

## LM15

### Incremental Magnetic Encoder

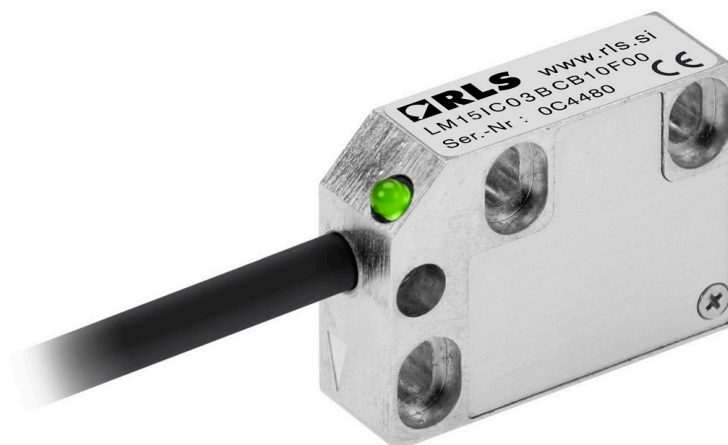
ROBUST

UNIQUE  
REFERENCE  
MARK

WEAR-FREE  
MEASURING  
PRINCIPLE

The LM15 is a high speed non-contact magnetic encoder designed to detect linear motion in harsh environments. It features a compact readhead that rides at up to 3.0 mm from the self-adhesive magnetic scale or ring.

Simple to install, the LM15 features a set-up LED and wide installation tolerances. The encoder is available with digital or analogue output variants and offers a range of customer selectable resolutions from 0.61  $\mu\text{m}$  to 625  $\mu\text{m}$ .



### Features and benefits

- ▶ Customer selectable resolutions
- ▶ High speed operation
- ▶ Excellent dirt immunity to IP68
- ▶ Linear position sensing with large ride height
- ▶ Non-contact and wear-free measuring principle
- ▶ CE compliant, including RoHS
- ▶ Highly resistant to shock, vibration and pressure



COMPACT SIZE



ASSEMBLY LINES



LINEAR MOTOR



PRINTING TECHNOLOGY



INDUSTRIAL AUTOMATION

## General information

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Engineered for extreme service, the solid-state LM15 linear encoders operate from  $-10\text{ }^{\circ}\text{C}$  to  $+80\text{ }^{\circ}\text{C}$ , have water-proof sealing to IP68 and are highly resistant to shock, vibration and pressure. The robust magnetic scale is also resistant to a range of chemicals commonly found in industry. The non-contact, frictionless design eliminates wear and reduces hysteresis.

### Choose your LM15 system

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The robust LM15 readhead is compatible with the RLS MS15 incremental scale. You can choose the length of the MS15 scale up to 150 m.

#### LM15 + magnetic scale



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

### Encoder variants

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#### LM15



LM15 readhead comes with analogue, incremental, RS422, Push-pull or Open collector outputs.

#### LM15 + cable with flexible stainless-steel conduit



LM15 with cable with flexible stainless-steel conduit which is excellent for harsh environments. It comes with standard LM15 outputs.

## Storage and handling

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

### Storage temperature



-40 °C to +85 °C

### Operating temperature

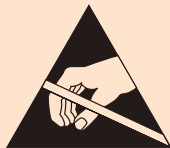
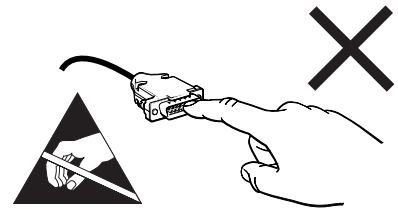
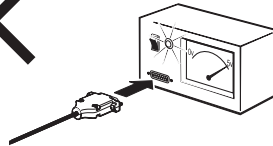
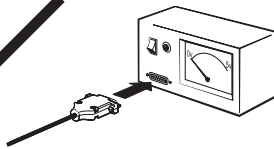


-10 °C to +80 °C

### IP protection

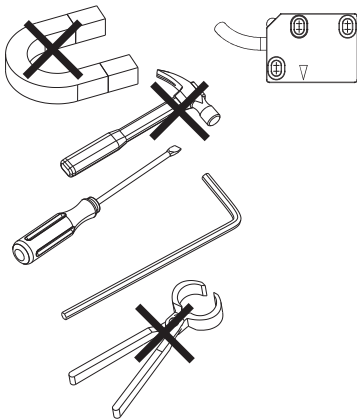


IP68



### 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.

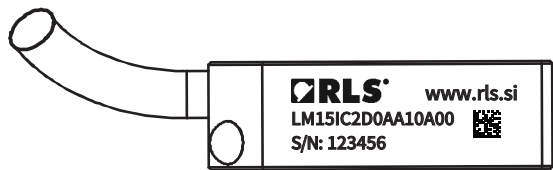


This encoder system is a high performance metrology product and must be handled carefully. The use of industrial tools during installation or exposure to strong magnets such as a magnetic base is not recommended as it carries the risk of damaging parts of the system which as a result might not perform in accordance with specifications.

## Packaging

Each readhead is packed individually in antistatic bag, according to ESD protection measures.

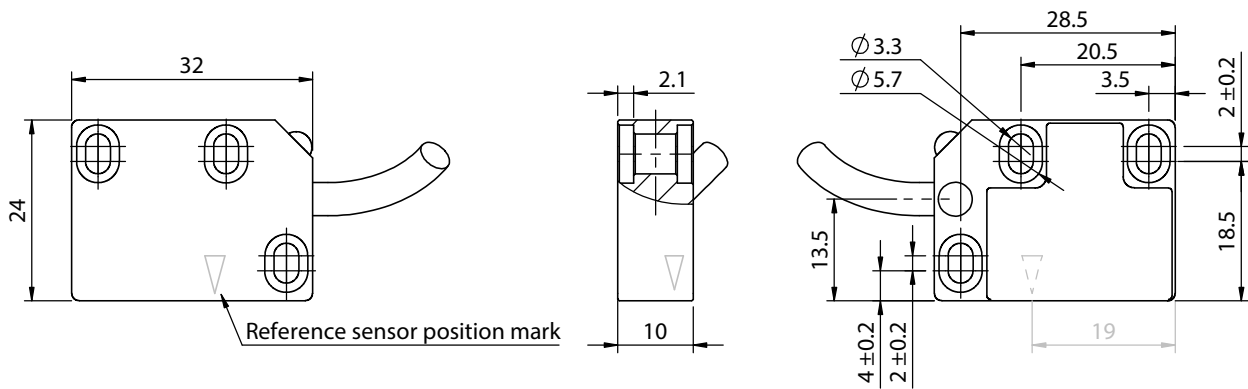
## Labeling



Label on the readhead contains: full PN, 6 digits long serial number and 2D code containing the serial number.

