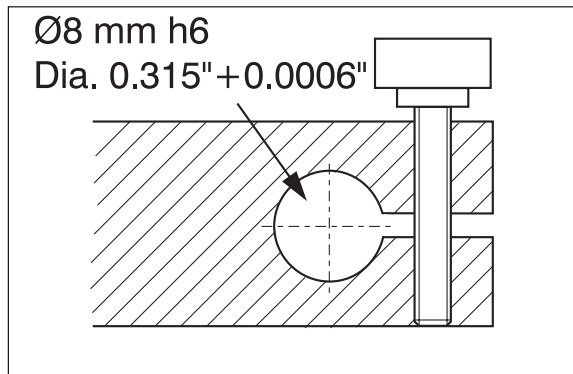
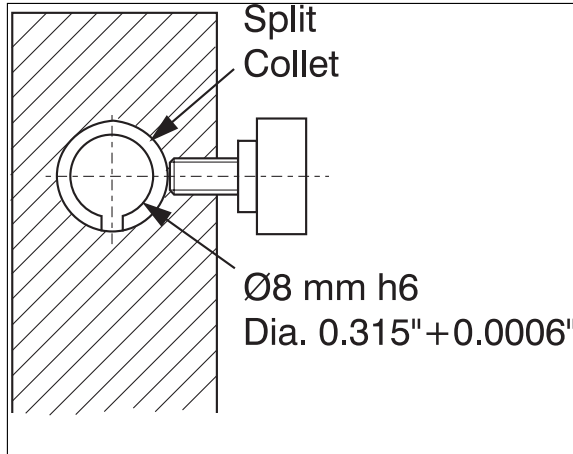
Keep cable away from moving parts to avoid potential damage.

Protect probe against shock loading or impact!

5.0: Mechanical Installation (continued)

5.1 Clamping Configurations

When mounting Linear Encoder do not over tighten clamp screws.



Recommended maximum tightening torque

$$= \frac{0.28d \left(\left(\frac{P}{\pi d} \right) + 0.15 \right)}{1 - \left(0.15 \frac{P}{\pi d} \right)}$$

Where d = screw dia mm

P = screw pitch mm

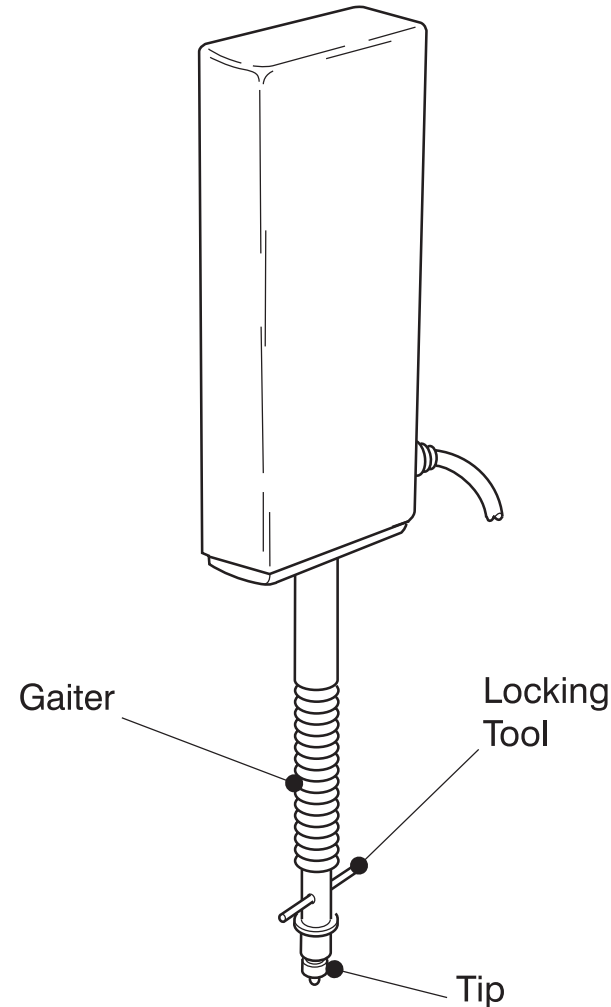
assuming a 'V' form thread and 0.15 coefficient of friction.

