



## Product Selector Optical Encoder ICs • Silicon for Motion®

### Active Photodiode Arrays

iC-LSB	iC-LSC	iC-LSHB	iC-LSHC	iC-PN Series	iC-PNH Series	iC-PD Series	
•	•	•				•	Incremental
	•					•	Commutation
	•		•	•	•	•	Absolute
		•				•	Sin/Cos

### Single-Chip TTL Encoder ICs

iC-OF	iC-OW	iC-LTA	iC-PT33 Series	iC-PT26 Series	iC-PT39 Series	
•	•	•	•	•	•	Incremental
		•	•	•	•	Commutation

### Absolute Optical Encoder ICs

iC-OV	iC-LV	iC-OG	iC-WG	
• 5 bit	• 5 bit	• 8 bit	• 14 bit	Singleturn
- / •	• / •	- / •	- / •	Multiturn
				Serial / Parallel
		•		Sin/Cos
				Incremental

### High-Resolution Absolute Optical Encoder ICs

iC-LNG	iC-LNB	iC-LG	iC-LGC	iC-PNxx, iC-MN	iC-PNHxx, iC-MN	
• 16 bit	• 18 bit	• 21 bit	• 21 bit	• 21...23 bit	• 21...24 bit	Singleturn
		Interface	Interface	Interface	Interface	Multiturn
• / •	• / •	• / •	• / •	• / -	• / -	Serial / Parallel
• 512/1024 CPR	• 1024 CPR	•	•	•	•	Sin/Cos
	• FlexCount					Incremental

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Active Photodiode Arrays

[Overview](#)

Incr. / Com. / Absolute Type

	• / - / - <a href="#">iC-LSB</a>	• / • / • <a href="#">iC-LSC</a>	• / - / - <a href="#">iC-LSHB</a>	- / - / • <a href="#">iC-LSHC</a>	- / - / • <a href="#">iC-PN Series</a> Ø 26 mm: 2656, 2612, 2624 Ø 33 mm: 3356, 3312, 3324 Ø 39 mm: 3924	- / - / • <a href="#">iC-PNH Series</a> Ø 33 mm: 3348	• / - / • <a href="#">iC-PD Series</a> Ø 39 mm: 3948
<b>Chip Size</b>	2.8 x 1.96 mm	2.8 x 2.76 mm	2.88 x 2.04 mm	2.88 x 3.37 mm	2.88 x 3.37 mm	2.88 x 3.37 mm	2.88 x 3.37 mm
<b>Photosensors</b>	8	12	6	12	phased array	phased array	phased array
<b>Incr. Tracks</b>	4	6	4	6	3	3	1+2 for A/B/Z
<b>Absol. Tracks</b>						2	4 for C/D
<b>Radial Track Pitch</b>	420 µm	420 µm	380 µm, 450 µm	450 µm, 630 µm	1100 µm	530 µm	430 µm, 600 µm
<b>Radial Scan Length</b>	1560 µm	2400 µm	1610 µm		2940 µm		2940 µm
<b>Optical Window</b>	1.8 x 1.8 mm	1.8 x 2.6 mm	1.9 x 2.0 mm		1.9 x 3.2 mm		1.9 x 3.2 mm
<b>Illumination</b>	3 mm LED	5 mm LED	5 mm LED		5 mm LED		5 mm LED
<b>Min. Dot Size</b>	Ø 2.5 mm	Ø 3.2 mm	Ø 2.8 mm		Ø 3.4 mm		Ø 3.4 mm
<b>Analog Outputs</b>	300 µA highside	300 µA highside	diff., 250 mVpk		differential, 250 mVpk		diff., 250 mVpk
<b>Digital Outputs</b>	8x	12x	5x +Ref		12x +Ref	2x TTL/CMOS	10x + 3x Ref
<b>Supply (typ.)</b>	4 to 5 V, 2 mA	4 to 5 V, 2 mA	5 V, 7 mA		5 V, 10 mA		5 V, 10 mA
<b>OTR Ta [°C]</b>	-20...90	-20...90	-40...110		-40...110		-40...110
<b>Chip Tj [°C]</b>	-40...125	-40...125	-40...125		-40...125		-40...125
<b>Package</b>							
optoBGA (mm)	• 14-pin (6 x 5)	• 14-pin (6 x 5)	• 15-pin (6 x 5)		• 15-pin (6 x 5)	n/a	• 15-pin (6 x 5)
optoQFN (mm)	-	• 32-pin (5 x 5)	-		• 32-pin (5 x 5)	• 32-pin (5 x 5)	• 32-pin (5 x 5)
<b>Application</b>	Incremental Enc. Sine Encoder	Incremental Enc. Motor Enc. Absolute Enc.	Incremental Enc.		Nonius Absolute		Motor Enc. Sine Encoder
<b>Code Wheels</b> (glass) diameter [mm] - ppr	LSB7S 42-1024 LSB8S 42-2048	6-pole com. (120°): LSC3S 42-1024U	LSHB2S 42-1024 LSHB4S 42-4096 LSHB5S 26-3600		LSHC4S 26-256N (21 bit) LSHC11S 26-512N (22 bit) LSHC1S 26-1024N (23 bit) LSHC13S 33-256N (21 bit) LSHC9S 33-512N (22 bit) LSHC10S 33-1024N (23 bit) LSHC12S 39-1024N (23 bit)	PNH1S 33-2048 (24 bit)	PD2S 39-2048
<b>Related Products</b>	iC-MSB, iC-MQ		iC-MQ, iC-MSB, iC-HE, iC-HD		iC-MN		iC-MSB
<b>Recommended LED</b>	iC-TL85, iC-SD85		iC-TL85, iC-SD85		iC-TL85, iC-SD85		iC-TL85, iC-SD85



