# iC-LSB

## 8-CHANNEL ACTIVE PHOTOSENSOR ARRAY



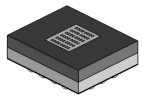
### FEATURES

- Monolithic array of independent photosensors with excellent matching
- Compact photosensor size of 800 µm x 300 µm enabling high-quality encoder scanning at reduced system dimensions
- Narrow track pitch of 0.42 mm cuts down illumination efforts
- Enhanced EMI immunity due to on-chip pre-amplification
- Dark current compensation permits high temperature operation
- Open-collector outputs as highside current source
- Simple gain setting and current-to-voltage conversion by external load resistors
- Single supply operation from 4 V to 5.5 V
- Low power consumption
- Space saving, RoHS compliant optoQFN and optoBGA packages
- Options: extended temperature range of -40 to 125 °C, customized COB modules, reticles and code discs

### APPLICATIONS

- Optical position encoding from analog sine/cosine signals
- Incremental encoders with index signal

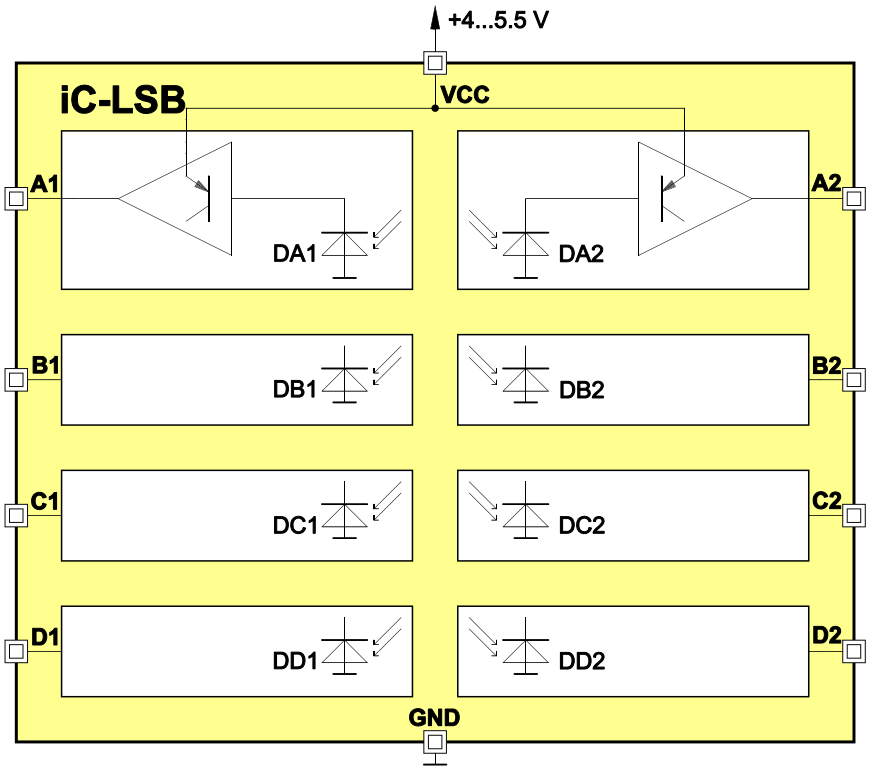
### PACKAGES



14-pin optoBGA

6.2 mm x 5.2 mm

### BLOCK DIAGRAM




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## DESCRIPTION

The iC-LSB sensor array, coming with 8 independent channels, is a general purpose optoelectronic scanner made to suit a variety of encoding applications, such as rotary and linear encoders used for motion control, robotics, power tools etc.

The sensor array features monolithically integrated photosensors with active areas of 800 µm x 300 µm each in combination with fast on-chip photocurrent amplifiers, enabling an analog output at reasonable signal strength to the circuit board.

