iC-LSHB

INCREMENTAL PHOTOSENSOR ARRAY

preliminary

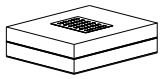
FEATURES

- Monolithic array of independent photosensors with excellent matching
- Compact photosensor size of 800 µm x 330 µm enabling smaller encoder systems
- Moderate track pitch for reasonable alignment tolerances
- 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 15-pin optoBGA package (RoHS compatible)
- Low power consumption from single 4.5 V to 5.5 V supply
- Operational temperature range of -40 to 125 °C
- Available options
  - reticle assembly, code discs
  - customized COB modules

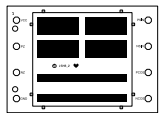
APPLICATIONS

- Incremental rotary encoders
- Linear scales

PACKAGES

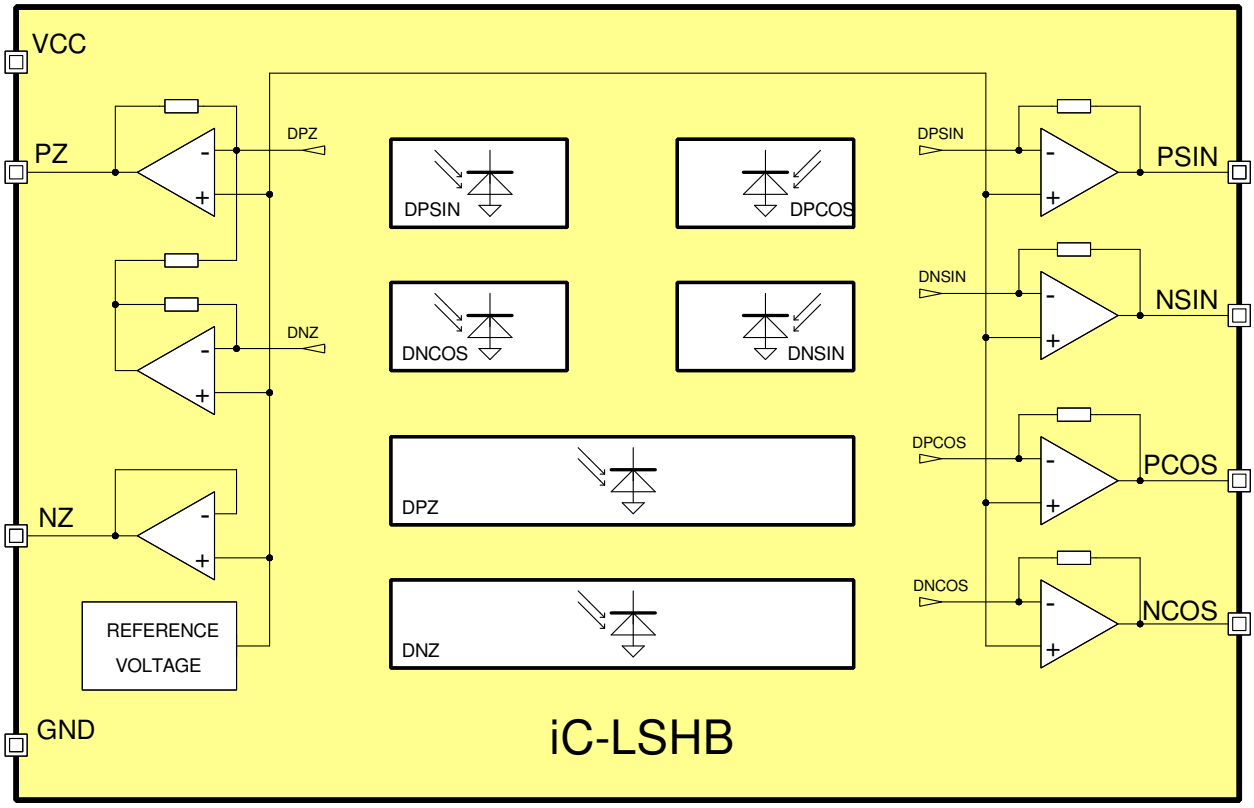


15-pin optoBGA
6.2 mm x 5.2 mm



Chip
2.88 mm x 2.04 mm

BLOCK DIAGRAM



DESCRIPTION

iC-LSHB is an optical sensor IC with 6 integrated photodiodes whose signal currents are converted into output voltages by low-noise transimpedance amplifiers.

