RLC2IC

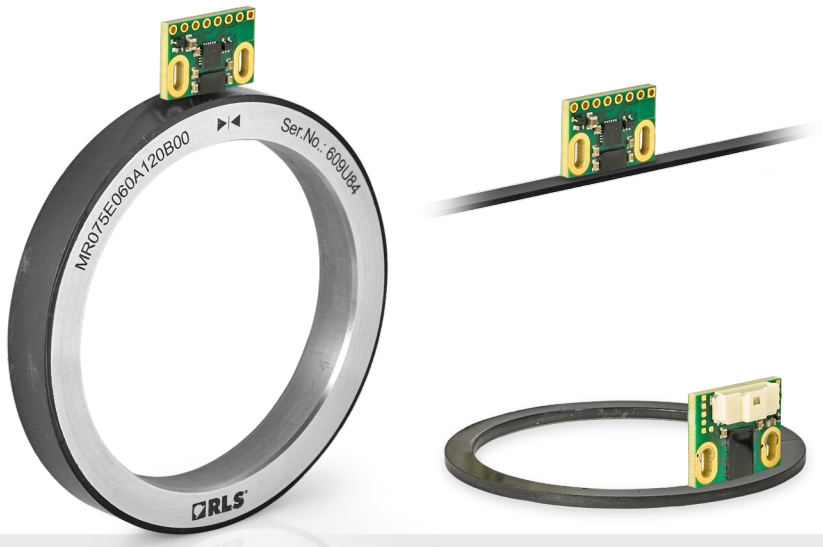
Miniature Incremental Magnetic Encoder Module

SMALL SIZE & SIMPLE INTEGRATION

UNIQUE REFERENCE MARK

HIGH OPERATING TEMPERATURE

RLC2IC 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 mounting tolerances and temperature ranges. Position information is output in incremental quadrature format with the option of a unique or periodic reference mark (each pole).



Features and benefits

- Miniature design
- Four different termination options
- Unique or periodic bidirectional reference mark
- Incremental quadrature output RS422
- Suitable for use with linear scales, radial and axial rings
- High system accuracy up to ±10 µm
- Non-contact and wear-free measuring principle

MEDICAL | PRINTING TECHNOLOGY | IN SMALL SIZE | ROBOTIC JOINTS | SMT PICK AND PLACE

General information

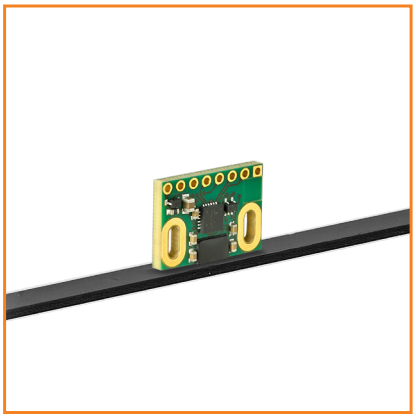
The RLC2IC is a small PCB-level encoder with differential incremental signals and the possibility of a reference signal. The encoder can be ordered with different types of connectors or through-hole pads and is very suitable for applications with limited space.

Choose your RLC2IC system

The robust RLC2IC 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. There is also a wide range of axial and radial incremental rings available.

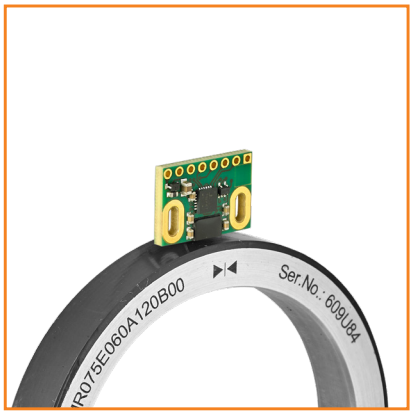
To ensure safety and reliability, the scale MS05 and the radial rings can be optionally covered with a protective stainless steel foil. Unique or distance-coded reference marks are also available to provide an even more reliable solution.

