iC-PN2656

PHASED ARRAY NONIUS ENCODER 26-256

preliminary

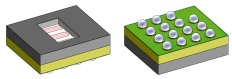
FEATURES

- Compact photosensor for high-resolution nonius scanning
- Phased-array design for 255/256/240 PPR (N/M/S channel) with excellent signal matching
- Reduced cross talk due to moderate track pitch
- Ultra low dark currents for operation to high temperature
- Low noise amplifiers with high transimpedance of typ. 4 MΩ
- Short-circuit-proof, low impedance voltage outputs for enhanced EMI tolerance
- Space saving optoQFN and optoBGA packages (RoHS compliant)
- Low power consumption from single 4.5 to 5.5 V supply
- Operational temperature range of -40 to +110 °C
- Suitable code discs:
  LSHC4S 26-256N (glass 1 mm)
  OD ⌀ 26 mm, ID ⌀ 11.6 mm, optical radius 10.905 mm
  LSHC5S 26-256N (plastic 1.15 mm),
  OD ⌀ 26 mm, ID ⌀ 7 mm, optical radius 10.905 mm

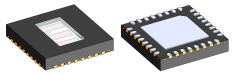
APPLICATIONS

Absolute position encoders

PACKAGES

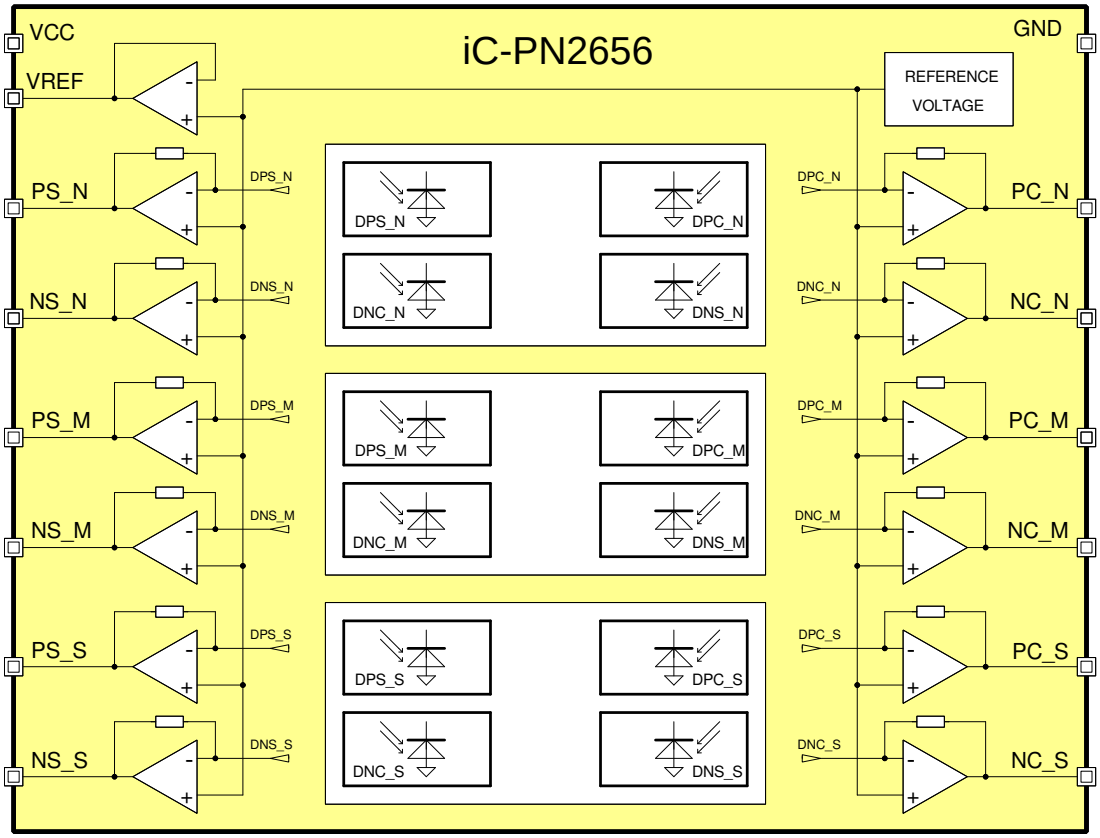


15-pin optoBGA
6.2 mm x 5.2 mm x 1.7 mm



32-pin optoQFN
5 mm x 5 mm x 0.9 mm

BLOCK DIAGRAM



DESCRIPTION

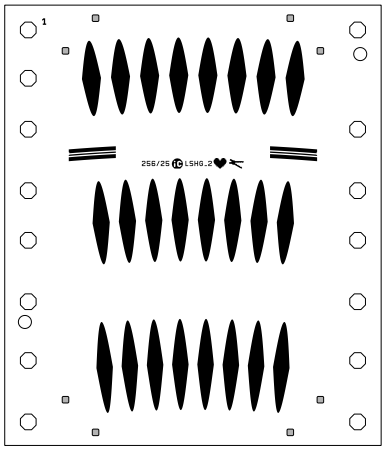
The optical encoder iC-PN2656 features 24 monolithically integrated photosensors arranged as a phased-array. The high transimpedance gain of typically 4 MΩ generates output signals of a few hundred millivolts already from illumination levels of 1 to 2 mW/cm^2. In most cases no additional measures must be considered to filter for noise and interferences.

