ID4506L
Dual Channel
Linear Encoder Kit

Product data

Features

- Highly miniaturized linear encoder in SMD-format
- Differential inductive sensing principle
- Insensitive to magnetic interference fields
- Robust against oil, water, dust, particles
- Programmable resolution and maximum speed
- Optional with cable, connector and holder

Applications

- Direct drives
- Industrial / laboratory / office automation
- X-Y and rotating stages
- Pick & Place equipment
- High-speed motion control
- Mechatronics applications

Key Specifications

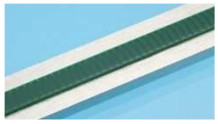
Output format.....A and B in quadrature
Resolution.....down to 0.02 um
Maximum speed .....up to 64 m/s
Airgap .....up to 0.6 mm
Supply.....5 V, 15 mA
Temperature .....-10 to 85°C

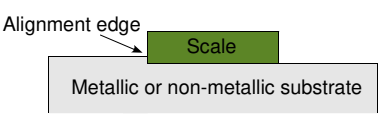
Description

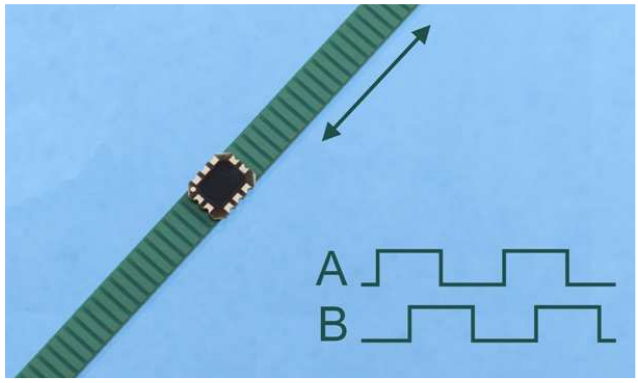
The ID4506L incremental encoder kit consists of an encoder and a linear scale (Fig. 1). The encoder is an integrated circuit in a PCB housing in SMD-format. It provides incremental A and B output signals in quadrature (Fig. 2). The linear scale is a PCB with passive copper strips. The orientation of the encoder is selected in Table 1.

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. The resolution and maximum speed for a certain maximum air-gap are selected in Tables 2 and 3.

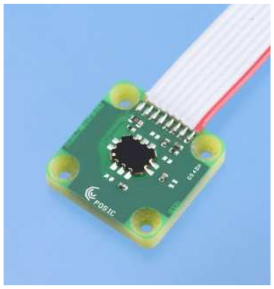
Scales
Scales with different lengths (Fig. 4) are selected in Table 6. Each scale has a backside adhesive layer and may be mounted on any substrate, using a 0.2 mm high alignment edge for correct positioning in front of the encoder.







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 (Figs. 5 - 7) and footprint (Fig. 8). 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. 9) 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. 9). The cable length and the connector type are selected in Tables 8 and 9.

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	Schematic: Fig. 6 or 7	3.0	3.3	3.6	V
		Schematic: Fig. 5	4.5	5.0	5.5	
Operating Temperature	T_A		-10		85	°C
Airgap	Z			0.3	0.6	mm
Lateral tolerance scale	ΔY	For scales TPLS04, TPLS05			0.5	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	12	15	18	mA
Maximum output frequency	F	A/B output signals	1.6	2	2.4	MHz
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 100 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 = max speed/10.

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

The encoder contains a LUT (LookUp Table) to compensate the periodic non-linearity, which depends on the period-length of the scale, the airgap and the mechanical tolerances. Table 4 allows you to select a standard LUT for POSIC's standard scales, leading to a non-linearity of about +/- 20 µm. Linearization against an accurate reference encoder allows you to reduce the non-linearity to about +/- 10 µm or even better. 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. More info on linearization in the EPT User Manual.

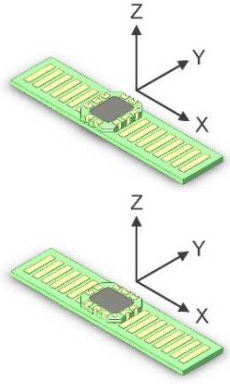


Fig. 1 Coordinate system XYZ.

