iC-PN2656

PHASED ARRAY NONIUS ENCODER 26-256

preliminary

FEATURES

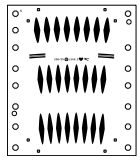
- Compact photosensor for high-resolution Nonius scanning
- Phased-array design for excellent signal matching
- Reduced cross talk due to moderate track pitch
- Ultra low dark currents for operation to high temperature
- Low noise amplifiers with high transimpedance of typ. 4 MΩ
- Short-circuit-proof, low impedance voltage outputs for enhanced EMI tolerance
- Space saving QFN and optoBGA packages (RoHS compliant)
- Low power consumption from single 4.5 to 5.5 V supply
- Operational temperature range of -40 to +125 °C
- Available code discs with 255/256/240 PPR
  - LSHC4S 26-256N (OD/ID ⌀26/11.6 mm, glass)
  - LSHC5S 26-256N (OD/ID ⌀26/7 mm, plastic)

APPLICATIONS

- Absolute position encoders

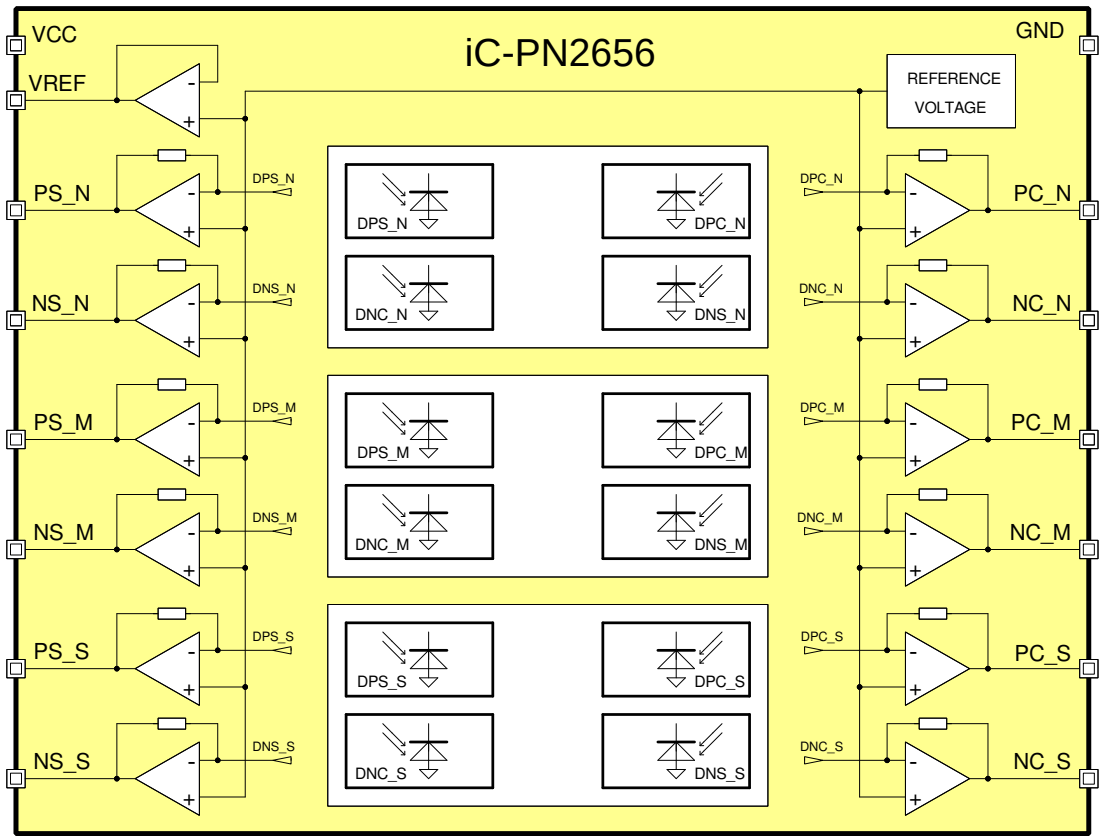
PACKAGES

32-pin QFN
15-pin optoBGA



Chip
2.88 mm x 3.37 mm

BLOCK DIAGRAM



DESCRIPTION

The phased-array iC-PN2656 features 24 monolithically integrated photosensors with active areas of 800 µm x 330 µm each. A high transimpedance gain of typically 4 MΩ generates output signals of a few hundret Millivolts already from illumination levels of 0.1 to 0.2 mW/cm^2. In most cases no additional measures must be considered to filter for noise and interferences.

