IT5602L
Triple Channel
Linear Encoder Kit

Product data

Features

- Highly miniaturized encoder
- Differential inductive sensing principle
- Insensitive to magnetic interference fields
- Robust against oil, water, dust, particles
- Ultra-thin encoder and scale (total < 2 mm)
- Optional with cable, connector and holder

Applications

- Linear actuators
- Industrial / laboratory / office automation
- X-Y stages
- Pick & Place assembly equipment
- High-speed motion control
- Mechatronics applications

Key Specifications

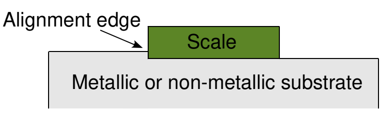
Output format....................A and B in quadrature + Index
Resolution.........................down to 37 nm
Maximum speed ....up to 10 m/s
Airgap ....up to 0.6 mm
Supply...............................5 V, 30 mA
Temperature ....-20 to 100°C

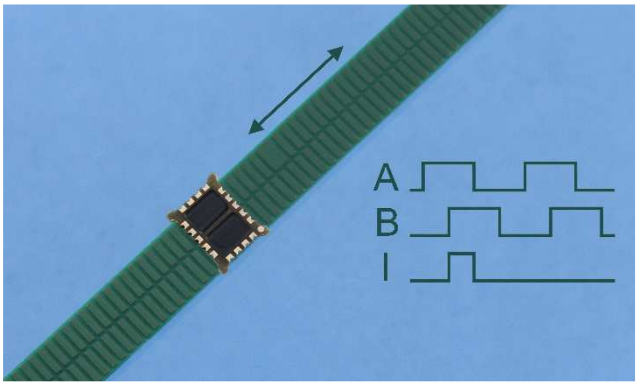
Description

The IT5602L incremental encoder kit consists of an encoder and a linear scale (Fig. 1). The encoder consists of two integrated circuits in a PCB housing. It provides incremental A and B output signals in quadrature and an Index signal, which is synchronous to A and B (Fig. 2). The linear scale is a PCB with passive copper strips.

Resolution, maximum speed and airgap
The resolution and the maximum speed of the encoder are user-programmable or can be programmed ex-factory. The resolution depends on a filter setting that limits the maximum speed of the encoder vs. the scale. The resolution also depends on the maximum distance between the encoder and the scale. Tables 2 and 3 allow the configuration of resolution and maximum speed for a certain maximum air-gap.

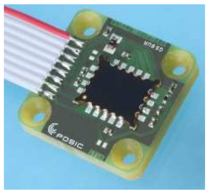
Scales
Scales with different lengths (Fig. 4) are selected in Table 5. Each scale has a backside adhesive layer and may be mounted on any substrate, using a 0.2 mm high alignment edge for correct positioning in front of the encoder.





Encoder assembly
The encoder can be assembled by reflow soldering on a rigid or flexible PCB. Optimum performances are obtained by following the recommended schematic (Fig. 5) and footprint (Fig. 6). In particular, there should be no copper traces or metal objects behind the encoder up to a distance of 3 mm in order to avoid any influence on the measured position. If this is not possible, a blank copper layer behind the encoder (rear-side of the PCB) may be envisaged and/or a linearization using the on-chip look-up table (LUT).

Encoder holder
The encoder holder **type A** is available (Fig. 7) and can be selected in Table 6. It includes the encoder and the external components according to the recommended schematic (Fig. 5). The encoder holder can be mounted on any substrate using 4 screw holes.



Encoder cable and connector
The encoder on holder can be supplied with a flat cable of pitch 1.27 mm and a connector (Fig. 7). The cable length and the connector type are selected in Tables 7 and 8.

Encoder programming
The Evaluation and Programming Tool (EPT) including an interface board and the ASSIST software is available for the linearization and programming of the encoder.

3D models of encoder, holder and scales
STEP models are available on www.posic.com.

