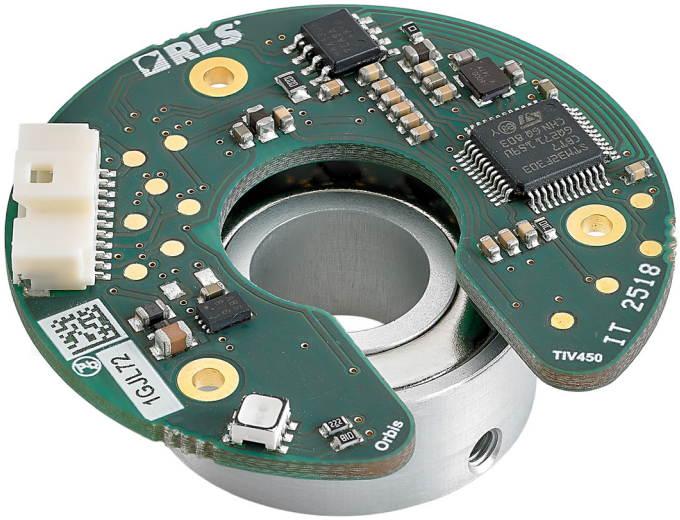
Data sheet
BRD01_06
Issue 6, 22nd November 2019

Orbis™ true absolute rotary encoder



Orbis™ is a true absolute rotary encoder suitable for applications where a typical OnAxis encoder cannot be mounted at the end of the rotating shaft due to space constraints or if hollow shaft is required.

The encoder comprises a diametrically magnetized permanent ring magnet and a printed circuit board. Geometric arrangement of RLS' proprietary Hall sensors on a PCB enables generation of one period of sine and cosine signals per mechanical magnet revolution. Moreover, it also enables cancellation of third harmonic component.

An adaptive filtering function ensures high resolution at low rotation speeds and low angle phase delay at high rotational speeds. Orbis™ also features an additional built-in self-calibration algorithm that improves encoder's accuracy after installation.

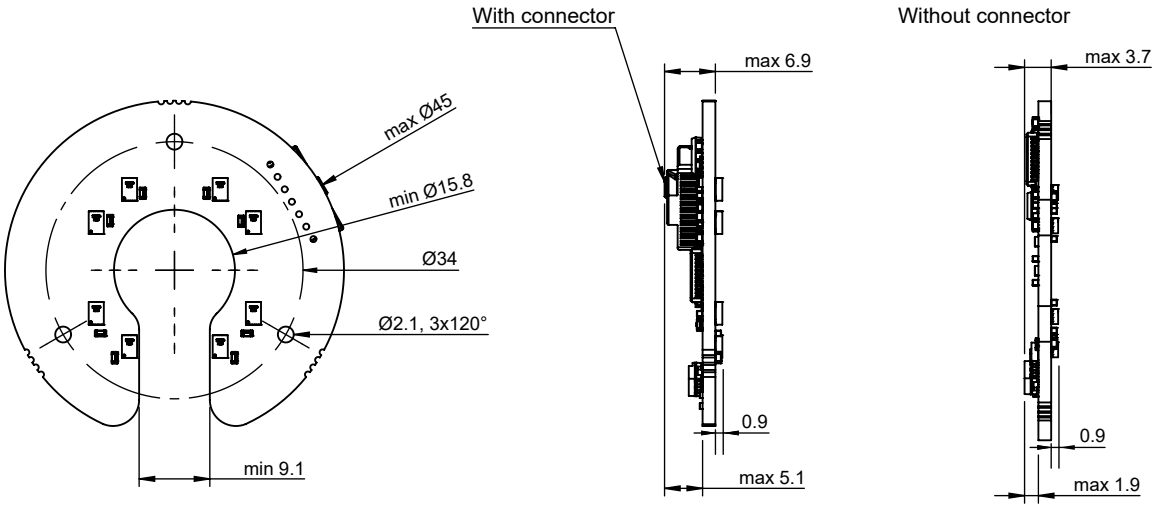
Orbis™ through-hole measuring principle allows customisation with various board and magnet sizes to suit your application.

- True absolute encoder
- 14 bit resolution
- Multi-turn counter option
- Through-hole design enables its mounting anywhere along the shaft
- Optional self-calibration after assembly
- Buit-in self-diagnostics
- Status LED
- BiSS-C, SSI, SPI, Asynchronous serial and communication PWM
- Wide installation tolerances

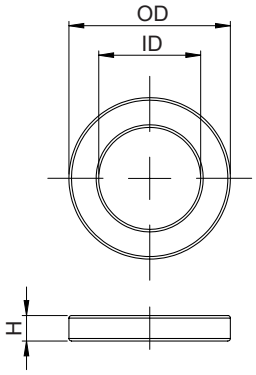
Dimensions

Dimensions and tolerances in mm.

Encoder readhead



Permanent magnet

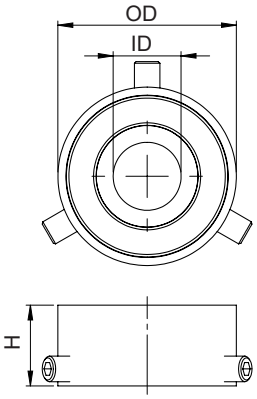


Available magnets:

ID	OD	H
12	19	3
16	24	3.5

ID and OD tolerances are ±0.05.