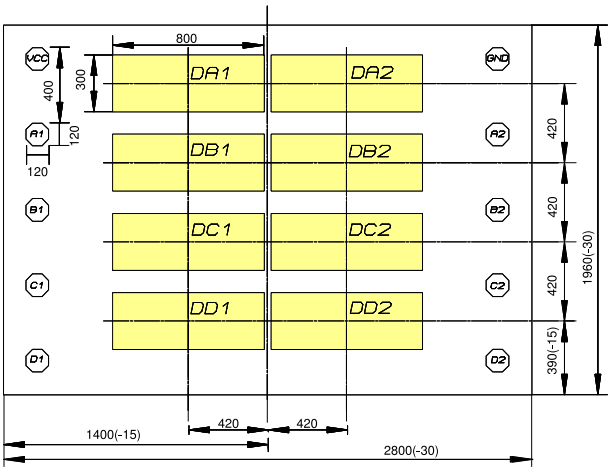
The highside current source output construction avoids a ground referenced signal and permits the subsequent electronics to adjust the gain. In its simplest form this is done by load resistors, for instance.

The spectral sensitivity range includes visible to near infrared light, with the maximum sensitivity being close to a wavelength of 700 nm.

Output currents of up to 50 µA are supplied under low light conditions, for instance when illuminated at only 3 µW/mm$^2$ by an 850 nm LED. The photocurrent gain is 46 dB typically.

## PACKAGES

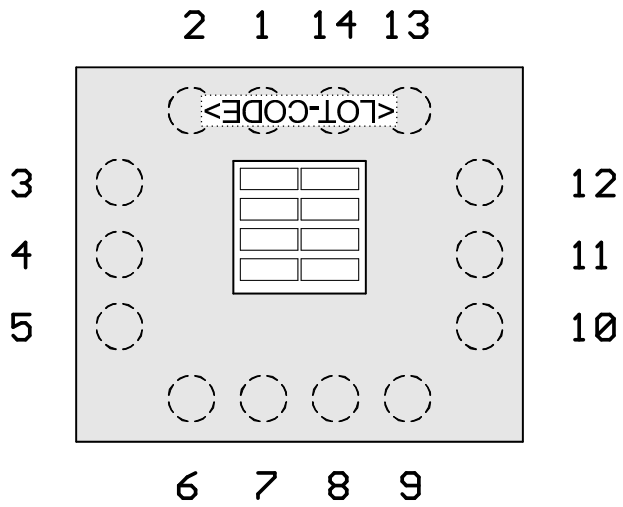
### PAD LAYOUT
**Chip size 2.80 mm x 1.96 mm**




### PAD FUNCTIONS

| No. | Name | Function |
|---|---|---|
| 1 | VCC | +4...5.5 V Supply Voltage |
| 2 | A1 | Highside Current Source Output |
| 3 | B1 | Highside Current Source Output |
| 4 | C1 | Highside Current Source Output |
| 5 | D1 | Highside Current Source Output |
| 6 | D2 | Highside Current Source Output |
| 7 | C2 | Highside Current Source Output |
| 8 | B2 | Highside Current Source Output |
| 9 | A2 | Highside Current Source Output |
| 10 | GND | Ground |

**PIN CONFIGURATION**
**oBGA LS2C (6.2 mm x 5.2 mm)**




**PIN FUNCTIONS**

| No. | Name | Function |
|---|---|---|
| 1 | VCC | +4...5.5 V Supply Voltage |
| 2 | A1 | Highside Current Source Output |
| 3 | B1 | Highside Current Source Output |
| 4 | C1 | Highside Current Source Output |
| 5 | D1 | Highside Current Source Output |
| 6...9 | n.c. | |
| 10 | D2 | Highside Current Source Output |
| 11 | C2 | Highside Current Source Output |
| 12 | B2 | Highside Current Source Output |
| 13 | A2 | Highside Current Source Output |
| 14 | GND | Ground |

Pin numbers marked n.c. are not in use. For dimensional specifications refer to the relevant package data sheets, available separately. IC top markings, such as <LOT CODE>, indicate the orientation of the device.

