iC-RB Series
High Resolution Optical Safety Encoder

Description

The iC-RB Series is an advanced high-resolution absolute optical encoder IC series for functional safety applications. It provides two autonomous channels, each scanning a serial pseudo-random code (PRC) track on the disc. The control channel (CC) and the safety channel (SC) both utilize high-definition phased-array photo sensors to read an incremental track of 1024 CPR. This generates sine/cosine signals, which are used to increase the resolution.

The control channel (CC) generates a 24-bit high-resolution absolute position value by using a 14-bit Sample&Hold SAR interpolator. The safety channel (SC) generates a 15-bit absolute position by using a 5-bit real-time interpolator. Thanks to the excellent signal fidelity of the HD phased array, no electrical signal conditioning is required.

Both CC and SC provide a BiSS slave interface which is compatible with the BiSS Safety protocol. The SC can also be configured for an SSI or SPI interface.

In addition, two multiturn interfaces are available, which can either read in two external multiturn sensors or enable internal battery-buffered multiturn counting.
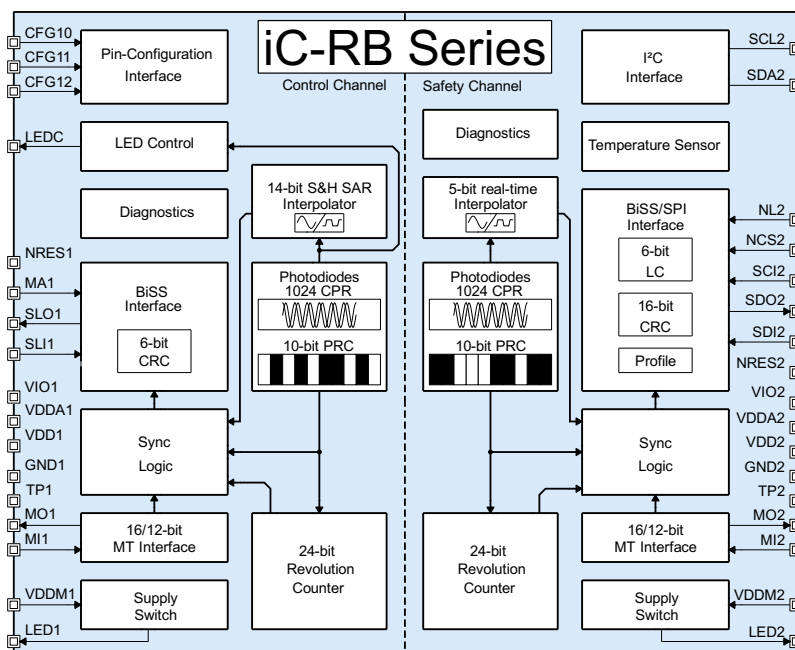
Features

- Robust and compact EncoderBlue® for a 10-bit PRC disc of Ø 26.5 mm, 42.5 mm
- Autonomous double-scanning with control (CC) and safety (SC) channels
- Resolution of 24 bits (CC) and 15 bits (SC)
- Pin-configured control channel (CC) with MT interface (SSI) and serial data output (BiSS)
- Flexible safety channel (SC) with CRC-monitored setup, OEM and user data, signal monitoring, temperature sensing, MT interface (SSI), and serial data output (BiSS, SSI, SPI)
- Compatible with BiSS Safety protocol
- Configuration (SC) via interface or external I²C EEPROM
- Separated channel supplies (5 V)
- 3.3 V-compatible I/O ports
- Signal stabilization by on-chip LED current control
- Operational temperature − 40 to +125 °C

Applications

- High resolution optical single-chip encoder (24-bit CPW)
- Functional safety encoder
- Singleturn and multiturn encoders for motor feedback

Block Diagram

iC-RB Series
High Resolution Optical Safety Encoder

Key Specifications

General

Main Supply Voltages	CC: 5 V ±10%, typ. 15 mA SC: 5 V ±10%, typ. 10 mA
I/O Port Supply Voltage	2.4 to 5.5 V
LED Current Control (LEDC)	up to 25 mA
Operating Speed	up to 14 400 rpm
Operational Temperature	−40 to +125 °C
Package (RoHS compliant)	38-pin optoQFN 7.0 mm × 5.0 mm, thickness 1.0 mm

