

RLB

Miniature Incremental Magnetic Encoder Module

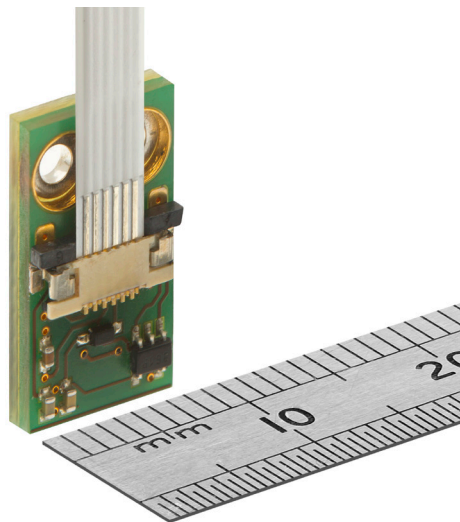
RLB is a PCB-level incremental encoder system consisting of a PCB sensor and a magnetic scale or ring. It is designed for embedded motion control applications as a position control loop element in applications with limited space.

The state-of-the-art position detection guarantees a highly repeatable position measurement under wide installation tolerances and temperature ranges.

MINIATURE
DESIGN

INCREMENTAL-
QUADRATURE
OUTPUT

SIMPLE
CONNECTION
WITH FLEX
CABLE



Features and benefits

- ▶ Miniature design: 4.1 x 8 x 14 mm
- ▶ Incremental quadrature A, B, Z (TTL)
- ▶ Periodic-bidirectional reference mark
- ▶ High speed operation
- ▶ Additional error output
- ▶ Flex cable connection
- ▶ RoHS compliant



SMT PICK AND PLACE



IN SMALL SIZE



PRINTING TECHNOLOGY



MEDICAL



GIMBALS

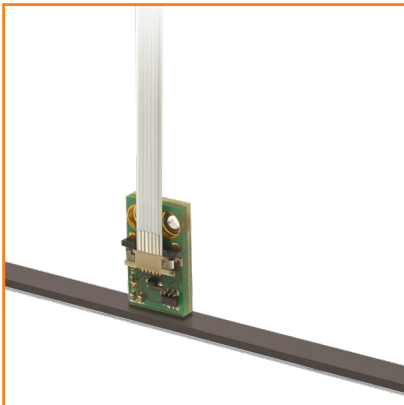
General information

The RLB's miniature design offers the possibility of integration into space-constrained and relatively clean applications, such as various medical devices, SMT pick-and-place machines, lighting fixtures, gimbals, XYZ motion stages, and the like. The readhead can be connected via the FFC low-profile connector with locking mechanism. The position information is output in incremental quadrature single-ended TTL format, with the option to output a periodic reference mark at each magnetic pole (2 mm).

Choose your RLB system

The robust RLB readhead is compatible with the RLS incremental scale MS05 as well as the RLS axial and radial rings. You can select the length of the MS05 scale up to 50 m in three different accuracy grades. There is also a wide range of axial and radial incremental rings available.

RLB + magnetic scale



More about the MS magnetic scales can be found in the MSD01 at [RLS Media center](#).

RLB + radial magnetic ring



More about the radial rings can be found in the MR02D02 at [RLS Media center](#).

RLB + axial magnetic ring



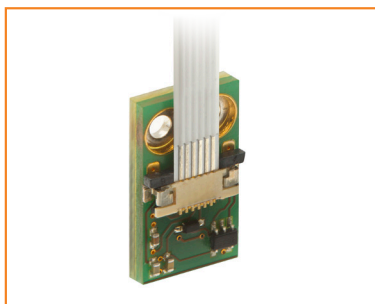
More about the axial rings can be found in the MR01D01 at [RLS Media center](#).

Encoder variants

RLB module



RLB module with ribbon cable included



Storage and handling

All data given below refer to the readhead only. Complete systems with magnetic scale or ring may have other limitations. For more information, see the MSD01, MR02D02 or MR01D01 data sheet at [RLS Media center](#).