RLC2IC + magnetic scale



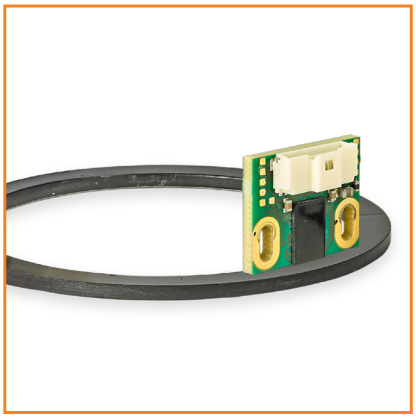
More about the MS magnetic scales can be found in the MSD01 at **RLS media center**.

RLC2IC + radial magnetic ring



More about the radial rings can be found in the MR02D02 at **RLS media center**.

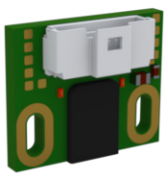
RLC2IC + axial magnetic ring



More about the axial rings can be found in the MR01D01 at **RLS media center**.

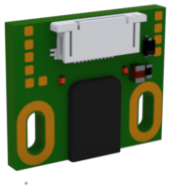
Encoder variants

RLC2IC with Molex 5015681107

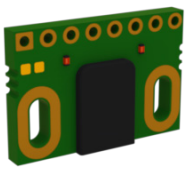


RLC2IC with AMPHENOL 10114828-11108LF

RLC2IC with Molex 527451197



RLC2IC with through-hole pads



Images are for illustration purpose only.

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 sheets at **RLS Media center.**

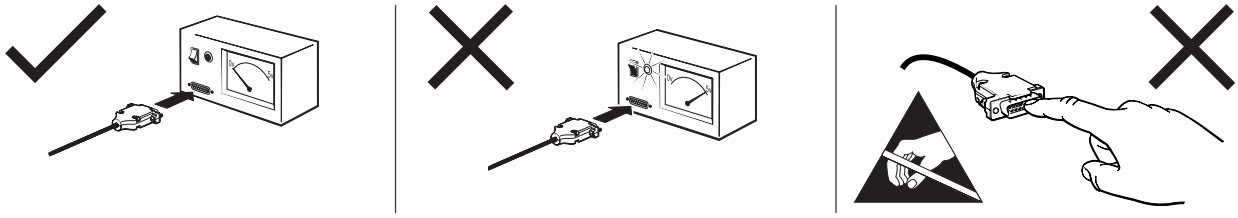
Storage and operating temperature

Temperature	Product variant with
–40 °C to +85 °C	Molex 527451197
–40 °C to +105 °C	Molex 5015681107 AMPHENOL 10114828-11108LF
	Through-hole variant
+15 °C to +30 °C –40 °C to +125 °C	(before soldering) (after wires are soldered)

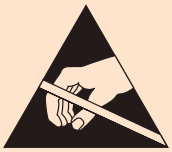
Humidity

Product variant with connector
Up to 70 % non-condensing

Through-hole variant
Up to 10 % (before soldering)
Up to 70 % non-condensing (after wires are soldered)



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

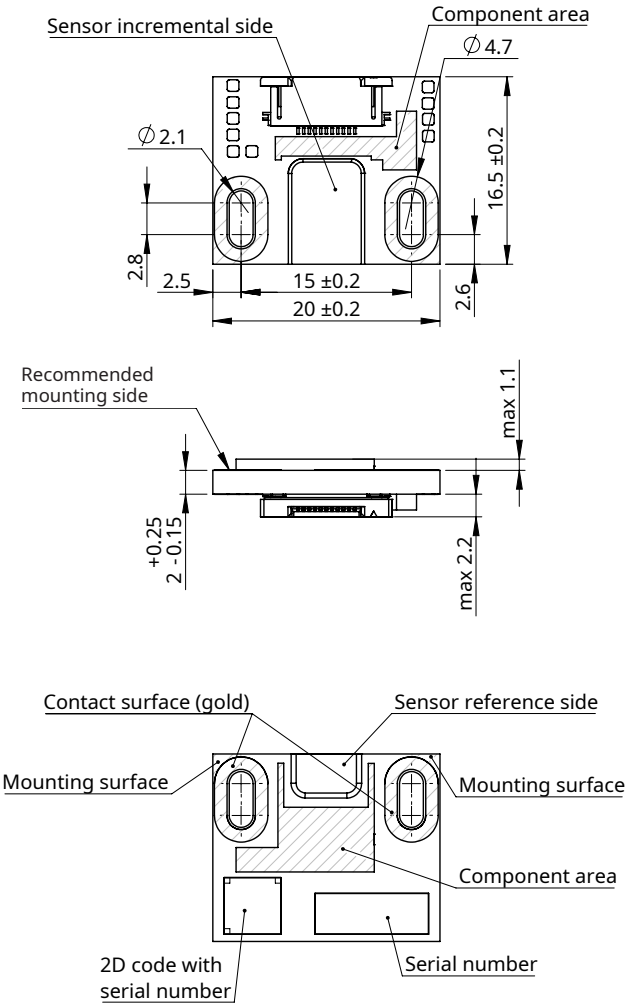
Less than 20 units are individually packed in antistatic boxes. For quantities of 20 pieces or more, the readheads are packed in trays (see table below). The trays are packed together in a cardboard box (20 trays per box).