## Dimensions

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

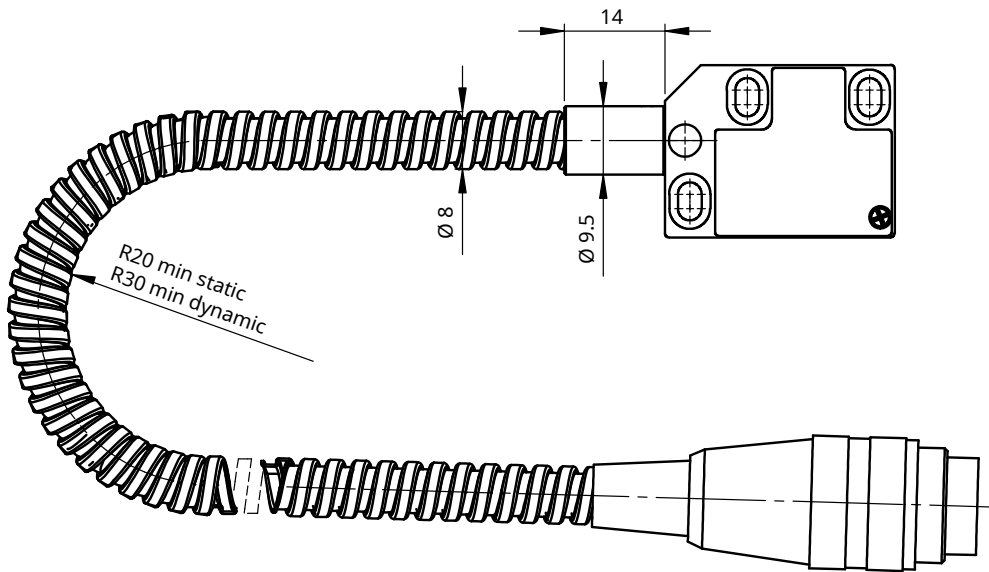


3D model available for download at [RLS Media center](#).

### 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   |

## LM15 readhead with cable with stainless-steel protection tube

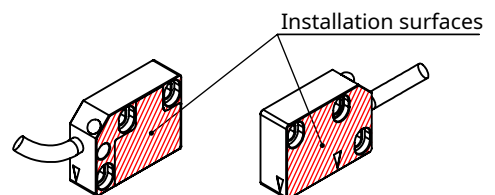


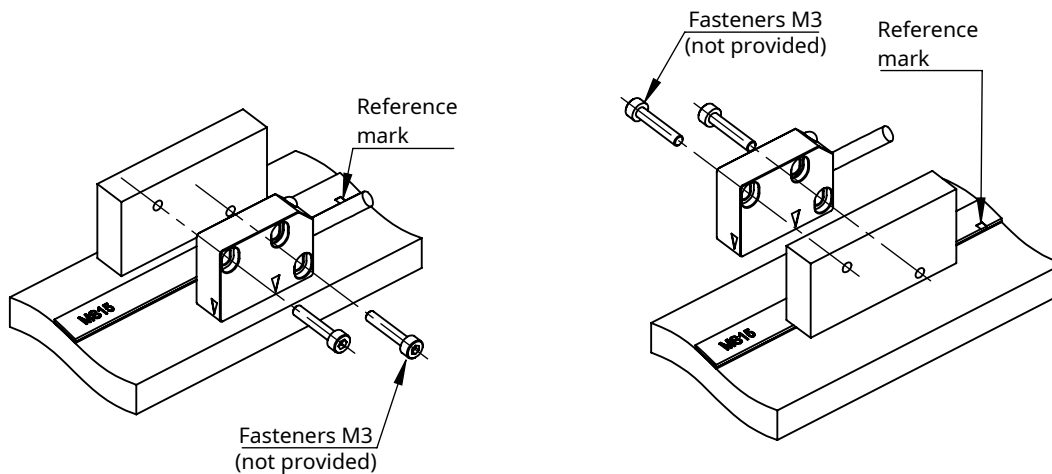
Max. length of cable with flexible stainless-steel conduit tube is 10 m.

## Installation instructions

The readhead LED must be green at all measuring length positions. Otherwise, the installation is not performed correctly. The 0.1 mm to 1.0 mm thick plastic spacer (shim) can be used to facilitate installation. For optimal installation, the recommended thickness of the shim is 0.3 mm. After mounting the magnetic scale, place the plastic shim and the readhead on the magnetic scale. Make sure that the readhead, shim and magnetic scale are in full contact.

**Improper mounting of the magnetic scale and readhead can impair the function of the magnetic encoder system and lead to total failure.**





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

#### Position of installation holes

Recommended use of M3 fasteners with washers. For more information, see [Table of recommended fastener tightening torques](#) at [RLS Media center](#).

- 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 with the red color LED. Magnetic field strengths greater than 25 mT will cause irreversible damage to the magnetic scale and will have to be replaced.

## Technical specifications

### System data

|                                 |                                                                                                                                       |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| <b>Pole length</b>              | 5 mm                                                                                                                                  |
| <b>Maximum measuring length</b> | 50 m (up to 150 m per request)                                                                                                        |
| <b>System accuracy</b>          | ±100 µm/m<br>Refer to MSD01 available at <a href="#">RLS Media center</a> .                                                           |
| <b>Hysteresis</b>               | < 12.5 µm up to 1 mm ride height                                                                                                      |
| <b>Repeatability</b>            | < 2.5 µm at 25°C (up to 3 mm ride height)                                                                                             |
| <b>Reference mark</b>           | Unique / Periodic / DCRM (Information about distance coded ref. mark can be found in the MSD01 at <a href="#">RLS Media center</a> .) |
| <b>Resolution</b>               | Max. 13 bit (~0.61µm)<br>For details refer to the <a href="#">Table of available resolutions</a> .                                    |
| <b>Maximum speed</b>            | Refer to MSD01 available at <a href="#">RLS Media center</a> .                                                                        |

### Electrical data

For electrical data see specific output type on pages 12 to 15.

