iC-PG MINIATURE REFLECTIVE OPTICAL ABSOLUTE ENCODER

preliminary

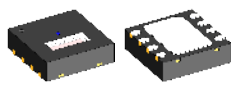
FEATURES

- Very compact lens-less opto encoder
- Suits reflective code discs of ⌀ 8 mm
- Integrated blue LED with power control, *EncoderBlue*®
- Push-button functionality: 64-step bounce-free analog output from 0.5 V to 4.5 V
- Parallel 5-bit Gray code output with 1.6 mA push-pull drivers
- 30 angle positions, resolution of 12°
- 2 positions reserved for PowerOn/Error indication
- Single-sided 5 V supply
- Operating temperature of -40 °C to +105 °C

APPLICATIONS

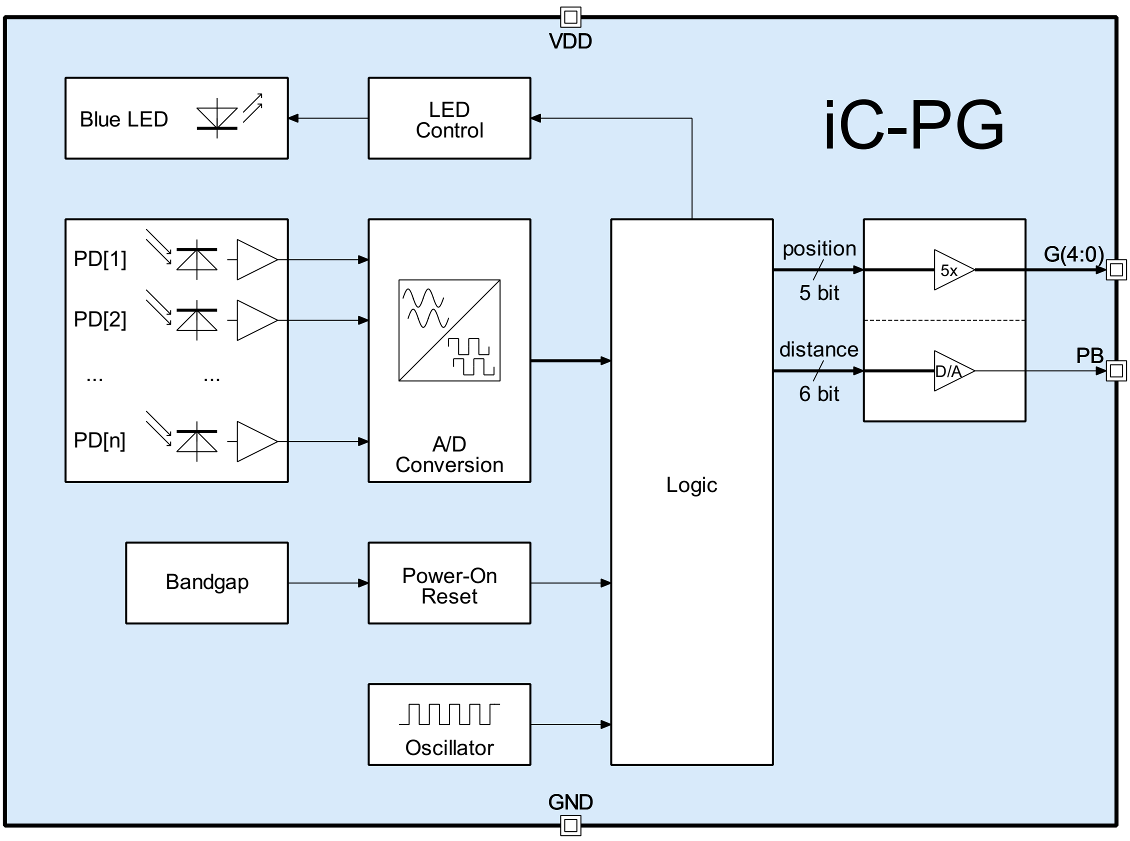
- Rotary control knob
- Human-machine interface
- AV equipment
- Electronic potentiometer

PACKAGES



8-pin optoDFN
3 mm x 3 mm x 0.9 mm
RoHS compliant

BLOCK DIAGRAM



DESCRIPTION

iC-PG is an easy-to-use optical-reflective absolute encoder featuring integrated photosensors and an integrated blue LED chip.

Its typical applications are rotary knobs and electronic potentiometers.

The device requires a single 5 V supply voltage without any need for configuration.

Push-button functionality is realized by an analog 0.5 V to 4.5 V output representing the distance between chip and code disc.

The device provides a capped 5-bit Gray-coded parallel output signal with 30 angle positions and a resolution of 12 degrees.