Storage temperature



–40 °C to +85 °C

Operating temperature

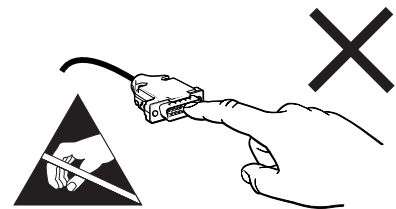
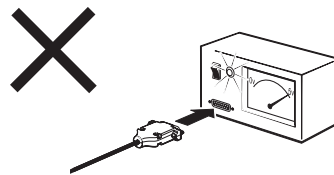
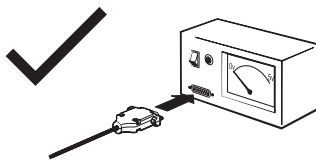


–30 °C to +85 °C

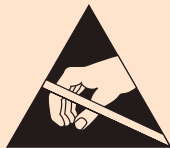
Humidity



Up to 70 % non-condensing



The encoder is a mechanically sensitive component. Handle it by its edges, touch it lightly, minimize pressure and eliminate bending while maintaining a secure grip to prevent falls. Maximize cleanliness. When it's not in use, place it in an ESD protective packaging (box or tray).



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.

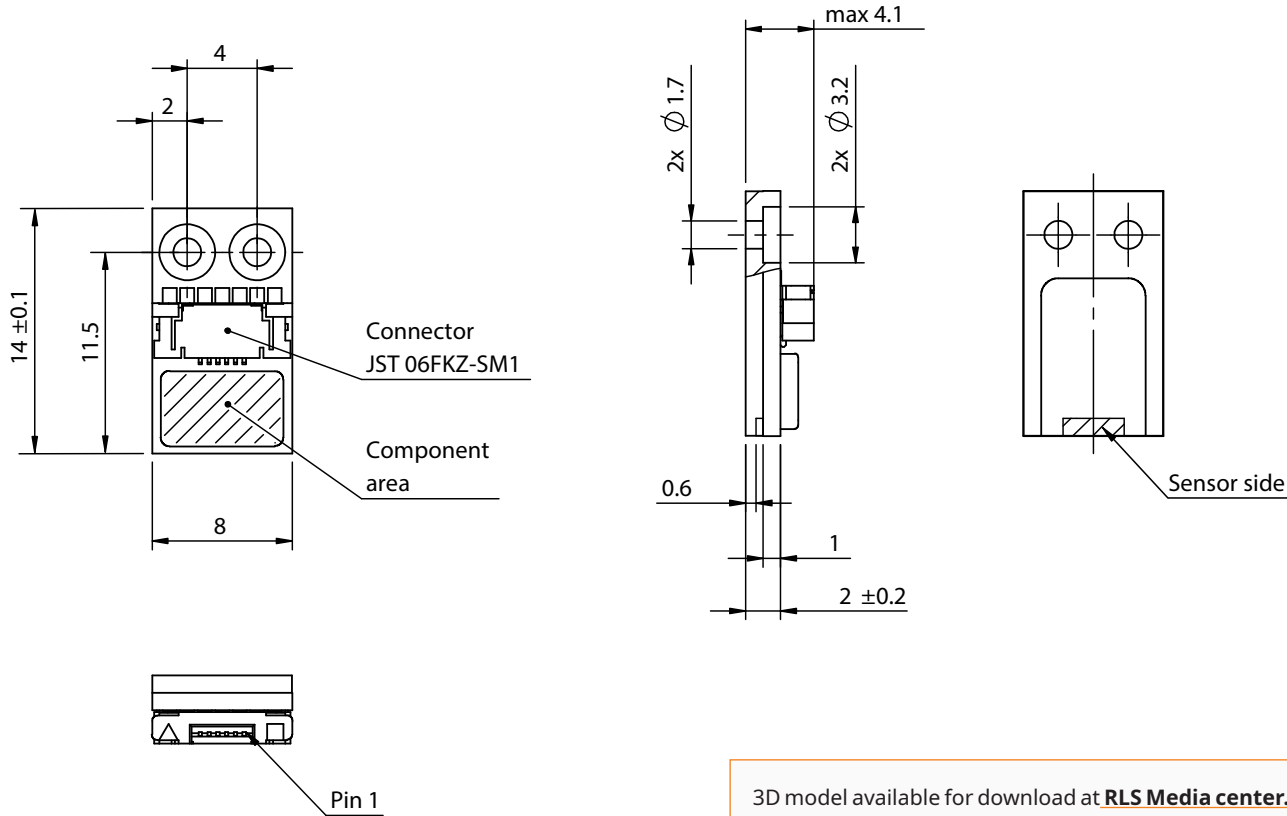
Packaging

Less than 20 units are individually packed in antistatic boxes. For quantities of 20 pieces or more, the readheads are packed in trays (see table below). The trays are packed together in a cardboard box (19 trays per box).

