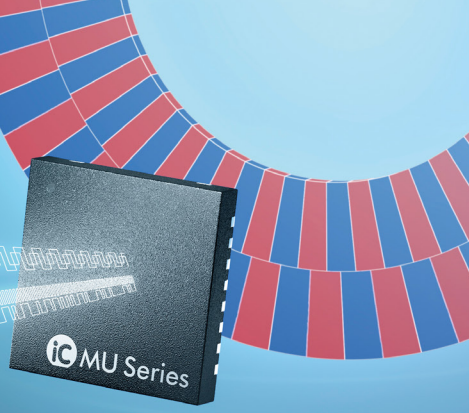
iC-MU Series

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 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, SSI, SPI), incrementally, or as analog signals through two ports in various modes of operation. Commutation signals (UVW) 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.

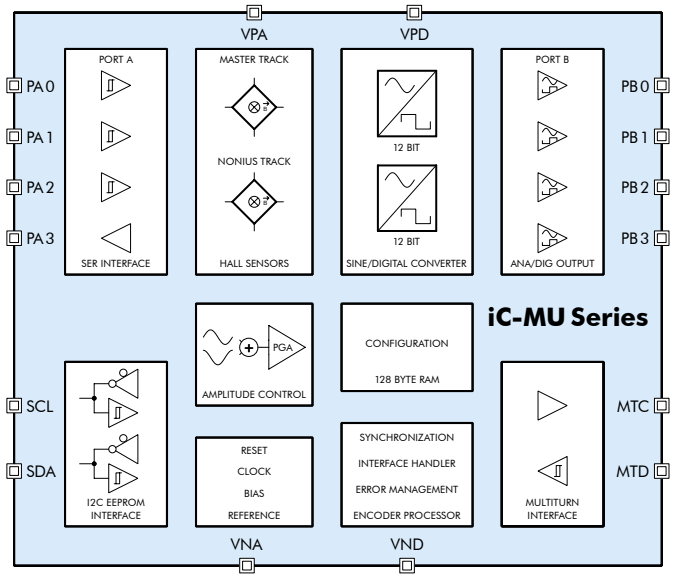
Applications

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

Features

- Integrated Hall sensors for two-track Nonius scanning
  - iC-MU128: pole width 1.28 mm
  - iC-MU150: pole width 1.50 mm
  - iC-MU200: pole width 2.00 mm
- Absolute position data output with up to 20 bits resolution
- For magnetic Nonius scales with 16, 32, or 64 Master pole pairs
- Signal conditioning for offset, amplitude, and phase
- Differential scanning for external magnetic field suppression
- Linear movement speed up to 20 m/s, rotational speed up to 24,000 RPM
- Serial interfaces BiSS/SSI and SPI for position data output, configuration and status monitoring
- FlexCount® for programmable ABZ output resolution up to 65,536 CPR
- UVW commutation signals for motors of 1 to 16 pole pairs
- Differential Sin/Cos outputs
- Position preset function
- Interface for external multiturn sensors
- Extension of scanning diameter and length with second iC-MU Series device
- Operational temperature range of:
  - DFN16-5×5 (iC-MU128, iC-MU150): –40°C to 110°C
  - QFN48-7×7 (iC-MU128, iC-MU150): –40°C to 115°C
  - QFN48-7×7 (iC-MU200): –40°C to 125°C
- iC-MU200 QFN48-7×7 AEC-Q100 qualified (Grade 1)

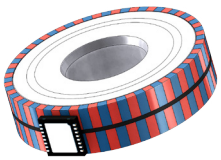
Block Diagram



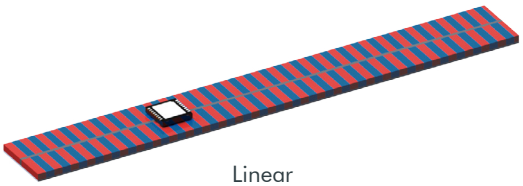
Magnetic Targets



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. 35 mA		
Max. Operating Frequency	7 kHz		
Max. Operating Speed	linear speed up to 20 m/s, rotational speed up to 24,000 RPM @ 16 pole pairs, up to 12,000 RPM @ 32 pole pairs, up to 6,000 RPM @ 64 pole pairs		
Magnetic Field Strength	15 to 100 kA/m		
Operational Temperature	DFN16-5×5 (iC-MU128, 150)	QFN48-7×7 (iC-MU128, 150)	QFN48-7×7 (iC-MU200)
	−40 to +110°C	−40 to +115°C	−40 to +125°C
	iC-MU128	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)	DFN16-5×5 QFN48-7×7	DFN16-5×5 QFN48-7×7	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

Position Resolution

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

Output Ports

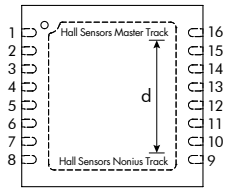
Characteristics	CMOS/TTL compatible, ±4 mA @ 5 V
PAx Port Modes	BiSS, SSI, SPI, ABZ
PBx Port Modes	ABZ, UVW, STEP/DIR, CW/CCW, Sin/Cos 250 mV_{pk}
Incremental Signals	AB up to 6.25 MHz, Z index (adjustable gating) FlexCount® resolution with 1 to 65,536 CPR
Commutation Signals	UVW for 1 to 16 pole pair motors, phase shift 60° or 120°

Data Interfaces

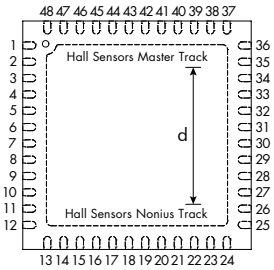
BiSS	up to 38 bits, ERROR, CRC protection, bidirectional, 10 MHz
SSI	up to 38 bits, error bits, unidirectional, 4 MHz
SPI	4-wire, 10 MHz, for position data and configuration
Multiturn	up to 18 bits, via SSI, 160 kHz

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 UVW Incremental signals ABZ Counter signals STEP/DIR, CW/CCW
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 ABZ
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		
	MU128	MU150	MU200	MU128	MU150	MU200	MU128	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**		
	MU128	MU150	MU200	MU128	MU150	MU200	MU128	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		
		MU128	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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