Magnetic actuator (magnet included)



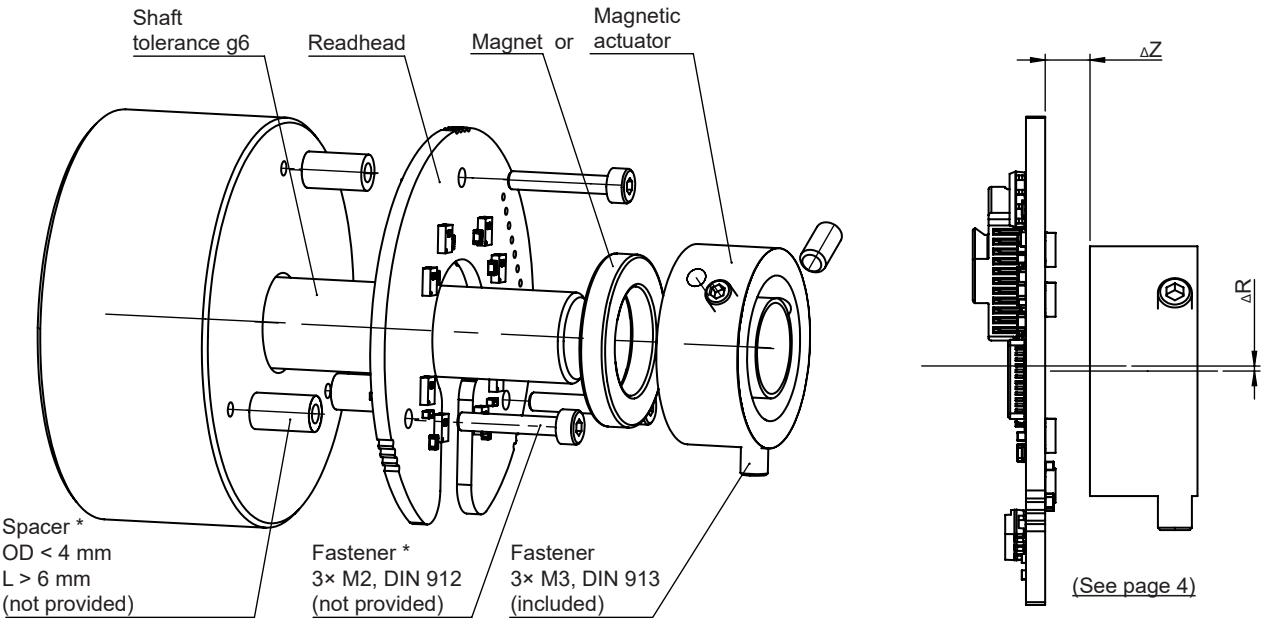
Available actuators:

ID	OD	H
6	21	9.5
8	21	9.5
10	22	9.5
12	27	10
14	27	10
15	27	10

ID tolerances are H7.

Installation drawing

Standard option



* Readhead should be only mounted on the golden plated surfaces around the mounting holes.

Technical specifications

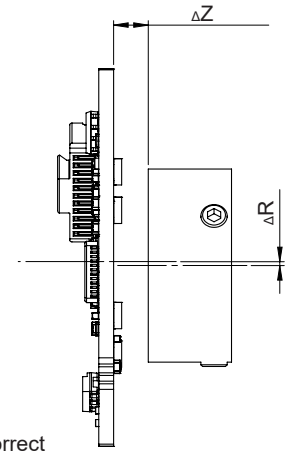
System data			
Reading type	Axial reading		
Resolution	14 bit		
Maximum speed	12,000 RPM		
Accuracy	±0.25°		
Accuracy thermal drift	±0.01°/°C		
Repeatability	±2 LSB (counts, unidirectional)		
Digital hysteresis	±2 LSB (counts)		
Position update rate	50 kHz		
Electrical data			
Supply voltage	4.5 V to 5.5 V (at the connector)		
Set-up time	100 ms (worst case: 200 ms)		
Current consumption	Typ. 65 mA (no output load)		
Connection	Molex 501568-1107 or soldering pads (through holes)		
Output load	PWM, SPI	Max. ±5 mA at 3.3 V	
	RS422	Max. ±100 mA at 5 V	
ESD protection	HBM, max. ±2 kV		
Mechanical data			
Mass	Readhead: 5.3 g		
	Magnetic actuators (ID): 6 mm: 6.0 g ; 8 mm: 5.5 g ; 10 mm: 5.7 g ; 12 mm: 8.7 g ; 15 mm: 7.1 g		
	Magnets (ID): 12 mm: 3.8 g ; 16 mm: 6.4 g		
Magnet material	Neodymium with Ni-Cu-Ni protective layer		
Actuator material	Anodised aluminium		
Environmental data			
Temperature	Operating Storage	0 °C to +85 °C -40 °C to +105 °C	Not valid for cables with DSUB-9 connector.
Humidity	0 % to 70 % non-condensing		
External magnetic field	Max. ±3 mT (DC or AC) on top side of readhead		

Status indicator LED

The LED provides visual feedback of signal strength, error condition and is used for set-up and diagnostic use.

LED	Status
Green	Normal operation; position data is valid.
Orange	Warning; position is valid, but the resolution and/or accuracy might be out of specification. Some operating conditions are outside limits.
Red	Error; position data is not valid.
Slow flashing	Communication has not been established.
	Position was not requested within last 200 ms. Color of flashing - see above.
No light	No power supply.
Continuously fast flashing red	System error during start-up or operation.
3 sec. fast flashing	Self-calibration result - see documents BRD04 or BRD05

Installation instructions



Installation tolerances
Precise magnet and readhead installation is key to achieve good overall accuracy.

	Magnet with 12 mm ID	Magnet with 16 mm ID
Axial (ΔZ) displacement (ride height)	4 mm nominal ±1 mm	5.5 mm nominal ±1 mm
Radial (ΔR) displacement	max 0.3 mm	max 0.3 mm

Nominal axial (ΔZ) displacement is valid with non-ferromagnetic shaft (aluminum, copper, plastic,...).
If ferromagnetic shaft is used, nominal axial displacement has to be bigger for approximately 20 % to 30 %. For more information contact RLS support.

Axial position adjustment (ride height)

Any non-magnetic and non-conductive tool with nominal ride height thickness can be used to check the correct ride height setting mechanically. The integrated LED can be used as a coarse indicator. When correct ride height is achieved, the LED glows green and should not change colour when the magnet rotates.

External magnetic field

Principle of operation of any magnetic encoder is sensing changes in the magnetic field of the magnetic actuator. External magnetic fields, generated by permanent magnets, electric motors, coils, magnetic brakes, etc. may influence the encoder operation.
The accuracy of Orbis is degraded in case of magnetic field gradients in axial direction.