Optical Encoder ICs • Silicon for Motion®

Single-Chip TTL Encoder

[Overview](#)

Incr. / Com. / Absolute Type	• / - / - <a href="#">iC-OF</a>	• / - / - <a href="#">iC-OW</a>	• / • / - <a href="#">iC-LTA</a>	• / • / - <a href="#">iC-PT33 Series</a> Ø 33 mm: 3313, 3310, 3324, 3320, 3325	• / • / - <a href="#">iC-PT26 Series</a> Ø 26 mm: 2610, 2613, 2656, 2650
<b>Chip Size</b>	2.8 x 2.08 mm	4.02 x 3.24 mm	2.88 x 3.37 mm	2.88 x 3.37 mm	
<b>Photosensors</b>	6	5	9	phased array	
<b>Incr. Tracks</b>	3	1+1	6	6	
<b>Absol. Tracks</b>					
<b>Radial Track Pitch</b>	2x 300 µm	860 µm, 1410 µm		370 µm, 440 µm	
<b>Radial Scan Length</b>	1.8 mm	3.0 mm	3.1 mm	3.1 mm	
<b>Optical Window</b>	0.9(1.9) x 1.8 mm	2.2 x 3.2 mm	1.9 x 3.1 mm	1.9 x 3.2 mm	
<b>Illumination</b>	3 mm LED	LED + lens	5 mm LED	5 mm LED	
<b>Min. Dot Size</b>	Ø 2.1 mm	Ø 3.9 mm	Ø 3.4 mm	Ø 3.4 mm	
<b>Digital Outputs</b>	A, B, Z TTL 1.6 mA	A, B, gated Z TTL 1.6 mA	A, B, Z, U, V, W 4 mA push-pull	A, B, Z, U, V, W 4 mA push-pull	
<b>Index Gating</b>		• (1/4 T)	• (1/4 T, 1/2 T, 1 T)	• (1/4 T, 1/2 T, 1 T)	
<b>Analog Outputs</b>	70 µA push-pull (3x)		100 mV (9x)	100 mV (9x)	
<b>Supply (typ.)</b>	5 V, 2.3 mA	5 V, 6 mA	5 V, 3 mA	5 V, 3 mA	
<b>OTR Ta [°C]</b>	-20(40)...90	-20...90	-40...110	-40...110	
<b>Chip Tj [°C]</b>	-40...125	-25...125	-40...125	-40...125	
<b>LED Control</b>		• 50 mA low-side	• 40 mA high-side	• 40 mA high-side	
<b>Package</b>					
optoBGA (mm)	• 8-pin (5 x 4)	• 12-pin (9 x 6)	-	-	
optoQFN (mm)	-	-	• 32-pin (5 x 5)	• 32-pin (5 x 5)	
others	• 8-pin BLCC (10 x 7)				
<b>Application</b>	Incremental Enc.	Incremental Enc.	Incremental Enc. BLDC Motor Com.	Incremental Enc. BLDC Motor Commutation	
<b>Code Wheels (glass)</b> diameter [mm] - ppr	OF2S 18-1024	OW1S 42-1024 (sensor suits 2100-standards)	contact factory	6-pole com. (120°): PT1S 33-1250 (2500) PT2S 33-1000 (2000) PT3S 33-1024 (2048) PT4S 33-2000 (4000)	8-pole com. (90°): PT6S 26-1250 (2500) PT15S 26-1000 (2000)
<b>(plastic)</b>				8-pole com. (90°): PT5S 33-2500 (5000)	8-pole com. (90°): PT8S 26-1250 (2500) PT13S 26-500 (1000) PT14S 26-256 (512) PT16S 26-250 (500)
<b>Related Products</b>	<a href="#">iC-DL</a>	<a href="#">iC-WE</a> , <a href="#">iC-WD</a>	<a href="#">iC-DC</a> , <a href="#">iC-HE</a> , <a href="#">iC-HD7</a> , <a href="#">iC-HD2</a> , <a href="#">iC-DL</a>		
<b>Recommended LED</b>		<a href="#">iC-SN85</a>	<a href="#">iC-TL85</a> , <a href="#">iC-SD85</a>		