Specifications

Recommended Operating Conditions

Parameter	Symbol	Remark	Min	Typ	Max	Unit
Supply voltage	VDD		4.5	5.0	5.5	V
Operating Temperature	T_A		-20		100	°C
Airgap	Z			0.2		mm
Lateral tolerance	ΔY				0.1	mm
Airgap tolerance	ΔZ				0.1	mm

Electrical Characteristics

Electrical characteristics over recommended operating conditions, typical values at VDD = 5.0 V, T_A = 25°C.

Parameter	Symbol	Remark	Min	Typ	Max	Unit
Supply current	IDD	No load	15	30	45	mA
Maximum frequency A/B signals	$F_{A/B}$	CC = 04 – 10 (Table 3) CC = 11 – 15 (Table 3)			1200 120	kHz
Derating for $F_{A/B}$ and for Max speed (Table 2)		Temp range 0 to 65°C Temp range -20 to 100°C			-8 -14	%
High level output voltage	V_{OH}	I_L = 2 mA	VDD–0.5			V
Low level output voltage	V_{OL}	I_L = 2 mA			0.5	V
Rise time, fall time	t_r, t_f	C_L = 47 pF			20	ns

If A is pulled up and B pulled down during power-up, the encoder enters into a test mode with a 50 kHz square wave on all outputs.

Encoding Characteristics

Encoding characteristics over recommended operating conditions, typical values at VDD = 5.0 V, T_A = 25°C, airgap = 0.2 mm, speed = 10 mm/s.

Parameter	Symbol	Remark	Min	Typ	Max	Unit
Pulse width error	ΔP	Nominal value 180°e		10	50	°e
State width error	ΔS	Nominal value 90°e		10	60	°e
Phase shift error	ΔΦ	Nominal value 90°e		10	45	°e

Linearity

For high-resolution high-precision applications, it is possible to linearize the encoder by means of a Look-Up Table (LUT) that is located inside the encoder. The LUT can be programmed in volatile or in non-volatile memory by means of the Evaluation and Programming Tool (EPT) or it can be pre-programmed ex-factory. The LUT option is selected in Table 4.

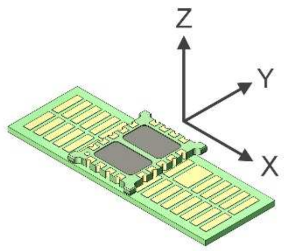


Fig. 1 Coordinate system XYZ.

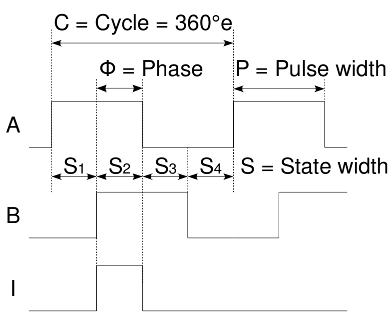


Fig. 2 Encoder output signals A and B in quadrature and Index.

Definitions

Airgap	Distance between encoder and scale in Z-direction. See Fig. 1.
Cycle	One A quad B period, see Fig. 2.
CPP	Cycles per scale-period.
°e	Electrical degree (one Cycle is 360°e)
Phase shift Φ	Number of electrical degrees between the center of the high state of channel A and the center of high state of channel B. Nominal 90°e. Fig. 2.
Pulse width P	Number of electrical degrees that an output is high during one cycle. Nominal 180°e. Fig. 2.
State width S	Number of electrical degrees between two neighboring A and B transitions. Nominal value is 90°e. See Fig 2.