Part	Tray size	Box size
RLB2HD with connector	120 units per tray	19 trays per box

Dimensions and installation drawings

Dimensions and tolerances are in mm. Dimensions without tolerance values are in accordance with ISO 2768-m.



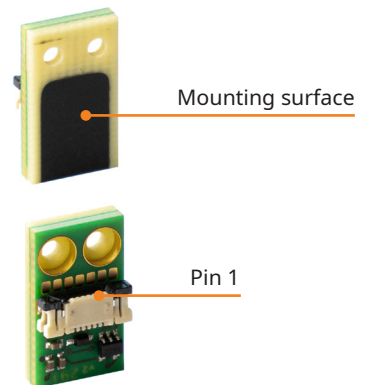
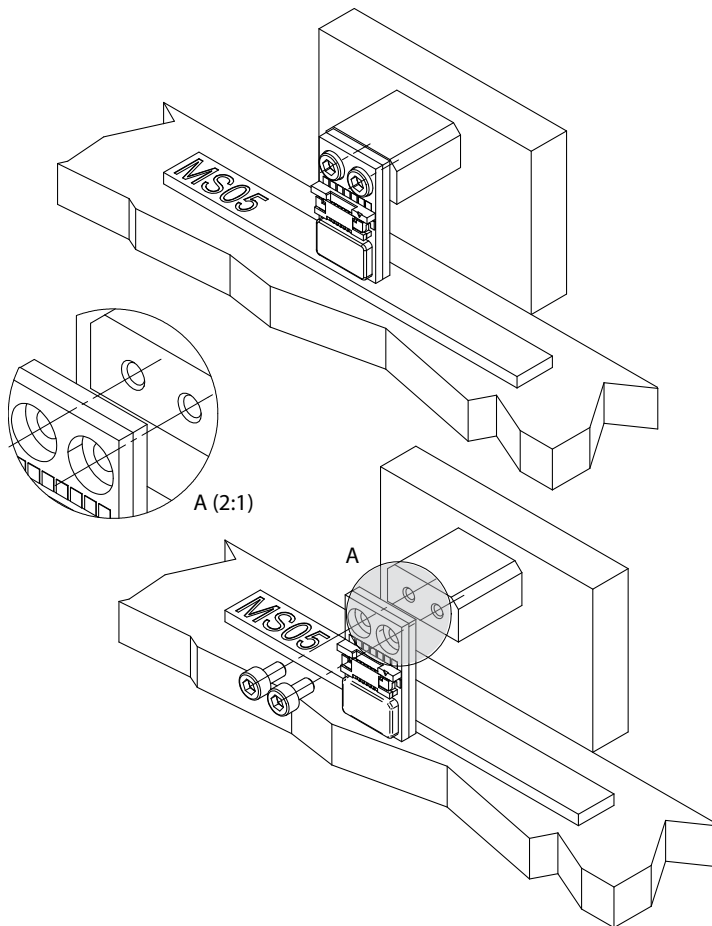
3D model available for download at [RLS Media center](#).

General tolerances for linear dimensions according to ISO 2768 m

Tolerance class	up to 6	6-30	30-120
m (medium)	± 0.1	± 0.2	± 0.3

Installation instructions

When mounting the RLB, make sure that only the mounting surfaces of the PCB assembly are in contact with the mounting bracket. All other parts of the PCB assembly should maintain a minimum distance of 0.1 mm from other metal objects. All permissible distance and angle tolerances must be strictly complied according to the mounting instructions found at MSD01, MR01D01 or MR02D02 data sheet at [RLS Media center](#).



Images are for illustration purposes only. Valid for all versions.

Position of installation holes

Recommended use of stainless steel, DIN912. For more information, see [Table of recommended fastener tightening torques](#) at [RLS Media center](#).

To avoid mechanical damage to the PCB assembly, do not use countersunk fasteners.