## 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 LS2C<br><br>(extended temperature range on request) | -20 | | 90 | °C |
| T02 | Ts | Storage Temperature Range | package oBGA LS2C | -30 | | 110 | °C |
| T03 | Tpk | Soldering Peak Temperature | package oBGA LS2C<br><br>tpk < 20 s, convection reflow<br>tpk < 20 s, vapor phase soldering<br><br>TOL (time on label) 8 h;<br>Please refer to customer information file No. 7 for details. | | | <br><br>245<br>230 | <br><br>°C<br>°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 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 | V |
| 002 | I(VCC) | Supply Current in VCC, dark | E() = 0<br>Tj = 27 °C | | <br>1.0 | 2 | mA<br>mA |
| 003 | I(VCC) | Supply Current in VCC | $\lambda_{LED}$ = $\lambda$pk, E() = 0.1 mW/cm$^2$<br>Tj = 27 °C | | <br>1.5 | 4 | mA<br>mA |
| 004 | Vc()hi | Clamp-Voltage hi at all pins | I() = 4 mA | | | 11 | V |
| 005 | Vc()lo | Clamp-Voltage lo at all pins | I() = -4 mA | -1.2 | | -0.3 | V |
| **Photosensors** | | | | | | | |
| 101 | E()mxr | Permissible Irradiance | $\lambda_{LED}$ = $\lambda$pk | | | 0.2 | mW/cm$^2$ |
| 102 | Aph() | Radiant Sensitive Area | 0.8 mm x 0.3 mm per sensor | | 0.24 | | mm$^2$ |
| 103 | $\lambda$ar | Spectral Application Range | Se($\lambda$ar) = 0.25 x S($\lambda$)max<br>see Figure 1 | 400 | | 950 | nm |
| 104 | $\lambda$pk | Peak Sensitivity Wavelength | see Figure 1 | | 680 | | nm |
| 105 | S($\lambda$) | Spectral Sensitivity | $\lambda_{LED}$ = $\lambda$pk | | 0.45 | | A/W |
| **Photocurrent Amplifiers** | | | | | | | |
| 201 | Iph() | Permissible Photocurrent Operating Range | per sensor | 0 | | 200 | nA |
| 202 | $\eta$()r | Photo Sensitivity (light-to-voltage conversion ratio) | $\lambda_{LED}$ = 740 nm | 60 | | 120 | A/W |
| 203 | CR() | Photocurrent Gain | CR() = Iout() / Iph() | 150 | 200 | 250 | |
| 204 | fc()hi | Cut-off Frequency (-3 dB) | | 150 | 200 | | kHz |
| 205 | $\Delta$Iout()m | Channel Matching | deviation from mean value | -15 | | +15 | % |
| 206 | $\Delta$Iout()m | Channel Cross Talk | only one photosensor illuminated at the same time | | 0 | | % |
| **Current Source Outputs** | | | | | | | |
| 301 | Vout() | Permissible Output Voltage (Operating Range) | | 1 | | VCC - 1.5 | V |
| 302 | Iout() | Permissible Output Current | Vout() = 1 V ... VCC - 1.5 V<br>VCC = 4.5...5.5 V, Vout() = 1 V ... VCC - 2 V | -50<br>-200 | | | µA<br>µA |
| 303 | tr(), tf() | Output Current Rise/Fall Time | Iph: 0 → 100 nA, 1T settling (63%);<br>Vout() = constant<br>CL = 30 pF, RL() = 10 kΩ | | 0.7<br>0.8 | | µs<br>µs |
| 304 | Iout()0 | Output Dark Current | | -0.6 | | +0.6 | µA |