Self-calibration after installation

The self-calibration function eliminates eccentricity-caused error, which is a dominant part of the encoder accuracy and is caused by the eccentric mounting of the ring. This function removes the one sine wave per revolution error. The self-calibration function can be triggered by user over selected communication interfaces or by using the appropriate USB encoder interface.
For details refer to the chosen communication interface description. If multiturn counter is being used in the encoder and if rotational speed is higher than ±300 RPM, it may have incorrect value after self-calibration. Multiturn error flag will be set in such case.

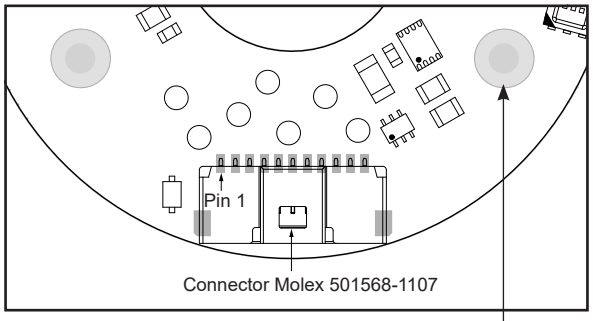
Requirements:

- Free mechanical rotation between 180° and 360° (desired angle can be selected over communication interface)
- Good signal throughout the calibration angle
- Maximum available time is 10 seconds
- Direction is not important
- Maximum speed during self-calibration up to 600 RPM
- Suitable communication interface or adaptor that allows triggering the function
- Self-calibration must be started when no error is present (green LED)
- When using SPI encoder version, LED must be visible for checking self-calibration status

Electrical connections

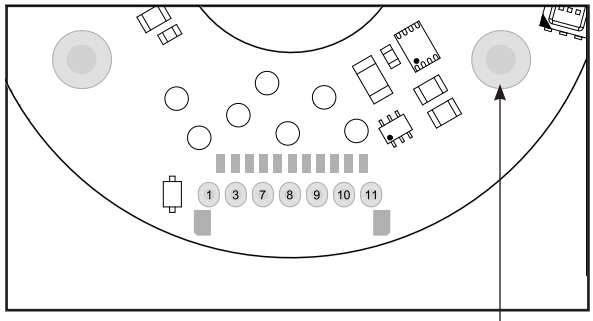
Pin	Wire color	BiSS-C	Asynchronous serial	PWM	SSI	SPI
1	Brown	5 V supply				
2	-	-				
3	White	0 V (GND)				
4	-	-				
5	Pink	-				
6	Grey	-				
7	Red	MA+	RX command in+	Status out	Clock+	SCK
8	Blue	MA–	RX command in–	-	Clock–	NCS
9	Cable shield					
10	Green	SLO+	TX data out+	PWM out	Data+	MISO
11	Yellow	SLO–	TX data out–	-	Data–	MOSI

Pinout



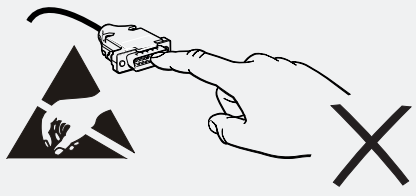
With Molex connector

Cable shield
(connected to pin 9)



With soldering pads
(through holes)
Pitch is 1.9 mm

Cable shield
(connected to pin 9)



WARNING!

ESD protection
Readhead is ESD sensitive - handle with care. Do not touch electronic circuit, wires or sensor area without proper ESD protection or outside of ESD controlled environment.

Chemical resistance of magnetic actuator

Chemical	Test performed with	Temperature (°C)	Adhesive joint
Water	deionized	25	✗
Sea water	Instant Ocean® sea salt, 3.5 %		✗
Ethanol	technical, ≥ 95 %		✓
Acetone	technical, ≥ 95 %		✓
Motor oil	SAE 15W-40	85	✓
Cutting oil	Rezilol SCM BCL		✓
Brake fluid	DOT-4		✓
Coolant	Blasocut® 2000 CF, 5%		✗
Grease	ISOFLEX® Topas NB 52		✓

✓ Resistant
✗ Not resistant

Test samples were immersed in the chemicals for 4 weeks at 25 °C or 85 °C in accordance to standard ISO 175:2010.
During the test axial load on the samples was monitored every 7 days.

Multiturn counter

Multiturn counter is available on the following communication interfaces: BiSS, Asynchronous serial (UART), SPI and SSI.
Multiturn option is chosen with Resolution in part number on page 16. Multiturn counter is 16 bit (0 to 65535 counts). Counting is available only when the encoder is powered, but the counter state is stored in a non-volatile memory at power-down and is restored at power-up. Maximum permissible rotation during power-down is ±90°. If encoder is rotated for ±360° or multiple rotations, this movement is not registered and also multiturn error is not set. If any other error is set during a 90° rotation or more, the multiturn counter value might become inconsistent with mechanical position.

Multiturn counter limitations

Counter may have invalid value in following circumstances:

Possible reasons for failure	Solution
If encoder is rotated for ±360° or multiple rotations during off state.	Use mechanical brake.
If error flag (red LED) is present for 90° rotation or more.	Read and evaluate error bit.
When encoder has moved for 90° or more or rotating at 300 RPM or more when encoder is performing blocking operation (saving information to non-volatile memory, factory reset, write protect, self-calibration).	Stop rotation before performing those operations.
If user changes single-turn position offset for 90° or more.	Set new multiturn counter value right after setting zero position offset.
If any function for saving information to non-volatile memory (save configuration, factory reset, write protect, self-calibration) is active when power-down happens.	Keep power supply stable when performing those operations.