### Mechanical data

|                 |                   |
|-----------------|-------------------|
| <b>Mass</b>     | 23 g              |
| <b>Material</b> | Die-cast, Zamak-5 |

### Environmental data

|                                                 |                                       |                                                                           |
|-------------------------------------------------|---------------------------------------|---------------------------------------------------------------------------|
| <b>Temperature</b>                              | Operating                             | -10 °C to +80 °C (-20 °C to +85 °C if cable under non-dynamic conditions) |
|                                                 | Storage                               | -40 °C to +85 °C                                                          |
| <b>Environmental sealing</b>                    | IP68 (according to IEC 60529)*        |                                                                           |
| <b>EMC Immunity</b>                             | IEC 61000-6-2                         |                                                                           |
| <b>EMC Emission</b>                             | IEC 61000-6-4                         |                                                                           |
| <b>Vibrations (55 Hz to 2000 Hz)</b>            | 300 m/s <sup>2</sup> (IEC 60068-2-6)  |                                                                           |
| <b>Shocks (6 ms)</b>                            | 300 m/s <sup>2</sup> (IEC 60068-2-27) |                                                                           |
| <b>External magnetic field during operation</b> | 1 mT                                  |                                                                           |

\* Limited by the connector.

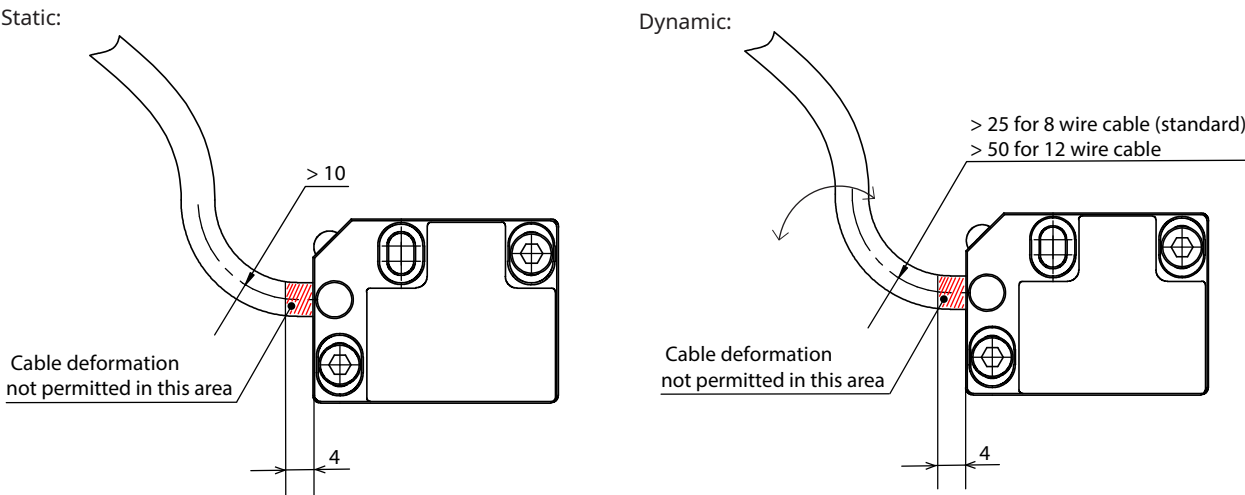
Cable

|                               |                                                                 |                                        |
|-------------------------------|-----------------------------------------------------------------|----------------------------------------|
| Type                          | PUR high flexible cable, drag-chain compatible, double-shielded |                                        |
| Number of wires               | 8                                                               | 12**                                   |
| Outer diameter                | 4.2 mm ±0.2 mm                                                  | 4.5 mm ±0.2 mm                         |
| Jacket material               | Extruded polyurethane (PUR)                                     |                                        |
| White wire                    | 0.14 mm², 26 AWG, 0.13 Ω/m                                      | 0.08 mm², 28 AWG, 0.23 Ω/m             |
| Other wires                   | 0.05 mm², 30 AWG, 0.35 Ω/m                                      |                                        |
| Durability                    | 20 million cycles at 25 mm bend radius                          | 20 million cycles at 50 mm bend radius |
| Weight                        | 34 g/m nominal                                                  | 38 g/m nominal                         |
| Bend radius (internal radius) | Dynamic: 25 mm, static: 10 mm                                   | Dynamic: 50 mm, static: 10 mm          |
| Dynamic torsion               | Not allowed*                                                    |                                        |

\* Cable is not torsion specified. A continuous torsion of the cable in a dynamic application could result in malfunctioning of the encoder system.

\*\* Applied only for option with additional alarm output (for IA, IC; not available for PRG option).

Cable installation



Cable tolerances

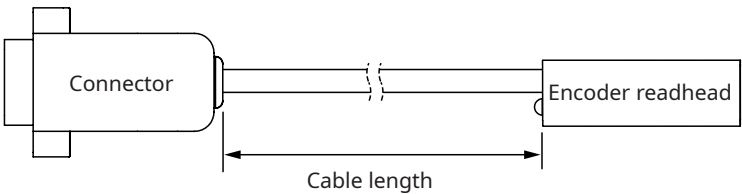
LM15 with cable

| Cable length* [m] | Tolerance [mm] |
|-------------------|----------------|
| ≤ 5               | +50/-20        |
| > 5 ≤ 10          | +70/-30        |
| > 10 ≤ 30         | +100/-40       |

LM15 with cable with stainless-steel protection tube

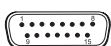
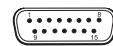
| Cable length* [m] | Tolerance [mm] |
|-------------------|----------------|
| ≤ 5               | +70/-30        |
| > 5 ≤ 10          | +100/-40       |

\* Cable length without connector. See image below.