Analog nonius-scale encoders are the typical application for iC-PN2656. Its 3-track scanning features a phased-array of 8 photosensors each per track, generating positive and negative going sine signals, as well as positive and negative going cosine signals. An excellent matching and common mode behavior of the differential signal paths is obtained by a paired amplifier design, reducing the needs for external signal calibration to an absolute minimum.

The spectral sensitivity range includes visible to near infrared light, with the maximum sensitivity being close to a wavelength of 680 nm. An output voltage of approximately 1 V is typical under low light conditions, for instance when iC-PN2656 is illuminated at only 1.3 mW/cm^2 by an 740 nm LED.

PACKAGES INFORMATION

PAD LAYOUT (2.88 mm x 3.37 mm)

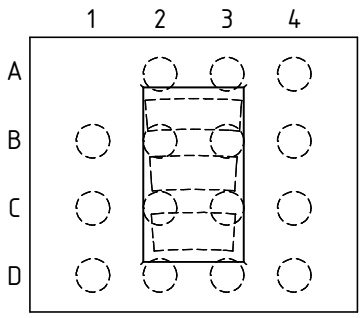


PAD FUNCTIONS

No.	Name	Function
1	VCC	+4.5..5.5 V Supply Voltage
2	VREF	Reference Voltage Output
3	PS_N	N-Track Sine +
4	NS_N	N-Track Sine -
5	PS_M	M-Track Sine +
6	NS_M	M-Track Sine -
7	PS_S	S-Track Sine +
8	NS_S	S-Track Sine -
9	NC_S	S-Track Cosine -
10	PC_S	S-Track Cosine +
11	NC_M	M-Track Cosine -
12	PC_M	M-Track Cosine +
13	NC_N	N-Track Cosine -
14	PC_N	N-Track Cosine +
15	GND	Ground

All outputs are analog voltage outputs.

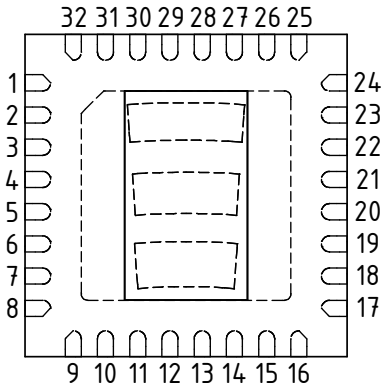
PIN CONFIGURATION
oBGA LSH2C (6.2 mm x 5.2 mm)



PIN FUNCTIONS

No.	Name	Function
A2	VCC	+4.5..5.5 V Supply Voltage
A3	VREF	Reference Voltage Output
A4	GND	Ground
B1	PS_N	N-Track Sine +
B2	NS_N	N-Track Sine -
B3	NC_N	N-Track Cosine -
B4	PC_N	N-Track Cosine +
C1	PS_M	M-Track Sine +
C2	NS_M	M-Track Sine -
C3	NC_M	M-Track Cosine -
C4	PC_M	M-Track Cosine +
D1	PS_S	S-Track Sine +
D2	NS_S	S-Track Sine -
D3	NC_S	S-Track Cosine -
D4	PC_S	S-Track Cosine +

PIN CONFIGURATION
oQFN32-5x5 (5 mm x 5 mm)



PIN FUNCTIONS

No.	Name	Function
1	VCC	+4.5..5.5 V Supply Voltage
2	VREF	Reference Voltage Output
3	PS_N	N-Track Sine +
4	NS_N	N-Track Sine -
5	PS_M	M-Track Sine +
6	NS_M	M-Track Sine -
7	PS_S	S-Track Sine +
8	NS_S	S-Track Sine -
17	NC_S	S-Track Cosine -
18	PC_S	S-Track Cosine +
19	NC_M	M-Track Cosine -
20	PC_M	M-Track Cosine +
21	NC_N	N-Track Cosine -
22	PC_N	N-Track Cosine +
24	GND	Ground
	BP	Backside pad (oQFN32-5x5 only): not intended as an electrical connection point; when using as shield a single link to GND is permissible.

Package qualification optoQFN32-5x5 pending.

ABSOLUTE MAXIMUM RATINGS

These ratings do not imply operating conditions; functional operation is not guaranteed. Beyond these ratings device damage may occur.