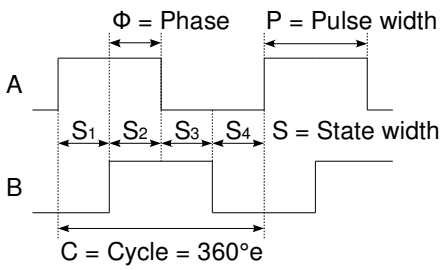
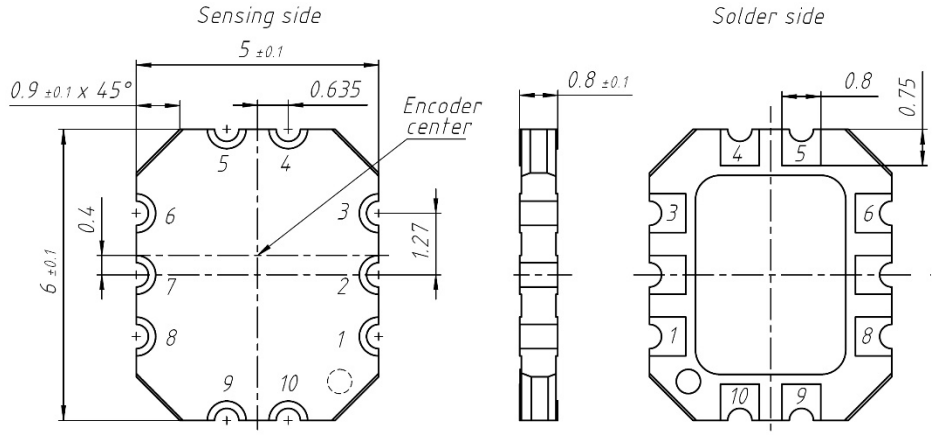


Fig. 2 Encoder output signals A and B in quadrature.

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 neighbouring A and B transitions. Nominal value is 90°e. See Fig 2.

Technical drawings



Pin	Name	Description
1	I	Index (periodic)
2	NI	Not Index (periodic)
3	VDDD	Internal supply
4	VSS	Gound 0V
5	VDDA	Internal supply
6	VDD	Supply voltage 5V
7	A	A
8	NA	Not A
9	B	B
10	NB	Not B

Fig. 3 Encoder dimensions (mm) and pin-out. The "Encoder center" must be centered with respect to the scale (see Fig. 4). The Index signal is repeated once per scale-period (once per 1.28 mm for scales TPLS04 and TPLS05 in Fig. 4)

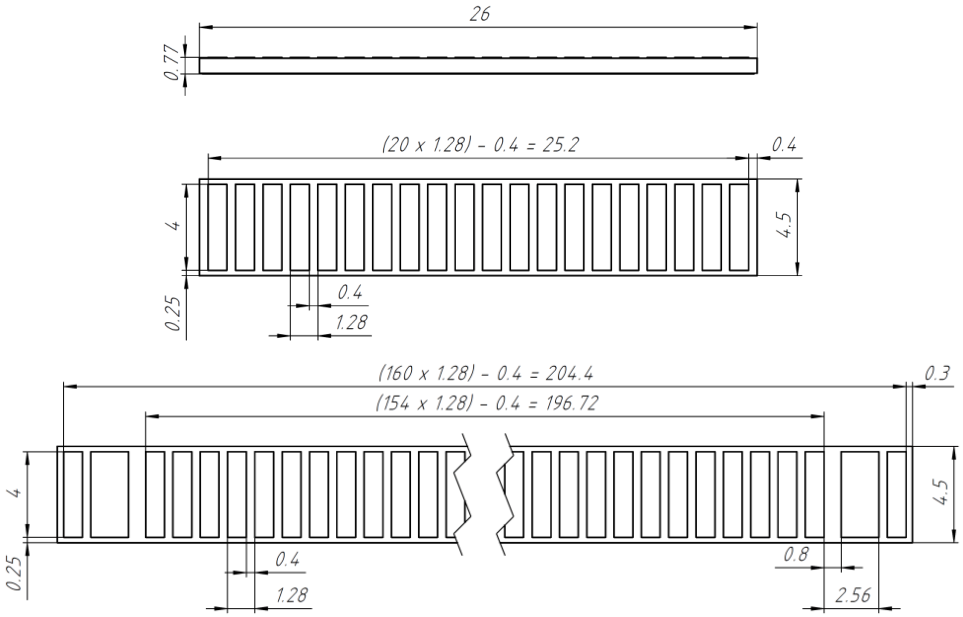


Fig. 4 Scales TPLS04-026 (top and middle) and TPLS05-205 (bottom). All dimensions in mm. Period-length is 1.28 mm. Both scales have backside adhesive. Scale thickness includes adhesive, but not the release liner. The special periods at the left and right ends of the scale are intended for another encoder and should not be used with the ID4506.