Technical drawings

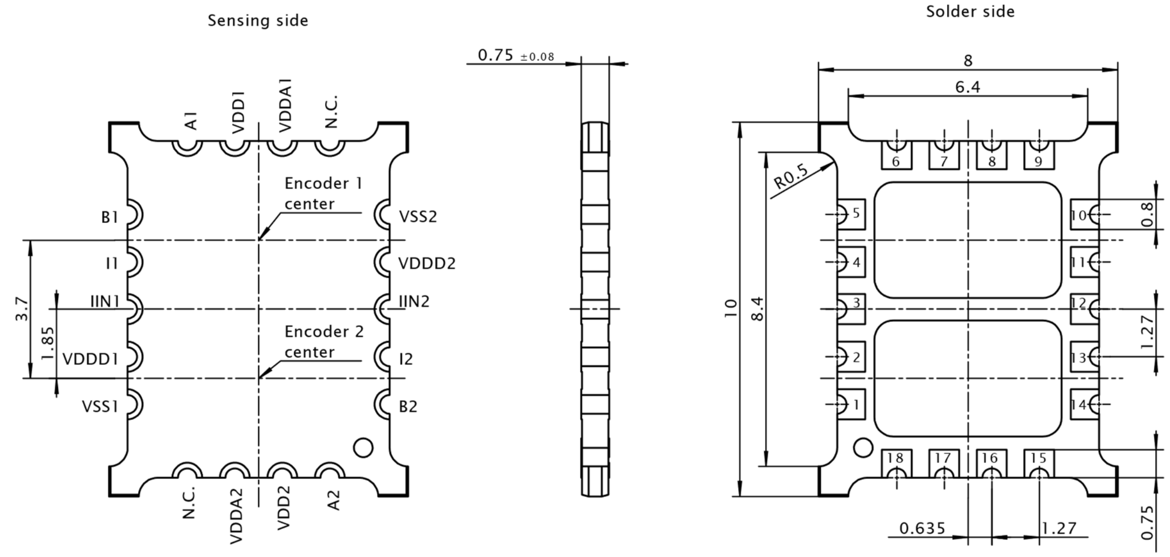


Fig. 3 Dimensions of the IT5602. Encoder 1 center must be aligned to the Index track and Encoder 2 center to the A quad B track (Fig 4).

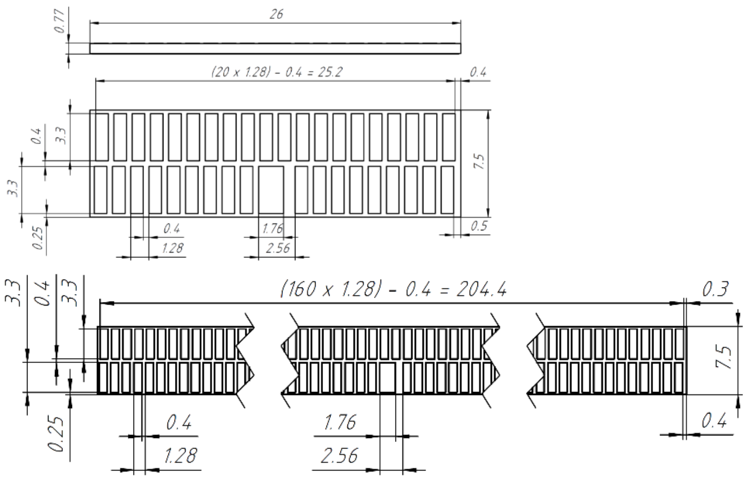


Fig. 4 Scales TPLD04-026 (top and middle) and TPLD05-205 (bottom). All dimensions in mm. Period-length is 1.28 mm, the index-position is in the center. Both scales have backside adhesive. Scale thickness includes adhesive, but not the release liner.

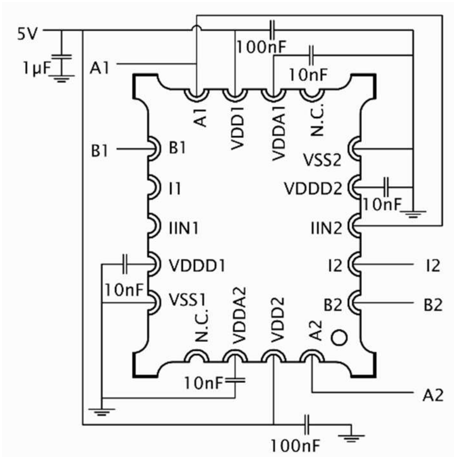


Fig. 5 Recommended schematic. The supply filter capacitor should be 1µF or more. The capacitors 100nF and 10nF should be placed close to the device. Connections A1, B1, A2, B2, I2 are required for programming and linearization.