The IC is well suited for the operation of interpolation circuits for linear or rotary incremental encoders with an index signal. iC-LSHB thus has a shamrock-style sensor layout of four photodiodes, each with an active area of 800 µm x 330 µm. Both a positive and negative sine signal and a positive and negative cosine signal are generated from a single shared code track. The signal amplifier layout ensures excellent paired channel matching, reducing signal differences to an absolute minimum.

Two separate photodiodes, with active areas of 1720 µm x 150 µm apiece, are employed for the differential scanning of the index track and to generate the zero signal.

The spectral sensitivity ranges from visible to near infrared light, with the maximum sensitivity close to a wavelength of 680 nm.

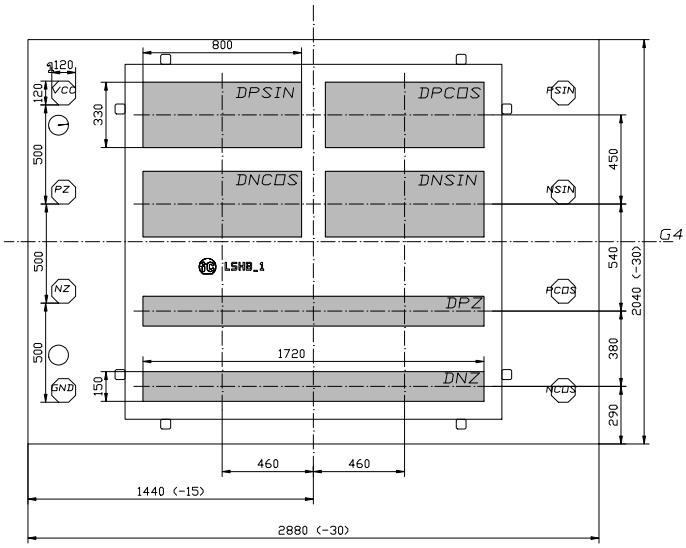
Due to a high transimpedance gain of typically 4 MΩ, signal voltages of several hundred millivolts are obtained at low illumination levels. An output signal amplitude of 1 V is typical in low light conditions, for instance when iC-LSHB is illuminated at only 0.2 mW/cm^2 by a 740 nm LED.

A threefold intensity is sufficient when using iC-LSHB for encoder applications with typical disc and mask codes. Therefore, a relatively low LED current is enough to operate the sensor, proving beneficial to the life expectancy of the LED at high operating temperatures.

iC-LSHB is suitable for on-chip or LED-end mounting of the grating (reticle), so that the period count, signal waveform, phase shift and index marker code can be selected with flexibility.

PACKAGES

PAD LAYOUT (2.88 mm x 2.04 mm)

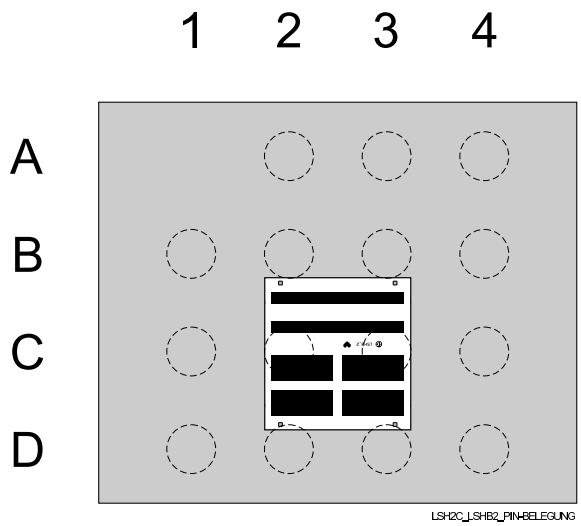


PAD FUNCTIONS

No.	Name	Function
1	VCC	+4.5..5.5 V Supply Voltage
2	PZ	Zero Signal (Index)
3	NZ	Reference Voltage Output
4	GND	Ground
5	NCOS	Cosine -
6	PCOS	Cosine +
7	NSIN	Sine -
8	PSIN	Sine +

Notes: All outputs supply analog voltages.
Dimension G4 is the reference radius of the chip center.