Product variant	Tray size	Box size
RLC2IC with through-hole pads	28 units per tray	20 trays per box
RLC2IC with connector	30 units per tray	

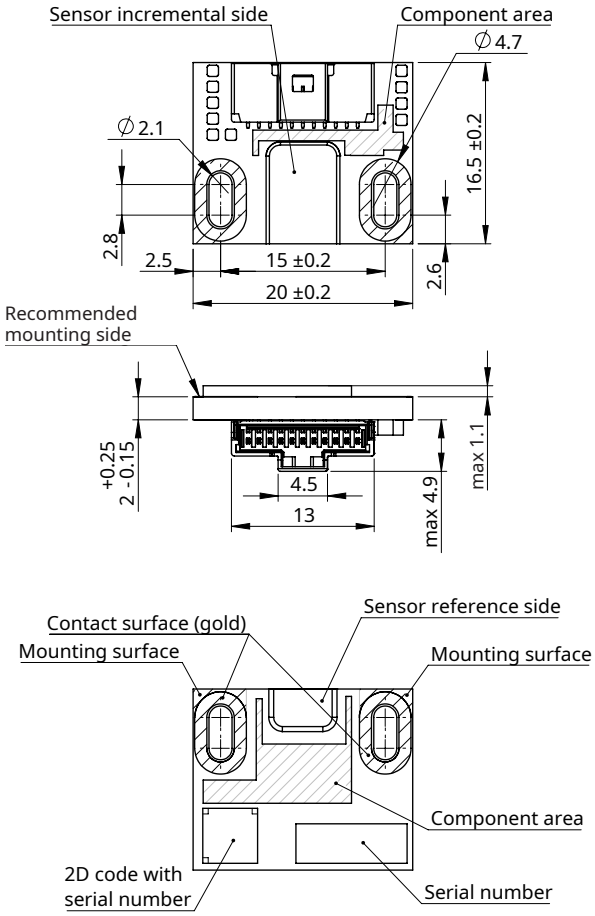
Dimensions and installation drawings

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

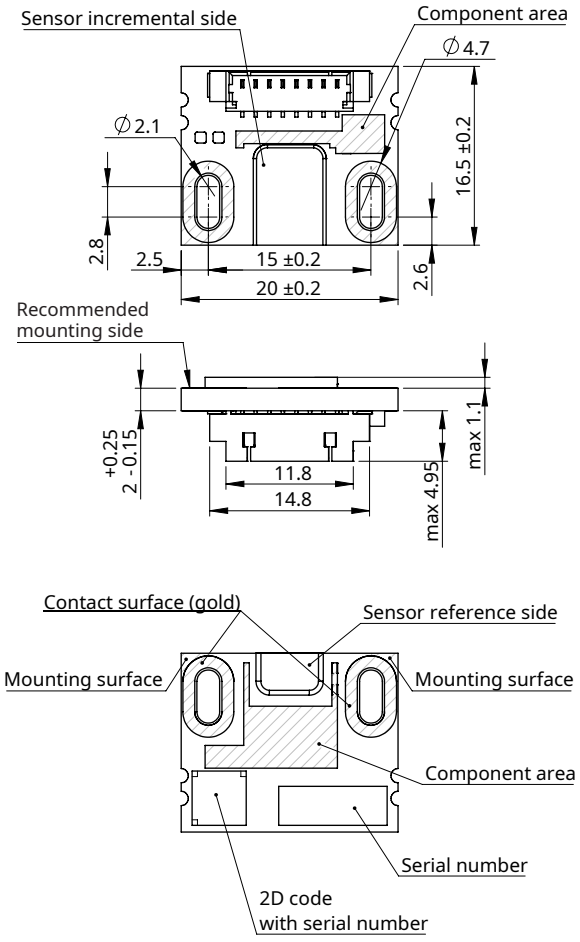
RLC2IC with Molex 527451197



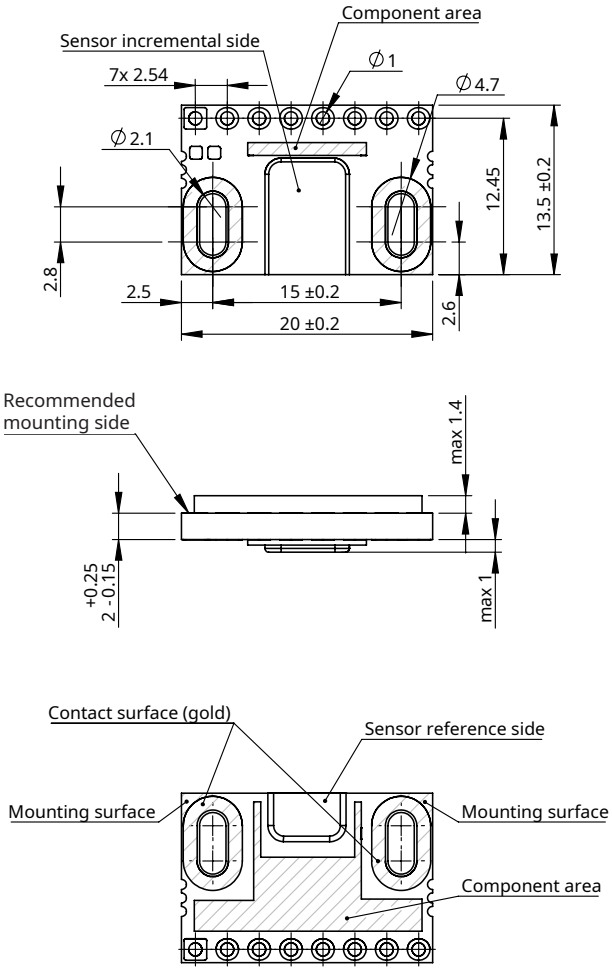