Multiturn error flag

Error flag is set in one of the following conditions:

- Detected movement of >90° and <270° when powered off
- Detected speed of more than 300 RPM during blocking operation
- High, unexpected positional difference detected (acceleration error)

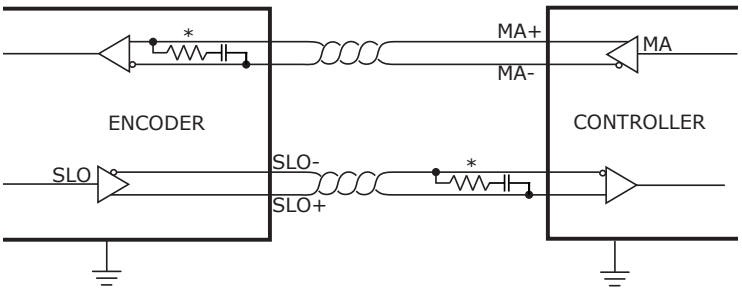
Multiturn error bit can be cleared by writting new multiturn counter value into the encoder or by power cycle. Clearing error bit on SSI interface requires power cycle.

BiSS-C interface

The encoder position, in 14 bit natural binary code, and the encoder status are available through the BiSS-C protocol. The position data is left aligned. After the position data there are two status bits (active low) followed by CRC (inverted).

BiSS is implemented for point-to-point operation; multiple slaves are not supported.

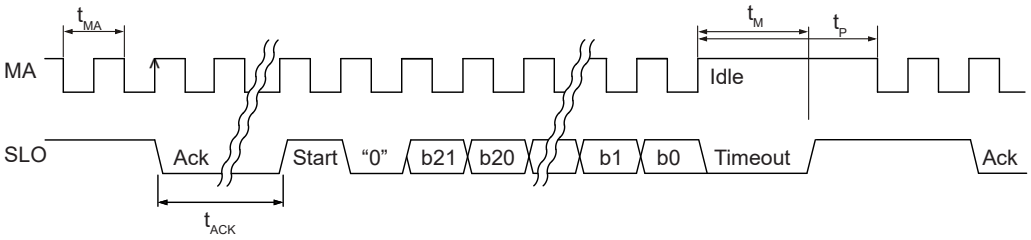
Electrical connection



Line signals	
MA+	Clock non-inverted signal
MA–	Clock inverted signal
SLO+	Data non-inverted signal
SLO–	Data inverted signal

* The MA and SLO signals are 5 V RS422 compatible differential pairs. MA signal is terminated with RC (100 Ω, 1 nF) inside the encoder.

BiSS-C timing diagram (single-turn)



MA is idle high. Communication is initiated with first falling edge.
The encoder responds by setting SLO low on the second rising edge on MA.
When the encoder is ready for the next request cycle it indicates this to the master by setting SLO high.
The absolute position and CRC data is in binary format, left aligned, MSB first.

Communication parameters

Parameter	Symbol	Min	Typ	Max
MA period	t_{MA}	200 ns		10 µs
MA frequency	f_{MA}	100 kHz		5 MHz
ACK length	t_{ACK}		5 bits	
Transfer timeout	t_M		13.5 µs	
Pause time	t_P	20 µs		

Structure of data packet

Bit	b37 : b22	b21 : b8	b7 : b6	b5 : b0
Data length	16 bits	14 bits	2 bits	6 bits
Meaning	Multi-turn counter (if specified in part number)	Encoder position	General status	CRC (inverted)

Encoder position	
b37 : b22	Multiturn counter (if specified in part number) - Left aligned, MSB first.
b21 : b8	Encoder position – Left aligned, MSB first.
General status	
b7	Error - If low, the position data is not valid. Bits b21 - b8 are replaced with error status bits.
b6	Warning - If low, the position data is valid, but some operating conditions are close to limits.
	Error and Warning bits can be set at the same time, in this case the Error bit has priority. The colour of the LED on the readhead housing indicates the value of the General status bits. LED is flashing (duty cycle 50 %, frequency 2.5 Hz), when the encoder is in idle state. If the controller requests the data every 200 ms or more often, the duty cycle of the LED is 100 % (always on).
CRC (inverted)	
b5 : b0	Polynomial for CRC calculation of position, error and warning data is: x6 + x1 + 1. Represented also as 0x43. Number must be inverted before comparison with calculated CRC.

CRC calculation example is in application note document CRCD01, available for download from www.rls.si/orbis.

Error status	
b21 : b16	Reserved
b15	Signal amplitude too high. The readhead is too close to the magnet or an external magnetic field is present.
b14	Signal amplitude low. The distance between the readhead and the ring is too large.
b13	The readhead temperature is out of specified range.
b12	Speed too high.
b11	Multiturn counter error.
b10 : b8	Reserved.

For more information regarding BiSS protocol see **biss-interface.com**.

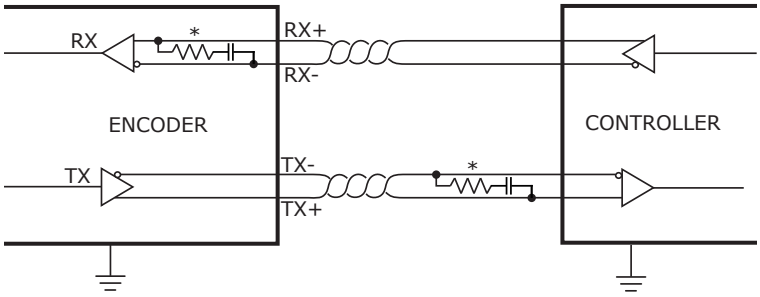
Encoder programming

Encoder supports register access which allows setting position offset, multiturn counter, running self-calibration function, configuring the encoder, reading signal level indicator, temperature, detailed status bits and electronic datasheet. It also allows storing up to 4 kB of user data into the encoder (eg. motor parameters, assembly data or similar).
Additional information can be found in the "Application note: Orbis BiSS-C register access", document BRD05, available for download from www.rls.si/orbis.

Asynchronous serial communication interface

Asynchronous serial communication is supported by a universal asynchronous receiver/transmitter commonly known as UART. It comprises two unidirectional communications channels, forming a full-duplex bidirectional data link. Every channel consists of a two wire differential twisted-pair connection conforming to the RS422 signalling standard.

