



Product Selector • Optical Encoder ICs

Incremental Opto Encoder ICs

	iC-OF	iC-LSC	iC-LSHB	iC-PD3948	iC-LTA	iC-PT H-Series (EncoderBlue®)	iC-PX Series EncoderBlue®	iC-PR Series EncoderBlue®
Reflective							•	•
Incremental	A/B/Z	A/B/Z	A/B/Z	Z	A/B/Z	A/B/Z	A/B	A/B/Z
Commutation		U/V/W			U/V/W	U/V/W		
Sin/Cos		•	•	S/C	•	•		•
Absolute		•		C/D				
Linear		•	•		•			•

Absolute Optical Encoder ICs

Part A

	iC-LV	iC-PG EncoderBlue®	iC-OG	iC-WG	iC-LNG	iC-LNB
Reflective		•				
Code	Gray	Serial	Gray / Incr.	Gray	Gray	Binary
Singleturn	• 5 bit	• 5 bit Gray	• 8 bit	• 14 bit	• 16 bit	• 18 bit
Multiturn	Cascadable					
Serial / Parallel	• / •	- / •	- / •	- / •	• / •	• / •
Sin/Cos					• 512 / 1024 CPR	• 1024 CPR
Incremental			•		•	A/B/Z FlexCount
Linear					•	•

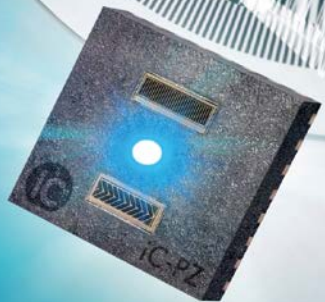
High-Resolution Absolute Optical Encoder ICs

Part B

	iC-LGC	iC-LGC & iC-MR3	iC-PN/H Series & iC-MNF (EncoderBlue®)	iC-RZ Series EncoderBlue®	iC-RZ Series & iC-MR3 EncoderBlue®	iC-PZ Series EncoderBlue®
Reflective						•
Code	Binary	Binary	Nonius	Pseudo-Random	Pseudo-Random	Pseudo-Random
Singleturn	• 9...22 bit	• 25 bit	• 20...25 bit	• 15 bit	• 24 bit	• 22 bit
Multiturn	Interface	Interface	Interface	Interface	Interface	Interface
Serial / Parallel	• / •	• / •	• / -	• / -	• / •	• / -
Sin/Cos	•	•	•	•	•	•
Incremental						A/B/Z FlexCount
Commutation						U/V/W
Linear						• 29 bit
Safety		•		•	•	