Absolute Optical Encoder ICs

Incr. / Com. / Absolute Type	- / - / • Multiturn <a href="#">iC-OV</a>	• / - / • <a href="#">iC-OG</a>	- / - / • <a href="#">iC-WG</a>	- / - / • Multiturn <a href="#">iC-LV</a>	• / - / • <a href="#">iC-LNG</a>	• / - / • <a href="#">iC-LNB</a>	PRELIM. - / - / • <a href="#">iC-LG</a> <a href="#">iC-LGC SAFETY</a>	- / - / • <a href="#">iC-PNxx</a> , <a href="#">iC-MN</a>
<b>Chip Size</b>	2.9 x 3.6 mm	3.0 x 5.1 mm	3.0 x 8.7 mm	1.7 x 3.5 mm	2.6 x 5.5 mm	3.3 x 5.5 mm	ca. 3.5 x 7.0 mm	2.9 x 3.4 mm (sensor)
<b>Photosensors</b>	6	16	28+	6	For further information refer to table High-Resolution Absolute Optical Encoder ICs			
<b>Absolute Tracks</b>	5 single-ended	8 differential	14 differential	5 single-ended				
<b>Analog Tracks</b>	1 reference			1 reference				
<b>Radial Track Pitch</b>	600 µm	300 µm per half track	300 µm per half track	600 µm				
<b>Radial Scan Length</b>	3.4 mm	4.8 mm	8.7 mm	3.4 mm				
<b>Optical Window</b>	1.0 mm x 3.4 mm	1 mm x 4.8 mm	2.2 mm x 8.7 mm	1.0 mm x 3.4 mm				
<b>Max. Signal Frequency</b>	to 200 kHz	to 200 kHz	to 100 kHz (3.000 rpm)	to 200 kHz				
<b>Signal Conditioning</b>								
<b>Interpolation</b>								
<b>Conversion Time</b>	< 0.5 µs	< 0.5 µs	< 0.5 µs	< 0.5 µs				
<b>Max. Angle Resolution</b>	<b>5 bit</b>	<b>8 bit</b>	<b>14 bit</b> <b>13 bit*</b>	<b>5 bit</b>				
<b>Interfaces</b> serial				SSI (2 MHz)				
microcontroller								
parallel	5 bit	8 bit	14 bit	5 bit				
analog		20 µA test only	20 µA test only					
multiturn								
EEPROM								
incremental								
<b>Supply</b> (typ.)	5 V (8 mA)	5 V (10 mA)	5 V (12 mA)	4 to 5.5 V (4 mA)	4 to 5.5 V (15 mA)	4 to 5.5 V (20 mA)	4 to 5.5 V (20 mA)	5 V (45 mA)
<b>OTR Ta</b> [°C]	-25...90	-20(40)...90(110)	-20(30)...90(110)	-40...125	-40...105	-40...110	-20(-40)...90(125)	-40...110
<b>Chip Tj</b> [°C]	-25...125	-40...125	-40...125	-40...125	-40...125	-40...125	-40...125	-40...125
<b>LED Control</b>	• 40 mA low-side	• 80 mA low-side	• 80 mA low-side	• 40 mA high-side	• 50 mA high-side	• 50 mA high-side	• 50 mA high-side	• 50 mA high-s.(iC-MN)
<b>External Components</b> active/passive	4x passive SMDs	4x passive SMDs	TTL line drivers, reverse protection diode, 5x passive SMDs					
<b>Package</b> optoBGA (mm)								
BLCC (mm)	• 14-pin (7.7 x 9.2)	• 20-pin (8.2 x 9.5)	• 28-pin (11.3 x 13.7)					
optoQFN (mm)								
<b>Application</b>	Multiturn (gear box scanning)	Singleturn, incremental, commutation	Singleturn	Multiturn (gear box scanning)	Singleturn incremental	Singleturn, incremental	Singleturn, Multiturn	Singleturn, Multiturn
<b>Code Wheels</b> diameter [mm] - ppr			WG1S 44-2048 (13 bit)		LNG1S 42-1024 (16 bit) LNG2S 25-512 (15 bit)	LNB1S 42-1024 (16 bit)	LG2S 42-2048 (19 bit) LG3S 42-4096 (20 bit) LG29S 25-1024 (18 bit) LG36S 32-2048 (19 bit)	LSHC4S 26-256 (21 bit) LSHC10S 33-1024 (23 bit)
<b>Related Products</b>	<a href="#">iC-DL</a>		<a href="#">iC-DL</a>		<a href="#">iC-SN85</a>	<a href="#">iC-SN85</a>	<a href="#">iC-MSB</a> , <a href="#">iC-LV</a> , <a href="#">iC-MV</a>	<a href="#">iC-LV</a> , <a href="#">iC-MV</a>
<b>Recommended LED</b>	<a href="#">iC-SN85</a>				<a href="#">iC-SN85</a>	<a href="#">iC-SN85</a>	<a href="#">iC-SG85</a>	<a href="#">iC-TL85</a> , <a href="#">iC-SD85</a>
			*) refers to WG1S		*) refers to LNG1S	*) refers to LNB1S	*) refers to LG2S	