The remaining 2 codes are reserved for error indications like power down, low contrast and read error.

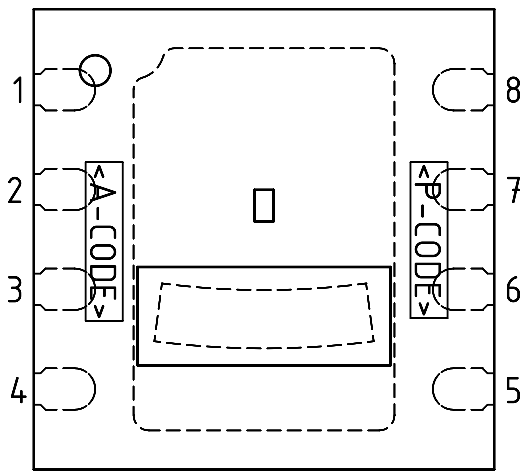
General notice on materials under excessive conditions
Epoxy resins (such as solder resists, IC package and injection molding materials, as well as adhesives) may show discoloration, yellowing, and surface changes in general when exposed longterm to high temperatures, humidity, irradiation, or due to thermal treatments for soldering and other manufacturing processes.

Equally, standard molding materials used for IC packages can show visible changes induced by irradiation, among others when exposed to light of shorter wavelengths, blue light for instance. Such surface effects caused by visible or IR LED light are rated to be of cosmetic nature, without influence to the chip's function, its specifications and reliability.

Note that any other material used in the system (e.g. varnish, glue, code disc) should also be verified for irradiation effects.

