iC-LSC
12-CHANNEL ACTIVE PHOTOSENSOR ARRAY

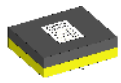
FEATURES

- 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 °C to 125 °C, customized COB modules, reticles and code discs

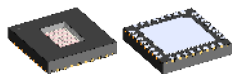
APPLICATIONS

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

PACKAGES

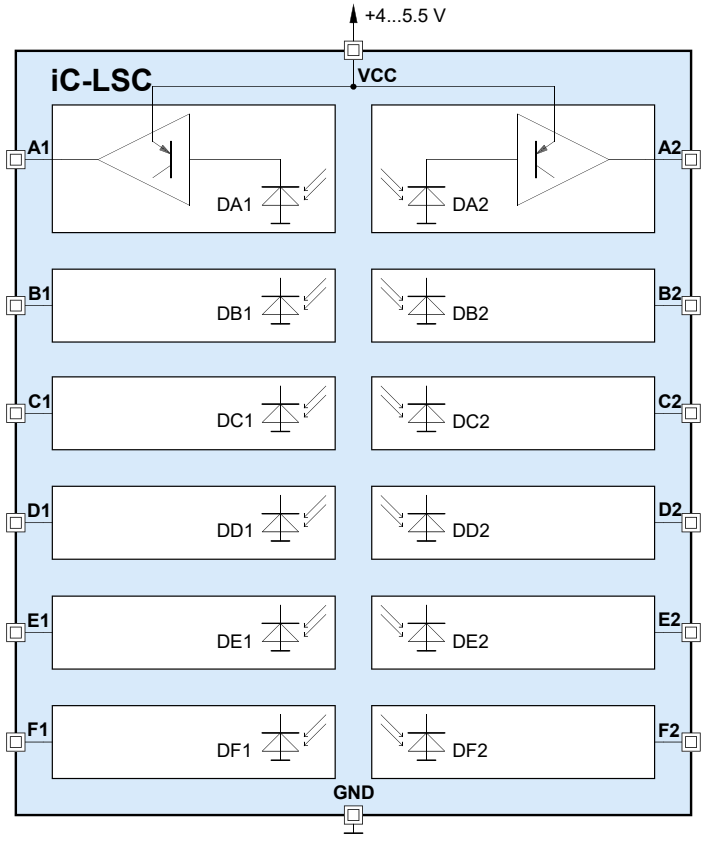


14-pin optoBGA
6.2 mm x 5.2 mm
RoHS compliant



32-pin optoQFN
5 mm x 5 mm / 0.9 mm
RoHS compliant

BLOCK DIAGRAM



DESCRIPTION

The iC-LSC sensor array, coming with 12 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, brushless DC motor commutation, 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.

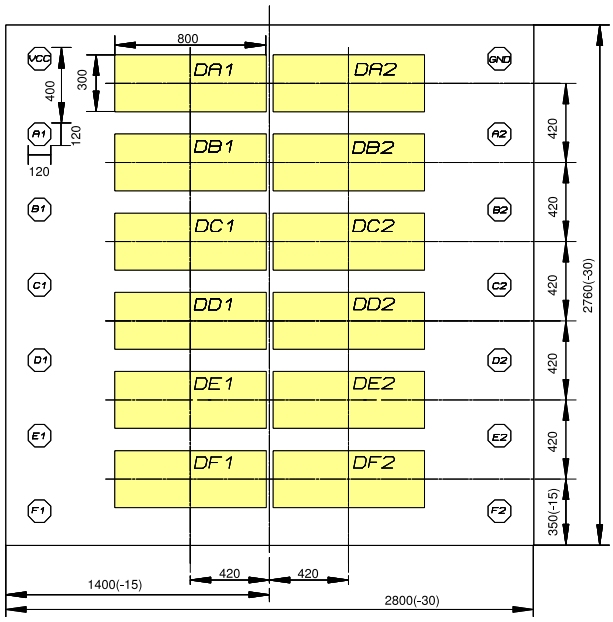
The highside current source output construction avoids a ground referenced signal and permits the subsequent electronics to adjust the gain. In its simplest form this is done by load resistors, for instance.