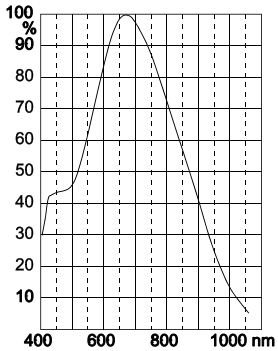



Figure 1: Relative spectral response

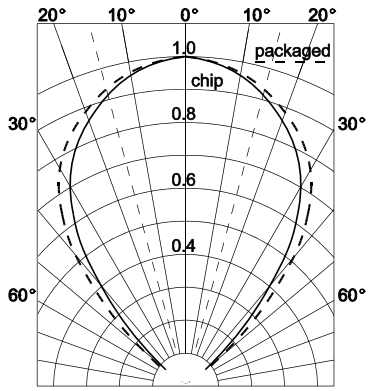



Figure 2: Typical directional characteristics

## APPLICATION CIRCUITS

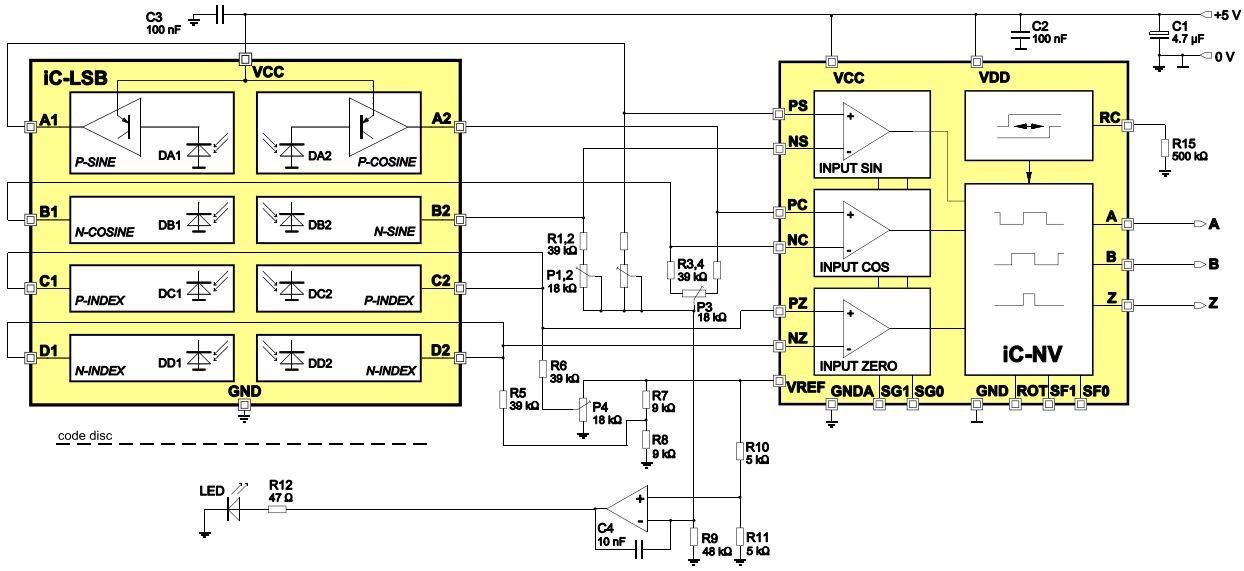



Figure 3: Optical encoder application example. Here, the sine-to-digital converter iC-NV is employed to output spike-free encoder quadrature signals featuring a minimum transition distance.


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We understand suitable application of our published designs to be state-of-the-art technology which can no longer be classed as inventive under the stipulations of patent law. Our explicit application notes are to be treated only as mere examples of the many possible and extremely advantageous uses our products can be put to.

## ORDERING INFORMATION

| Type | Package | Options | Order Designation |
|---|---|---|---|
| iC-LSB | - | | iC-LSB chip |
| | 14-pin optoBGA<br>6.2 mm x 5.2 mm | glass lid | iC-LSB oBGA LS2C |
| | 14-pin optoBGA<br>6.2 mm x 5.2 mm | on-chip reticle | iC-LSB oBGA LS2C-LSBxR |

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

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