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	iC-OF	iC-LSC	iC-LSHB	iC-PD3948	iC-LTA	iC-PT H-Series	iC-PX	iC-PR Series	iC-PR256
Application	Incremental rotary enc.	Incr. lin/rotary enc., motor commutation, low-res. absolute enc.	Incremental rotary enc.	Sine encoders (elevators), AC servo feedback	Incremental rotary enc., AC servo feedback, BLDC commutation	Incremental rotary enc., AC servo feedback, BLDC commutation <i>(EncoderBlue®)</i>	Incremental rotary enc.	Incremental rotary enc.	Linear position enc.
Related Components	iC-DL, iC-VX		iC-MSB, iC-MQ, iC-PI, iC-HE, iC-HD7	iC-MSA, iC-MSB, iC-MSC	iC-HF, iC-HD7	iC-HF, iC-HD7	iC-HD7	iC-TW28, iC-HD7	iC-TW28, iC-TW29
Recommended LED	IR LED Ø 3 mm	IR LED Ø 5 mm	iC-TL85, iC-SD85	iC-SD85, iC-TL46	iC-SD85, iC-TL46	iC-SD85, iC-TL46	Built-in	Built-in	Built-in
Type	Transmissive Disc Size [mm] Ø 18, custom Disc Pattern 6 tracks Disc Track Width Radial 1.8 mm Disc Resolution	Transmissive Ø 42, custom 6 tracks 2.4 mm	Transmissive Ø 26, 42, custom 3 tracks 1.6 mm 1024, 3600, 4096 CPR	Transmissive Ø 39 7 tracks 3.0 mm	Transmissive Custom 6 tracks 3.1 mm	Transmissive Ø 26, 33, 39 6 tracks 3.1 mm 250... 2500 CPR	Reflective Ø 26, 32 1 tracks 1.9 mm 360... 720 CPR	Reflective Ø 4, 14, 26, 43 2 tracks 1.1 mm 64... 720 CPR	Reflective Custom 2 tracks 1.1 mm 256 µm
Scanning	Pixel array Number of Photo Sensors 6 Radial Track Pitch 300 µm per half track Optical Window 0.9 x 1.8 mm	Pixel array 12 420 µm 1.8 x 2.6 mm	Pixel array 6 380... 450 µm 1.9 x 2.0 mm	Phased array Multiple (4 for C/D) 430... 600 µm 1.9 x 3.2 mm	Pixel array 9 370... 450 µm 1.9 x 3.1 mm	Phased array Multiple (3 for UVW) 370... 450 µm 1.9 x 3.2 mm	Phased array Multiple (single track) 1.1 mm 1.7 x 0.9 mm	Phased array Multiple 1.1 mm 1.8 x 1.8 mm	Phased array Multiple 1.1 mm 1.8 x 1.8 mm
Operating Speed	Typ. System Accuracy			6000 rpm 20" (0.7" for C/D)		9600... 96000 rpm 180... 40"	9600... 32000 rpm 240... 60"	9600... 180000 rpm 240... 60"	28... 50 m/s
Interpolation	Comparators	-	-	-	Flash conversion 400 kHz x1, x2, x4	Flash conversion 400 kHz 32" (@ 2500 CPR) x1, x2, x4	6-bit Flash conversion 200 kHz 28" (@ 720 CPR) x1 to x16	6-bit Flash conversion 200 kHz 28" (@ 720 CPR) x1 to x16	6-bit Flash conversion 200 kHz 4 µm (per 256 µm) x1 to x16
Typ. Latency	1.5 µs				1 µs	1 µs	2 µs	2 µs	2 µs
Signal Conditioning	Offset / Ampl. / Phase Linearization / Stabiliz.	- / - / - - / -	- / - / - - / -	- / - / - - / ● (iC-MSA/MSB)	- / - / - - / ● LED Control	- / - / - - / ● LED Control	- / - / - - / ● LED Control	- / - / - - / ● LED Control	- / - / - - / ● LED Control
Interfaces	Gated Z Incremental (A,B,Z) Commutation (U,V,W) Analog Sin/Cos Absolute Position Serial I/O Parallel I/O I ² C Interf. / On-Chip E ² P ADI (Period Counting)	- TTL 1.6 mA (3x) - 70 µA push-pull (3x)	- - - 300 µA high-side (12x)	- - - 200... 500 mVpp, and reference (1x)	- - - 200... 500 mVpp, and reference (3x) Sin/Cos 1 cpr at C/D	1/4 T, 1/2 T, 1 T 4 mA push-pull (6x) 4 mA push-pull (3x) 200... 500 mVpp (w/o reference)	1/4 T, 1/2 T, 1 T 4 mA push-pull (6x) 4 mA push-pull (3x) 200... 500 mVpp (w/o reference)	- 4 mA push-pull (2x) - 500 or 1000 mVpp (w. optional reference)	1/4 T, 1/2 T, 1 T 4 mA push-pull (6x) - 500 or 1000 mVpp (w. optional reference)
Configuration	n/a	n/a	n/a	n/a	By pins	By pins	By pins	By pins	By pins
Supply	5 V (2.3 mA)	4 ... 5 V (2 mA)	5 V (7 mA)	5 V (10 mA)	5 V (3 mA)	5 V (3 mA)	5 V (15 mA)	5 V (20 mA)	5 V (20 mA)
Operating Temp. Range	-20(-40)... +90 °C	-20... +90 °C	-40... +110 °C	-40... +110 °C	-40... +120 °C	-40... +120 °C	-40... +105 °C	-40... +105 °C	-40... +105 °C
Special Functions					LED control output	LED control output	Integrated LED	Integrated LED	Integrated LED
Package	8-pin oBGA (5 x 4) 8-pin BLCC (10 x 7)	14-pin oBGA (6 x 5) 32-pin oQFN (5 x 5)	15-pin oBGA (6 x 5)	15-pin oBGA (6 x 5) 32-pin oQFN (5 x 5)	15-pin oBGA (6 x 5) 32-pin oQFN (5 x 5)	32-pin oQFN (5 x 5)	8-pin oDFN (3 x 3)	24-pin oQFN (4 x 4)	24-pin oQFN (4 x 4)

