

# Linear Motors & Distance Measuring Systems

## HIWIN MAGIC – magnetic distance measuring systems

### 7. HIWIN MAGIC – magnetic distance measuring systems

The magnetic distance measuring systems of the HIWIN MAGIC series are optimised for measuring the distances travelled in linear movements and particularly on linear motor axes. They are particularly suitable for use in harsh environmental conditions and are resistant to oil, dirt, vibrations and shocks.

The robust housing is electrically shielded, and signals are output in real time.

Two types are available:

- HIWIN MAGIC: type with separate encoder
- HIWIN MAGIC-PG: distance measuring system integrated in a linear guideway

#### Characteristics of MAGIC and MAGIC-PG

- Zero contact measurement with 1 V<sub>PP</sub> or digital output
- Digital resolution of 1 µm
- Encoder and housing are resistant to dust, humidity, oil and chips
- Encoder with metal housing and IP67 protection class
- Simple assembly
- Signal output in real time
- Special housing for EMC optimization

#### 7.1 HIWIN distance measuring systems

This distance measuring system consists of a separate encoder (Fig. 7.1) and a magnetic scale (Fig. 7.2). The customer can select suitable positions for both of these and install them. The measuring system HIWIN MAGIC is optimised for use on linear motor axes.

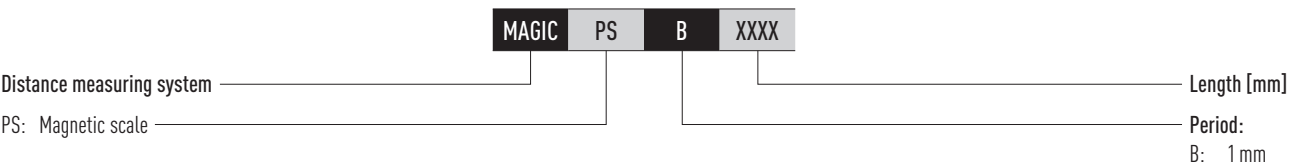


Fig. 7.1 MAGIC encoder

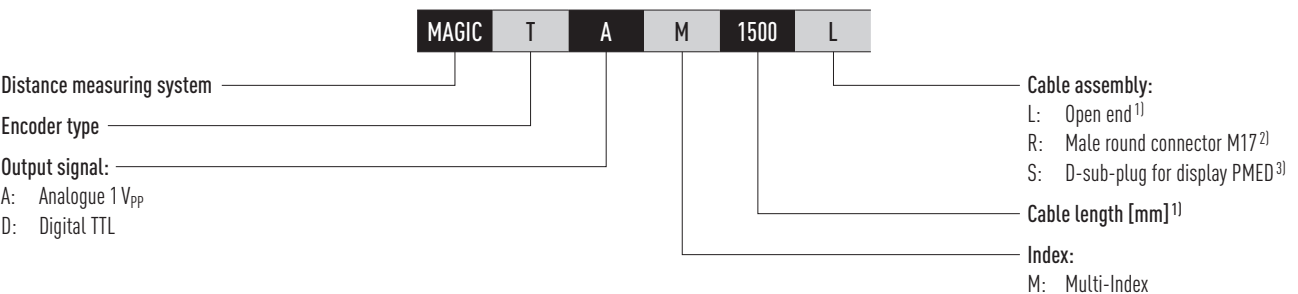


Fig. 7.2 MAGIC magnetic scale

#### 7.1.1 Order code for magnetic scale of HIWIN MAGIC distance measuring system



#### 7.1.2 Order code for encoder of HIWIN MAGIC distance measuring system



<sup>1)</sup> With open ends, the 1,000 cable length should be selected as standard (max. length: 5,000 mm)

<sup>2)</sup> Suitable for the pre-assembled HIWIN extension cable, see Section 7.4.1

<sup>3)</sup> The display has to be ordered separately

## 7.2 HIWIN MAGIC-PG distance measuring system

For this type, the distance measuring system is integrated in a linear guideway. The complete unit is referred to as a positioning guideway (PG). The encoder is fitted to a

standard block. It is suitable for HG\_20, HG\_25, QH\_20, QH\_25, CG\_20 and CG\_25. A magnetic scale is integrated directly in a profile rail (see Fig. 7.3 and Fig. 7.4).

