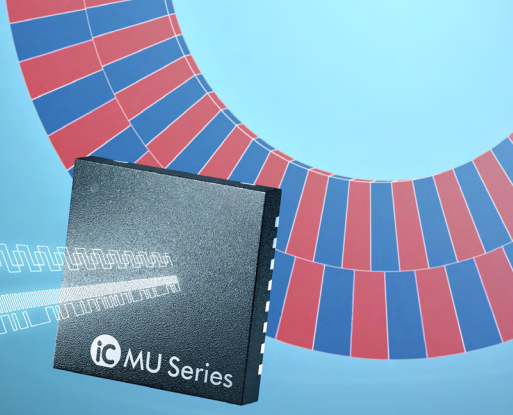
iC-MU Series

Magnetic Off-Axis Absolute Position Encoders



Description

iC-MU Series is used for magnetic off-axis position detection with integrated Hall sensors. By scanning two separate channels i.e. the master and nonius track, the device provides an absolute position within one mechanical revolution. The internal 12-bit sine/digital converters generate two position words that supply high-precision position data within one sine-period. The integrated nonius calculation engine calculates the absolute position within one mechanical revolution and synchronizes this with the master track position word. Position data can be transmitted serially (BiSS C, SSI, SPI), incrementally, or as analog signals through two ports in various modes of operation. Commutation signals (U, V, W) for brushless DC (BLDC) motors with up to 16 pole pairs are derived from the absolute position and supplied through a 3-pin interface. Besides 2-track nonius computation, iC-MU Series is capable of extending the rotary or linear absolute position range using 3-track nonius computation. A second iC-MU Series iC can be connected in a special daisy chain mode using the multiturn interface.

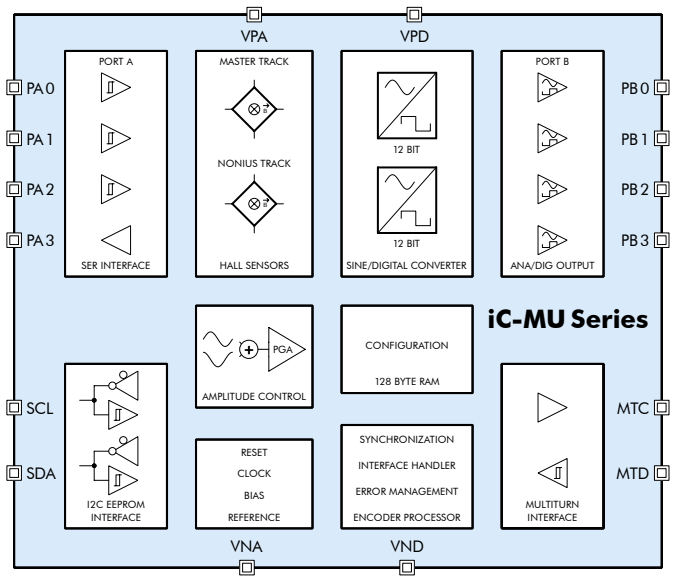
Applications

- Rotary absolute encoders, linear absolute scales
- Singleturn and multiturn encoders, motor feedback encoders
- BLDC motor commutation, hollow shaft encoder
- Multi-axis measurement systems

Features

- Integrated Hall sensors for two-track scanning
  - iC-MU: pole pitch 1.28 mm
  - iC-MU150: pole pitch 1.50 mm
  - iC-MU200: pole pitch 2.00 mm
- Precise signal conditioning for offset, amplitude, and phase
- Sine/digital realtime conversion with 12-bit resolution (14-bit filtered)
- 2-track nonius absolute value calculation up to 18 bit
- 16, 32, or 64 pole pairs per measurement distance
- Enlargement of measurement distance with second iC-MU/ iC-MU150/iC-MU200
- Linear speed up to 16 m/s, rotational speed up to 24 000 RPM
- Position data output via fast serial interfaces (BiSS C, SSI, SPI)
- Incremental encoder quadrature outputs (A, B, Z)
- FlexCount® resolution with 1 to 65 536 CPR
- Commutation signals for motors of up to 16 pole pairs (U, V, W)
- Counter signals and sin/cos signals optionally available
- Serial multiturn interface up to 18 bits
- Position preset function
- Device setup via BiSS C, SPI, or I²C from external EEPROM
- Operational temperature range of –40°C to 115°C