Note: A clearance hole in the fixturing of Ø9.5mm is advisable around the gaiter for satisfactory operation.

5.0: Handling & Maintenance (continued)

5.2 Replacing the probe tip

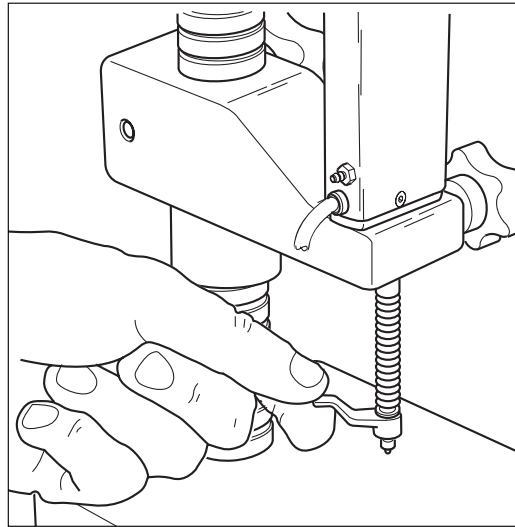
1. Slide back gaiter (fitted to IP65 and pneumatic versions only) to reveal the hole in the shaft.
2. Insert locking tool (supplied) in the hole.
3. Unscrew tip while holding locking tool to prevent any damage to the read head.
4. Install new tip while holding locking tool.
5. Torque tip to 18-22cNm.
6. Slide down gaiter (IP65 and pneumatic versions only).



6.0: Operation

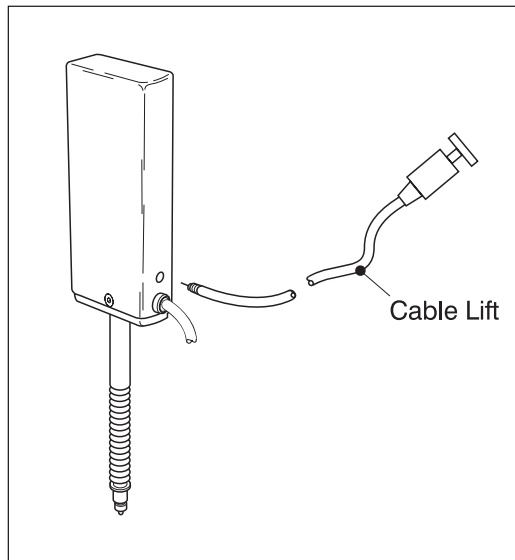
6.1 Finger Lift

Snaps over probe tip enabling tip to be lifted without transferring heat to shaft.



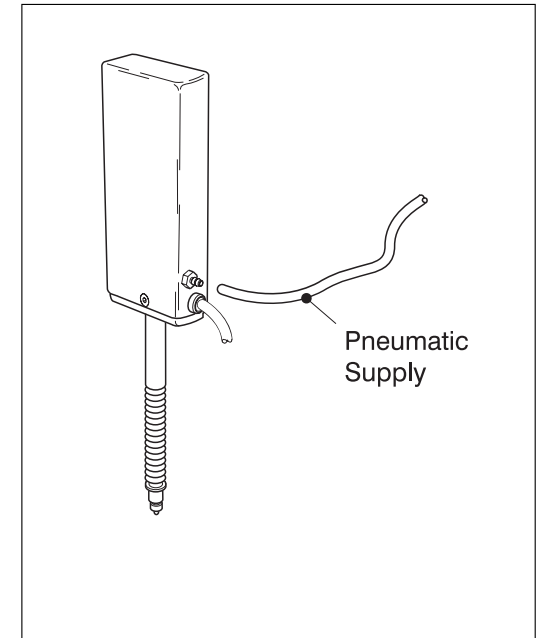
6.2 Cable Lift

Allows tip to be retracted without touching Linear Encoder. Cable retract screws into probe body after removal of blanking screw.



