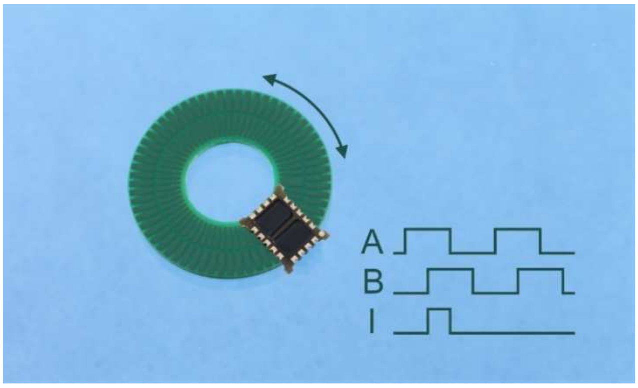
IT5602C
Triple Channel
Rotary Encoder Kit

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 codewheel (total < 2 mm)
- Optional with cable, connector and holder

Applications

- Brushed and brushless motors
- Industrial / laboratory / office automation
- Rotary stages
- Robotics, assembly equipment

Key Specifications

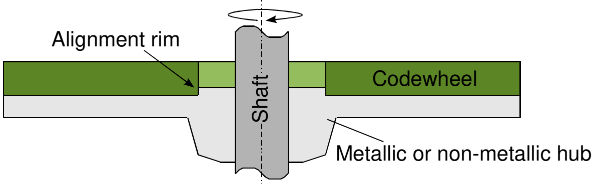
Output format	A and B in quadrature + Index
Resolution	256 – 1'474'560 CPR
Maximum speed	up to 8'600 RPM
Airgap	up to 0.6 mm
Supply	5 V, 30 mA
Temperature	-40 to 125°C
Codewheels	diameter 28, 53 or 73 mm

Description

The IT5602C incremental encoder kit consists of an encoder and a codewheel (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 codewheel is a PCB with passive copper strips.

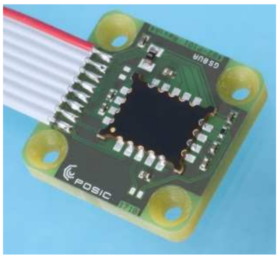
Resolution, maximum speed and airgap
The resolution and the maximum speed of the encoder are user-programmable or can be programmed ex-factory. The resolution depends on a filter setting that limits the maximum speed of the encoder vs. the codewheel. The resolution also depends on the maximum distance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

Codewheel
The codewheel is shown in Fig. 4 and is selected in Table 5. The codewheel may be mounted on a hub, using a rim of 0.1 to 0.2 mm for accurate 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, holders and codewheels
STEP and IGES 3D models 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		-40		125	°C
Airgap	Z			0.2		mm
Radial play + eccentricity	ΔY				0.1	mm
Axial play	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
Operating frequency	F	A/B signals, CC = 04 – 10 A/B signals, CC = 11 – 15			1000 100	kHz
Derating for $F_{A/B}$ and for Max speed (Table 2)		Temp range 0 to 65°C Temp range -20 to 100°C Temp range -40 to 125°C			-8 -14 -20	%
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 RPM.

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.

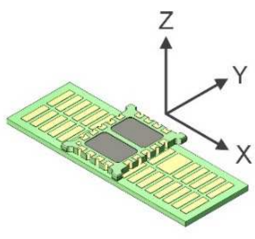


Fig. 1 Coordinate system XYZ.

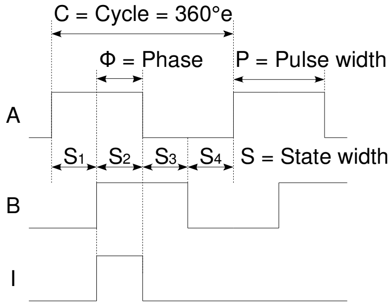


Fig. 2 Encoder output signals A and B in quadrature and Index.