- The magnetic encoder system must be installed and mounted in strict compliance with the dimensions and tolerances given on **page 4**. All permissible distance and angle tolerances must be strictly complied according to the mounting instructions found at MSD01, MR01D01 or MR02D02 data sheet at [RLS Media center](#).
- It is important that the space between the readhead and the magnetic scale is maintained over the entire measuring range.
- The magnetic encoder system must be used in accordance with the specified degree of protection. The following factors must be taken into account: IP protection class, operating temperature, external magnetic field, humidity level, mechanical load and EMC compatibility.
- The magnetic encoder system is sensitive to the external magnetic fields. The magnitude of the influence on the magnetic encoder system depends on the magnitude and direction of the external magnetic field. In particular, the rapidly changing stray magnetic fields affect the system and can alter its function. Magnetic field strength within 1 mT reduces the accuracy of the system. Field strengths greater than 1 mT will cause the system to malfunction and as a result the readhead will report an incorrect position. Magnetic field strengths greater than 25 mT will cause irreversible damage to the magnetic scale or ring and will have to be replaced.

Technical specifications

System data

Pole length		2 mm
Maximum measuring length		50 m
System accuracy	Linear application	$\pm 10 \mu\text{m/m}$ / $\pm 20 \mu\text{m/m}$ / $\pm 40 \mu\text{m/m}$
	MS05 magnetic scale	Different accuracy grades of MS05 magnetic scale available. Refer to MSD01 available at RLS Media center .
	Rotary application	Axial: Refer to MR01D01 available at RLS media center Radial: Refer to MR02D02 available at RLS media center
Hysteresis		< 3 μm (at 0.3 mm ride height)
Repeatability (unidirectional)		< 1 μm
Interpolator latency		< 250 ns
Reference mark		Periodic (per pole pitch - 2 mm)
Set-up time		< 10 ms (after power supply voltage is set in operating range)
Resolution		Max. 13 bit ($\sim 0.244 \mu\text{m}$) For details refer to the Table of available resolutions .
Maximum speed	Linear application	Refer to MSD01 available at RLS media center
	Rotary application	Axial: Refer to MR01D04 available at RLS media center . Radial: Refer to speed calculator available at RLS website .

Electrical data

Power supply	5 V ± 0.25 V – voltage on readhead
Current consumption	< 20 mA
Reverse polarity protection	With reverse polarity protection
Maximum cable length	Flex cable: 0.5 m ($R \leq 0.75 \Omega/\text{m}$)

Mechanical data

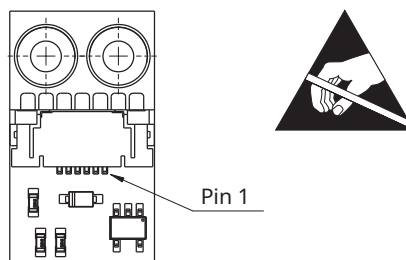
Mass	0.46 g
Connection type	JST 06FKZ-SM1

Environmental data

Temperature	Operating	-30 °C to +85 °C
	Storage	-40 °C to +85 °C
Vibrations (55 Hz to 2000 Hz)	300 m/s ² (IEC 60068-2-6)	
Shocks (6 ms)	300 m/s ² (IEC 60068-2-27)	
Humidity	70 % non condensing	
External magnetic field during operation	< 1 mT	
ESD immunity	HBM, Class 2, ±2kV	

Electrical connections

Pin	Signal
1	Error
2	Vdd
3	GND
4	Z
5	B
6	A



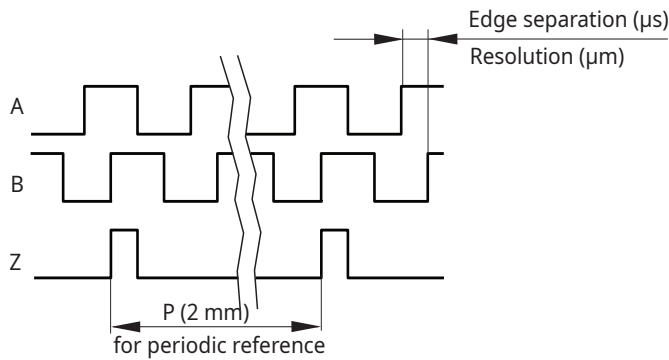
The test pads do not correspond to the pin-out of the connector and must not be used for soldering wires.

Output type

Incremental, no line driver
RLB2HD

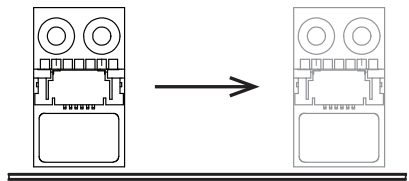
Specifications	
Output signals	Digital – TTL-level (A, B, Z)
Saturation voltage hi (I = -4 mA)	$V_{dd} - 0.4\text{ V}$
Saturation voltage Io (I() = 4 mA)	0.4 V
Rise and fall time (cc = 50 pF)	60 ns

Timing diagram



Positive direction

Digital output signals – A leads B



For more information, see the MSD01, MR02D02 or MR01D01 data sheet at **RLS Media center**.