Schematic diagrams

5 V supply with in-circuit programming
Fig. 5 shows the schematic diagram for 5 V operation. During OTP programming the supply voltage is raised from 5 V to 6.5 V

3.3 V supply without in-circuit programming
Fig 6 shows the schematic diagram for 3.3 V operation without the possibility to program the encoder's OTP memory. Application of a supply voltage VDD higher than 3.6 V may cause permanent damage. This circuit is recommended for pre-programmed encoders.

3.3 V supply with in-circuit programming
Fig. 7 shows the schematic diagram for 3.3 V operation with the possibility to program the encoder's OTP memory. During OTP programming the supply voltage is raised from 3.3 V to 6.5 V.

Capacitors
The supply filter capacitor should be 1 uF or more.
The 10 nF and 100 nF capacitors should be placed as close as possible to the encoder chip.

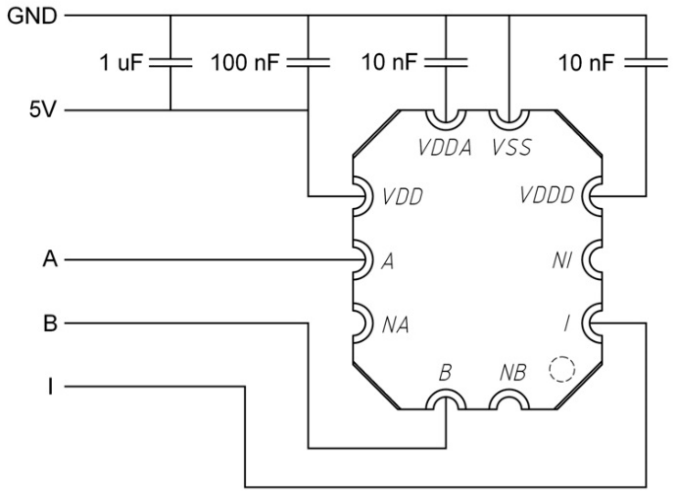


Fig. 5 Recommended schematic for 5 V operation.

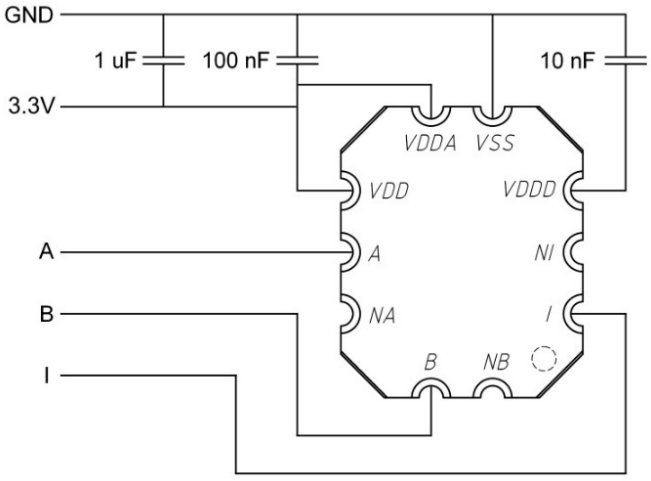


Fig. 6 Recommended schematic for 3.3 V operation without in-circuit OTP programming. Application of the 6.5 V OTP programming voltage will cause permanent damage when VDD and VDDA are short-circuited.

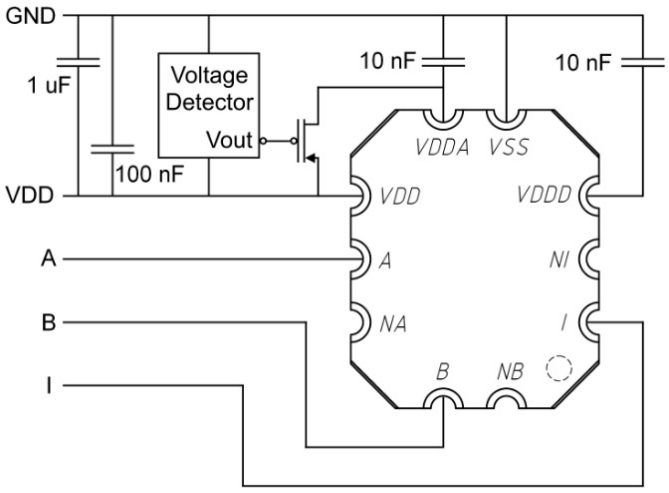


Fig. 7 Recommended schematic for 3.3V operation.