RLC2IC with Molex 5015681107



RLC2IC with AMPHENOL 10114828-11108LF

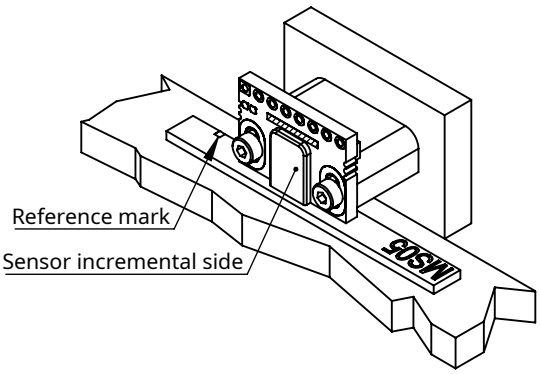


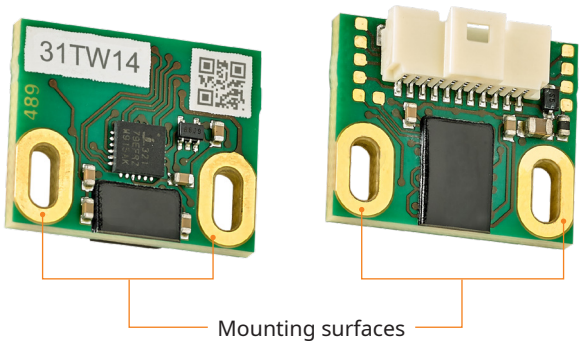
RLC2IC through-hole pads

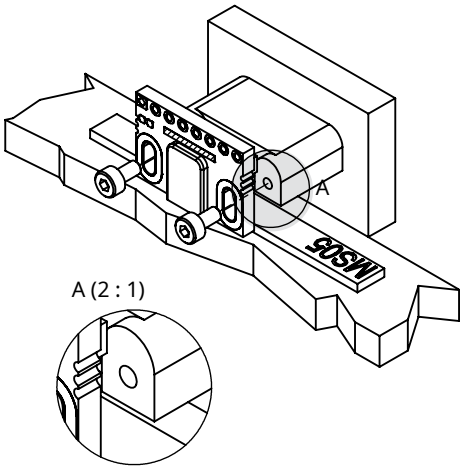


Installation instructions

When mounting the RLC2IC, 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 sheets at **RLS Media center**.