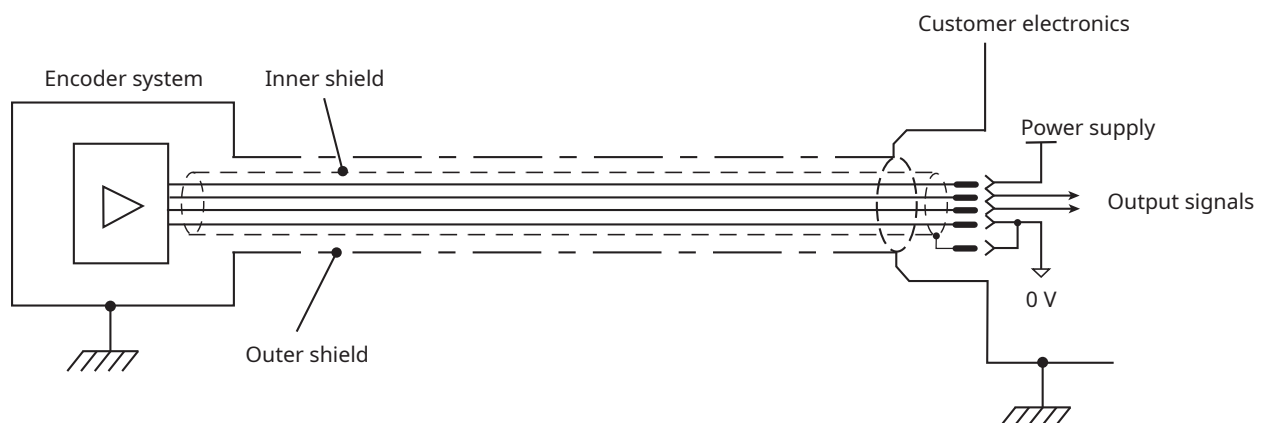
## Electrical connections

|                                      |                       |                      | 9 pin D type<br>plug<br>(option A)                                                | 15 pin D type<br>plug<br>(option D)                                               | 15 pin HD<br>type plug<br>(option H)                                              | 15 pin D type<br>plug<br>(option L)                                                 | 9 pin D type<br>plug<br>(option P)                                                  | 7 pin DIN<br>EN60130-9<br>plug<br>(option U)                                        |
|--------------------------------------|-----------------------|----------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Function                             | Signal                | Colour<br>(option F) |  |  |  |  |  |  |
| Power                                | Vdd                   | Brown                | 5                                                                                 | 7                                                                                 | 7                                                                                 | 4                                                                                   | 5                                                                                   | 5                                                                                   |
|                                      | GND                   | White                | 9                                                                                 | 2                                                                                 | 2                                                                                 | 12                                                                                  | 1                                                                                   | 1                                                                                   |
| Incremental<br>/ analogue<br>signals | A / V <sub>1</sub>    | Green                | 4                                                                                 | 14                                                                                | 14                                                                                | 9                                                                                   | 2                                                                                   | 3                                                                                   |
|                                      | A- / V <sub>1</sub> - | Yellow               | 8                                                                                 | 6                                                                                 | 6                                                                                 | 1                                                                                   | 6                                                                                   | -                                                                                   |
|                                      | B / V <sub>2</sub>    | Blue                 | 3                                                                                 | 13                                                                                | 13                                                                                | 10                                                                                  | 4                                                                                   | 4                                                                                   |
|                                      | B- / V <sub>2</sub> - | Red                  | 7                                                                                 | 5                                                                                 | 5                                                                                 | 2                                                                                   | 8                                                                                   | -                                                                                   |
| Reference<br>signals                 | Z / V <sub>0</sub>    | Pink                 | 2                                                                                 | 12                                                                                | 12                                                                                | 3                                                                                   | 3                                                                                   | 6                                                                                   |
|                                      | Z- / V <sub>0</sub> - | Grey                 | 6                                                                                 | 4                                                                                 | 4                                                                                 | 11                                                                                  | 7                                                                                   | -                                                                                   |
| Alarm*                               | E                     | Violet               | -                                                                                 | 11                                                                                | 11                                                                                | -                                                                                   | -                                                                                   | -                                                                                   |
|                                      | E-                    | Black                | -                                                                                 | 3                                                                                 | 3                                                                                 | -                                                                                   | -                                                                                   | -                                                                                   |
| Shield                               | Inner                 | -                    | 1                                                                                 | 15                                                                                | 15                                                                                | 15                                                                                  | 9                                                                                   | -                                                                                   |
|                                      | Outer                 | -                    | Case                                                                              | Case                                                                              | Case                                                                              | Case                                                                                | Case                                                                                | Case                                                                                |

\* For alarm output "07" option must be ordered.

## Shield connection

Figure below shows a recommended shield termination in order to ensure electromagnetic compatibility.



Housing of the encoder is galvanically connected with the housing of the connector via the cable outer shield. The encoder system must be correctly integrated to achieve EMC compliance. In particular, attention to shielding arrangements is essential.

## Response time

|                                      | LM15AV       | LM15IB       | LM15IC_02*   | LM15IA_02*   | LM15IA   | LM15IC   |
|--------------------------------------|--------------|--------------|--------------|--------------|----------|----------|
| <b>Set-up time</b>                   | 10 ms        | 10 ms        | 10 ms        | 10 ms        | 10 ms    | 10 ms    |
| <b>Interpolation conversion time</b> | —            | < 250 ns     | < 250 ns     | < 250 ns     | < 250 ns | < 250 ns |
| <b>Transition time</b>               | < 10 $\mu$ s | < 10 $\mu$ s | < 10 $\mu$ s | < 10 $\mu$ s | < 100 ms | < 100 ms |

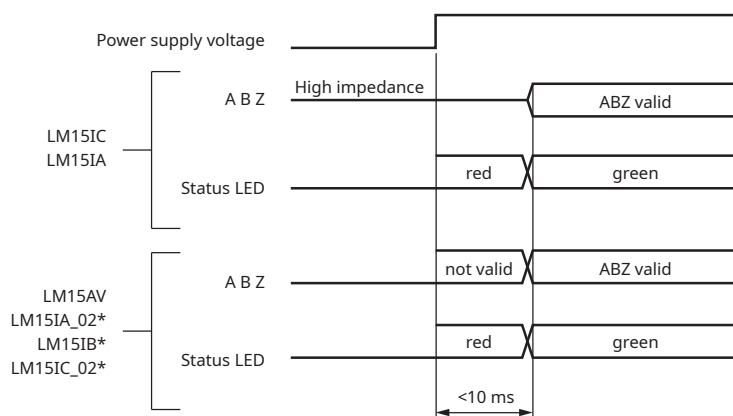
\* Shortened reaction time option.

**Set-up time** is the time needed for the encoder readhead to start reading the position information after power-on (see diagram 1).