Item No.	Symbol	Parameter	Conditions	Min.	Max.	Unit
G001	VCC	Voltage at VCC		-0.3	6	V
G002	I(VCC)	Current in VCC		-20	20	mA
G003	V()	Pin Voltage, all signal outputs		-0.3	VCC + 0.3	V
G004	I()	Pin Current, all signal outputs		-20	20	mA
G005	Vd()	ESD Susceptibility, all pins	HBM, 100 pF discharged through 1.5 kΩ		2	kV
G006	Tj	Junction Temperature		-40	150	°C
G007	Ts	Chip Storage Temperature		-40	150	°C

THERMAL DATA

Item No.	Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
T01	Ta	Operating Ambient Temperature Range	package oBGA LSH2C package oQFN32-5x5* (extended temperature range on request)	-40 -40		110 110	°C °C
T02	Ts	Storage Temperature Range	package oBGA LSH2C, package oQFN32-5x5*	-40		110	°C
T03	Tpk	Soldering Peak Temperature	package oBGA LSH2C tpk < 20 s, convection reflow tpk < 20 s, vapor phase soldering TOL (time on label) 8 h; Please refer to customer information file No. 7 for details.			 245 230	 °C °C
T04	Tpk	Soldering Peak Temperature	package oQFN32-5x5* 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

*) Package qualification pending.

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: VCC = 4.5...5.5 V, Tj = -40..125 °C, unless otherwise stated

Item No.	Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Total Device							
001	VCC	Permissible Supply Voltage		4.5		5.5	V
002	I(VCC)	Supply Current in VCC	no load, photocurrents within linear op. range (no override)		9.5	15	mA
003	Vc()hi	Clamp-Voltage hi at all pins	I() = 4 mA			11	V
004	Vc()lo	Clamp-Voltage lo at all pins	I() = -4 mA	-1.2		-0.3	V
Photosensors							
101	λar	Spectral Application Range	Se(λar) = 0.25 x S(λ)max	400		950	nm
102	λpk	Peak Sensitivity Wavelength			680		nm
103	Aph()	Radiant Sensitive Area			0.11		mm^2
104	S(λ)	Spectral Sensitivity	λ_{LED} = 740 nm		0.5		A/W
105	S(λpk)max	Maximum Spectral Sensitivity	λ_{LED} = λpk		0.55		A/W
106	E()mxr	Irradiance For Maximum Signal Level	λ_{LED} = 740 nm, Vout() not saturated	0.7	1.3	2.1	mW/cm^2
Photocurrent Amplifiers							
201	Iph()	Permissible Photocurrent Operating Range		0		280	nA
202	η()r	Photo Sensitivity (light-to-voltage conversion ratio)	λ_{LED} = 740 nm	0.8	1.2	2.0	V/µW
203	Z()	Equivalent Transimpedance Gain	Z = Vout() / Iph()	2.69	4.0	5.46	MΩ
204	TCz	Temperature Coefficient of Transimpedance Gain			-0.12		%/°C
209	ΔZ()pn	Transimpedance Gain Matching	P.. channel vs. corresponding N.. channel	-0.2		0.2	%
210	ΔVout()pn	Signal Matching	no illumination, any output vs. any output	-35		35	mV
211	ΔVout()pn	Signal Matching	no illumination, P.. output vs. corresponding N.. output	-2.5		2.5	mV
212	fc()hi	Cut-off Frequency (-3 dB)		120	180	280	kHz
213	VNoise()	RMS Output Noise	illuminated to 500 mV signal level above dark level, 500 kHz band width		0.5		mV
Signal Outputs							
301	Vout()mx	Permissible Maximum Output Voltage	illumination to E()mxr, linear gain	2.45	2.72	3.02	V
302	Vout()d	Dark Signal Level	no illumination, load 20 kΩ vs. +2 V	600	770	1000	mV
303	Vout()acmx	Maximum Signal Level	Vout()acmx = Vout()mx - Vout()d	1.48	1.96	2.35	V
304	Isc()hi	Short-Circuit Current hi	load current to ground	100	420	800	µA
305	Isc()lo	Short-Circuit Current lo	load current to IC	250	480	700	µA
306	Ri()	Internal Output Resistance	f = 1 kHz	70	110	180	Ω
307	ton()	Power-On Settling Time	VCC = 0 V → 5 V			100	µs
Reference Voltage VREF							
401	VREF	Reference Voltage	I(VREF) = 0...+1.6 mA	600	770	1000	mV
402	dVout()	Load Balancing	I(VREF) = 0...+1.6 mA	-10		+10	mV
403	Isc()hi	Short-Circuit Current hi	load current to ground	200	420	800	µA
404	Isc()lo	Short-Circuit Current lo	load current to IC	2	4.5	10	mA