6.3 Pneumatic Operation

A pneumatic nozzle is fitted as standard to LE/12/P & LE/25/P. By applying air between 0.5 & 0.8 bar measuring tip will extend to meet component under test. On no account should a pressure exceeding 1.0 bar be applied.



WARNING: Damage/injury could be caused if the maximum recommended air pressure is exceeded.

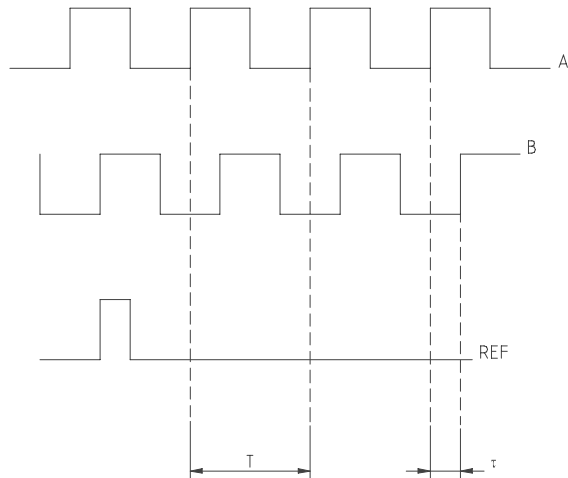


CAUTION

Ensure that air supply for pneumatic operation is clean, dry and oil free.

7.0: Electrical Interface

The Linear Encoder with integral digitising electronics provides incremental TTL compatible square wave outputs. (RS422)



Incremental Signal: are square pulse trains APOS and BPOS, which are phase shifted 90° apart. The inverted equivalent of APOS and BPOS (ANEG and BNEG) are provided for differential applications.

Reference Signal: a positive reference pulse signal REFPOS, its inverted equivalent REFNEG is provided.

Fault Detection: a single ended active low signal, (ERROR) is generated if the probe gauging speed is too high for correct operation, or if the probe signals are out of specification.

7.1 Measuring Technique

The incremental signals can be used to give two resolutions or measuring steps. Using either A or B the resolution is T. Combining A and B together gives a resolution between successive edges t. The available resolutions are:

Available Resolutions (Factory Set)

Probe Output Resolution (T)	Quad Edge Resolution (t)	Gauging Speed/ Slew Rate	Interpolation Rate (See Note)
$0.4\mu\text{m}$	$0.1\mu\text{m}$	0.5ms^{-1}	x100 (A)
$0.2\mu\text{m}$	$0.05\mu\text{m}$	0.5ms^{-1}	x200 (B)
$0.1\mu\text{m}$	$0.025\mu\text{m}$	0.4ms^{-1}	x300 (C)
$0.05\mu\text{m}$	$0.0125\mu\text{m}$	0.2ms^{-2}	x800 (D)

Note: A,B,C and D refer to the Interpolation rate, as stated in the product part number.

7.0: Electrical Interface (continued)

7.2 Connections

The Linear Encoder is available with wire ends or different electrical connectors as specified. (The bare wire colours and signals are detailed.)

Please refer to the separate attachment to the manual if the Linear Encoder is supplied with a connector, for technical data on the connector and pin out.

Wire Ended Versions

Signal	Bare Wire Colour
A POS	Red
A NEG	Pink
B POS	Yellow
B NEG	Green
0V	Black
5V	Blue
REF POS	Brown
REF NEG	Orange
ERROR	Grey
SCREEN	Screen (connect to 0V)

Option	Phase Relationship
-00	A leads B for Outward Stroke
-06 (Reverse)	A leads B in Inward Stroke

7.3 Cable Length

For maximum protection against electrically induced interference, it is advised to add a ferrite to the output cable from the ibox. This should comprise 3 turns through a ferrite type TDKZCAT3035-1330.