Error output

To enable successful error diagnosis, different types of errors are signaled on the error line with a PWM formatted code as described below. In case of an amplitude or frequency error, the PWM cycle frequency is approximately 16.5 Hz (cycle duration: 60.7 ms).

Failure mode	Error output	Possible cause of failure
No error (position data is valid)	High	-
Amplitude error (position data is not valid)	Low: 75 % High: 25 %	Readhead removed from the scale / ring The readhead is out of alignment with the magnetic scale or the magnetic scale/ring is demagnetised*
Frequency error (position data is not valid)	Low: 50 % High: 50 %	Velocity too high**
System error (position data is not valid)	Low	Undervoltage EEPROM Configuration

*The Amplitude error does not indicate non-optimal installation of the readhead such as accuracy outside of specification.

**For max. speed table for axial rings refer to the MR01D01 at [RLS Media center](#) or speed calculator for radial rings at [RLS website](#).

For max. speed table for magnetic scales refer to the MSD01 at [RLS Media center](#).

If an amplitude error occurs, the conversion process is stopped and the incremental output signals are terminated. An amplitude error excludes the possibility of a frequency error.

The error output is an open collector type with built-in pull-up resistor. It can be used in a “wired-OR” digital logic configuration with other error signals in the system.

Part numbering

	RLB	2	HD	A	13B	A	00	C	00
Pole length									
2 - 2 mm									
Output type									
HD - Incremental, no line driver									
Option									
A - Standard									
Interpolation factor (Resolutions)*									
13B - 8192 (~0.244 μm)			09B - 512 (~3.906 μm)			D10 - 100 (~20 μm)			
12B - 4096 (~0.488 μm)			D50 - 500 (~4 μm)			D08 - 80 (~25 μm)			
11B - 2048 (~0.976 μm)			D40 - 400 (~5 μm)			06B - 64 (~31.25 μm)			
2D0 - 2000 (~1 μm)			D32 - 320 (~6.25 μm)			D04 - 40 (~50 μm)			
1D6 - 1600 (~1.25 μm)			08B - 256 (~7.812 μm)			05B - 32 (~62.5 μm)			
10B - 1024 (~1.953 μm)			D20 - 200 (~10 μm)			04B - 16 (~125 μm)			
1D0 - 1000 (~2 μm)			D16 - 160 (~12.5 μm)			03B - 8 (~250 μm)			
D80 - 800 (~2.5 μm)			07B - 128 (~15.625 μm)						
*For exact values see table of Available resolutions .									
Minimum edge separation									
K - 0.07 μs (15 MHz)			E - 4 μs (0.25 MHz)			The customer's controller must support the selected edge separation time even if the encoder is used below the maximum speed.			
A - 0.12 μs (8 MHz)			F - 5 μs (0.2 MHz)						
B - 0.5 μs (2 MHz)			G - 10 μs (0.1 MHz)						
C - 1 μs (1 MHz)			H - 20 μs (0.05 MHz)						
D - 2 μs (0.5 MHz)									
Connector									
00 - connector only									
06 - With FFC cable, length 127 mm									
Reference mark									
C - Periodic reference mark as per scale pitch (every 2 mm)									
Reference periods correspond to pole length of magnetisation. Magnetic scale or ring must be ordered with no reference mark.									
Special requirements									
00 - No special requirements (standard)									

Not all part number combinations are valid. Please refer to the table of available combinations on the next page for available options.

Table of available combinations

Series	Pole length	Output type	Option	Interpolation factor	Minimum edge separation	Connector	Reference mark	Special requirements
RLB	2	HD	A	xxx*	K / A / B / C / D / E / F / G / H	00 / 06	C	00
				04B	A / B / C / D / E / F / G / H			
				03B	B / C / D / E / F / G / H			

*Please check the table below for available interpolation factors.

For the part numbering of the MS incremental magnetic scale or the MR radial and axial incremental magnetic ring, refer to the corresponding data sheet at [RLS Media Center](#).

