iC-Haus

18 bit
5 arcsec

incremental

commutation
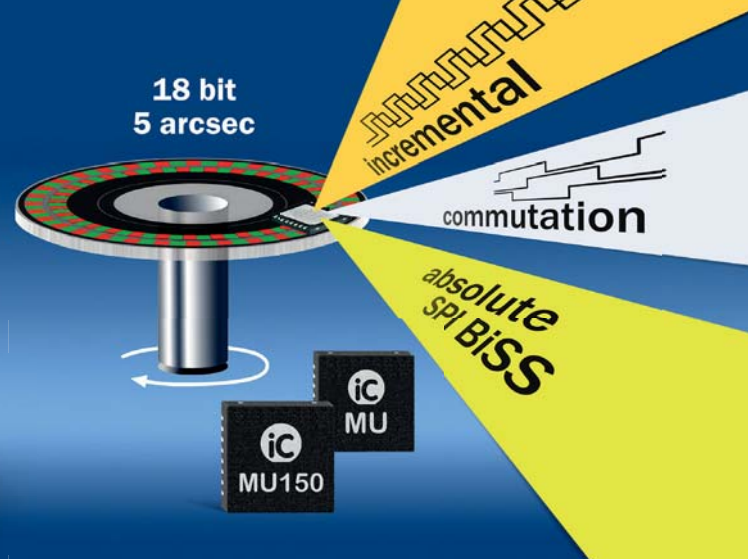
absolute SPI BiSS

iC MU

iC MU150

iC-MU, iC-MU150
Magnetic Off-Axis
Absolute Position Encoders

Description

iC-MU 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 can provide 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 (SSI, BiSS, SPI), incrementally, or analog 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 is capable of extending the rotary or linear absolute position using 3-track nonius computation. A second iC-MU can be connected to a special daisy chain mode using the multiturn interface.
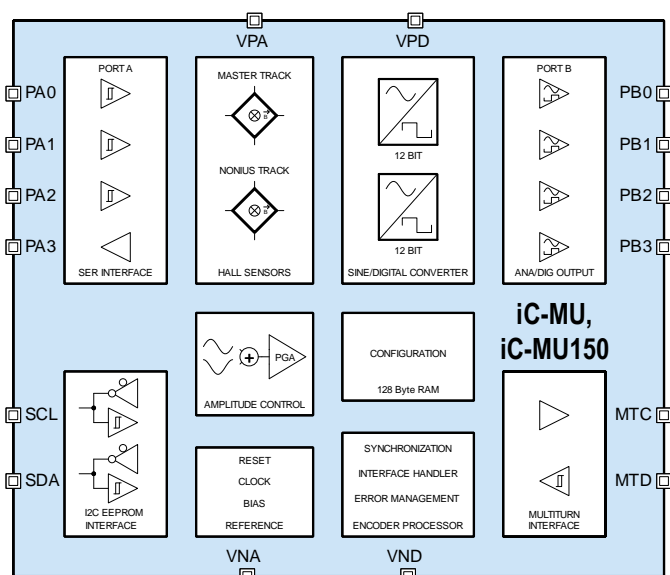
Applications

- Rotative 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
- Hall sensors optimized for master track
    - iC-MU: pole width 1.28 mm
    - iC-MU150: pole width 1.50 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 bits
- 16, 32, or 64 pole pairs per measurement distance
- Enlargement of measurement distance with second iC-MU/iC-MU150
- Linear speed to 16 m/s, rotational speed to 24 000 RPM
- Position data output via fast serial interfaces (SPI, SSI, BiSS C)
- Incremental encoder quadrature outputs (A, B, Z)
- FlexCount® resolution for 1 to 65 536 CPR
- Motor commutation signals for 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 SPI, BiSS C, or I²C from external EEPROM
- Operational temperature range of –40°C to 110°C
- Small 16-pin DFN Package of 5 mm x 5 mm (RoHS compliant)
- Magnetic targets available (rotary / linear)

Block Diagram

iC-MU, iC-MU150

Magnetic Targets

Axial Rotary

Radial Rotary

Linear

iC-MU, iC-MU150
Magnetic Off-Axis Absolute Position Encoders

Key Specifications

General

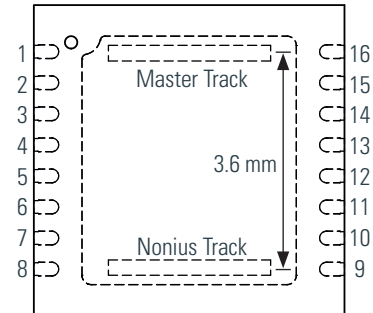|	
Supply	+4.5 V ... +5.5 V, typ. 53 mA
Max. Operating Frequency	7 kHz
Max. Operating Speed	linear speed to 16 m/s, rotational speed to 24 000 RPM @ 16 pole pairs, to 12 000 RPM @ 32 pole pairs, to 6000 RPM @ 64 pole pairs
Magnetic Field Strength	15 to 100 kA/m
Operational Temperature	−40°C to +110°C

Sine-to-Digital Conversion

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

Position Resolution

Nonius of 16/15*	18 bits (filtered)**, 5 arcsec
Nonius of 32/31*	19 bits (filtered)**, 2.5 arcsec
Nonius of 64/63*	20 bits (filtered)**, 1.25 arcsec
*) No. of signal periods	**) 18 bits max. for A/B outputs

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 for 1 to 65 536 CPR
Commutation Signals	U/V/W for 1 to 16 pole pairs, phase shift 60° or 120°

Data Interfaces

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

Pin Configuration DFN16-5x5

Pin Functions

No.	Name	Function
1	SCL	EEPROM interface, clock
2	SDA	EEPROM interface, data
3	VPA	+4.5 V ... +5.5 V analog supply voltage
4	VNA	Analog Ground
Port B - configurable IO interface		
5	PB0	Analog sin/cos signals
6	PB1	Commutation signals U, V, W
7	PB2	Incremental signals A, B, Z
8	PB3	Counter signals up/down, step/dir
Port A - configurable IO interface		
9	PA3	SPI interface (config. & position)
10	PA2	BiSS interface (config. & position)
11	PA1	SSI interface (position)
12	PA0	Incremental signals A, B, Z
13	VND	Digital Ground
14	VPD	+4.5 V ... +5.5 V digital supply voltage
15	MTD	Multiturn interface, data input
16	MTC	Multiturn interface, clock output
	BP	Backside Pad

Target Dimensions

Rotary Targets

Axial	16		32		64	
	MU	**MU150**	**MU**	**MU150**	**MU**	**MU150**
Largest inner Ø	3 mm	5.5 mm	15 mm	20 mm	40 mm	51 mm
Smallest outer Ø	18 mm	18 mm	30 mm	34 mm	56 mm	64 mm

Radial	16		32		64	
	MU	**MU150**	**MU**	**MU150**	**MU**	**MU150**
Largest inner Ø	5 mm	7 mm	18 mm	23 mm	40 mm	50 mm
Smallest outer Ø	11.5 mm	13.7 mm	24.5 mm	29 mm	50.5 mm	59.6 mm

Linear Targets

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