8.0: Application Note

Consideration of Output Signal Frequency and Shaft Velocity for Linear Encoders with TTL Interpolation Module (LE TTL)

Linear Encoders with TTL Interpolation Module (LE TTL)

When using LE TTL variants it is important that the interface electronics (counter card, EIM etc.) used to read the output has a suitable frequency specification. If the maximum input frequency range is too low the encoder will appear to lose count.

The output frequency from the LE TTL is dependent on:

- Shaft velocity (gauging speed)
- Interpolation Rate

The maximum LE TTL output frequency from the interpolation module is calculated as follows:

- Output Frequency (kHz) = Shaft Velocity (ms^{-1}) x 25 x Configurator Interpolation Rate*.

The table shows typical values of Output frequency versus Velocity and Interpolation Rate*.

Configurator Interpolation Rate	A (X100)	B (X200)	C (X400)	D (X800)
Shaft	Square Wave Output Frequency			
m/s	kHz	kHz	kHz	kHz
0.1	250	500	1000	2000
0.2	500	1000	2000	4000
0.3	750	1500	3000	
0.4	1000	2000	4000	
0.5	1250	2500		

*The Interpolation Rates shown assume that the counter used to read the LE TTL output is set to quadrature count mode (quad edge detection.)

Note: With pneumatic Linear Encoders the inherently higher shaft velocity results in a higher output frequency, therefore the interpolation rate must be limited to type A (X100) and Type B (X200)

There are restrictions on cable lengths for LE TTL. See specification. Technical advice is available.

8.0: Application Note (continued)

Dynamic Linear Encoder (LEIM)

To allow the Linear Encoder to be used as part of the Dynamic Orbit network, a special version of the Linear Encoder has been developed. The LEIM combines a LE TTL and an Encoder Input Module (EIM) to provide a 'Dynamic' Linear Encoder, a feature not possible with the standard Orbit Linear Encoder.

The EIM has a maximum input frequency of 1.2MHz, this limits the shaft velocity of the Linear Encoder to 0.24ms^{-1} . If the probe is moved faster than this, the system will lose count. There is currently no method of signalling this condition and care should be taken when designing measurement systems with the LEIM.

Note: cable length and power supply voltage.

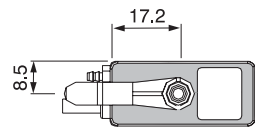
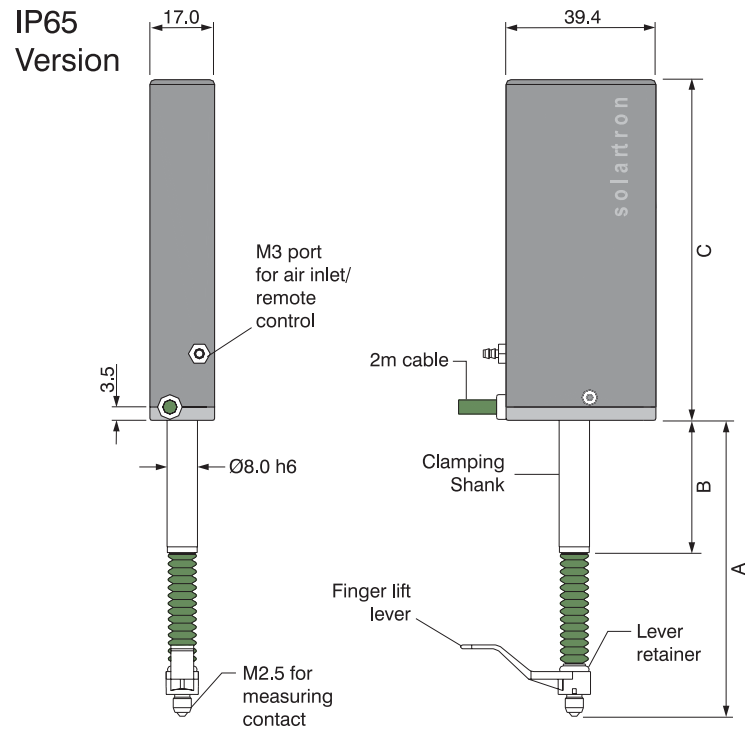
9.0: Specification