Available resolutions

Table of available resolutions

Part number	Pole length [mm]	Interpolation factor	Resolution [μm]
13B	2	2 ¹³	0.244140625
12B		2 ¹²	0.48828125
11B		2 ¹¹	0.9765625
2D0		2000	1
1D6		1600	1.25
10B		2 ¹⁰	1.953125
1D0		1000	2
D80		800	2.5
09B		2 ⁹	3.90625
D50		500	4
D40		400	5
D32		320	6.25
08B		2 ⁸	7.8125
D20		200	10
D16		160	12.5
07B		2 ⁷	15.625
D10		100	20
D08		80	25
06B		2 ⁶	31.25
D04		40	50
05B		2 ⁵	62.5
04B		2 ⁴	125
03B		2 ³	250

Resolutions calculation

$$\text{Resolution } [\mu\text{m}] = \frac{\text{Pole length } [\mu\text{m}]}{\text{Interpolation factor}} = \frac{2000}{\text{Interpolation factor}}$$

For ring applications:

CPR – Counts per revolution (resolution)

$$\text{Resolution [CPR]} = \text{Pole number}^* \times \text{Interpolation factor}$$

PPR – Pulses per revolution

$$\text{Resolution [PPR]} = \frac{\text{Resolution [CPR]}}{4}$$

*See pole numbers in the MR01D01 or MR02D02 data sheet at [RLS Media center](#).

Accessories



USB encoder interface
E201-9Q



Connector adapter FFC to
DB9 (connects to E201):
RLACC005

Head office

RLS Merilna tehnika d.o.o.

Poslovna cona Žeje pri Komendi
Pod vrbami 2
SI-1218 Komenda
Slovenia

T +386 1 5272100
E mail@rls.si

www.rls.si

Global support

Visit our [website](#) to contact your nearest sales representative.

Date	Issue	Page	Description
15. 12. 2022	5	General	New design, data amended

This product is not designed or intended for use outside the environmental limitations and operating parameters expressly stated on the product's datasheet. Products are not designed or intended for use in medical, military, aerospace, automotive or oil & gas applications or any safety-critical applications where a failure of the product could cause severe environmental or property damage, personal injury or death. Any use in such applications must be specifically agreed to by seller in writing, and is subject to such additional terms as the seller may impose in its sole discretion. Use of products in such applications is at buyer's own risk, and buyer will indemnify and hold harmless seller and its affiliates against any liability, loss, damage or expense arising from such use. Information contained in this datasheet was derived from product testing under controlled laboratory conditions and data reported thereon is subject to the stated tolerances and variations, or if none are stated, then to tolerances and variations consistent with usual trade practices and testing methods. The product's performance outside of laboratory conditions, including when one or more operating parameters is at its maximum range, may not conform to the product's datasheet. Further, information in the product's datasheet does not reflect the performance of the product in any application, end-use or operating environment buyer or its customer may put the product to. Seller and its affiliates make no recommendation, warranty or representation as to the suitability of the product for buyer's application, use, end-product, process or combination with any other product or as to any results buyer or its customer might obtain in their use of the product. Buyer should use its own knowledge, judgment, expertise and testing in selecting the product for buyer's application, end-use and/or operating environment, and should not rely on any oral or written statement, representation, or samples made by seller or its affiliates for any purpose. EXCEPT FOR THE WARRANTIES EXPRESSLY SET FORTH IN THE SELLER'S TERMS AND CONDITIONS OF SALE, SELLER MAKES NO WARRANTY EXPRESS OR IMPLIED WITH RESPECT TO THE PRODUCT, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE, WHICH ARE DISCLAIMED AND EXCLUDED. All sales are subject to seller's exclusive terms and conditions of sale which, where the seller is (a) RLS Merilna tehnika d.o.o., are available at <https://www.rls.si/eng/salesterms>, (b) Renishaw, Inc., are available at <https://www.renishaw.com/legal/en/-/42186>, or (c) another person, are available on request, and in each case, are incorporated herein by reference, and are the exclusive terms of sale. No other terms and conditions apply. Buyer is not authorized to make any statements or representations that expand upon or extend the environmental limitations and operating parameters of the products, or which imply permitted usage outside of that expressly stated on the datasheet or agreed to in writing by seller.

RLS Merilna tehnika d.o.o. has made considerable effort to ensure the content of this document is correct at the date of publication but makes no warranties or representations regarding the content. RLS Merilna tehnika d.o.o. excludes liability, howsoever arising, for any inaccuracies in this document. © 2022 RLS d.o.o.