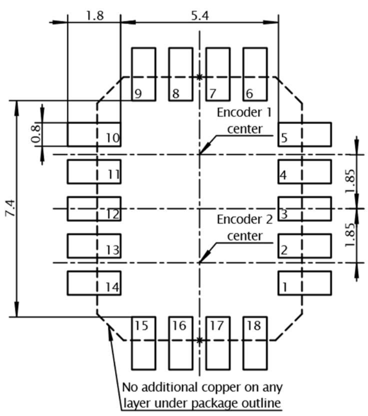


Fig 6 Recommended footprint.

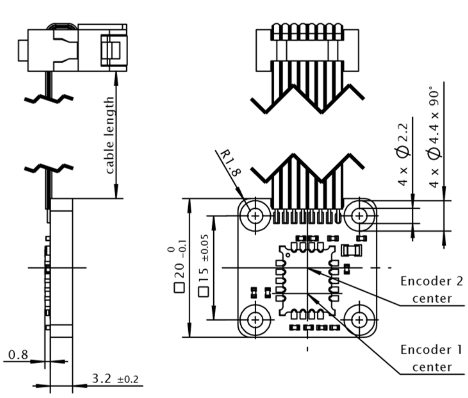


Fig. 7 Dimensions (mm) and connector pin-out of encoder on holder type A with flat cable (pitch 1.27 mm) and 8-pin DIN41651 connector.

Pin	Name	Description
1	VDD	5V Supply
2	VSS	Ground
3	A1	For programming purposes
4	B1	
5	I1	
6	A2	Output A
7	B2	Output B
8	I2	Output I

Ordering information

Ordering code: IT5602L-ABBCCD-EEEEE-F-GGG-HH

A	Orientation	Table 1
BB	Maximum speed	Table 2
CC	Resolution	Table 3
D	Look-Up Table	Table 4
EEEEE	Linear scale	Table 5
F	Encoder holder	Table 6
GGG	Cable	Table 7
HH	Connector	Table 8

Table 1: Orientation. Arrows indicate direction of movement of the scale with rising edge A prior to B.

A	Orientation
0	Not progr.
3	0°

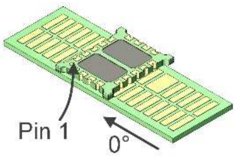


Table 2: Maximum speed

BB	Max speed (m/s)*	Max value CC
00	Not programmed	
01	0.005	15
02	0.010	15
03	0.021	14
04	0.043	13
05	0.086	12
06	0.17	11
07	0.34	10
08	0.69	10
20	5.5	10
21	11.0	09

*Max speed valid at 25°C, temp. derating in specs, page 2. Lower Max speed leads to a lower jitter of the A/B outputs.

Table 3: Resolution

CC	Resolution		Max value BB	Maximum Airgap* (mm)
	CPP	um		
00	Not programmed			
04	4	80	21	0.6
05	8	40	21	0.6
06	16	20	21	0.5
07	32	10	21	0.5
08	64	5	21	0.4
09	128	2.5	21	0.4
10	256	1.25	20	0.3
11	512	0.625	06	0.3
12	1024	0.313	05	0.2
13	2048	0.156	04	0.2
14	4096	0.078	03	0.2
15	8192	0.039	02	0.2

* Recommended airgap = 0.2 mm. Sequence of A and B transitions is correct up to Maximum Airgap, but encoding specifications may be out of range.

Table 4: Look-Up Table (LUT)

D	Look-Up Table programmed in OTP
0	Not programmed
1	LUT according to scale, to be specified
8	Custom LUT, to be specified
9	Default LUT, no scale specified

Table 5: Linear scale (see Fig. 4)

EEEEE	Scale	Dimensions
00000	No scale	
04026	TPLD04	L x W x T = 26 x 7.5 x 0.77 mm
05205	TPLD05	L x W x T = 205 x 7.5 x 0.77 mm

The scale is made of FR4-material and can be cut to the desired length.

Table 6: Encoder holder

F	Encoder holder
0	No holder
A	Holder A (Fig. 5)

Table 7: Cable (only in combination with holder, Table 6)

GGG	Cable
000	No cable
0xx	Flat ribbon cable, length xx cm

Table 8: Connector

HH	Connector
00	No connector
04	8-pin connector DIN 41651 (Fig. 6)