PIN CONFIGURATION
oBGA LSH2C (6.2 mm x 5.2 mm)



PIN FUNCTIONS

No.	Name	Function
A2		
A3		
A4		
B1		
B2		
B3		
B4		
C1	NCOS	Cosine -
C2	PCOS	Cosine +
C3	NZ	Reference Voltage Output
C4	GND	Ground
D1	NSIN	Sine -
D2	PSIN	Sine +
D3	VCC	+4.5..5.5 V Supply Voltage
D4	PZ	Zero Signal (Index)

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	-40		125	°C
T02	Ts	Storage Temperature Range	package oBGA LSH2C	-40		125	°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

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 output load, photocurrents within linear operating range (no override)		6.5	12	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 of DPSIN, DPCOS, DNSIN, DNCOS	0.8 mm x 0.33 mm		0.264		mm^2
104	Aph()	Radiant Sensitive Area of DPZ, DNZ	1.72 mm x 0.15 mm		0.258		mm^2
105	S(λr)	Spectral Sensitivity	λ_{LED} = 740 nm		0.5		A/W
106	S(λ)max	Maximum Spectral Sensitivity	λr = λpk		0.55		A/W
107	E()mx	Irradiance For Maximum Signal Level	λ_{LED} = 740 nm, Vout() not yet saturated	0.15	0.5	0.8	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 Of Paired Amplifiers	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 PSIN, NSIN, PCOS, NCOS, PZ							
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
Reference Voltage NZ							
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 HINTS