**Interpolation conversion time** is the time needed for the encoder readhead to convert the position information into an output signal.

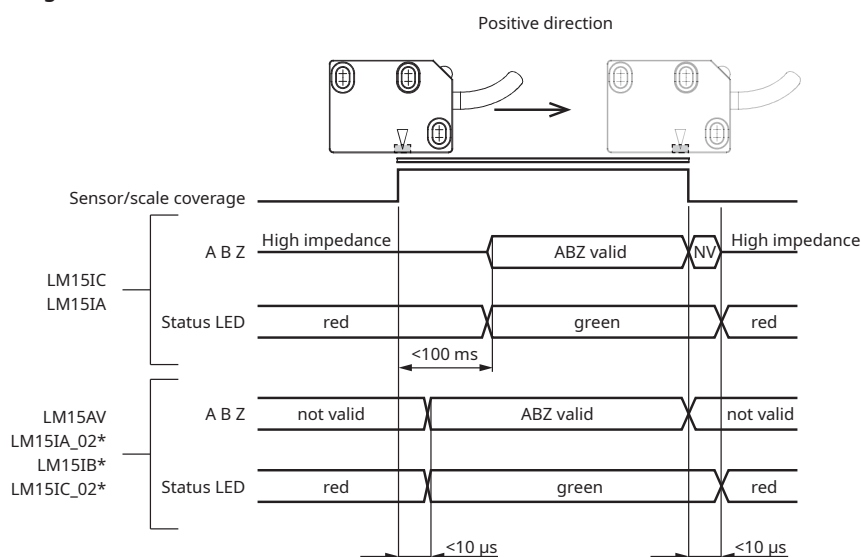
**Transition time** is the time it takes the encoder readhead to switch from an alarm state to a valid output signal (see diagram 2).

Diagram 1: Set-up time



\*In alarm state LED flashes red/green.

Diagram 2: Transition time



## Status indicator LED

After installation of the magnetic scale (refer to MSD01 data sheet at [RLS Media center](#)), the readhead can be easily adjusted on the machine using the set-up LED indicator.

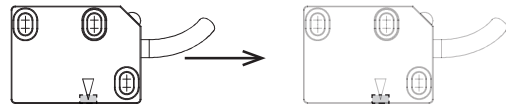
| LED Signal                                                                                                  | Status                                                                                                                                                                                                                                                                                                                | Error output (special option 07) |                          |                           |                           |
|-------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|--------------------------|---------------------------|---------------------------|
|                                                                                                             |                                                                                                                                                                                                                                                                                                                       | IC (E)                           | IC (E-)                  | IA (E)                    | IA (E-)                   |
|  <b>Green</b>              | Good signal strength/set-up                                                                                                                                                                                                                                                                                           | $U_L \leq 0.5 \text{ V}$         | $U_H \geq 2.5 \text{ V}$ | $U_L \leq 1.15 \text{ V}$ | $U_H \geq 3.45 \text{ V}$ |
|  <b>Red</b>                | Poor signal strength. Possible reasons: <ul style="list-style-type: none"> <li>• Incorrect readhead orientation.</li> <li>• Readhead installation out of tolerance.</li> <li>• Demagnetisation of measuring scale.</li> <li>• Insufficient power supply voltage.</li> </ul>                                           | $U_H \geq 2.5 \text{ V}$         | $U_L \leq 0.5 \text{ V}$ | $U_H \geq 3.45 \text{ V}$ | $U_L \leq 1.15 \text{ V}$ |
|  <b>Red/green flashing</b> | IB, IC_02, IA_02: poor signal strength<br>Poor signal strength. Possible reasons: <ul style="list-style-type: none"> <li>• Incorrect readhead orientation.</li> <li>• Readhead installation out of tolerance.</li> <li>• Demagnetisation of measuring scale.</li> <li>• Insufficient power supply voltage.</li> </ul> | Not applicable.                  |                          |                           |                           |

The LED signal functions listed in the table above do not indicate non-optimal installation of the readhead, such as accuracy outside the specified range or improper operation of the reference mark.

## Positive direction

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

**Analogue output signals ( $1 V_{pp}$ )** –  $V_1$  leads  $V_2$



For more information, see the MSD01 data sheet at [RLS Media center](#).

# Output type

## Analogue output signals (1 V<sub>pp</sub>)

LM15AV

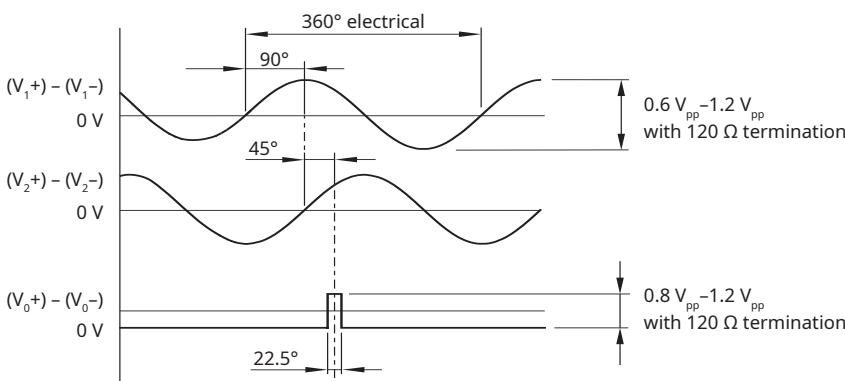
### Specifications

|                                               |                                               |                              |
|-----------------------------------------------|-----------------------------------------------|------------------------------|
| <b>Power supply*</b><br>(voltage on readhead) | 4.7 V to 7 V<br>Reverse polarity protection   |                              |
| <b>Current consumption</b>                    | < 50 mA (without load)                        |                              |
| <b>Voltage drop over cable**</b>              | ~24 mV/m (without load)                       |                              |
| <b>Output signals</b>                         | $V_1, V_2, V_0$                               |                              |
| <b>Sinusoidal period length</b>               | 5 mm                                          |                              |
| <b>Sine / cosine signals</b>                  | Amplitude<br>(with 120 $\Omega$ termination)  | $0.6 V_{pp}$ to $1.2 V_{pp}$ |
|                                               | Phase shift                                   | $90^\circ \pm 0.5^\circ$     |
| <b>Reference signal</b>                       | Amplitude<br>(with 120 $\Omega$ termination)  | $0.8 V_{pp}$ to $1.2 V_{pp}$ |
|                                               | Position                                      | $45^\circ$                   |
|                                               | Width                                         | $22.5^\circ$                 |
| <b>Termination</b>                            | $Z_0 = 120 \Omega$ between associated outputs |                              |
| <b>Maximum cable length*</b>                  | 30 m                                          |                              |

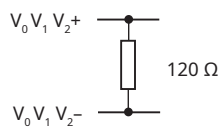
\* Please consider voltage drop over cable.