Product Selector • Absolute Opto Encoder ICs



	iC-LV	iC-PG	iC-OG	iC-WG	iC-LNG	iC-LNB	Other
Type	Transmissive Disc Size [mm] Custom Disc Pattern Gray code	Reflective EncoderBlue® Ø 8 Serial	Transmissive Custom Gray code / incremental	Transmissive Ø 44, custom Gray code	Transmissive Ø 42 Gray code + sin/cos 512, 1024 cpr	Transmissive Ø 26, 42 Binary code + sin/cos 1024 cpr	Refer to Product Selector High-Resolution Absolute Encoder ICs Part B
Disc Track Width Radial	3.4 mm	2.3 mm	4.8 mm	8.7 mm	5.2 mm	5.2 mm	
Disc Resolution	5 bit	5 bit	8 bit	13 bit	11 bit	10 bit	
Scanning	Single-ended vs. ref	PRC array	Differential	Differential	Single-ended vs. ref	Leading/trailing vs. ref	
Number of Photo Sensors	6	36	16	28+	15	26	
Radial Track Pitch	600 µm	(single track)	300 µm per half track	300 µm per half track	400 µm	400 µm	
Optical Window	1.0 mm x 3.4 mm	0.6 x 1.7 mm	1 mm x 4.8 mm	2.2 mm x 8.7 mm	1.9 mm x 5.4 mm	1.9 mm x 5.4 mm	
Operating Speed	360000 rpm	300 rpm	80000 rpm	3000 rpm	12000 rpm	12000 rpm @ 16 bit 6000 (3000) rpm @ 17 (18) bit	
Typ. System Accuracy	5.6'	6'	80"	80"	20"	20"	
Interpolation	- (comparators)	-	- (comparators)	- (comparators)	6-bit Flash	8-bit Vector Tracking	
Max. Sine Frequency	200 kHz		200 kHz	100 kHz	200 kHz	200 kHz @ 16 bit 100 (50) kHz @ 17 (18) bit	
Max. Resol. (per rev.)	5 bit	12° (30 steps)	8 bit	14 bit	16 bit @ 1024 CPR	18 bit @ 1024 CPR	
AB Interpol. Factors					x1, x2, x4, x8, x16	FlexCount®	
Accuracy (per inp. cyc.)					+/- 1 LSB	+/- 1 LSB @ 16 bit	
Typ. Latency	1.5 µs	250 µs (1 ms max)	1.5 µs	1.5 µs	1 µs	1.5 µs	
Signal Conditioning							
Offset / Ampl. / Phase	- / - / -		- / - / -	- / - / -	• / • / -	• / • / -	
Linearization / Stabiliz.	- / • LED Control		- / • LED Control	- / • LED Control	- / -	- / -	
Interfaces							
Gated Z	-	-	-	-	1/2 T	1/4 T, 1/2 T	
Incremental (A,B,Z)	-	-	-	-	1024, ..., 16384 CPR	1... 65536 CPR	
Commutation (U,V,W)	-	-	-	-	-	-	
Analog Sin/Cos	-	0.5... 4.5V lin. for Z axis	20 µA test only	20 µA test only	2 Vpp (1 kΩ)	2 Vpp (1 kΩ)	
Absolute Position	• Gray code • Binary code	• Gray code	• Gray code	• Gray code	• Gray code (all interfaces)	• Gray code (all interfaces) • Binary code (shift reg.)	
Serial I/O	Shift reg., SSI (2 MHz)				Shift register (16 MHz) SSI (with ext. Flip-Flop)	Shift register (16 MHz) SSI (timeout via µC)	
Parallel I/O	5 bit	5 bit (1.6 mA push-pull)	8 bit	14 bit	4-pin SPI (10 MHz, 3.3V up)	4-pin SPI (10 MHz, 3.3V up)	
I ² C Interf. / On-Chip E ² P	- / -	- / -	- / -	- / -	14 bit	16 bit	
Absol. Data Interf. (MT)	-	-	-	-	- / -	- / -	
Period Counting	-	-	-	-	-	-	
External Components							
Active		-		TTL line drivers, reverse protection diode	Microcontroller 3.3 V, RS422 Transceiver, IR LED (iC-SN85)	Microcontroller 3.3 V, RS422 Transceiver, IR LED (iC-SN85)	
Passive		1 SMD	Approx. 4 SMDs	Approx. 5 SMDs			
Configuration	By pins	n/a	n/a	n/a	External MCU	External MCU	
Supply	4 to 5.5 V (4 mA)	5 V (8 mA)	5 V (10 mA)	5 V (12 mA)	5 V (15 mA)	5 V (20 mA)	
Operating Temp. Range	-40... +125 °C	-40... +105 °C	-20(-40)... +90(+110) °C	-20(-30)... +90(+110) °C	-40... +110 °C	-40... +110 °C	
Special Functions	Daisy chain capable	Push-button function				Arbitrary ABZ output	
Package	16-pin BLCC (7 x 7) 32-pin oQFN (5 x 5)	8-pin oDFN (3 x 3)	20-pin BLCC (8.2 x 9.5)	28-pin BLCC (11.3 x 13.7)	30-pin oBGA (7.6 x 7.1) 38-pin oQFN (7 x 5)	30-pin oBGA (7.6 x 7.1) 38-pin oQFN (7 x 5)	