Definitions

Airgap	Distance between encoder and codewheel in Z-direction. See Fig. 1.
Cycle	One A quad B period, see Fig. 2.
CPP	Cycles per codewheel-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

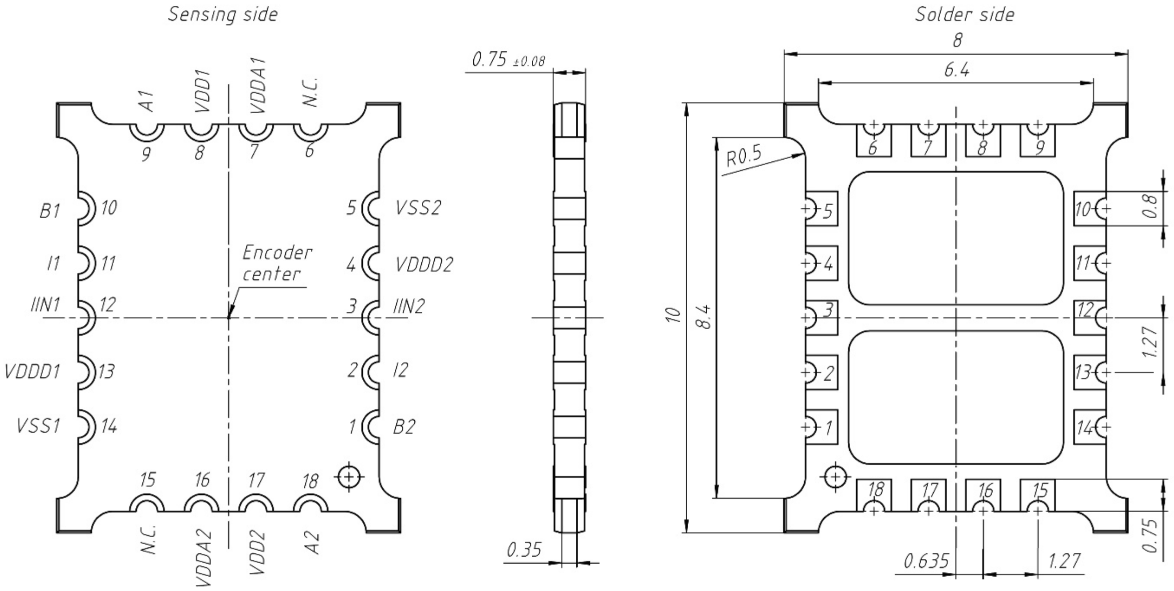
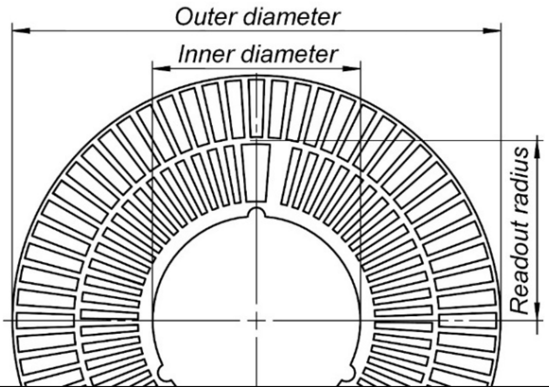


Fig. 3 Dimensions of IT5602 encoder on encoder-holder type B. The "Encoder center" must be centered with respect to the "Readout radius" of the Codewheel (Fig 4)



Codewheel type	TPCD05	TPCD06	TPCD07
Number of periods	64	128	180
Inner diameter (mm)	12	36	56
Outer diameter (mm)	28.2	52.7	72.55
Readout radius* (mm)	10.35	22.6	32.53

* Readout Radius = position of Encoder Center (Fig. 3)
Codewheel thickness 0.73 mm +/- 10%

Fig. 4 Codewheel dimensions.