PRELIM.

Device	<a href="#">iC-WG</a>	<a href="#">iC-LNG</a>	<a href="#">iC-LNB</a>	<a href="#">iC-LG</a>	<a href="#">iC-LGC SAFETY</a>	<a href="#">iC-PN26xx (33xx, 39xx)</a> <a href="#">iC-MN</a>
<b>Chip Size</b>	3.0 x 8.7 mm	2.6 x 5.5 mm	3.3 x 5.5 mm	3.5 x 7.0 mm	3.6 x 7.0 mm	2.9 x 3.4 mm (sensor)
<b>Photosensors Scanning</b>	28+ differential	15 single-ended vs. ref	26 leading/trailing vs. ref	62+ leading/trailing, fully differential	see iC-LG	24+ phased array, differential
<b>Absolute Tracks Sin/Cos CPR</b>	13(14) bits Gray	11 bits Gray 512, 1024	10 bits binary 1024	10...13 bits binary 512, 1024, 2048, 4096, 8192		256/255/240 ... 1024/1023/992
<b>Radial Track Pitch</b>	300 µm / half track	400 µm	400 µm	250 µm (420 µm)		450 µm (630 µm)
<b>Radial Scan Length</b>	8.7 mm	5.2 mm	5.2 mm	6.9 mm		3.3 mm
<b>Optical Window</b>	2.2 mm x 8.7 mm	1.9 mm x 5.4 mm	1.9 mm x 5.4 mm	2.8 mm x 6.9 mm		1.9 mm x 3.3 mm
<b>Max. Signal Frequency</b>	100 kHz (3000 rpm)	200 kHz (12000 rpm)	16 bit: 200 kHz (12000 rpm) 17 bit: 100 kHz (6000 rpm) 18 bit: 50 kHz (3000 rpm)	400 kHz (12000 rpm @ 2048 CPR)		200 kHz (12000 rpm @ 1024 CPR)
<b>Signal Conditioning</b>		<ul style="list-style-type: none"> <li>Offset</li> <li>Amplitude</li> </ul>	<ul style="list-style-type: none"> <li>Offset</li> <li>Amplitude</li> </ul>	<ul style="list-style-type: none"> <li>Offset</li> <li>Amplitude</li> </ul>		<ul style="list-style-type: none"> <li>Offset</li> <li>Amplitude</li> <li>Phase</li> </ul>
<b>Interpolation Conversion Time</b>	< 0.5 µs	6 bit flash 100 ns	8 bit vector tracking < 0.5 µs	8 bit S&H SAR ca. 4 µs @ 8 bit		13 bit S&H SAR ca. 4.2 µs @ 13 bit
<b>Max. Angle Resolution</b>	<b>13 bit @ 2048 CPR</b> (14 bit @ 4095 CPR)	<b>16 bit</b>	<b>18 bit</b>	<b>19 bit @ 2048 CPR</b> (21 bit @ 8192 CPR)	<b>21 bit @ 2048 CPR*</b>	<b>21 bit @ 256 CPR</b> (23 bit @ 1024 CPR)
<b>Elec. Accuracy</b>	80"	20" (+/- 1 LSB)	20" (+/- 1 LSB @ 16 bit)	10" (+/- 2 LSB)		20" (+/- 4 LSB)
<b>Alignment Chip to Disc</b>	@ WG1S 44-2048:	@ LNG1S 42-1024:	@ LNB1S 42-1024:	@ LG2S 42-2048		@ LSHC4S 26-256:
Tilt Angle	+/- 0.1°	+/- 0.6°	+/- 1.8°	+/- 0.7° (+/- 0.35° @ LG3S)		+/- 0.2°