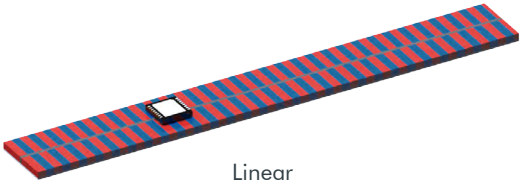
Block Diagram



Magnetic Targets

Axial Rotary

Radial Rotary



Linear

iC-MU Series
Magnetic Off-Axis Absolute Position Encoders

Key Specifications

General

Supply	+4.5 V to +5.5 V, typ. 53 mA
Max. Operating Frequency	7 kHz
Max. Operating Speed	linear speed up to 16 m/s, rotational speed up to 24 000 RPM @ 16 pole pairs, up to 12 000 RPM @ 32 pole pairs, up to 6000 RPM @ 64 pole pairs
Magnetic Field Strength	15 to 100 kA/m
Operational Temperature	DFN16-5×5: –40°C to +110°C QFN48-7×7: –40°C to +115°C

	iC-MU	iC-MU150	iC-MU200
Pole Pitch (Master Track)	1.28 mm	1.5 mm	2.0 mm
Master to Nonius Track Distance (d)	3.6 mm	3.6 mm	4.0 mm
Package (RoHS compliant)	QFN48-7×7 DFN16-5×5	QFN48-7×7 DFN16-5×5	QFN48-7×7

Sine-to-Digital Conversion

Conversion Resolution	up to 12 bits per signal period (14 bits filtered)
Conversion Accuracy	2 LSB @ 12 bits
Analog Cutoff Frequency	20 kHz (–3 dB)

Position Resolution

Nonius of 16/15	18 bit (filtered), 5 arcsec
Nonius of 32/31	19 bit (filtered), 2.5 arcsec
Nonius of 64/63	20 bit (filtered), 1.25 arcsec
Incremental Output	18 bit max. (65 536 AB cycles)

Output Ports

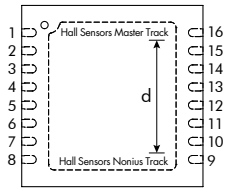
Characteristics	CMOS/TTL compatible, ±4 mA @ 5 V
PAx Port Modes	SPI, SSI, BiSS C, A/B/Z
PBx Port Modes	A/B/Z, U/V/W, STEP/DIR, CW/CCW, Sin/Cos 250 mVpk
Incremental Signals	A/B to 5 MHz, Z index (adjustable gating) FlexCount® resolution with 1 to 65 536 CPR
Commutation Signals	U/V/W for 1 to 16 pole pair motors, phase shift 60°or 120°

Data Interfaces

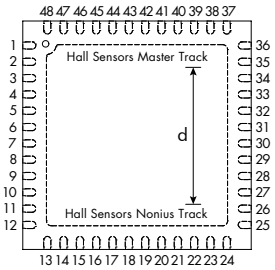
SPI	4-wire, 10 MHz, for position data and configuration
BiSS C	up to 38 bits, ERROR, CRC protection, bidirectional, 5 MHz
SSI	up to 38 bits, error bits, unidirectional, 4 MHz
Multiturn	up to 18 bits via SSI, 160 kHz

Pin Configuration

DFN16-5×5



QFN48-7×7



Pin Functions

QFN48-7×7 No.	DFN16-5×5 No.	Name	Function
3	1	SCL	EEPROM interface, clock
4	2	SDA	EEPROM interface, data
5	3	VPA	+4.5 V to +5.5 V analog supply voltage
6	4	VNA	Analog Ground
		Port B - Configurable I/O Interface	
7	5	PB0	Analog sin/cos signals Commutation signals U, V, W Incremental signals A, B, Z Counter signals up/down, step/dir
8	6	PB1	
9	7	PB2	
10	8	PB3	
		Port A - Configurable I/O Interface	
27	9	PA3	SPI interface (config. & position) BiSS interface (config.& position) SSI interface (position) Incremental signals A, B, Z
28	10	PA2	
29	11	PA1	
30	12	PA0	
31	13	VND	Digital Ground
32	14	VPD	+4.5 V to +5.5 V digital supply voltage
33	15	MTD	Multiturn interface, data input
34	16	MTC	Multiturn interface, clock output
		BP	Backside Pad
other		nc	not connected

Target Dimensions

Rotary Targets

Axial	16			32			64		
	MU	MU150	MU200	MU	MU150	MU200	MU	MU150	MU200
Largest inner Ø in mm	3	5.5	9	15	20	29	40	51	70
Smallest outer Ø in mm	18	18	24	30	34	44	56	64	85
Radial	**16**			**32**			**64**		
	MU	MU150	MU200	MU	MU150	MU200	MU	MU150	MU200
Largest inner Ø in mm	5	7	11	18	23	31	40	50	72
Smallest outer Ø in mm	11.5	13.5	19	24.5	29	39	50.5	59.5	80

Linear Targets

Tracks	Pole Pairs	Absolute Measurement Length in mm		
		MU	MU150	MU200
2-tracks	Master 16, Nonius 15	40.96	48	64
	Master 32, Nonius 31	81.92	96	128
	Master 64, Nonius 63	163.84	192	256
3-tracks	256, 255, 240	655.36	768	1024
	1024, 1023, 992	2621.44	3072	4096

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