Images are for illustration purpose 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.

- 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 MS05 magnetic scale	±10 µm/m / ±20 µm/m / ±40 µm/m 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
Reference mark		Unique / Periodic
Set-up time		< 50 ms (after power supply voltage is set in operating range)
Resolution		Max. 13 bit (~0.244 µm) For details refer to the **Table of available resolutions**.
Maximum speed	Linear application	Refer to MS speed calculator available at **RLS website**.
	Rotary application	**Axial:** Refer to speed calculator available at **RLS website**. **Radial:** Refer to speed calculator available at **RLS website**.

Electrical data

Power supply	5 V ±0.25 V – voltage on readhead
Current consumption	< 30 mA without 120 Ω termination < 130 mA with 120 Ω termination
Reverse polarity protection	Without reverse polarity protection.
Maximum cable length	10 m (Flex cable: 0.5 m (R ≤ 0.75 Ω/m)
Recommended wire gauge	Through-hole: 21 AWG to 30 AWG

Mechanical data

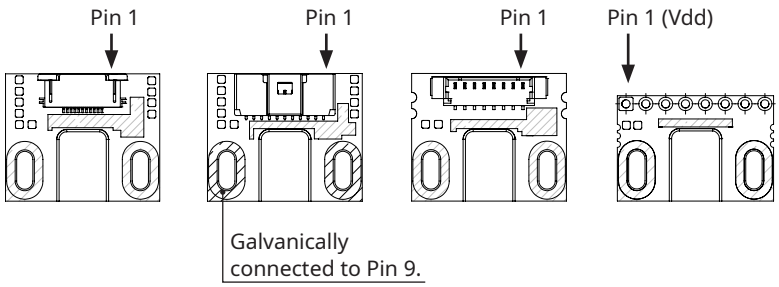
Mass	Through-hole	1.35 g
	With connector	~1.85 g
Connection types		Molex 527451197, AMPHENOL 10114828-11108LF, Molex 5015681107, Through-hole

Environmental data

Operating and storage temperature	With Molex 527451197	–40 °C to +85 °C
	With Molex 5015681107 or AMPHENOL 10114828-11108LF	–40 °C to +105 °C
	Through-hole design	–40 °C to +125 °C (after soldering) +15 °C to +30 °C (before soldering)
Vibrations (55 Hz to 2000 Hz)	300 m/s² (IEC 60068-2-6)	
Shocks (6 ms)	300 m/s² (IEC 60068-2-27)	
Humidity	With Connector	70 % non condensing
	Through-hole design	Up to 10 % (before soldering) Up to 70 % non-condensing (after soldering)
External magnetic field during operation	< 1 mT	
ESD immunity	HBM, Class 2 ±2 kV	

Electrical connections

Function	Signal	Molex 527451197	Molex 501568-1107	AMPHENOL 10114828-11108LF	Through-hole
Power	Vdd	1	1, 2	1	1
	GND	2, 10	3, 4	2	8
Incremental signals	A+	6	5	4	6
	A–	7	6	3	7
	B+	8	7	5	4
	B–	9	8	6	5
Reference signals	Z+	3	10	8	2
	Z–	4	11	7	3
Cable shield	-	-	9	-	-
N.C.	-	5, 11	-	-	-



In configurations without reference mark the Z+ and Z– outputs maintain constant voltage potential levels of RS422 interface.