Electrical connection



Line signals	
RX+	RX data in +
RX–	RX data in –
TX+	TX data out +
TX–	TX data out –

* The RX and TX signals are 5 V RS422 compatible differential pairs. RX signal is terminated with RC (100 Ω, 1 nF) inside the encoder.

Communication parameters

Character length	8 bits
Parity	None
Stop bits	1
Flow control	None
Bit order	LSB first (standard)

Communication speed is set with the *Communication interface variant* in the part number:

Communication interface variant	A	B	C	D	E	F
Baud rate [kbps]	115.2	128	230.4	256	500	1000

Command set

Command "1" (0x31) – position request	
Response	1 byte ASCII "1" 2 bytes (4 for multiturn) hex – see Encoder position data structure
Command "3" (0x33) – short position request	
Response	2 bytes (4 for multiturn) hex – see Encoder position data structure
Command "d" (0x64) – position request + detailed status	
Response	1 byte ASCII "d" 2 bytes (4 for multiturn) hex – see Encoder position data structure 1 byte hex – see Detailed status data structure
Command "t" (0x74) – position request + temperature	
Response	1 byte ASCII "t" 2 bytes (4 for multiturn) hex – see Encoder position data structure 2 bytes hex – temperature (temperature of the readhead in °C multiplied by 10) (Signed binary) Temperature of the sensor in (°C). This value is typically 10 °C to 15 °C higher than ambient. Tolerance of the readout is ±5 °C.
Command "v" (0x76) – serial number	
Response	1 byte ASCII "v" 6 bytes ASCII – serial number

Encoder position data structure

Encoder position		
	b31 : b16	Multiturn counter (if specified in part number) - Left aligned, MSB first.
	b15 : b2	Encoder position – Left aligned, MSB first.
General status		
	b1	Error - If low, the position data is not valid. The last valid position is sent out.
	b0	Warning - If low, the position data is valid, but some operating conditions are close to limits.
	Error and Warning bits can be set at the same time, in this case the Error bit has priority. The colour of the LED on the readhead housing indicates the value of the General status bits. LED is flashing (duty cycle 50 %, frequency 2.5 Hz), when the encoder is in idle state. If the controller requests the data every 200 ms or more often, the duty cycle of the LED is 100 % (always on).	
Detailed status		
	b7	Signal amplitude too high. The readhead is too close to the magnet or an external magnetic field is present.
	b6	Signal amplitude low. The distance between the readhead and the ring is too large.
	b5	The readhead temperature is out of specified range.
	b4	Speed too high.
	b3	Multiturn counter error.
	b2 : b0	Reserved.

Encoder programming

Encoder supports changing default baud rate, position offset, multiturn counter, running self-calibration function, automatic transmission of selected data packet at programmable frame rate.
Additional information on encoder programming can be found in the "Application note: Programming encoders with Async serial interface", document BRD04, available for download from www.rls.si/orbis.

PWM - Pulse width modulation interface

The PWM interface transmits the information about the absolute angle position over the pulse width modulated PWM Out signal.
An additional digital Status signal indicates the encoder's error condition.

Electrical connection
The Status and PWM Out signals are 3.3 V LVTTL compatible. These signals have weak ESD protection. Handle with care. Maximum current sourced from or sunk into signal lines should not exceed 5 mA.

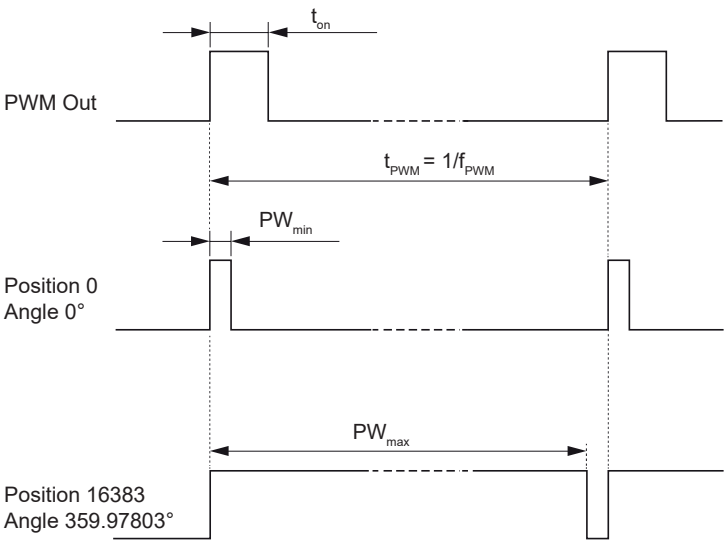
Status signal
The Status signal indicates the current status of the encoder. The Status signal is high for normal operation and valid position information. The low state of the Status signal indicates an error state of the encoder which can be caused by:

- Operation outside the installation tolerances
- Sensor malfunction
- System error
- No power supply

When the Status signal is low, the PWM Out signal is low and no pulses are output.
The encoder position is latched on the rising edge of the PWM Out signal. The Status signal should also be checked at the rising edge of the PWM Out signal. If the Status signal changes during the PWM period, it does not affect the currently transmitted position information.

PWM Out signal
The PWM Out is a pulse width modulated output with 14-bit resolution whose duty cycle is proportional to the measured position.
The change of the pulse width by PW_{min} corresponds to a change in position by one count (change in angle for 360° / 65536 ≈ 0.00549°).

PWM Out signal timing diagram



Communication parameters
Communication interface variant in the part number defines the PWM frequency and all other dependent parameters.