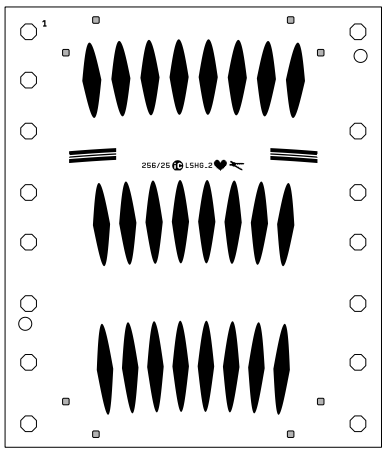
Analog nonius encoders are the typical application for iC-PN2656. Its 3-track scanning features a phased-array of 8 photosensors each per track, generating positive and negative going sine signals, as well as positive and negative going cosine signals.

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 2 µW/mm^2 by an 740 nm LED. A threefold intensity is sufficient when using iC-PN2656 for encoder applications with typical disc and mask codes.

PACKAGES INFORMATION

PAD LAYOUT (2.88 mm x 3.37 mm)

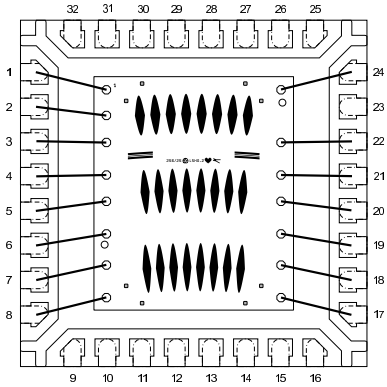


PAD FUNCTIONS

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
cQFN32 (5 mm x 5 mm),
oQFN32 (5 mm x 5 mm)



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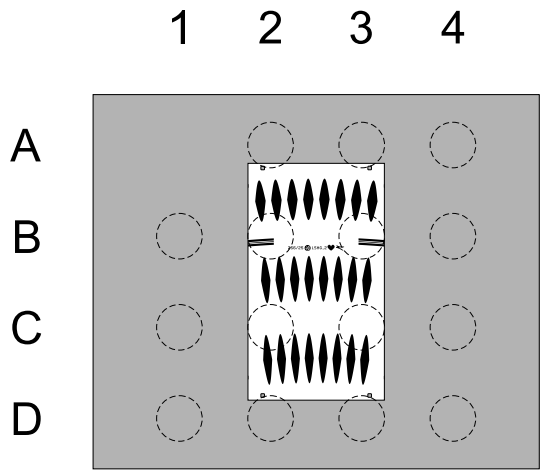
6	NS_M	M-Track Sine -
7	PS_S	S-Track Sine +
8	NS_S	S-Track Sine -
9	NC_S	S-Track Cosine -
10	PC_S	S-Track Cosine +
11	NC_M	M-Track Cosine -
12	PC_M	M-Track Cosine +
13	NC_N	N-Track Cosine -
14	PC_N	N-Track Cosine +
15	GND	Ground

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 +

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 cQFN32 (clear) package oQFN32 (black) package oBGA LSH2C	-20 -40 -40		70 110* 125	°C °C °C
T02	Ts	Storage Temperature Range	package cQFN32 (clear) package oQFN32 (black) package oBGA LSH2C	-20 -40 -40		70 110* 125	°C °C °C
T03	Tpk	Soldering Peak Temperature	package cQFN32 (clear) tpk < 10 s, convection reflow MSL 5A (max. floor live 24 h at 30 °C and 60 % RH) Please refer to customer information file No. 7 for details. Not suitable for vapour phase soldering.			245	°C
T04	Tpk	Soldering Peak Temperature	package cQFN32 (black) tpk < 10 s, convection reflow MSL 3 (max. floor live 168 h at 30 °C and 60 % RH) Please refer to customer information file No. 7 for details. Not suitable for vapour phase soldering.			245*	°C
T05	Tpk	Soldering Peak Temperature	package oQFN32 (black) 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.			260 230	°C °C

*) Package qualification pending.

All voltages are referenced to ground unless otherwise stated.
All currents into the device pins are positive; all currents 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	no load, photocurrents within op. range		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	0.8 mm x 0.33 mm (each sensor)		0.264		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	Permissible Irradiance	λ_{LED} = 740 nm, Vout() not saturated	0.18	0.37	0.78	mW/cm^2
107	E()mxpk	Permissible Irradiance	λ_{LED} = λpk, Vout() not saturated	0.16	0.34	0.71	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	1.12	2.0	3.28	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 vs. N path per diff. channel	-0.2		0.2	%
210	ΔVout()pn	Output Signal Matching	P vs. N path per diff. channel, illumination to E()mxr	-6		6	mV
211	ΔVout()pn	Dark Signal Matching	P vs. N path per diff. channel	-2.5		2.5	mV
212	fc()hi	Cut-off Frequency (-3 dB)		220	310	465	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	Maximum Output Voltage	illumination to E()mxr	2.45	2.72	3.02	V
302	Vout()d	Dark Signal Level	load 20 kΩ vs. +2 V, no illumination	640	770	985	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	200	540	800	µA
305	Isc()lo	Short-Circuit Current lo	load current to IC	250	425	600	µA
306	Ri()	Internal Output Resistance	f = 1 kHz	70	110	180	Ω
Reference Voltage VREF							
401	VREF	Reference Voltage	I(VREF) = 0...-1.6 mA	640	770	985	mV