Position Acquisition

Singleturn Resolution	CC: 24 bits, SC: 15 bits (per 360°)
Multiturn Resolution	CC, SC: 0, 12/16 (ext. sensor), 24 bits (counted)

Temperature Sensor

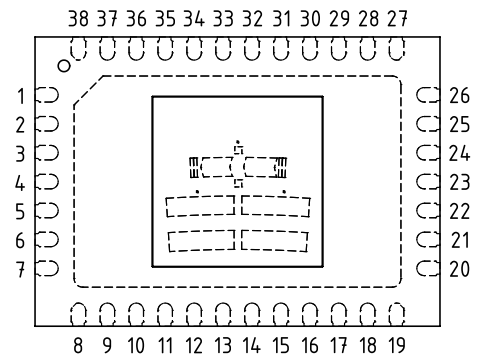|	
Resolution	1° C/LSB, range −64 to +191 °C
Monitoring	by adjustable high/low warning thresholds (SC only)

Interfaces and Protocols

	CC	SC	Description
SPI		•	4-wire, 10 MHz for position data and configuration
BiSS C	•[1]	•[2]	bidirectional, up to 10 MHz
SSI		•[3]	unidirectional, approx. 500 kHz, binary
Multiturn	•	•	SSI master, 100 kHz, data frame 0/12/16 bits, sync bits, 1 error bit (default); 24-bit internal counter
I²C		•	for configuration from EEPROM

[1] Data frame of 0/12/16/20/24 bits MT, 16/24 bits ST, error/warning bit, 6-bit CRC
[2] Data frame of 0/12/16/24 bits MT, 9 to 16 bits ST, error/warning bit, 6-bit sign-of-life counter, 16-bit CRC
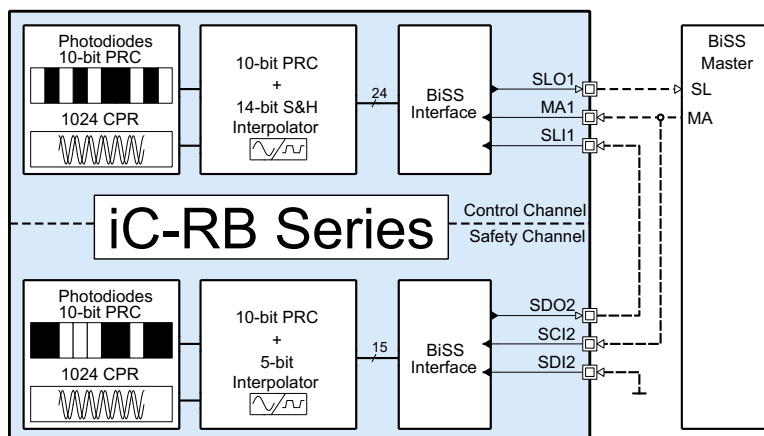[3] Data frame of 0/12/16/24 bits MT, 9 to 16 bits ST

Pin Configuration oQFN38-7×5

Pin Functions

Name	Function
VDDx	Digital Supply Voltage Inputs
VDDAx	Analog Supply Voltage Inputs
VDDMx	Multiturn Supply Voltage Inputs
VIOx	I/O Supply Voltages
GNDx, TPx	Ground Pins, Test Pins
LEDC, LED1, LED2	LED Control Outputs
MA1, SLO1, SLI1	BiSS Interface (CC): clock / data
NL2, NCS2, SCI2, SDO2, SDI2	BiSS/SPI Interface (SC): latch, chip select, clock in, data out, data in
NRES2	REBOOT input/indication output
MOx, Mix	MT Interface (CC, SC): clock and data
SCL2, SDA2	I²C Interface (SC): clock and data
CFG1/1, CFG1/0, CFG12	Configuration Inputs (CC)

Application Examples

24-bit single-turn encoder with safety channel