Radial Displacement	+/- 30 µm	+/- 30 µm	+/- 100 µm	+/- 30 µm		+/- 50 µm
<b>Data Formats</b>	<ul style="list-style-type: none"> <li>Gray code (by code disc)</li> </ul>	<ul style="list-style-type: none"> <li>Gray code (all interfaces)</li> </ul>	<ul style="list-style-type: none"> <li>Gray code (all interfaces)</li> <li>binary code (shift reg.)</li> </ul>	<ul style="list-style-type: none"> <li>Gray code (all interfaces except µC interface)</li> <li>binary code (all interfaces)</li> </ul>	<ul style="list-style-type: none"> <li>Gray code (all interfaces except µC interface)</li> <li>binary code (all interfaces)</li> </ul>	<ul style="list-style-type: none"> <li>Gray code (SSI)</li> <li>binary code (BiSS, SSI)</li> </ul>
<b>Interfaces serial</b>		Shift register (16 MHz) SSI (by external Flip-Flop) 4-pin SPI (3.3 V, 10 MHz)	Shift register (16 MHz) SSI (timeout via µC) 4-pin SPI (3.3 V, 10 MHz)	SSI (100 kHz...4 MHz) <b>BiSS B</b> (10 MHz) 8-bit parallel 15 bit (max. @ 4096 CPR)	SSI (2 MHz) <b>BiSS C</b> (10 MHz) 8-bit parallel 15 bit (max. @ 4096 CPR)	SSI (4 MHz) <b>BiSS C</b> (10 MHz)
microcontroller	14 bit	14 bit	16 bit	8-bit parallel 15 bit (max. @ 4096 CPR)	8-bit parallel 15 bit (max. @ 4096 CPR)	1 Vpp differential SSI, BiSS C (1, 4, 8...24 bit)
parallel	20 µA test only	2 Vpp diff. (1 kOhm)	2 Vpp diff. (1 kOhm)	250 mVp single-ended SSI (12, 16, 20, 24 bit)	250 mVp single-ended SSI (12, 16, 20, 24 bit)	I2C (CRC protected)
analog		A/B/Z (x1, 2, 4, 8, 16): 1024, ..., 16384 PPR	A/B/Z FlexCount®: 1, ..., 65536 PPR	I2C (check value)	I2C (CRC protected)	
multiturn						
EEPROM						
incremental						
<b>External Components</b>	TTL line drivers, reverse protection diode, 5x passive SMDs	Microcontroller 3.3 V, RS422 Transceiver	Microcontroller 3.3 V, RS422 Transceiver	EEPROM, RS422 Transceiver, OpAmps, reverse protection diode, ca. 20 passive SMDs		EEPROM, ca. 5 passive SMDs
<b>Package</b> optoBGA (mm)		• 30-pin (7.6 x 7.1)	• 30-pin (7.6 x 7.1)	• 42-pin (8 x 10)		• 15-pin (6 x 5),
BLCC (mm)	• 28-pin (11.3 x 13.7)	2012: • 38-pin (7 x 5)	2012: • 38-pin (7 x 5)	• 40-pin (10.2 x 11.9)		• 32-pin (5x5), 48-pin QFN (7x7)
optoQFN (mm)						