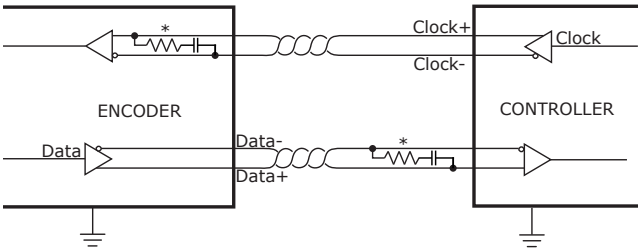
		Communication interface variant				
Parameter	**Symbol**	**A**	**D**	**E**	**Unit**	**Note**
PWM frequency	f_{PWM}	122.07	549.32	1098.63	Hz	
Signal period	t_{PWM}	8192	1820.44	910.22	µs	
Minimum pulse width	PW_{min}	0.5	0.111	0.0556	µs	Position 0 (Angle 0°)
Maximum pulse width	PW_{max}	8191.5	1820.33	910.17	µs	Position 16383
Min. counter frequency	f_{CNTR}	2	9	18	MHz	
Resolution		14	14	14	Bit	

$$\textit{Position}\ [\text{counts}] = \frac{(t_{on} - PW_{min}) \times 16383}{PW_{max} - PW_{min}}$$

SSI - Synchronous serial interface

The encoder position, in 14 bit natural binary code, and the encoder status are available through the SSI protocol. The position data is left aligned. After the position data there are two general status bits followed by the detailed status information.

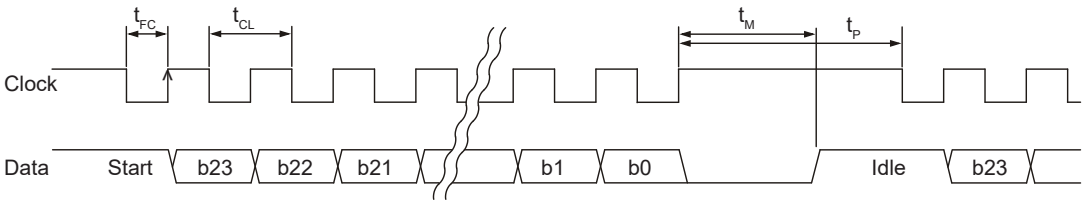
Electrical connection



Line signals	
Clock+	Clock non-inverted signal
Clock–	Clock inverted signal
Data+	Data non-inverted signal
Data–	Data inverted signal

* The Clock and Data signals are 5 V RS422 compatible differential pairs. Clock signal is terminated with RC (100 Ω, 1 nF) inside the encoder.

SSI timing diagram



The controller requests the position and status data of the encoder by sending a pulse train to the Clock input. The Clock signal always starts from high. The first falling edge of the Clock latches the last position data available and on the first rising edge of the Clock the most significant bit (MSB) of the position is transmitted to the Data output. The Data output should then be read on the following falling or rising edge. On subsequent rising edges of the Clock signal the next bits are transmitted.

After the transmission of the last bit the Data output goes to low. When the t_M time expires, the Data output goes high. The Clock signal must remain high for at least t_P before the next reading can take place.

While reading the data, the half of a Clock period t_{CL} must always be less than t_M. However, reading the encoder position can be terminated at any time by setting the Clock signal to high for the duration of t_M.

Communication parameters

Parameter	Symbol	Min	Typ	Max
Clock period	t_{CL}	2 µs (400 ns *)		15 µs
Clock frequency	f_{CL}	70 kHz		500 kHz (2.5 MHz *)
Delay first clock	t_{FC}	1.25 µs		13 µs
Transfer timeout	t_M		14 µs	
Pause time	t_P	20 µs		

* With *Delay First Clock* function of the controller.

Structure of data packet

Bit	b39 : b24	b23 : b10	b9 : b8	b7 : b0
Data length	16 bits	14 bits	2 bits	8 bits
Meaning	Multiturn counter (if specified in part number)	Encoder position	General status	Detailed status

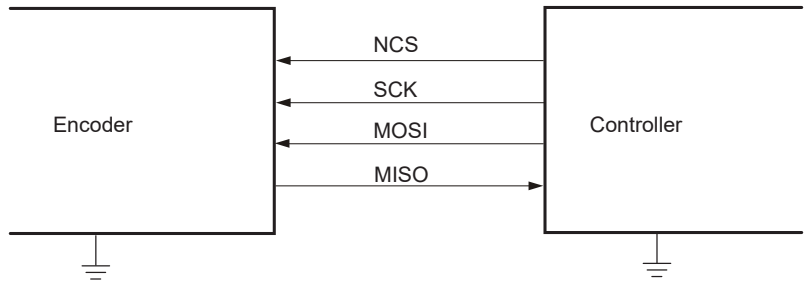
Encoder position		
	b39 : b24	Multiturn counter (if specified in part number) - Left aligned, MSB first.
	b23 : b10	Encoder position – Left aligned, MSB first.
General status		
	b9	Error - If high, the position data is not valid. The last valid position is sent out.
	b8	Warning - If high, the position data is valid, but some operating conditions are close to limits.
	Error and Warning bits can be set at the same time, in this case the Error bit has priority. The colour of the LED on the readhead housing indicates the value of the General status bits. LED is flashing (duty cycle 50 %, frequency 2.5 Hz), when the encoder is in idle state. If the controller requests the data every 200 ms or more often, the duty cycle of the LED is 100 % (always on).	
Detailed status		
	b7	Signal amplitude too high. The readhead is too close to the magnet or an external magnetic field is present.
	b6	Signal amplitude low. The distance between the readhead and the ring is too large.
	b5	The readhead temperature is out of specified range.
	b4	Speed too high.
	b3	Multiturn counter error.
	b2 : b0	Reserved.

SPI - Serial peripheral interface (slave mode)

The Serial Peripheral Interface (SPI) bus is a four wire bidirectional synchronous serial communication interface, typically used for short distance communication. It operates in full duplex mode, where master (controller) selects the slave with NCS line, generates clock signal on SCK line, sends command over MOSI line and receives data over MISO line.