Part A

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	iC-LGC		iC-PN Series		iC-PNH Series		iC-RZ Series NEW		iC-PZ2656 PRELIM.		iC-PZ205 PRELIM.	
	iC-MR3		iC-LSHC		(EncoderBlue®)		EncoderBlue®		EncoderBlue®		EncoderBlue®	
Type	Transmissive		Transmissive		Transmissive		Transmissive		Reflective		Reflective Lin./Off-Axis	
Disc Size [mm]	Ø 32, 42, custom		Ø 18, 26, 33, 39, custom		Ø 26, 33, 39		Ø 26.5, 42.8, 43.6		Ø 26		Length to 6.71 m	
Disc Pattern	Binary + sin/cos		3-track Nonius		3-t. Nonius +2-bit Gray		PRC +Incr. +Sin/Cos		PRC + Incremental		PRC + Incremental	
Disc Track Width Radial	512, 1024, 2048, 4096, 8192 cpr		64 CPR ... 1024 CPR		128 CPR ... 2048 CPR		1024 CPR (2048 CPR)		256 CPR		204.8 µm	
Disc Resolution	6.9 mm		3.3 mm		3.3 mm		2.6 mm		8 bit		15 bit	
	10... 13 bits		6... 10 bit		7... 11 bit		10 bit PRC (11 bit)					
Scanning	Leading/trailing, differential		Phased array		Phased array		Phased & PRC arrays (2x)		Phased & PRC arrays		Phased & PRC arrays	
Number of Photo Sensors	62+		Multiple		Multiple		600... 800 µm		1.2 mm (track to LED)		1.2 mm (track to LED)	
Radial Track Pitch	250 µm (420 µm)		1080 µm		530 µm		2.6 mm x 2.6 mm		0.7 mm x 2.6 mm (2x)		0.7 mm x 2.6 mm (2x)	
Optical Window	2.8 mm x 6.9 mm		1.9 mm x 3.2 mm		1.9 mm x 3.2 mm							
Operating Speed	14000 rpm @ 2048 CPR		14000 rpm @ 2048 CPR		12000 rpm @ 1024 CPR		14400 rpm		14000 rpm @ 2048 CPR		56000 rpm	
	7200 rpm @ 4096 CPR		7200 rpm @ 4096 CPR		6000 rpm @ 2048 CPR						50 m/s	
Typ. System Accuracy	20"		20"		60" ... 10"		40" (raw data)		40" ... 10"		40" ... 20"	
Interpolation	3-bit Flash / 10-bit S&H SAR		13-bit S&H SAR		14-bit S&H SAR		5-bit Flash (2x)		13-bit S&H SAR		14-bit Vector Tracking	
Max. Sine Frequency	500 kHz		500 kHz		200 kHz		500 kHz		500 kHz		240 kHz	
Max. Angle Resolution (per revolution)	21 bit @ 2048 CPR		24 bit @ 2048 CPR		25 bit @ 2x1024 CPR		15 bit (2x)		23 bit @ 1024 CPR		240 kHz	
AB Interpol. Factors	22 bit @ 4096 CPR		25 bit @ 4096 CPR						24 bit @ 2048 CPR		29 bit	
Accuracy (per inp. cyc.)	+/- 3 LSB		+/- 2 LSB		+/- 4 LSB		+/- 0.5 LSB @ 15 bit		+/- 2 LSB		FlexCount®	
Typ. Latency	Approx. 5.5 µs (@ 10 bit)		Approx. 3.5 µs (@ 13 bit)		Approx. 3.5 µs (@ 13 bit)		Approx. 3.5 µs (@ 13 bit)		Approx. 3.5 µs (@ 13 bit)		Approx. 0.5 µs	
Signal Conditioning	● / ● / -		● / ● / ●		- / - / -		● / ● / ●		● / ● / ●		● / ● / ●	
Offset / Ampl. / Phase Linearization / Stabiliz.	- / ● LED Control		- / ● LED Control		- / - / -		- / ● LED Control		- / ● LED Control		● Ecc.- Corr. / ● LED Ctrl.	
