iC-PG
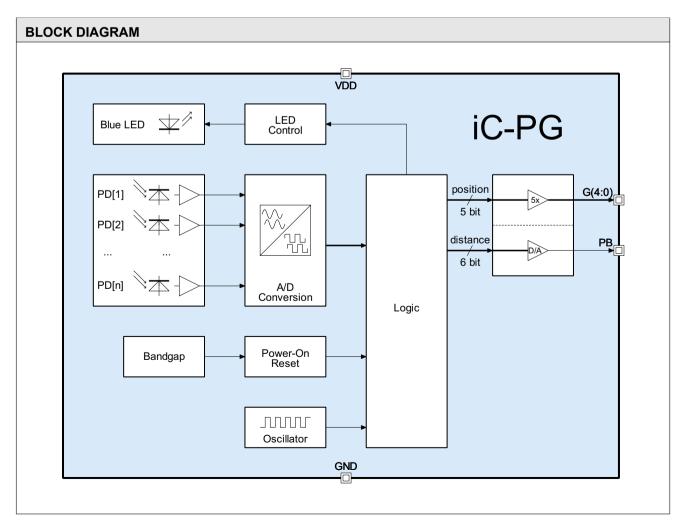## Miniature Optical Absolute Reflective Encoder *preliminary*

iC-Haus

FEATURES

♦ Reflective, compact, absolute rotary encoder IC
♦ For reflective code discs of $\varnothing$ 8 mm
♦ Integrated blue LED with power control, *EncoderBlue*®
♦ 5V single supply voltage
♦ Push-Button functionality: 5V analog output, bounce-free
♦ Gray-coded digital output:
♦ 5-bit gray-coded parallel output
♦ 30 positions, 12° resolution
♦ remaining 2 codes for error indication

APPLICATIONS

♦ Rotary knob
♦ Electronic potentiometer

PACKAGES

oDFN8
3 mm x 3 mm x 0.9 mm

RoHS compliant

BLOCK DIAGRAM

iC-PG
Miniature Optical Absolute Reflective Encoder

preliminary

iC Haus

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 5V supply voltage without the need of any configuration whatsoever.

Push-Button functionality is realized by an analog 0.5 .. 4.5V output representing the distance between chip and codedisk.

The device provides a capped 5-bit gray-coded parallel output signal with 30 positions and 12° resolution.

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

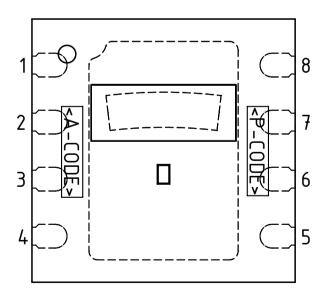**General notice on materials under excessive conditions**
Epoxy resins (such as solder resists, IC package and injection molding materials, as well as adhesives) may show discoloration, yellowing, and surface changes in general when exposed longterm to high temperatures, humidity, irradiation, or due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

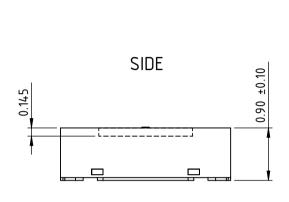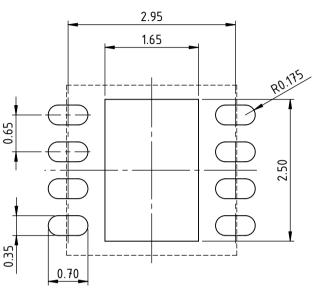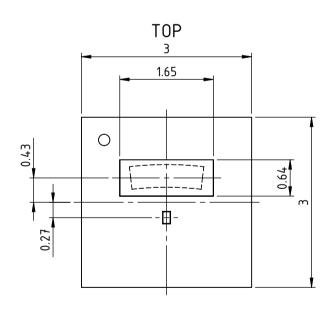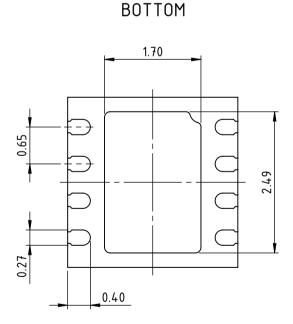| No.	Name	Function
1	PB	Push-Button analog output
2	GND	Ground
3	VDD	+4.5 V . . . +5.5 V Supply Voltage
4	G(4)	Gray-coded output
5	G(3)	Gray-coded output
6	G(2)	Gray-coded output
7	G(1)	Gray-coded output
8	G(0)	Gray-coded output