PACKAGING INFORMATION

PIN CONFIGURATION

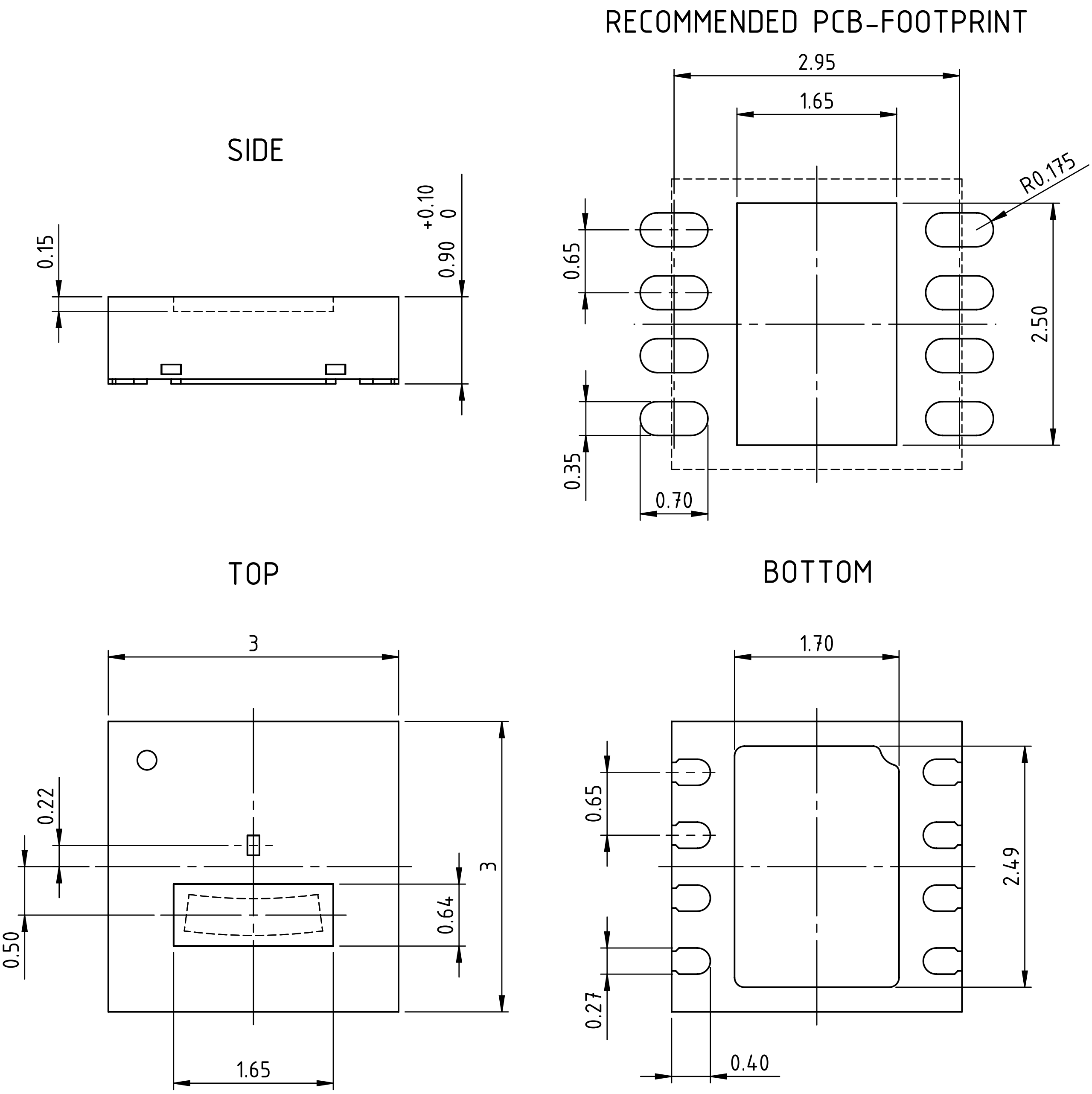


PIN FUNCTIONS

No.	Name	Function
1	G3	Gray-coded output
2	G2	Gray-coded output
3	G1	Gray-coded output
4	G0	Gray-coded output
5	PB	Push-button analog output
6	GND	Ground
7	VDD	+4.5 V. . . +5.5 V Supply Voltage
8	G4	Gray-coded output

IC top marking: <P-CODE> = product code, <A-CODE> = assembly code (subject to changes), <D-CODE> = date code (subject to changes)

PACKAGE DIMENSIONS



All dimensions given in mm. General tolerances of form and position according to JEDEC MO-229.
Positional tolerance of sensor pattern: ±70µm / ±1° (with respect to center of backside pad).
Maximum molding excess +20µm / -75µm versus surface of glass. Small pits in the mold surface, which may occasionally appear due to the manufacturing process, are cosmetic in nature and do not affect reliability.

dra_odfn8-3x3-1_pg_z1_pack_1, 15:1

ABSOLUTE MAXIMUM RATINGS

Beyond these values damage may occur; device operation is not guaranteed.

Item No.	Symbol	Parameter	Conditions	Min.	Max.	Unit
G001	VDD	Voltage at VDD		-0.3	7	V
G002	I(VDD)	Current in VDD				
G003	V()	Pin Voltage, all other pins		-0.3	VDD + 0.3	V
G004	I()	Pin Current, all other pins				
G005	Vd()	ESD Susceptibility, all pins				
G006	Tj	Junction Temperature		-40	125	°C

THERMAL DATA

Item No.	Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
T01	Ta	Operating Ambient Temperature Range		-40		105	°C
T02	Ts	Permissible Storage Temperature Range		-40		105	°C
T03	Tpk	Soldering Peak Temperature	tpk < 20 s, convection reflow tpk < 20 s, vapor phase soldering MSL 5A (max. floor life 24 h at 30 °C and 60 % RH); Refer to Handling and Soldering Conditions for details.			245 230	°C °C
T04	Rthja	Thermal Resistance Chip to Ambient	package mounted on PCB according to JEDEC standard				

All voltages are referenced to ground unless otherwise stated.
All currents flowing into the device pins are positive; all currents flowing out of the device pins are negative.

ELECTRICAL CHARACTERISTICS

Operating conditions: VDD = 4.5...5.5 V, Tj = -40...125 °C, unless otherwise noted

Item No.	Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Supply							
001	VDD	Supply Voltage	referenced to GND	4.5	5.0	5.5	V
002	I(VDD)	Supply Current	no external load, code disc at specified distance		4	8	mA
003	I(VDD)	Supply Current	no external load, without code disc		7	12	mA
Outputs							
101	Isc()hi	Short-Circuit Current high G(4:0)	V() = GND	-55			mA
102	Isc()lo	Short-Circuit Current low G(4:0)	V() = VDD			45	mA
103	Isc(PB)hi	Short-Circuit Current high PB	V(PB) = GND	-15			mA
104	Isc(PB)lo	Short-Circuit Current low PB	V(PB) = VDD			35	mA
105	Vs()hi	Saturation Voltage High G(4:0)	Vs()hi = VDD - V(); I() = -1.6 mA			0.4	V
106	Vs()lo	Saturation Voltage Low G(4:0)	I() = 1.6 mA			0.4	V
107	Vs(PB)	Saturation Voltage at PB	Full range (V(PB) = 0.1*VDD ... 0.9*VDD) I(PB) = ±1 mA	-25		25	mV
PowerOn							
201	VDDon	Turn-on Threshold VDD (power-on release)	increasing voltage at VDD	3.9	4.2	4.4	V
202	VDDoff	Turn-off Threshold VDD (power-down reset)	decreasing voltage at VDD	3.7	3.95	4.2	V
203	VDDhys	Threshold Hysteresis VDD	VDDhys = VDDon - VDDoff	0.2	0.25	0.3	V
General							
301	tupd	Refresh Rate G(4:0), PB			250	1000	µs
302	n	Maximum Revolution Speed	code disc at specified distance	300			RPM

FUNCTION

The iC-PG is a reflective opto encoder that is ready to use immediately after power-up, as it requires no configuration.