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.

PACKAGING INFORMATION

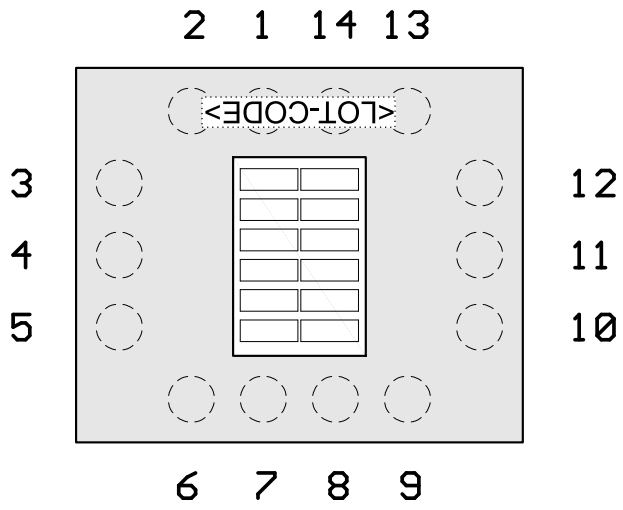
PAD LAYOUT
Chip size 2.80 mm x 2.76 mm



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	E1	Highside Current Source Output
7	F1	Highside Current Source Output
8	F2	Highside Current Source Output
9	E2	Highside Current Source Output
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 CONFIGURATION
oBGA LS2C (6.2 mm x 5.2 mm)

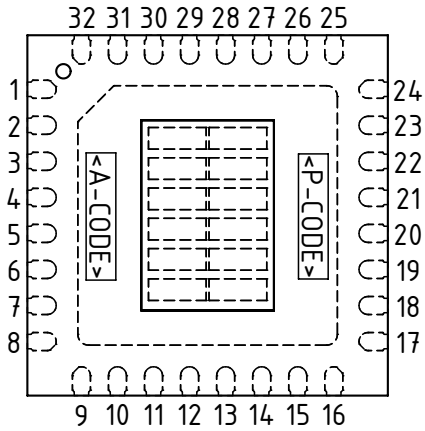


PIN FUNCTIONS

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	E1	Highside Current Source Output
7	F1	Highside Current Source Output
8	F2	Highside Current Source Output
9	E2	Highside Current Source Output
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

For dimensional specifications refer to the relevant package data sheet, available separately.
IC top markings (such as <P-CODE> = product code, <A-CODE> = assembly code, <LOT-CODE> = assembly and lot code) indicate the orientation of the device.