APPLICATION CIRCUITS

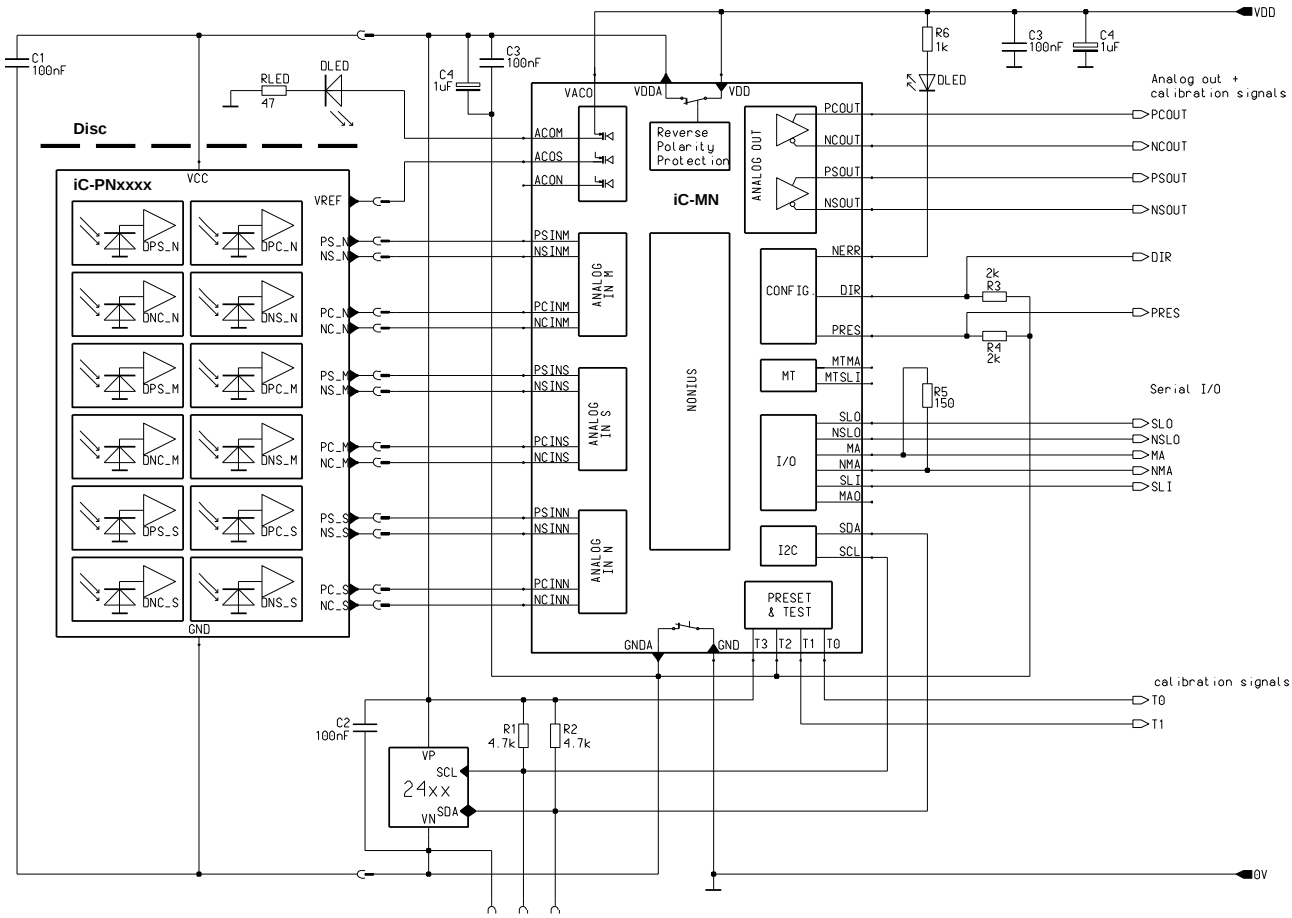


Figure 1: Application example of absolute encoder circuit.

ORDERING INFORMATION

Type	Package	Options	Order Designation
iC-PN2656	- QFN32 5 mm x 5 mm (clear) QFN32 5 mm x 5 mm (black) optoBGA 6.2 mm x 5.2 mm		iC-PN2656 chip iC-PN2656 cQFN32 iC-PN2656 oQFN32 iC-PN2656 oBGA LSH2C
		Encoder discs	
		Nonius code disc 255/256/240 PPR, OD/ID ∅26/11.6 mm, glass	LSHC4S 26-256N
		Nonius code disc 255/256/240 PPR, OD/ID ∅26/7 mm, plastic	LSHC5S 26-256N

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

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