Output type

Incremental, RS422

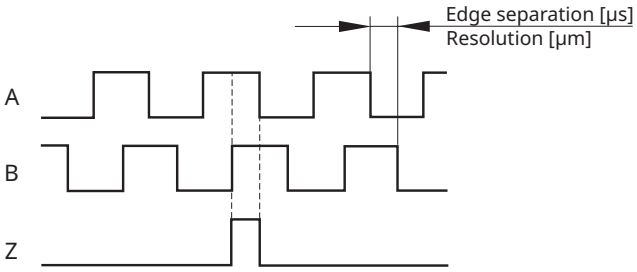
RLC2IC

Specifications

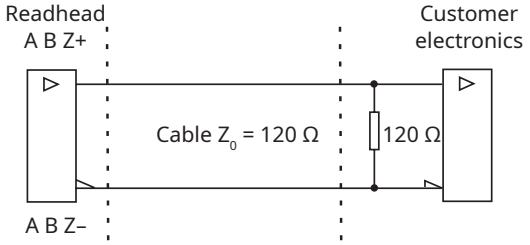
Output signals	3 square-wave signals A, B, Z and their inverted signals A–, B–, Z–
Reference signal	1 or more square-wave pulse Z and its complementary pulse Z–
Signal level	Differential line driver according to EIA standard RS422
Permissible load	$Z_0 \geq 120\ \Omega$ between associated outputs

Timing diagram

Complementary signals not shown

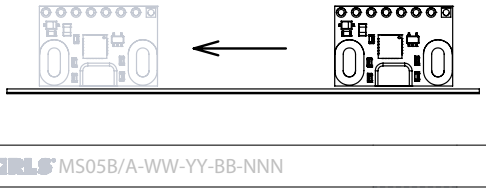


Recommended signal termination



Positive direction

Digital output signals – A leads B (magnetic scale is stationary)



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

Part numbering

RLC 2 IC A 13B A 00 C 00

Pole length
2 - 2 mm

Output type
IC - Incremental, RS422; 5 V

Option
A - Standard

Interpolation factor (Resolutions)* — **Max Speed Calculators**

13B - 8192 (~0.244 µm)
12B - 4096 (~0.488 µm)
11B - 2048 (~0.976 µm)
2D0 - 2000 (~1 µm)
1D6 - 1600 (~1.25 µm)
10B - 1024 (~1.953 µm)
1D0 - 1000 (~2 µm)
D80 - 800 (~2.5 µm)
09B - 512 (~3.906 µm)
D50 - 500 (~4 µm)
D40 - 400 (~5 µm)
D32 - 320 (~6.25 µm)
08B - 256 (~7.812 µm)
D20 - 200 (~10 µm)
D16 - 160 (~12.5 µm)
07B - 128 (~15.625 µm)
D10 - 100 (~20 µm)
D08 - 80 (~25 µm)
06B - 64 (~31.25 µm)
D04 - 40 (~50 µm)
05B - 32 (~62.5 µm)
04B - 16 (~125 µm)
03B - 8 (~250 µm)

* For exact values see **Table of available resolutions** on the following page.

Minimum edge separation — **Max Speed Calculators**

K - 0.07 µs (15 MHz)
A - 0.12 µs (8 MHz)
B - 0.5 µs (2 MHz)
C - 1 µs (1 MHz)
D - 2 µs (0.5 MHz)
E - 4 µs (0.25 MHz)
F - 5 µs (0.2 MHz)
G - 10 µs (0.1 MHz)
H - 20 µs (0.05 MHz)

The customer's controller must support the selected edge separation time even if the encoder is used below the maximum speed.

Connector
00 - No connector, through-hole
12 - Connector Molex 5015681107
13 - Connector Molex 527451197
20 - Connector AMPHENOL 10114828-11108LF

Reference mark
A - With unique reference mark
Magnetic scale or ring must be ordered with reference mark.
B - No 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
RLC	2	IC	A	xxx*	K / A / B / C / D / E / F / G / H	00 / 12 / 13 / 20	A / B / C	00
				04B	A / B / C / D / E / F / G / H		B / C	
				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 data sheets MSD01, MR02D02 and MR01D01 at **RLS Media Center**.