PACKAGE DIMENSIONS

All dimensions given in mm.

SIDE

RECOMMENDED PCB-FOOTPRINT

TOP

BOTTOM

All dimensions given in mm. 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 encapsulation excess +100μm / -75μm versus surface of glass.

dr_pre1_odfn8-3x3_pg_0_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 live 24 h at 30 °C and 60 % RH); Please refer to customer information file No. 7 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, codedisk at specified distance		4	8	mA
003	I(VDD)	supply current	no external load, without codedisk		7	12	mA
Pins							
101	Isc()hi	short-circuit current high G(4:0)	V()=GND	-55			mA
102	Isc()lo	short-circuit current lo 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 lo PB	V(PB)=VDD			35	mA
105	Vs()hi	saturation voltage high G(4:0)	Vs()hi =VDD -V() $I()=-1.6mA$			0.4	V
106	Vs()lo	saturation voltage low G(4:0)	$I()=1.6mA$			0.4	V
107	Vs(PB)	saturation voltage PB	Full range (V(PB)=0.1*VDD..0.9*VDD) $I(PB)=\pm1mA$	-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
Main							
301	tr	Refresh rate G(4:0), PB			250	1000	us
302	n	Maximum revolution speed	Codedisk at specified distance	300			RPM

Function

iC-PG is a reflective opto-encoder that requires no configuration and is ready to use upon power-up.

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

An additional analog output is also available for push button actuation monitoring. This analog signal outputs a voltage that is proportional to the push button distance between the iC-PG chip and the codedisc. The range of this output is a resolution of 64 steps in relation to $10\% \ldots 90\%$ of VDD. By providing a means to sense push button actuation, the iC-PG becomes a complete rotary pushbutton single-chip encoder system. Allowing for a means to monitor push button actuation on-chip electronically also minimizes system mechanical requirements

Initially the position output G(4:0) is "00000", indicating power-off state. After voltage is applied between GND and VDD, exceeding the threshold VDDon, the chip changes to G(4:0)="10000". This is the error state, indicating that no valid position was found yet.

The iC-PG parallel output G(4:0) is simple to interface with and initially outputs "00000" during the power-off state. Once voltage is applied between VDD and GND, and exceeds the threshold VDDon, the iC-PG is powered on and the parallel output G(4:0) changes to "10000". This current state is the error condition which indicates that a valid position has not been found yet. Once in the "10000" output state, the iC-PG performs the following to update its parallel output G(4:0) with the actual rotary position and push button actuation distance. This output update sequence happens at a refresh rate of tr:

- 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 codedisc is output on pin PB

- 5. The rotary knob position is output on parallel output 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.

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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

Please send your purchase orders to our order handling team:

Fax: +49 (0) 61 35 - 92 92 - 692
E-Mail: dispo@ichaus.com

For technical support, information about prices and terms of delivery please contact:

iC-Haus GmbH   **Tel.: +49 (0) 61 35 - 92 92 - 0**
Am Kuemmerling 18   **Fax: +49 (0) 61 35 - 92 92 - 192**
D-55294 Bodenheim   **Web: http://www.ichaus.com**
GERMANY   **E-Mail: sales@ichaus.com**

Appointed local distributors: http://www.ichaus.com/sales_partners