iC-MU

MAGNETIC OFF-AXIS ABSOLUTE POSITION ENCODER

iC-MU is an all-in-one, off-axis, magnetic position sensor featuring integrated Hall sensors with automatic signal conditioning and processing. The nonius scanning of two magnetic tracks (a master and a nonius track) is evaluated by two real-time-tracking sine-to-digital converters. Following power up and nonius computation, iC-MU provides incremental encoder quadrature signals with an index of any count up to 65,536 CPR and an output at an adjustable minimum edge distance. It also gives the absolute singleturn position with up to 18 bits per revolution through various serial interfaces (SSI, BiSS, SPI).

Commutation signals for brushless motors with up to 16 pole pairs are derived from the absolute position and supplied through a 3-pin interface. The commutation starting angle can be preset. External counters can be supplied with pulse signals for cw and ccw or for step and direction.

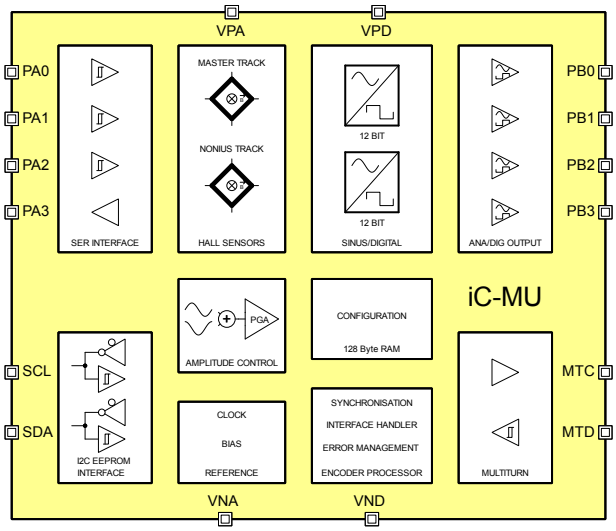
iC-MU captures full revolutions with its embedded 24-bit period counter and can thus supplement the position data output for data lengths of up to 38 bits. Optionally, using the multiturn interface the counter can be loaded following a reset by an external 12-bit multiturn sensor, for instance. The data is read and synchronized with the internal position data, and is cyclically checked during operation. A preset function permits the adjustment of the absolute position after encoder installation.

Features

- Two-track Hall sensor scanning for 1.28 mm pole width
- Precise signal conditioning for offset, amplitude, and phase
- Synchronous 12-bit sine-to-digital conversion per track
- Nonius computation of absolute position with up to 18 bits
- 16, 32, or 64 pole pairs per measurement distance
- 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 65536 CPR
- Motor commutation signals for up to 16 pole pairs (U, V, W)
- Counter signals and sin/cos signals optionally available
- Serial 12-bit multiturn interface
- Position preset function
- Device setup via SPI or I²C from external EEPROM
- Operational temperature range of –40°C to 95°C
- Small 16-pin DFN Package of 5 mm x 5 mm
- Magnetic targets available

Applications

- Non-contact position measurement
- Linear scales and rotary encoders
- Motion control, motor feedback



iC-Haus

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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 up and evaluated using the multiturn interface. In doing so, the length of the absolute position measurement can be extended.

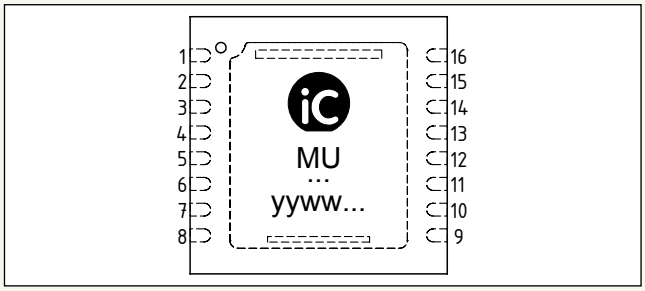
Besides its automatic signal conditioning functions iC-MU features manual compensation of the sine/cosine signal offsets and phase errors for both channels, allowing it to cope with magnet errors and encoder assembly inaccuracies.

Upon cycling power iC-MU loads its CRC-protected setup from the external EEPROM connected up to the I²C interface. Alternatively, using the SPI interface the device can be configured and operated by an external microcontroller.

Pin Functions

No.	Name	Function
1	SCL	EEPROM I²C Interface, clock line
2	SDA	EEPROM I²C Interface, data line
3	VPA	+4.5 V to +5.5 V Analog Supply Voltage
4	VNA	Analog Ground
5	PB0	Port B, Pin 0: Digital I/O, analog output configurable
6	PB1	Port B, Pin 1: Digital I/O, analog output configurable
7	PB2	Port B, Pin 2: Digital I/O, analog output configurable
8	PB3	Port B, Pin 3: Digital I/O, analog output configurable
9	PA3	Port A, Pin 3: Digital I/O, configurable
10	PA2	Port A, Pin 2: Digital I/O, configurable
11	PA1	Port A, Pin 1: Digital I/O, configurable
12	PA0	Port A, Pin 0: Digital I/O, configurable
13	VND	Digital ground
14	VPD	+4.5 V to +5.5 V Digital Supply Voltage
15	MTD	Multiturn Interface, data line
16	MTC	Multiturn Interface, clock line
	TP	Thermal Pad

Pin Configuration DFN16 5x5 mm²



Key Specifications

General	
Supply Voltage	+4.5 V to +5.5 V
Supply Current	50 mA max.
Max. Operating Frequency	6.4 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 6,000 RPM @ 64 pole pairs
Magnetic Field Strength	15 to 100 kA/m
ESD Susceptibility	2 kV (HBM 100 pF, 1.5 kΩ)
Operational Temperature	-40°C to +95°C
Package (RoHS compliant)	16-pin DFN (5 mm x 5 mm)

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 / 0.156 µm
Nonius of 32/31 *	19 bits (filtered), 2.5 arcsec / 0.156 µm
Nonius of 64/63 *	20 bits (filtered), 1.25 arcsec / 0.156 µm
* No. of signal periods	(18 bits max. for A/B outputs)

Absolute Linear Measurement Distance	
Nonius of 32/31	up to 81.9 mm (signal phase tolerance +/- 40 µm max.)
Nonius of 64/63	up to 163.8 mm (signal phase tolerance +/- 20 µm max.)
Nonius of 1024/1023/992	up to 2.62 m (two iC-MU cascaded and operated at 32/31)

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 65536 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 data bits, error bits, CRC protection, bidirectional, 10 MHz
SSI	up to 38 bits, error bits, unidirectional, 4 MHz
Multiturn	12 bit SSI, 200 kHz

Magnetic Targets (pole wheels)	
MU1S 19-16	16/15 pole pairs, OD Ø 19 mm, bore hole 10M6
MU2S 30-32	32/31 pole pairs, OD Ø 30 mm, bore hole 10M6
MU3S 56-64	64/63 pole pairs, OD Ø 56 mm, bore hole 10M6

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