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

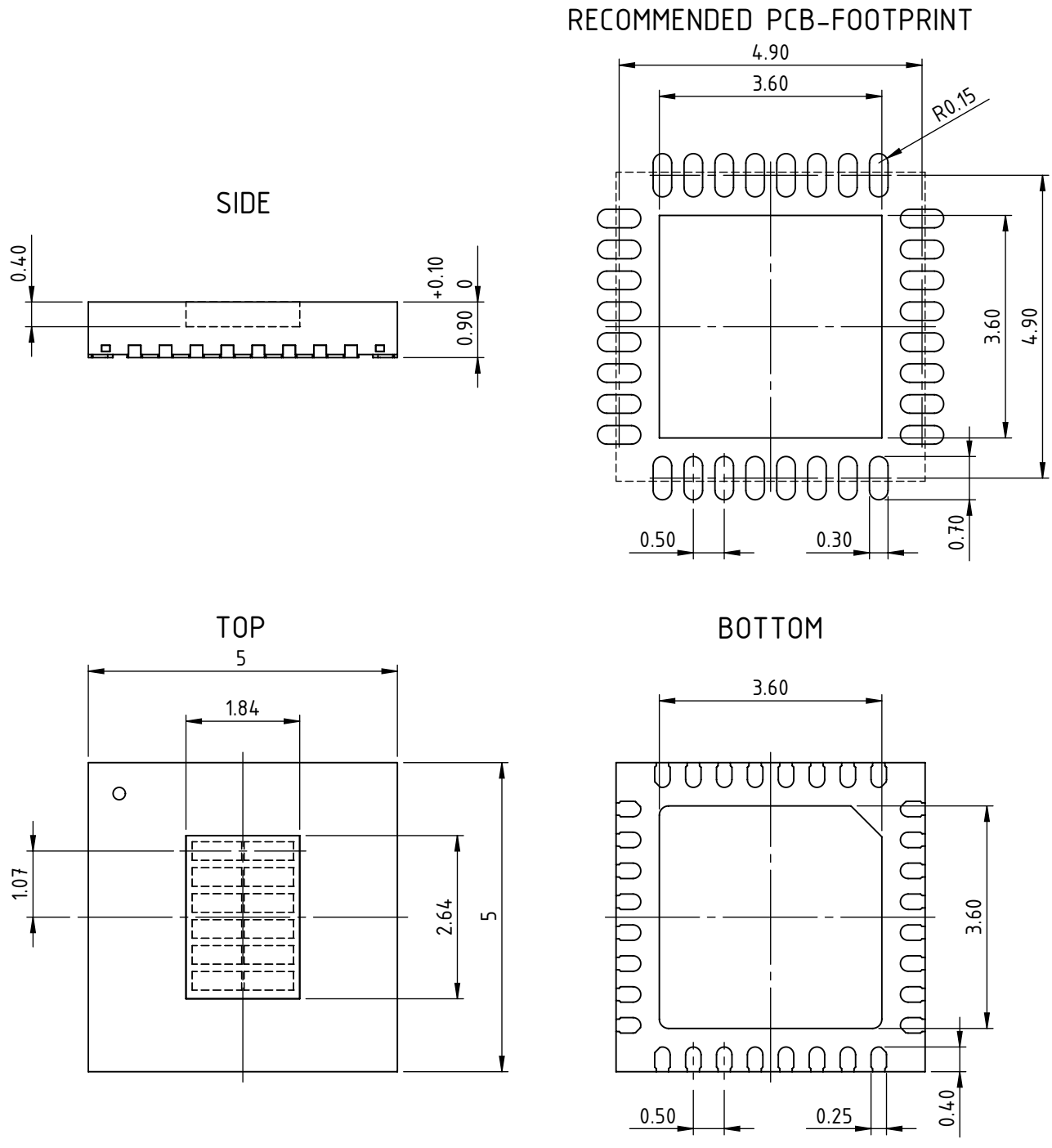


PIN FUNCTIONS

No.	Name	Function
1	VCC	+4...5.5 V Supply Voltage
2	n.c. [1]	
3	A1	Highside Current Source Output
4	B1	Highside Current Source Output
5	C1	Highside Current Source Output
6	D1	Highside Current Source Output
7	E1	Highside Current Source Output
8	F1	Highside Current Source Output
9...16	n.c.	
17	F2	Highside Current Source Output
18	E2	Highside Current Source Output
19	D2	Highside Current Source Output
20	C2	Highside Current Source Output
21	B2	Highside Current Source Output
22	A2	Highside Current Source Output
23	n.c.	
24	GND	Ground
25...32	n.c.	
	BP	Backside Paddle [2]

IC top marking: <P-CODE> = product code, <A-CODE> = assembly and lot code (subject to changes);
[1] Pin numbers marked n.c. are not in use.
[2] The backside paddle may have a single link to GND. A current flow across the paddle is not permissible.

PACKAGE DIMENSIONS oQFN32-5x5



All dimensions given in mm. General Tolerances of form and position according to JEDEC MO-220.
Positional tolerance of sensor pattern: ±70µm / ±1° (with respect to center of backside pad).
Maximum molding excess +20µm / -75µm versus surface of glass. Small pits in the mold surface, which may occasionally appear due to the manufacturing process, are cosmetic in nature and do not affect reliability.