Interfaces	Gated Z		-		-		-		-		1/4 T, 1/2 T, 1 T	
Incremental (A,B,Z)	-		-		A/B 1 CPR		-		-		1... 1048576 CPR (2 ²⁰)	
Commutation (U,V,W)	-		-		-		-		-		1... to 2 ²⁷	
Analog Sin/Cos	250 mVp single-ended		500 mVpp @100Ω		200... 500 mVpp		200... 500 mVpp		500 mVpp (1 kΩ)		500 or 2000 mVpp	
Absolute Position	● Gray code (all interfaces except µC interface)		● Binary code (all interfaces)		-		● Gray code (SSI)		● Binary code (BISS, SSI)		● Gray code (SSI)	
Serial I/O	SSI (4 MHz)		SSI (4 MHz)		-		SSI (500 kHz)		SSI (4 MHz)		SSI (20 MHz)	
	BISS C (10 MHz)		BISS C (10 MHz)		-		BISS C (10 MHz)		BISS C (10 MHz)		BISS C (20 MHz)	
	4-pin SPI (10 MHz, 2.5V up)		4-pin SPI (10 MHz, 2.5V up)		4-pin SPI (8 MHz, 3.3V up)		5-pin SPI (8 MHz, 3.3V up)		4-pin SPI (10 MHz, 2.5V up)		4-pin SPI (12 MHz, 2.5V up)	
Parallel I/O	14/15 bit @ 2048/4096 CPR		8-bit MCU		-		-		8-bit MCU		-	
i ² C Interf. / On-Chip E ² P	Single-master / -		Single-master / -		- / -		Single-master / -		Multi-master / -		Multi-master / -	
Absol. Data Interf. (MT)	SSI (12, 16, 20, 24 bit)		SSI, BiSS C (0...14, ...48 bit)		-		SSI, BiSS C (1... 24 bit)		2x SSI (0, 12, 16 bit) and other modes		SSI (1... 32 bit)	
Period Counting	24 bit max.		13 bit (ST) + 24 bit (MT)		-		24 bit max.		24 bit max.		32 bit max.	
External Components	Active		EEPROM, RS422 Transceiver, OpAmps, reverse protection diode, IR LED (iC-SG85)		IR LED (iC-TL85) or blue LED (iC-TL46)		IR LED (iC-TL85) or blue LED (iC-TL46)		EEPROM, blue LED (iC-TL46, iC-SZ)		EEPROM, RS422 Transceiver, reverse & ESD protection diodes	
Passive	Approx. 20 SMDs						Approx. 5 SMDs		Approx. 5 SMDs		Approx. 5 SMDs	
Configuration	External EEPROM		Ext. EEPROM, MCU (SPI, PAR)		-		Ext. EEPROM, SPI, BiSS		By pin (CC), ext. EEPROM or SPI (SC), BiSS (CC, SC)		Ext. EEPROM, MCU (SPI, PAR)	
Supply	5 V (15 mA)		5 V (2.5 to 5 V) (34 mA)		5 V (10 mA)		5 V (10 mA) (VB >1.8 V)		5 V (60 mA)		5 V (2.5 to 5 V) (34 mA)	
Operating Temp. Range	-20(-40)... +90(+120) °C		-40... +125 °C		-40... +110 (+125) °C		-40... +125 °C		-40... +125 °C		-40... +125 °C	
Special Functions	Temperature monitoring		Safety diagnostics, temperature sensor input		Low power MT		GPIO pins, BiSS transceiver, reverse polarity protection		Safety channel (SC), temperature monitoring		Safety diagnostics, temperature sensor input	
Package	42-pin BLCC (8 x 10)		48-pin QFN (7 x 7)		32-pin oQFN (5 x 5)		32-pin oQFN (5 x 5)		48-pin QFN (7 x 7)		38-pin oQFN (7 x 5)	
	40-pin oBGA (10.2 x 11.9)				15-pin oBGA (6 x 5)						48-pin QFN (7 x 7)	