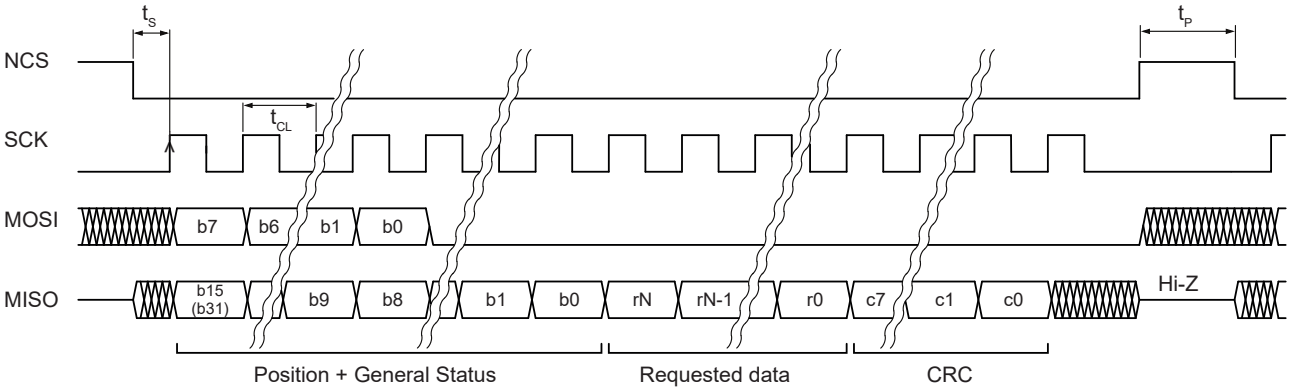
Electrical connection

All data signals are 3.3 V LVTTL. Inputs are 5 V tolerant. Maximum current sourced or sunk from signal lines should not exceed 20 mA. Single-ended signals should be as short as possible, especially if high frequencies are used.



Signal	Description
NCS	Active low. NCS line is used for synchronisation between master and slave devices. During communication it must be held low. Idle is high. When NCS is high, MISO line is in high-Z mode. This allows connection of multiple slaves in paralell, sharing all lines except NCS.
SCK	Serial clock. Shifts out the data on rising edge.
MOSI	Master output ⟶ Slave input. Command from the controller to encoder.
MISO	Master input ⟵ Slave output. Data is output on rising edge on SCK after NCS low. When NCS is high, MISO line is in high-Z mode.

SPI timing diagram



Controller starts the communication by setting the NCS signal low. The last available position data is latched at the same time. A delay of t_S is required for the encoder to prepare the data which is shifted to MISO output on rising edges of clock signal SCK. The command is received on 8 consecutive rising edges of SCK. 16 bits of Position and General Status (active low) data are sent out regardless of the received command. The following Requested data length as well as the content depends on the command. The last eight bits contain CRC (inverted) of the complete data packet.

Communication parameters

Parameter	Symbol	Min	Typ	Max
Clock period	t_{CL}	250 ns		
Clock frequency	f_{CL}			4 MHz
Time after NCS low to first SCK rising edge	t_S	2.5 µs for 14B resolution 8 µs for 14M resolution		
Pause time	t_P	5 µs		

Structure of data packet

Bit	b31 : b16	b15 : b2	b1 : b0	rN : r0	c7 : c0
Data length	16 bits	14 bits	2 bits	Variable	8 bits
Meaning	Multi-turn counter (if specified in part number)	Encoder position	General status	Requested data	CRC (inverted)

Encoder position - for all commands		
	b31 : b16	Multi-turn counter (if specified in part number) - Left aligned, MSB first.
	b15 : b2	Encoder position - Left aligned, MSB first.
General status - for all commands		
	b1	Error - If low, position data is not valid. Last valid position is sent out.
	b0	Warning - If low, position data is valid, but some operating conditions are close to limits.
	Error and Warning bits can be set at the same time, in this case Error bit has priority. The color of the LED on the readhead housing indicates the value of the General status bits. LED is flashing (duty cycle 50 %, frequency 2.5 Hz), when the encoder is in idle state. If the controller request the data every 20 ms or more often, the duty cycle of the LED is 100 % (always on).	
Requested data - Command "v" (0x76) - serial number request		
	r47 - r0	6 bytes (48 bits) of ASCII serial number.
Requested data - Command "t" (0x74) - temperature request		
	r15 - r0	16 bits, signed. Number represents temperature of the readhead in °C multiplied by 10.
Requested data - Command "d" (0x64) - detailed status request		
	r7	Signal amplitude too high. Readhead is too close to the magnet or an external magnetic field is present.
	r6	Signal amplitude low. Distance between the readhead and the magnet is too large.
	r5	Readhead temperature is out of range.
	r4	Speed is too high.
	r3	Multiturn counter error.
	r2 - r0	Reserved.
CRC (inverted)		
	c7 : c0	Polynomial for CRC calculation of the sent data is: x8 + x7 + x4 + x2 + x1 + 1. Represented also as 0x97. Number must be inverted before comparison with calculated CRC.

CRC calculation example is in application note document CRCD01, available for download from www.rls.si/orbis.

If command byte does not match any of listed commands, encoder will send only Position, Status, CRC data. If additional data is not required, MOSI line of the encoder should be tied to GND.

Encoder programming

Encoder supports setting position offset, presetting multiturn counter value and running self-calibration function.
Additional information on encoder programming can be found in the "Application note: Programming encoders with SPI interface", document BRD09. Contact RLS Support to obtain this document.

Readhead part numbering

BR10 SF A 14B 16 C D 00

Special requirements
00 - No special requirements (standard)

Connector option
D - Molex 501568-1107
H - Soldering pads with through holes

Operating temperature range
C - 0 °C to +85 °C

Magnet type compatibility
12 - BM120A190A1ABx00 or actuator BA060–BA100
16 - BM160B240A1ABx00 or actuator BA120–BA150

Resolution
14B - 14 bits per revolution
14M - 14 bits per revolution + 16 bit multi-turn counter (for **DC, SC, SF** and **SP** only)

Communication interface
DC - BiSS-C, RS422
PW - Pulse width modulation (PWM), LVTTL
SC - Synchronous serial (SSI), RS422
SF - Asynchronous serial, RS422
SP - SPI slave, LVTTL

Communication interface variant
See table next to the description of the chosen communication interface for detailed information
For **DC**: **D -** BiSS-C, 5 ACK bits, bidirectional
For **PW**: Base frequency in Hz:

A	D	E
122.07	549.32	1098.63

For **SC**: **B -** Start bit and idle data line 1
For **SF**: Link speed in kbps:

A	B	C	D	E	F
115.2	128	230.4	256	500	1000

For **SP**: **C -** Standard, full duplex

Valid combinations

Series	Communication protocol	Communication protocol variant	Resolution	Magnet type compatibility	Temperature range	Connector option	Special requirements
BR10	DC	D	14B	12 / 16	C	D / H	00
			14M				
	PW	A / D / E	14B				
	SC	B	14B				
			14M				
	SF	A / B / C / D / E / F	14B				
			14M				
	SP	C	14B				
			14M				

Magnet part numbering

BM 120 A 190 A 1 A B A 00

Series
BM - Orbis magnet

Inner diameter
120 - 12 mm
160 - 16 mm

Thickness
A - 3 mm
B - 3.5 mm

Outer diameter
190 - 19 mm
240 - 24 mm

Material
A - NdFeB

Grade
1 - Grade 1 tested magnet

Surface finishing
A - NiCuNi

Temperature range
B - -40 °C to +120 °C

Packaging
A - Individual packaging
B - Bulk packaging

Special requirements
00 - No special requirements

Valid combinations

Series	Inner diameter	Thickness	Outer diameter	Material	Grade	Surface finishing	Temperature range	Packaging	Special requirements
BM	120	A	190	A	1	A	B	A / B	00
	160	B	240						

Magnetic actuator part numbering

BA 060 AB 01 A A 00

Series
BA - Orbis magnetic actuator

Shaft diameter
060 - 6 mm
080 - 8 mm
100 - 10 mm
120 - 12 mm
140 - 14 mm
150 - 15 mm

Form
AB - With 3 fasteners

Magnet type
01 - BM120A190A1ABA00
02 - BM160B240A1ABA00

Material
A - Anodized aluminium

Packaging
A - Individual packaging
B - Bulk packaging

Special requirements
00 - No special requirements

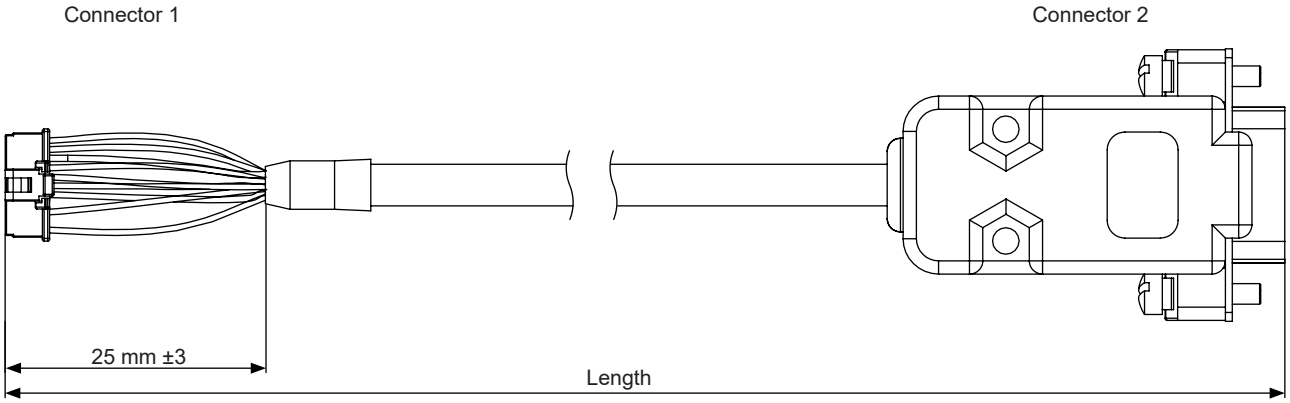
Valid combinations

Series	Shaft Size	Form	Magnet type	Material	Packaging	Special requirements
BA	060	AB	01	A	A / B	00
	080					
	100					
	120		02			
	140					
	150					

Accessories

Cables with crimped connectors

Part number	Length	Connector 1	Connector 2	Notes
ACC012	1.0 m	Molex 501330-1100 and 501334-0000	Flying leads	Single-shielded
ACC024	3.0 m			
ACC027	1.0 m		DSUB-9 M	



Connector 1 pin	Connector 2 pin	Wire color	BiSS-C	Asynchronous serial	PWM	SSI	SPI
1	5	Brown	5 V supply				
2	-	-	-				
3	9	White	0 V (GND)				
4	-	-	-				
5	8	Pink	-				
6	4	Grey	-				
7	2	Red	MA+	RX command in+	Status out	Clock+	SCK
8	3	Blue	MA–	RX command in–	-	Clock–	NCS
9	1	Cable shield	Cable shield				
10	6	Green	SLO+	TX data out+	PWM out	Data+	MISO
11	7	Yellow	SLO–	TX data out–	-	Data–	MOSI

Cable specifications

Part numbers	ACC012, ACC024, ACC027
Cable specifications	LI12YC12Y
Configuration	4 × 2 × 0.14 mm²
Sheath colour	Grey (RAL7032)
Rated voltage	250 V
Temperature range	Operating –30 °C to +125 °C Storage –40 °C to +130 °C Not valid for cables with DSUB-9 M connector.
Environmental conformation	RoHS conform 73/23/EWG-Guideline CE conform Halogen free
Chemical resistance	Largely resistant to acids, bases and usual oils. Free from lacquer damaging substances and silicone.

ACC027 can be used for direct connection to E201-9S or E201-9B USB encoder interface.

Head office

RLS merilna tehnika d.o.o.
Poslovna cona Žeje pri Komendi
Pod vrbami 2
SI-1218 Komenda
Slovenia

T +386 1 5272100
F +386 1 5272129
E sales@rls.si
www.rls.si

Document issues

Issue	Date	Page	Corrections made
5	14. 10. 2019	2	Dimensions on technical drawings amended
		4	Multiturn counter added
		6	Chemical resistance table added
		7	BiSS communication parameters amended
		18	Accessories chapter added, Cable data added
6	22. 11. 2019	2	Technical drawings amended
		4	Self-calibration paragraph added
		9, 15	Speed information removed