dra_oqfn32-5x5-4_lsc_z_pack_1, 10:1

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 Range		-40	150	°C

THERMAL DATA

Item No.	Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
T01	Ta	Operating Ambient Temperature Range	package oQFN32-5x5 package oBGA LS2C package oBGA LS2C ET-40/125, extended temp. range	-40 -20 -40		125 90 125	°C °C °C
T02	Ts	Storage Temperature Range	package oQFN32-5x5 package oBGA LS2C package oBGA LS2C ET-40/125, extended temp. range	-40 -30 -40		125 110 125	°C °C °C
T03	Tpk	Soldering Peak Temperature	package oQFN32-5x5 tpk < 20 s, convection reflow tpk < 20 s, vapor phase soldering MSL 5A (max. floor life 24 h at 30 °C and 60 % RH); Refer to Handling and Soldering Conditions for details.			 245 230	 °C °C
T04	Tpk	Soldering Peak Temperature	package oBGA LS2C tpk < 20 s, convection reflow tpk < 20 s, vapor phase soldering TOL (time on label) 8 h; MSL 5A (max. floor life 24 h at 30 °C and 60 % RH); Refer to Handling and Soldering Conditions 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 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 Tj = 27 °C		 1.5	2	mA mA
003	I(VCC)	Supply Current in VCC	λ_{LED} = λpk, E() = 0.1 mW/cm^2 Tj = 27 °C		 2.2	4	mA 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	λ_{LED} = λpk			0.2	mW/cm^2
102	Aph()	Radiant Sensitive Area	0.8 mm x 0.3 mm per sensor		0.24		mm^2
103	λar	Spectral Application Range	Se(λar) = 0.25 x S(λ)max see Figure 1	400		950	nm
104	λpk	Peak Sensitivity Wavelength	see Figure 1		680		nm
105	S(λ)	Spectral Sensitivity	λ_{LED} = λpk		0.45		A/W
Photocurrent Amplifiers							
201	Iph()	Permissible Photocurrent Operating Range	per sensor	0		200	nA
202	η()r	Photo Sensitivity (light-to-voltage conversion ratio)	λ_{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	ΔIout()m	Channel Matching	deviation from mean value	-15		+15	%
206	ΔIout()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 VCC = 4.5...5.5 V, Vout() = 1 V ... VCC - 2 V	-50 -200			µA µA
303	tr(), tf()	Output Current Rise/Fall Time	Iph: 0 → 100 nA, 1T settling (63%); Vout() = constant CL = 30 pF, RL() = 10 kΩ		 0.7 0.8		 µs µs
304	Iout()0	Output Dark Current		-0.75		+0.75	µA