\*\* At added termination expect higher current consumption, which will result in a higher voltage drop over cable.

### Timing diagram



### Recommended signal termination



## Incremental, Push-Pull output

LM15IA

### Specifications

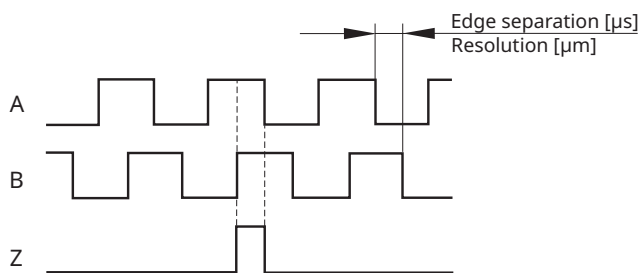
|                                                          |                                                                                                                                                                                                                                        |
|----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Power supply*</b><br>(voltage on readhead)            | 4.7 V to 30 V<br>Without reverse polarity protection                                                                                                                                                                                   |
| <b>Current consumption</b>                               | < 35 mA (without load)                                                                                                                                                                                                                 |
| <b>Voltage drop over cable**</b>                         | ~17 mV/m (without load)                                                                                                                                                                                                                |
| <b>Output signals</b>                                    | 3 square-wave signals A, B, Z and their inverted signals A-, B-, Z-                                                                                                                                                                    |
| <b>Reference signal</b>                                  | 1 or more square-wave pulse Z and its inverted pulse Z-                                                                                                                                                                                |
| <b>Signal level</b>                                      | For 30 V: $U_H \geq 29.2 \text{ V}$ at $-I_H = 30 \text{ mA}$<br>$U_L \leq 0.5 \text{ V}$ at $I_L = 30 \text{ mA}$<br>For 5 V: $U_H \geq 4.2 \text{ V}$ at $-I_H = 20 \text{ mA}$<br>$U_L \leq 0.5 \text{ V}$ at $I_L = 20 \text{ mA}$ |
| <b>Permissible load</b>                                  | $I_L \leq 50 \text{ mA}$ max. load per output<br>Outputs are protected against short circuit to 0 V and to +5 V                                                                                                                        |
| <b>Alarm</b>                                             | High impedance on output lines A, B, A-, B-<br>Special option 02: Alarm is not signaled by high impedance state of the A, B, /A, /B signals<br>Special option 07: Alarm signal is output parallel as line driver signal                |
| <b>Switching time - A, B, Z signals<br/>(10 to 90 %)</b> | For 24 V: $t_+ = t_- < 380 \text{ ns}$ (typ. 120 ns)<br>For 5 V: $t_+ = t_- < 200 \text{ ns}$ (typ. 42 ns)<br>Measured at $C_{\text{LOAD}} = 1000 \text{ pF}$                                                                          |
| <b>Maximum cable length*</b>                             | 30 m                                                                                                                                                                                                                                   |

\* If power supply voltage is <10 V, please consider voltage drop over cable.

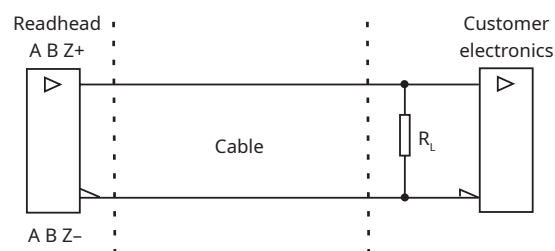
\*\* At added termination expect higher current consumption, which will result in a higher voltage drop over cable.

### Timing diagram

Complementary signals are not shown



### Recommended signal termination



| $V_{\text{supply}}$ | $R_L$        | $I_{\text{load}}$ |
|---------------------|--------------|-------------------|
| 5 V                 | 250 $\Omega$ | 20 mA             |
| 30 V                | 1 k $\Omega$ | 30 mA             |

# Incremental, Open Collector NPN

LM15IB

## Specifications

|                          |                                     |
|--------------------------|-------------------------------------|
| Power supply             | 5 V to 30 V                         |
|                          | Without reverse polarity protection |
| Current consumption      | < 35 mA (without load)              |
| Voltage drop over cable* | ~17 mV/m (without load)             |
| Output signals           | A, B, Z                             |
| Reference signal         | 1 or more square-wave pulses Z      |
| Maximum load             | 10 mA                               |
| Maximum cable length     | See table below                     |

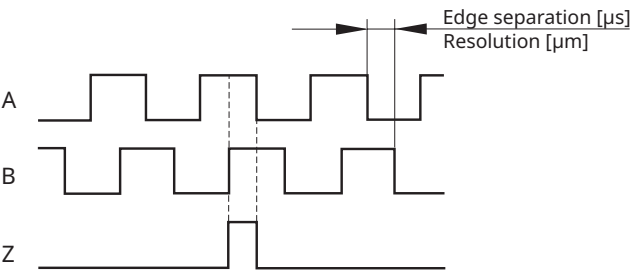
\* At added termination expect higher current consumption, which will result in a higher voltage drop over cable.

| Edge separation [ $\mu$ s] | Maximum cable length [m] |      |      |      |
|----------------------------|--------------------------|------|------|------|
| 0.07                       | 0.2                      | 0.3  | 1    | 1.5  |
| 0.12                       | 3                        | 2.5  | 1    | 1    |
| 0.5                        | 10                       | 7    | 4    | 3    |
| 1                          | 10                       | 10   | 9    | 6    |
| 2, 4, 5, 10, 20            | 10                       | 10   | 10   | 10   |
| Power supply voltage [V]   | 5                        | 12   | 24   | 30   |
| $R_L$ [ $\Omega$ ]*        | 500                      | 1200 | 2400 | 3000 |

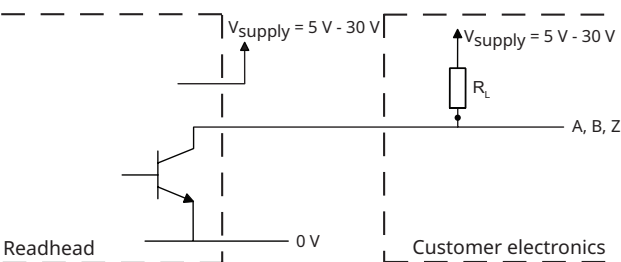
Encoder cable length and all other cable extensions should be taken into account.