Available resolutions

Table of available resolutions

Part number	Pole length [mm]	Interpolation factor	Resolution [µm]
13B		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	2	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

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

$$\text{Resolution [ppr]} = \frac{\text{Resolution [cpr]}}{4} = \frac{\text{Pole number*} \times \text{Interpolation factor}}{4}$$

*See pole numbers in the MR01D01 or MR02D02 data sheet at **RLS Media center.**

Accessories

Cable assembly
ACC054

Cable assembly
ACC055

Cable assembly
ACC056

Cable assembly
ACC057

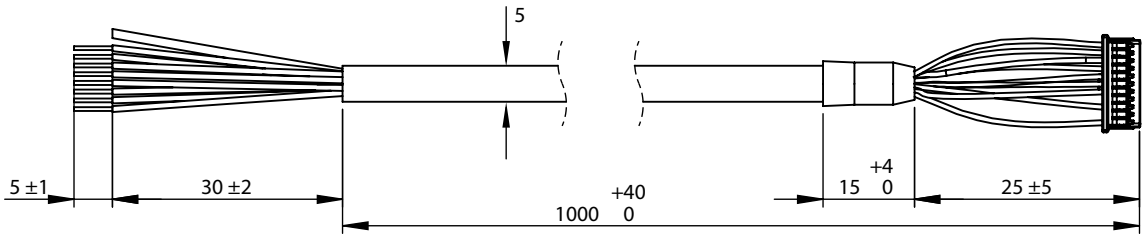
USB encoder interface
E201-9Q

Cable assembly
ACC058
ACC059

ACC054

Part number	Length	Cable connector	RLC2IC connector	Termination
ACC054	1 m	Molex 501330-1100	Molex 501568-1107	Flying leads

Dimensions in mm.



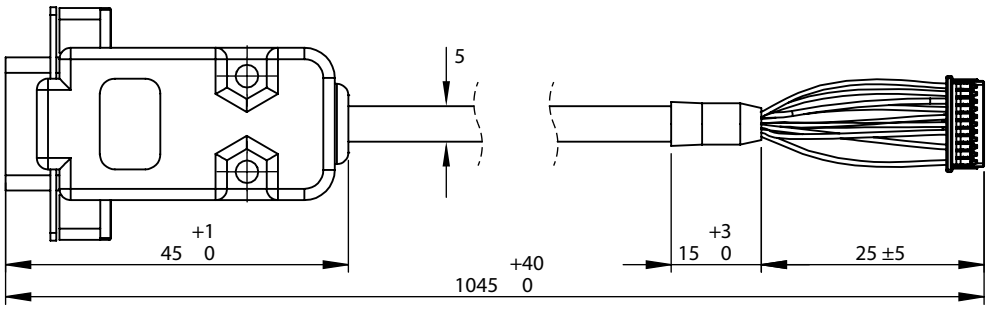
Flying leads	
Wire number	**Wire color**
1	Brown
2	White
3	Green
4	Yellow
5	Blue
6	Red
7	Shield
8	Pink
9	Grey

Molex 501330-1100		
Pin number	**Signal**	**Color**
1	V_{IN} +5 V	Brown
2	V_{IN} +5 V	NC
3	GND	White
4	GND	NC
5	A+	Green
6	A–	Yellow
7	B+	Blue
8	B–	Red
9	Shield	Black
10	Z+	Pink
11	Z–	Grey

ACC055

Part number	Length	Cable connector	RLC2IC connector	Termination
ACC055	1 m	Molex 501330-1100	Molex 501568-1107	DB-9 connector

Dimensions in mm.



DB-9 male connector (plastic housing)	
Pin number	**Wire color**
1	Shield
2	Pink
3	Blue
4	Green
5	Brown
6	Grey
7	Red
8	Yellow
9	White

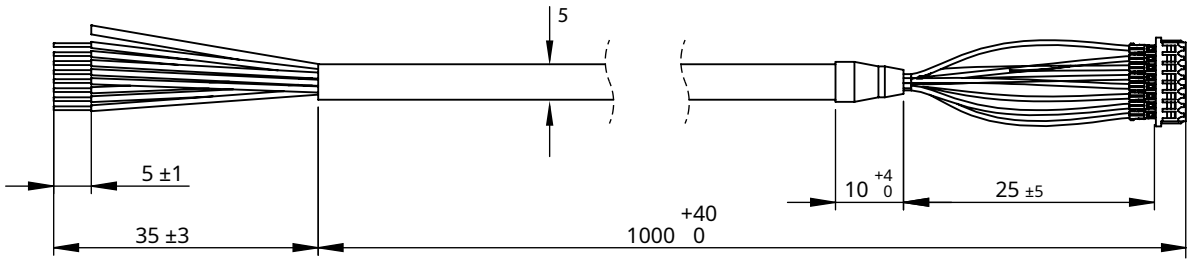
The pin-out matches the pin-out on the E201-9Q interface.