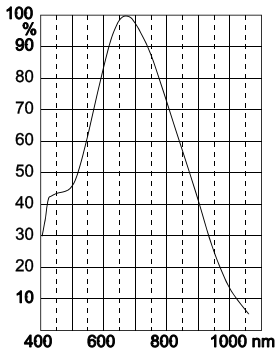


Figure 1: Relative spectral response

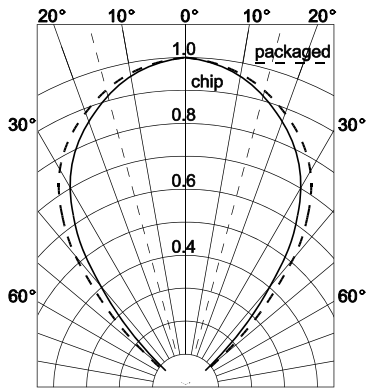


Figure 2: Typical directional characteristics

APPLICATION CIRCUITS

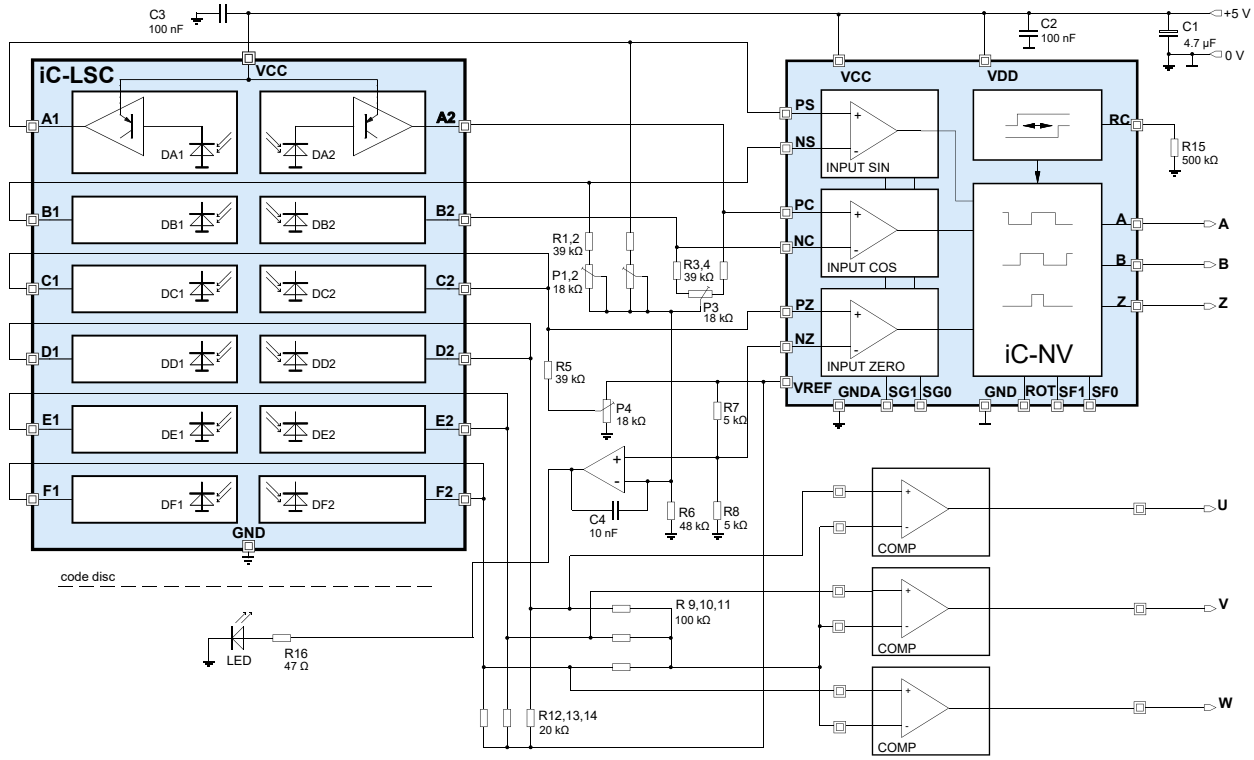


Figure 3: Optical encoder application example. Here, the sine-to-digital converter iC-NV is employed to output spike-free encoder quadrature signals featuring a minimum transition distance.

REVISION HISTORY

Rel.	Rel. Date*	Chapter	Modification	Page
C1	2013-04-19		RoHS supplemented, oQFN package drawing updated, thermal data: notes removed, Elec.Char. 304 leakage current, ordering information updated	

Rel.	Rel. Date*	Chapter	Modification	Page
D1	2021-06-23	PACKAGING INFORMATION	Update of oQFN package drawings and footnotes	3, 4
		THERMAL DATA	Items T01, T02: introduction of extended operational temperture ranges Item T03, T04: hyperlink to customer information	5
		ORDERING INFORMATION	Update of listing	9

* Release Date format: *YYYY-MM-DD*

ORDERING INFORMATION

Type	Package	Options	Order Designation
iC-LSC	32-pin optoQFN 5 mm x 5 mm, thickness 0.9 mm RoHS compliant	glass lid	iC-LSC oQFN32-5x5
	14-pin optoBGA 6.2 mm x 5.2 mm RoHS compliant	glass lid	iC-LSC oBGA LS2C
		on-chip reticle	iC-LSC oBGA LS2C-xR
iC-LSC	14-pin optoBGA 6.2 mm x 5.2 mm	glass lid, leaded solder balls	iC-LSC oBGA LS2C-1
		glass lid, leaded solder balls, extended temperature range	iC-LSC oBGA LS2C-1 ET-40/125

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