\* Recommended values. For higher values of  $R_L$  shorter cables should be used.

## Timing diagram



## Recommended signal termination



## Incremental, RS422

LM15IC

### Specifications

|                                                          |                                                                                                                                                                                                                                                    |
|----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Power supply*</b><br>(voltage on readhead)            | 4.7 V to 7 V<br>Reverse polarity protection                                                                                                                                                                                                        |
| <b>Current consumption</b>                               | < 35 mA (without load)                                                                                                                                                                                                                             |
| <b>Voltage drop over cable**</b>                         | ~17 mV/m (without load)                                                                                                                                                                                                                            |
| <b>Output signals</b>                                    | 3 square-wave signals A, B, Z and their inverted signals A-, B-, Z-                                                                                                                                                                                |
| <b>Reference signal</b>                                  | 1 or more square-wave pulse Z and its inverted pulse Z-                                                                                                                                                                                            |
| <b>Signal level</b>                                      | Differential line driver according to EIA standard RS422:<br>$U_H \geq 2.5 \text{ V}$ at $-I_H = 20 \text{ mA}$<br>$U_L \leq 0.5 \text{ V}$ at $I_L = 20 \text{ mA}$                                                                               |
| <b>Permissible load</b>                                  | $Z_0 \geq 100 \Omega$ between associated outputs<br>$I_L \leq 20 \text{ mA}$ max. load per output<br>Capacitive load $\leq 1000 \text{ pF}$<br>Outputs are protected against short circuit to 0 V and to +5 V<br>Only one output shorted at a time |
| <b>Alarm</b>                                             | High impedance on output lines A, B, A-, B-<br>Special option 02: Alarm is not signalled by high impedance state of the A, B, /A, /B signals***<br>Special option 07: Alarm signal is output parallel as line driver signal                        |
| <b>Switching time – A, B, Z signals<br/>(10 to 90 %)</b> | $t_+$ , $t_- < 30 \text{ ns}$ (with 1 m cable and recommended input circuit)                                                                                                                                                                       |
| <b>Maximum cable length*</b>                             | 100 m                                                                                                                                                                                                                                              |

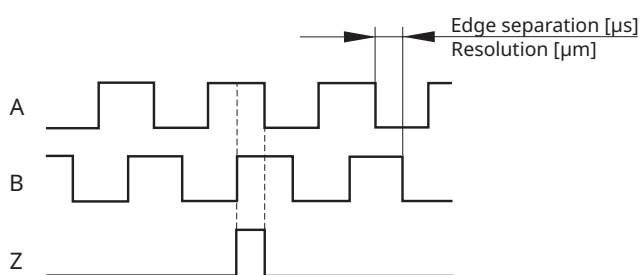
\* If power supply voltage is <10 V, please consider voltage drop over cable.

\*\* At added termination expect higher current consumption, which will result in a higher voltage drop over cable.

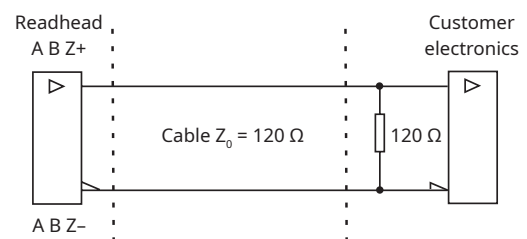
\*\*\* See diagrams 1 and 2 on [page 10](#)

### Timing diagram

Complementary signals not shown



### Recommended signal termination



### Programming (for IC output only)

Readheads can be ordered preset to the required resolution or supplied so they can be programmed on the machine to the selected resolution. This programming is done by connecting the readhead to a computer via a programming interface [UPRG01](#). The readhead must be ordered with the PRG option to use this function. For more information on the programming function of the LM15 readhead, see [UPRG01 Programming interface website](#).

## Part numbering

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | LM15 | IC | D20 | C | A | 10 | F | 00 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----|-----|---|---|----|---|----|
| <b>Output type</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |      |    |     |   |   |    |   |    |
| AV - Analogue voltage 1 V <sub>pp</sub><br>IA - Incremental Push-Pull outputs<br>IB - Incremental, Open Collector NPN<br>IC - Incremental, RS422                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |    |     |   |   |    |   |    |
| <b>Interpolation factor</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |      |    |     |   |   |    |   |    |
| AV:<br>000 - N/A<br>IA, IB and IC:<br>13B - 8192 (~0.61 μm)      09B - 512 (~9.765 μm)      D10 - 100 (50 μm)<br>12B - 4096 (~1.22 μm)      D50 - 500 (10 μm)      D08 - 80 (62.5 μm)<br>11B - 2048 (~2.441 μm)      D40 - 400 (12.5 μm)      06B - 64 (78.125 μm)<br>2D0 - 2000 (2.5 μm)      D32 - 320 (15.625 μm)      D04 - 40 (125 μm)<br>1D6 - 1600 (3.125 μm)      08B - 256 (~19.531 μm)      05B - 32 (156.25 μm)<br>10B - 1024 (~4.882 μm)      D20 - 200 (25 μm)      04B - 16 (312.5 μm)<br>1D0 - 1000 (5 μm)      D16 - 160 (31.25 μm)      03B - 8 (625 μm)<br>D80 - 800 (6.25 μm)      07B - 128 (39.0625 μm)<br>PRG - Programmable (preset to 5 μm) (for IC only) |      |    |     |   |   |    |   |    |
| <b>Minimum edge separation</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |      |    |     |   |   |    |   |    |
| IA, IB and IC:<br>K - 0.07 μs (15 MHz)      E - 4 μs (0.25 MHz)<br>A - 0.12 μs (8 MHz)      F - 5 μs (0.2 MHz)<br>B - 0.5 μs (2 MHz)      G - 10 μs (0.1 MHz)<br>C - 1 μs (1 MHz)      H - 20 μs (0.05 MHz)<br>D - 2 μs (0.5 MHz)                                                                                                                                                                                                                                                                                                                                                                                                                                                 |      |    |     |   |   |    |   |    |
| AV:<br>A - N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |      |    |     |   |   |    |   |    |
| The customer's controller must support the selected edge separation time even if the encoder is used below the maximum speed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |      |    |     |   |   |    |   |    |
| <b>Reference mark sensor</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |    |     |   |   |    |   |    |
| A - With reference mark sensor<br>Magnetic scale must be ordered with reference mark. If required, the cover foil can be installed over the reference mark.<br>B - Without reference mark sensor<br>C - Without reference mark sensor but with periodic reference impulse as per scale pitch (every 5 mm)<br>Reference periods correspond to pole length of magnetisation. Magnetic scale must be ordered with no reference mark.                                                                                                                                                                                                                                                 |      |    |     |   |   |    |   |    |
| <b>Cable length</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |      |    |     |   |   |    |   |    |
| 10 - 1.0 m (standard)<br>(e.g. 13 - 1.3 m cable or 13 - 13 m cable if special option 0M is chosen)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |      |    |     |   |   |    |   |    |
| <b>Connector</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |    |     |   |   |    |   |    |
| A - 9 pin D type plug      H - 15 pin HD type plug<br>D - 15 pin D type plug      L - 15 pin D type plug<br>F - Flying lead, no connector      P - 9 pin D type plug<br>U - 7 pin DIN EN60130-9 plug                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |      |    |     |   |   |    |   |    |
| <b>Special requirements</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |      |    |     |   |   |    |   |    |
| 00 - No special requirements (standard)      40 - Protective stainless-steel tube for cable<br>02 - Shortened reaction time      0M - Cable length in meters<br>07 - Additional alarm output      M2 - Shortened reaction time and cable in meters<br>10 - Not potted, protected to IP50      4M - Protective stainless-steel tube and cable in meters<br>19 - Stainless steel housing                                                                                                                                                                                                                                                                                            |      |    |     |   |   |    |   |    |