Model	LE12	LE25
Stroke	12mm (0.5")	25mm (1.0")
Resolution	0.4µm to 0.0125µm (Refer to 7.0)	
Accuracy	± 0.5µm (20 millionths inch)	
Reference temp	20°C (68°F)	
Slew rate	Refer to 7.0	
Operating attitude	ANY	
Gauging forces: (typical at mid stroke)		
Downwards	0.6N	
Upwards	0.01N	
Horizontal	0.5N	
Max side load	0.1N	
Shock	100g (6ms)	
Vibration	10g (50-2000 Hz)	
Temp range		
- Operating	0° to 50°C (32° to 122°F)	
- Storage	-20° to +70°C (-4° to 158°F)	

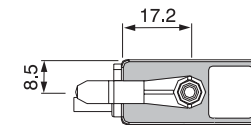
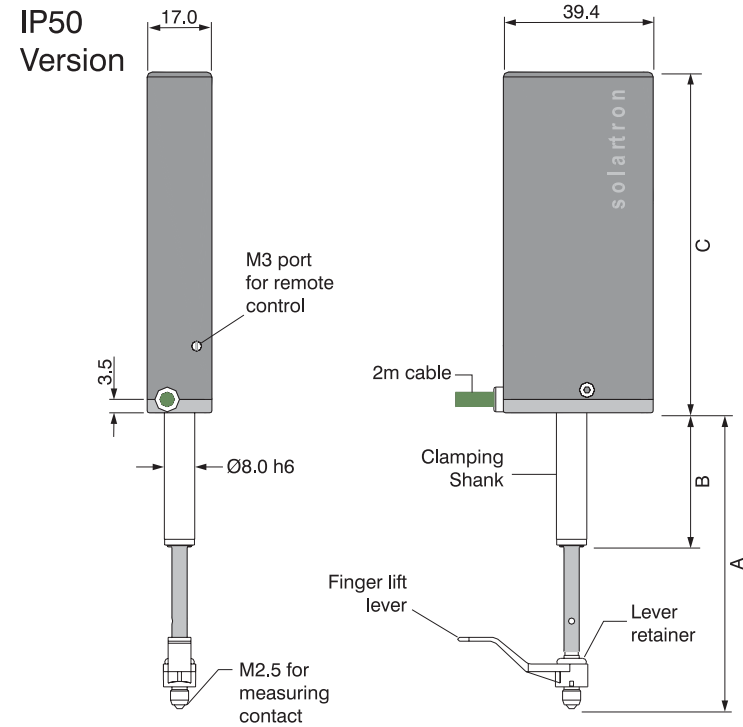
IP Rating	
Probe:	Depending upon probe option
Digitising Module:	IP50
Mounting	8mm h6
Tip thread size	M2.5x6 deep
Supply Voltage (see note1)	5V to 5.25 VDC
Supply Current (max)	180mA
EMC (see section 7.3)	EN50081-1 & EN61000-6-2

Note 1:
The supply voltage should not be less than 5V (5V to 5.25V)
For cable length greater than 3m please refer to technical support.

10.0: Outline Drawings



	LE/12/S	LE/12/P	LE/25/S	LE/25/P
A	56.0	43.0	92.0	66.0
	43.0	56.0	66.0	92.0
B	20.5	20.5	33.0	33.0
C	66.0	66.0	89.5	89.5



	LE/12/S	LE/25/S
A	50.5	76.0
	37.5	50.0
B	20.5	33.0
C	66.0	89.5

Note:
All dimensions in mm
All dimensions stated
are nominal