Molex 501330-1100		
Pin number	**Signal**	**Wire color**
1	V_{IN} +5 V	Brown
2	V_{IN} +5 V	NC
3	GND	White
4	GND	NC
5	A+	Green
6	A–	Yellow
7	B+	Blue
8	B–	Red
9	Shield	Black
10	Z+	Pink
11	Z–	Grey

ACC056

Part number	Length	Cable connector	RLC2IC connector	Termination
ACC056	1 m	Amphenol 10114826-00008LF	Amphenol 10114828-11108LF	Flying leads

Dimensions in mm.



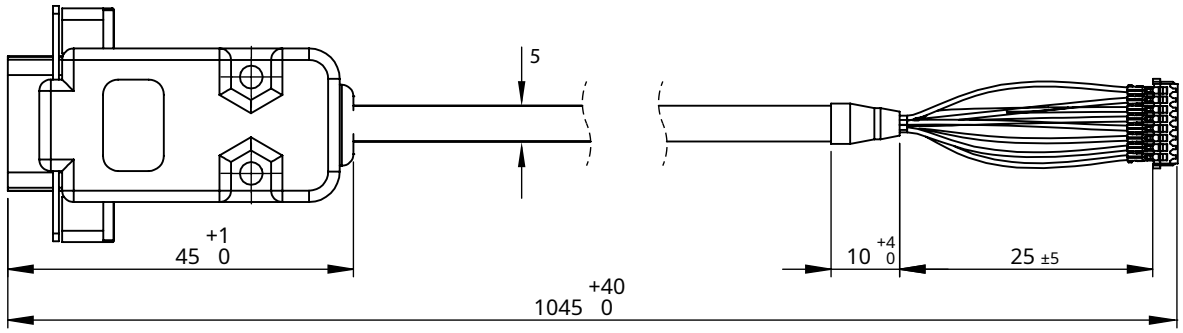
Flying leads	
Wire number	**Wire color**
1	Brown
2	White
3	Yellow
4	Green
5	Blue
6	Red
7	Grey
8	Pink
9	Shield

Amphenol 10114826-00008LF		
Pin number	**Signal**	**Wire color**
1	V_{dd} +5 V	Brown
2	GND	White
3	A–	Yellow
4	A+	Green
5	B+	Blue
6	B–	Red
7	Z–	Grey
8	Z+	Pink

ACC057

Part number	Length	Cable connector	RLC2IC connector	Termination
ACC057	1 m	Amphenol 10114826-00008LF	Amphenol 10114828-11108LF	DB-9 connector

Dimensions in mm.



DB-9 male connector (plastic housing)	
Pin number	**Wire color**
1	Shield
2	Pink
3	Blue
4	Green
5	Brown
6	Grey
7	Red
8	Yellow
9	White

Amphenol 10114826-00008LF		
Pin number	**Signal**	**Wire color**
1	V_{dd} +5 V	Brown
2	GND	White
3	A–	Yellow
4	A+	Green
5	B+	Blue
6	B–	Red
7	Z–	Grey
8	Z+	Pink

The pin-out matches the pin-out on the E201-9Q interface.

Cable assemblies

Part number	Length	Cable connector	RLC2IC connector	Termination
ACC058*	152 mm	–	RLC2IC - Molex 527451197	FFC connector
ACC059*	305 mm		RLC2IC - Molex 0150200809	

* 20 cycles at 4 mm bending radius.

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Document issues

Issue	Date	Page	Description
12	20. 11. 2023	12, 15	Added ACC059
13	12. 2. 2024	5	RLC2IC through-hole dimension amended
		9	Drawing in Positive direction chapter added
		12 - 15	Technical drawings amended
14	8. 7. 2024	3	Temperature and humidity data amended
15	4. 9. 2024	3, 7	Operating temperature and humidity data amended
16	17. 2. 2025	Cover	New image
17	31. 3. 2025	10-11	Special requirement 18 removed
18	22. 4. 2025	13, 15	Text E201 added