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 | Output type | Interpolation factor | Minimum edge separation           | Reference mark | Cable length | Connector             | Special requirements                       |
|--------|-------------|----------------------|-----------------------------------|----------------|--------------|-----------------------|--------------------------------------------|
| LM15   | IC          | PRG**                | A                                 | A / B / C      | 10***        | A** / D / H / F / U** | 00 / 07 / 10 / 19 / 40 / 0M / 4M           |
|        |             | xxx*                 | K / A / B / C / D / E / F / G / H |                |              |                       | 00 / 02 / 07 / 10 / 19 / 40 / 0M / M2 / 4M |
|        |             | 04B                  | A / B / C / D / E / F / G / H     | B / C          |              |                       |                                            |
|        |             | 03B                  | B / C / D / E / F / G / H         |                |              |                       |                                            |
|        | IA          | xxx*                 | K / A / B / C / D / E / F / G / H | A / B / C      |              | A / F / U             | 00 / 10 / 19 / 40 / 0M / 4M                |
|        |             | 04B                  | A / B / C / D / E / F / G / H     | B / C          |              |                       |                                            |
|        |             | 03B                  | B / C / D / E / F / G / H         |                |              |                       |                                            |
|        | IB          | xxx*                 | K / A / B / C / D / E / F / G / H | A / B / C      |              | A / L / P / F         |                                            |
|        |             | 04B                  | A / B / C / D / E / F / G / H     | B / C          |              |                       |                                            |
|        |             | 03B                  | B / C / D / E / F / G / H         |                |              |                       |                                            |
|        | AV          | 000                  | A                                 | A / B / C      |              |                       |                                            |

\* See chapter **Available resolutions** for available interpolation factors.

\*\* Not available with special option 07.

\*\*\* See the Output Type section for the max cable length for each output type.

For the part numbering of the MS incremental magnetic scale, refer to the MSD01 data sheet at **RLS Media center**.

# Available resolutions

Table of available resolutions

| Part number | Pole length [mm] | Interpolation factor | Resolution [μm] |
|-------------|------------------|----------------------|-----------------|
| 13B         | 5                | 2 <sup>13</sup>      | ~0.6            |
| 12B         |                  | 2 <sup>12</sup>      | ~1.22           |
| 11B         |                  | 2 <sup>11</sup>      | ~2.441          |
| 2D0         |                  | 2000                 | 2.5             |
| 1D6         |                  | 1600                 | 3.125           |
| 10B         |                  | 2 <sup>10</sup>      | ~4.882          |
| 1D0         |                  | 1000                 | 5               |
| D80         |                  | 800                  | 6.25            |
| 09B         |                  | 2 <sup>9</sup>       | ~9.765          |
| D50         |                  | 500                  | 10              |
| D40         |                  | 400                  | 12.5            |
| D32         |                  | 320                  | 15.625          |
| 08B         |                  | 2 <sup>8</sup>       | ~19.531         |
| D20         |                  | 200                  | 25              |
| D16         |                  | 160                  | 31.25           |
| 07B         |                  | 2 <sup>7</sup>       | 39.0625         |
| D10         |                  | 100                  | 50              |
| D08         |                  | 80                   | 62.5            |
| 06B         |                  | 2 <sup>6</sup>       | 78.125          |
| D04         |                  | 40                   | 125             |
| 05B         |                  | 2 <sup>5</sup>       | 156.25          |
| 04B         |                  | 2 <sup>4</sup>       | 312.5           |
| 03B         |                  | 2 <sup>3</sup>       | 625             |

Resolutions calculation

$$\text{Resolution } [\mu\text{m}] = \frac{\text{Pole length } [\mu\text{m}]}{\text{Interpolation factor}} = \frac{5000}{\text{Interpolation factor}}$$

## Accessories

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USB encoder interface  
**E201-9Q**

(Compatible only with LM15IC)



Programmable interface  
**UPRG01**

(Compatible only with LM15IC)

## Head office

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### Document issues

| Date         | Issue | Page    | Description                                                  |
|--------------|-------|---------|--------------------------------------------------------------|
| 13. 10. 2022 | 5     | General | New design, data amended                                     |
|              |       | 8       | Cable length drawing added                                   |
| 20. 4. 2023  | 6     | 9       | Electrical connections data amended                          |
|              |       | 12-15   | Current consumption and voltage drop over cable data amended |

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