The output interface is a simple parallel 5-bit position output G(4:0), which allows 30 Gray-coded output positions. This allows output positions with a resolution of 12°, including a code for power-off and a code for error monitoring.

An additional analog output is available for monitoring the push-button actuation. The analog signal output provides a voltage proportional to the probe distance between the iC-PG chip and the code disc. The analog output resolves 64 steps in relation to 10 % ... 90 % of VDD. Because the axial actuation of a push-button is also detected, iC-PG can be used as a complete single-chip encoder for push-button applications. The electronic monitoring of the push-button actuation minimizes the mechanical requirements for the overall structure.

The position output G(4:0) is initially "00000" and indicates the power-off state. Since "00000" is presented when power is missing, interfacing iC-PG's parallel outputs is simple. After the supply voltage at VDD has exceeded the power-on threshold VDDon, the output G(4:0) changes to "10000". This is the error state and indicates that no valid position has been found yet.

Once in the "10000" output state, the iC-PG performs the following to update its parallel outputs with the actual rotary position and push-button actuation distance. This update sequence is repeated at the refresh rate tupd:

- 1. Turn on the LED
- 2. Wait for the photodiodes to collect the incoming light
- 3. The photodiode information is latched, evaluated, and transformed into position and distance
- 4. The distance between the iC-PG chip and code disc is output on pin PB
- 5. The rotary knob angle position is output on the parallel outputs G(4:0)

Position	G(4)	G(3)	G(2)	G(1)	G(0)
Power off	0	0	0	0	0
1	0	0	0	0	1
2	0	0	0	1	1
3	0	0	0	1	0
4	0	0	1	1	0
5	0	0	1	1	1
6	0	0	1	0	1
7	0	0	1	0	0
8	0	1	1	0	0
9	0	1	1	0	1
10	0	1	1	1	1
11	0	1	1	1	0
12	0	1	0	1	0
13	0	1	0	1	1
14	0	1	0	0	1
15	0	1	0	0	0
16	1	1	0	0	0
17	1	1	0	0	1
18	1	1	0	1	1
19	1	1	0	1	0
20	1	1	1	1	0
21	1	1	1	1	1
22	1	1	1	0	1
23	1	1	1	0	0
24	1	0	1	0	0
25	1	0	1	0	1
26	1	0	1	1	1
27	1	0	1	1	0
28	1	0	0	1	0
29	1	0	0	1	1
30	1	0	0	0	1
Error	1	0	0	0	0

Table 4: Gray Code Assignment

SAFETY ADVICE

Depending on the mode of operation, these devices emit highly concentrated visible blue light which can be hazardous to the human eye. Products which incorporate these devices have to follow the safety precautions given in IEC 60825-1 and IEC 62471.

HANDLING ADVICE

Because of the specific housing materials and geometries used, these LED devices are sensitive to rough handling or assembly and can thus be easily damaged or may fail in regard to their electro-optical operation. Excessive mechanical stress or load on the LED surface or to the glass windows must be avoided.

REVISION HISTORY

Rel.	Rel. Date*	Chapter	Modification	Page
A1	2019-04-08		Initial release	all

Rel.	Rel. Date*	Chapter	Modification	Page
A2	2021-06-15		Correction of English descriptions	1-6

Rel.	Rel. Date*	Chapter	Modification	Page
B1	2021-08-18	PACKAGES	Revised Package Picture	1
		PACKAGING INFORMATION	Pin Configuration and Pin Designation changed	2
		PACKAGE DIMENSIONS	Package Drawing updated	3

* Release Date format: *YYYY-MM-DD*

ORDERING INFORMATION

Type	Package	Options	Order Designation
iC-PG	8-pin optoDFN, 3 mm x 3 mm, 0.9 mm thickness RoHS compliant		iC-PG oDFN8-3x3
Evaluation kit	Kit with Reflective Encoder IC PG1M (61mm x 64 mm), Code Disc		iC-PG EVAL PG1M
Mother board	Adapter PCB (80 mm x 110 mm)	incl. ribbon cable and iC-PG inlay	iC-PR EVAL PR2M

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