APPLICATION CIRCUITS

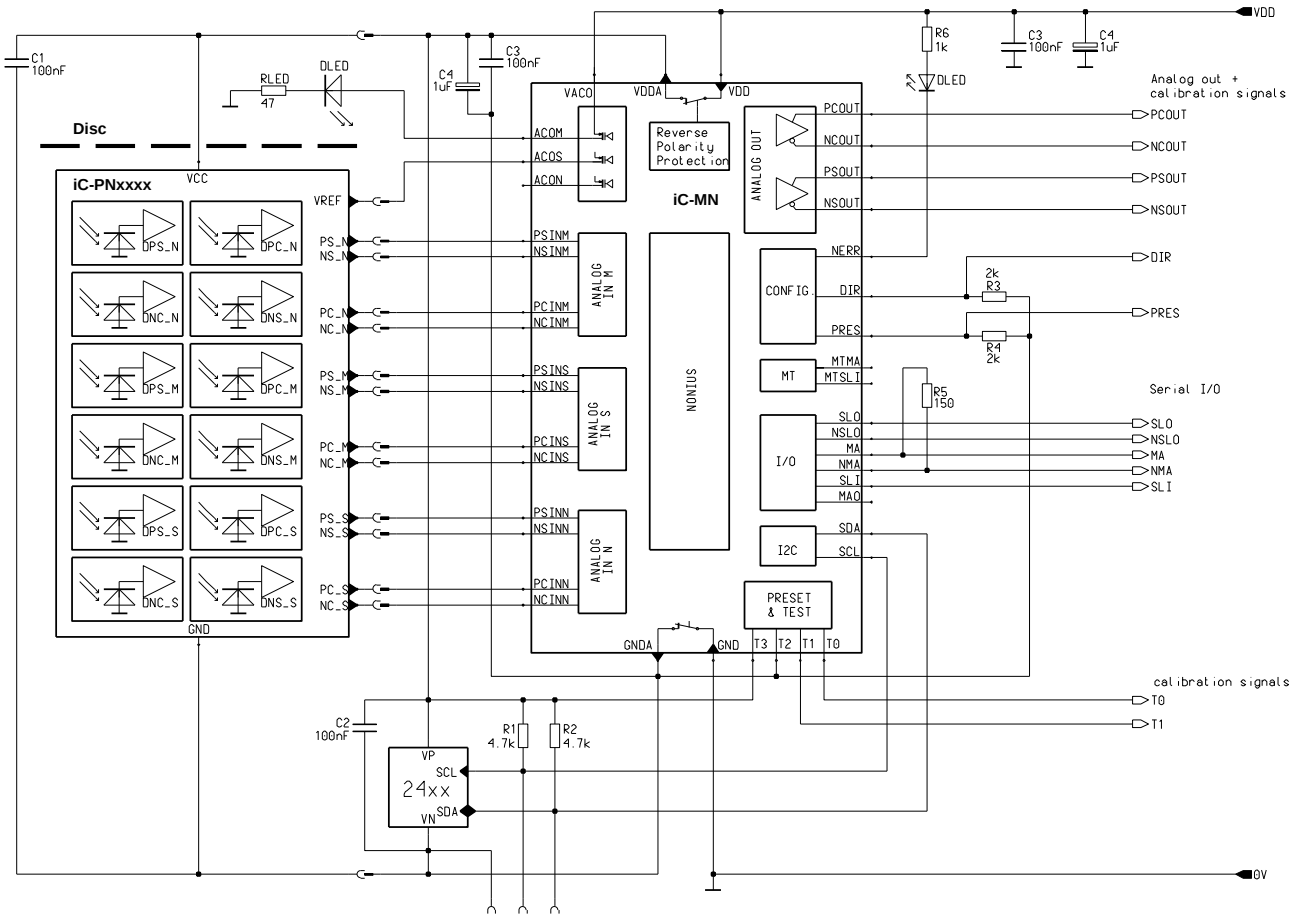


Figure 1: Application example of absolute encoder circuit.

ORDERING INFORMATION

Type	Package	Options	Order Designation
iC-PN2656	-		iC-PN2656 chip
	15-pin optoBGA, 6.2 mm x 5.2 mm, thickness 1.7 mm		iC-PN2656 oBGA LSH2C
	32-pin optoQFN, 5 mm x 5 mm, thickness 0.9 mm		iC-PN2656 oQFN32-5x5
		Suitable code discs	
		255/256/240 PPR OD ⌀ 26 mm, ID ⌀ 11.6 mm, optical radius 10.905 mm (glass 1 mm)	LSHC4S 26-256N
		255/256/240 PPR OD ⌀ 26 mm, ID ⌀ 7 mm, optical radius 10.905 mm (plastic 1.15 mm)	LSHC5S 26-256N

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