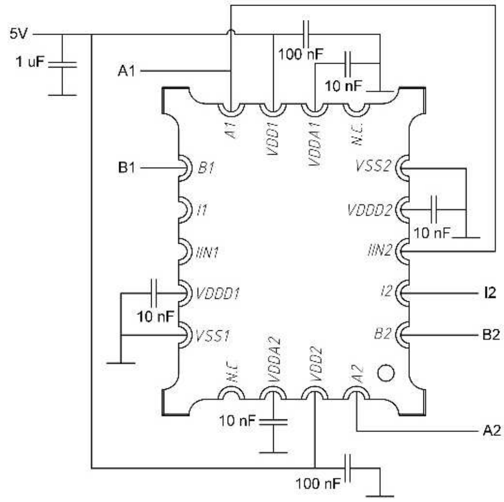
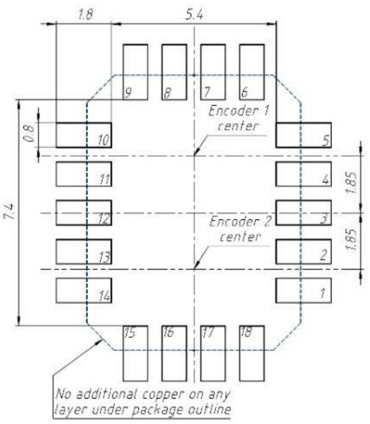
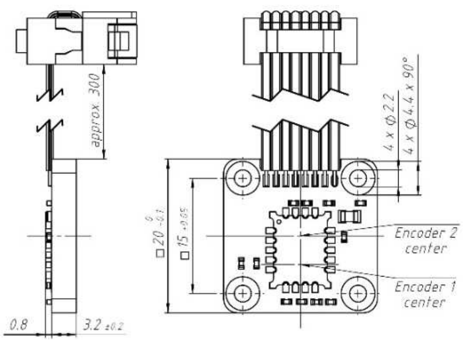


Fig. 5 Recommended schematic. The supply filter capacitor should be 1µF or more. The capacitors 100nF and 10nF should be placed close to the device. Connections A1, B1, A2, B2, I2 are required for programming and linearization.





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

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.

Ordering information

Ordering code: IT5602C-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	Codewheel	Table 5
F	Encoder holder	Table 6
GGG	Cable	Table 7
HH	Connector	Table 8

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

A	Orientation
0	Not progr.
3	0°

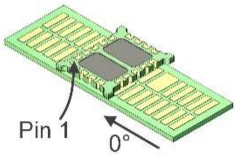


Table 2: Maximum speed

BB	Max speed (RPM)* Nr. of periods on Codewheel			Max value CC
	64	128	180	
00	Not programmed			
01	4	2	1	15
02	8	4	2	15
03	16	8	5	14
04	33	16	11	13
05	67	33	23	12
06	134	67	47	11
07	269	134	95	10
08	539	269	191	10
20	4’313	2’156	1’533	10
21	8’626	4’313	3’067	9

*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 CPR Nr. of periods on Codewheel			Max value BB	Max Airgap* (mm)
	64	128	180		
00	Not programmed				
04	256	512	720	21	0.6
05	512	1’024	1’440	21	0.6
06	1’024	2’048	2’880	21	0.5
07	2’048	4’096	5’760	21	0.5
08	4’096	8’192	11’520	21	0.4
09	8’192	16’384	23’040	21	0.4
10	16’384	32’768	46’080	20	0.3
11	32’768	65’536	92’160	06	0.3
12	65’536	131’072	184’320	05	0.2
13	131’072	262’144	368’640	04	0.2
14	262’144	524’288	737’280	03	0.2
15	524’288	1’048’576	1’474’560	02	0.2

* Recommended airgap = 0.2 mm. Sequence of A and B transitions is correct up to Max 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 codewheel, to be specified
8	Custom LUT, to be specified
9	Default LUT, no codewheel specified

Table 5: Codewheel (see Fig. 4)

EEEEE	Codewheel	Description
00000	No codewheel	
05064	TPCD05	64 periods, OD 28.2 mm
06128	TPCD06	128 periods, OD 52.7 mm
07180	TPCD07	180 periods, OD 72.6 mm

Table 6: Encoder holder

F	Encoder holder
0	No holder
A	Holder A (Fig. 5)
B	Holder B (Fig. 3)

Table 7: Cable

GGG	Cable
000	No cable
0xx	Flat ribbon cable, -20 to 100°C, length xx cm

Table 8: Connector

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