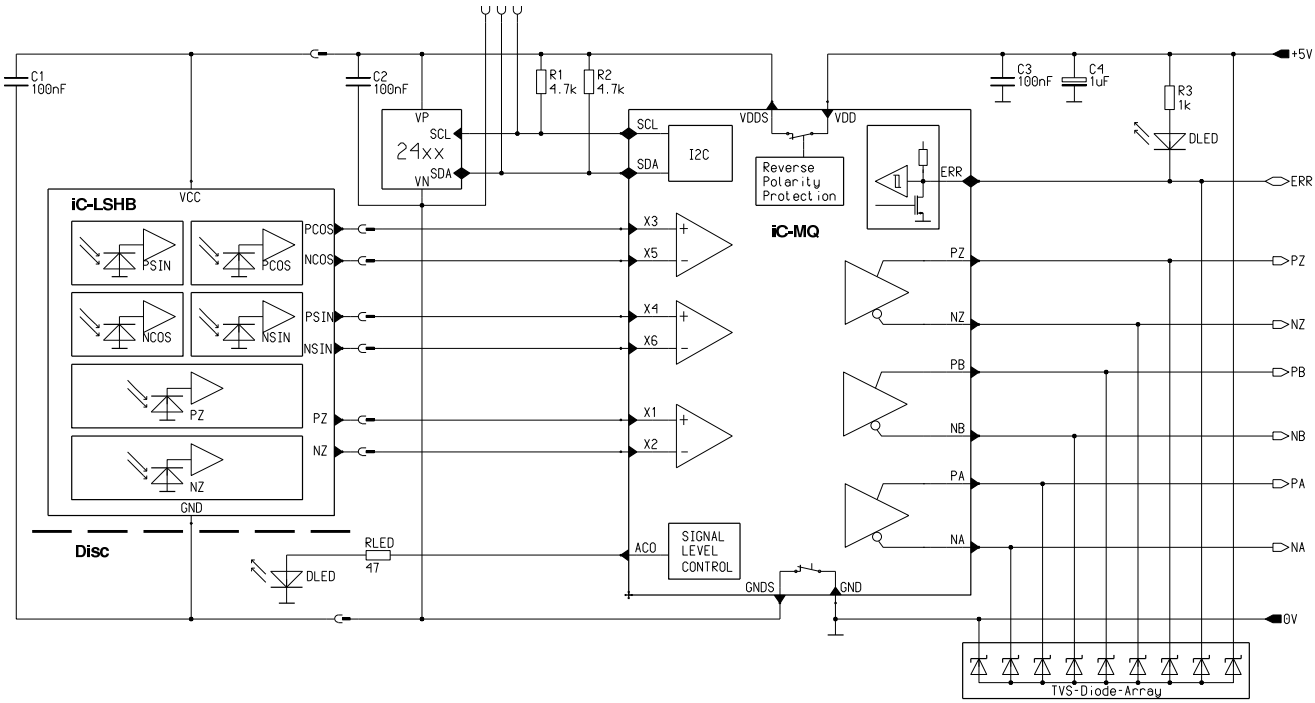


Figure 1: Example of incremental encoder with RS422 output

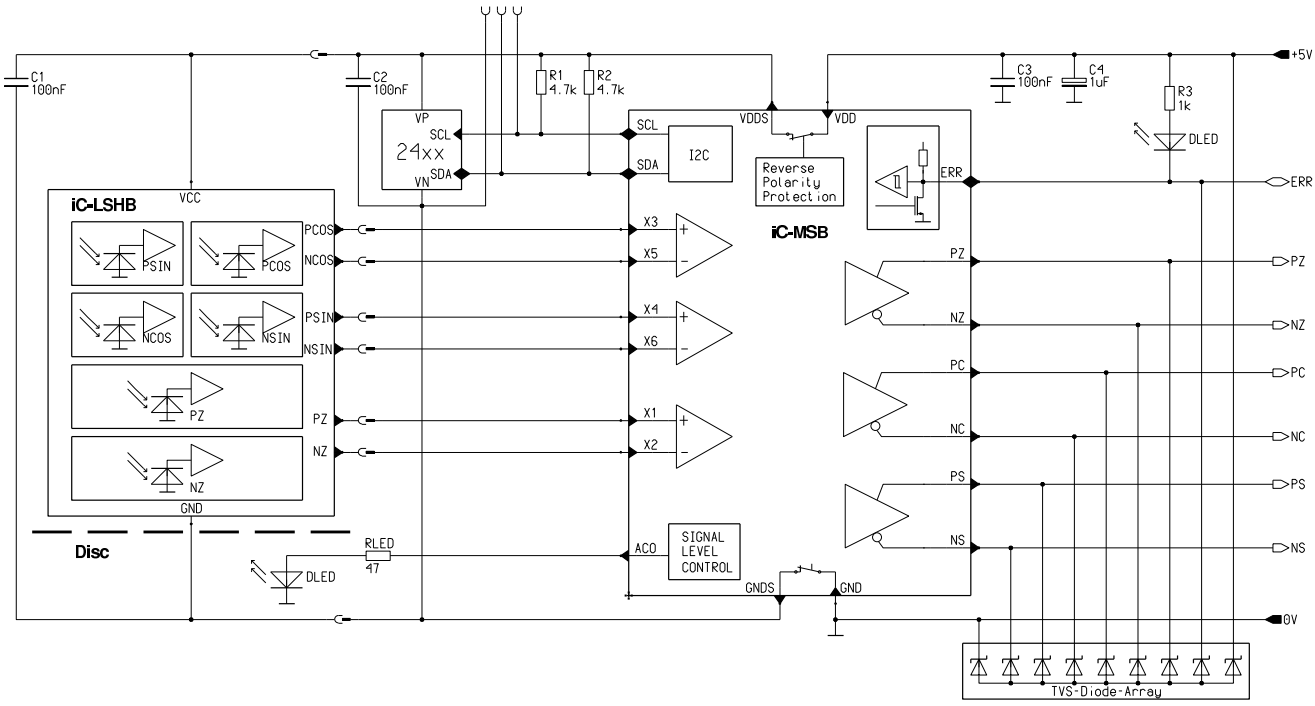


Figure 2: Example of sine encoder with 1 Vpp output

ORDERING INFORMATION

Type	Package	Options	Order Designation
iC-LSHB		-	iC-LSHB chip
	optoBGA 6.2 mm x 5.2 mm	-	iC-LSHB OBGA LSH2C
	optoBGA 6.2 mm x 5.2 mm	reticle 42-1024	iC-LSHB OBGA LSH2C-2R
	optoBGA 6.2 mm x 5.2 mm	reticle 42-4096	iC-LSHB OBGA LSH2C-4R
		Code Disc 1024 PPR, OD/ID ∅42/18 mm, glass	LSHB2S 42-1024
		Code Disc 4096 PPR, OD/ID ∅42/18 mm, glass	LSHB4S 42-4096

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

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