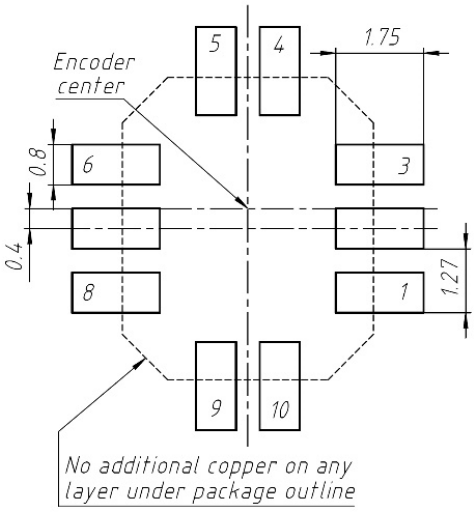
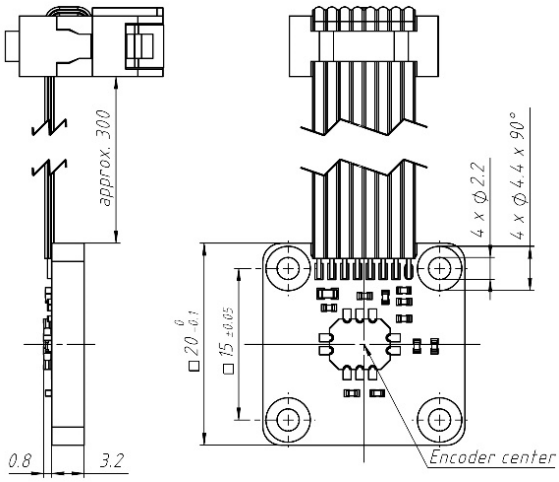


Fig 8 Recommended footprint.



Pin	Name	Description
1	VDD	5V Supply
2	VSS	Ground
3	A	A
4	B	B
5	I	I (periodic*)
6	NA	Not A
7	NB	Not B
8	NI	Not I (periodic)

* 1 index-pulse per scale-period (per copper strip)

Fig. 9 Dimensions (mm) and connector pin-out of encoder on holder type A with flat cable (pitch 1.27 mm) and 8-pin DIN41651 connector.

Ordering information

Ordering code: ID4506L-ABBCCD-E-FFFFF-G-HHH-II

A	Orientation	Table 1
BB	Maximum speed	Table 2
CC	Resolution	Table 3
D	Look-Up Table	Table 4
E	Supply voltage	Table 5
FFFFF	Linear scale	Table 6
G	Encoder holder	Table 7
HHH	Cable	Table 8
II	Connector	Table 9

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°
4	90°
5	180°
6	270°

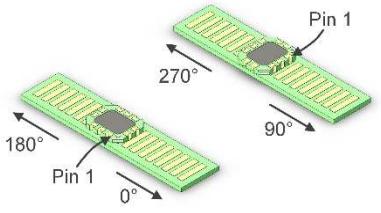


Table 2: Maximum speed

BB	Max speed (m/s)	Max value CC
00	Not programmed	
01	0.031	16
02	0.062	16
03	0.12	16
04	0.25	15
05	0.5	14
06	1	13
07	2	12
08	4	11
09	8	10
21	16	09
22	32	08
23	64	07

Lower Max speed leads to a lower jitter of the A/B outputs.

Table 3: Resolution

CC	Resolution		Maximum value BB	Maximum Airgap* (mm)
	Cycles per Period	µm		
00	Not programmed			
03	2	160	23	0.6
04	4	80	23	0.6
05	8	40	23	0.6
06	16	20	23	0.6
07	32	10	23	0.6
08	64	5	22	0.5
09	128	2.5	21	0.5
10	256	1.25	09	0.4
11	512	0.63	08	0.4
12	1'024	0.31	07	0.3
13	2'048	0.16	06	0.3
14	4'096	0.078	05	0.2
15	8'192	0.039	04	0.2
16	16'384	0.020	03	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	
	LUT Type	Airgap
0	Not programmed	
1	Standard LUT for scales TPLS04 and TPLS05, period-length 1.28 mm	~0.3 mm
2		~0.1 mm
3		~0.5 mm
8	Custom LUT, to be specified	
9	Default LUT, no scale specified	

Table 5: Supply voltage (see Figs. 5, 6, 7)

E	Supply voltage
0	Not programmed
3	3.3 V
5	5 V

Table 6: Linear scale (see Fig. 4)

FFFFF	Scale	Dimensions
00000	No scale	
04026	TPLS04	L x W x T = 26 x 4.5 x 0.77 mm
05205	TPLS05	L x W x T = 205 x 4.5 x 0.77 mm

Table 7: Encoder holder

G	Encoder holder
0	No holder
A	Holder type A (Fig. 9)

Table 8: Cable

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

Table 9: Connector

II	Connector
00	No connector
04	8-pin connector DIN 41651 (Fig. 9)