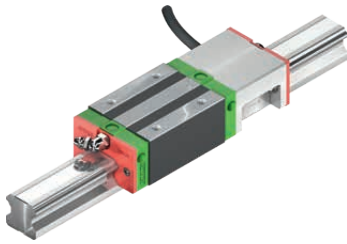


Fig. 7.3 MAGIC-PG system for HG and QH blocks

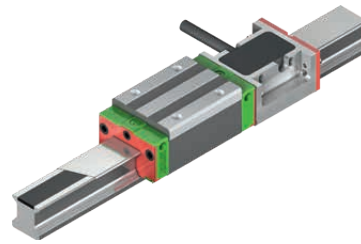


Fig. 7.4 MAGIC-PG system for CG blocks

### 7.2.1 Order code for HIWIN MAGIC-PG linear guideways

| PG        | H                                                                                   | W                                                                            | 20                             | C                                                                     | A | 1 | /2 | T | 1600 | ZA                                                                                                                                                                                                                                                                                                           | H |
|-----------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------|--------------------------------|-----------------------------------------------------------------------|---|---|----|---|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| PG-series | H: Based on the HG series<br>Q: Based on the QH series<br>C: Based on the CG series | Block type:<br>W: Flange type<br>H: High square block<br>L: Low square block | Sizes:<br>20, 25 <sup>1)</sup> | Load type:<br>S: Average load<br>C: Heavy load<br>H: Super heavy load |   |   |    |   |      | Accuracy class:<br>H<br>Preload ID:<br>Z0, ZA, ZB<br>Rail length [mm]<br>Rail mounting:<br>R: From above<br>T: From below (HGR20 only)<br>Number of blocks per axis <sup>2)</sup><br>Total number of blocks with sensor per axis <sup>2)</sup><br>Block mounting:<br>A: From above<br>C: From above or below |   |

Continuation order code for HIWIN MAGIC-PG linear guideway:

| 1                                     | /2                           | ZZ                                                                                             | E2                                 | M                                                                 | A | M | 2500 | L                                                                                                                                                                                                                                                                                                                                                               | 1 |
|---------------------------------------|------------------------------|------------------------------------------------------------------------------------------------|------------------------------------|-------------------------------------------------------------------|---|---|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| Number of rails with measuring system | Rails per axis <sup>3)</sup> | Dust protection:<br>SS, ZZ <sup>4)</sup><br>None: Standard<br>E2: With E2 oil lubrication unit | Measuring system type:<br>M: MAGIC | Output signal:<br>A: Analogue 1 V <sub>pp</sub><br>D: Digital TTL |   |   |      | Encoder orientation <sup>8)</sup> :<br>1: Orientation 1 (default)<br>2: Orientation 2<br>3: Orientation 3<br>4: Orientation 4<br>Cable assembly:<br>L: Open end <sup>5)</sup><br>R: M17 round plug connector (male connector) <sup>6)</sup><br>S: Sub-D connector for display PMED <sup>7)</sup><br>Cable length [mm] <sup>5)</sup><br>Index:<br>M: Multi-Index |   |

<sup>1)</sup> PGH, PGQ: not identical to the standard rail HGR25R without groove. Mounting screw M5 instead of M6

<sup>2)</sup> In the PG series, the total number of blocks per axis is specified (all blocks of the ordered article)

<sup>3)</sup> The figure 2 is also a quantity, i.e. one item of the above-mentioned article consists of a pair of rails. No number is specified for individual rails

<sup>4)</sup> If nothing is specified, the block will be supplied with standard dust protection (standard end seal and bottom seal)

<sup>5)</sup> With open ends, the 1,000 cable length should be selected as standard (max. length PGH, PGQ: 5,000 mm; PGQ: 1,000 mm)

<sup>6)</sup> Suitable for the pre-assembled HIWIN extension cable, see Section 7.4.1

<sup>7)</sup> The display has to be ordered separately

<sup>8)</sup> See Section 7.3.1

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## HIWIN MAGIC – magnetic distance measuring systems

### 7.3 HIWIN MAGIC distance measuring systems: technical data

#### 7.3.1 Orientation of the HIWIN MAGIC-PG encoder

According to the order code (Section 7.2.1) the HIWIN MAGIC-PG encoder is available the orientations 1 to 4. Without a statement about the required orientation the encoder is delivered by default (orientation 1).

For more than one block on a rail or on a rail pair, the encoder is assembled on block 1, rail 1, as shown in Fig. 7.5. If a non-standard orientation is needed, this has to be defined in the MAGIC-PG project planning sheet ([www.hiwin.de](http://www.hiwin.de)).

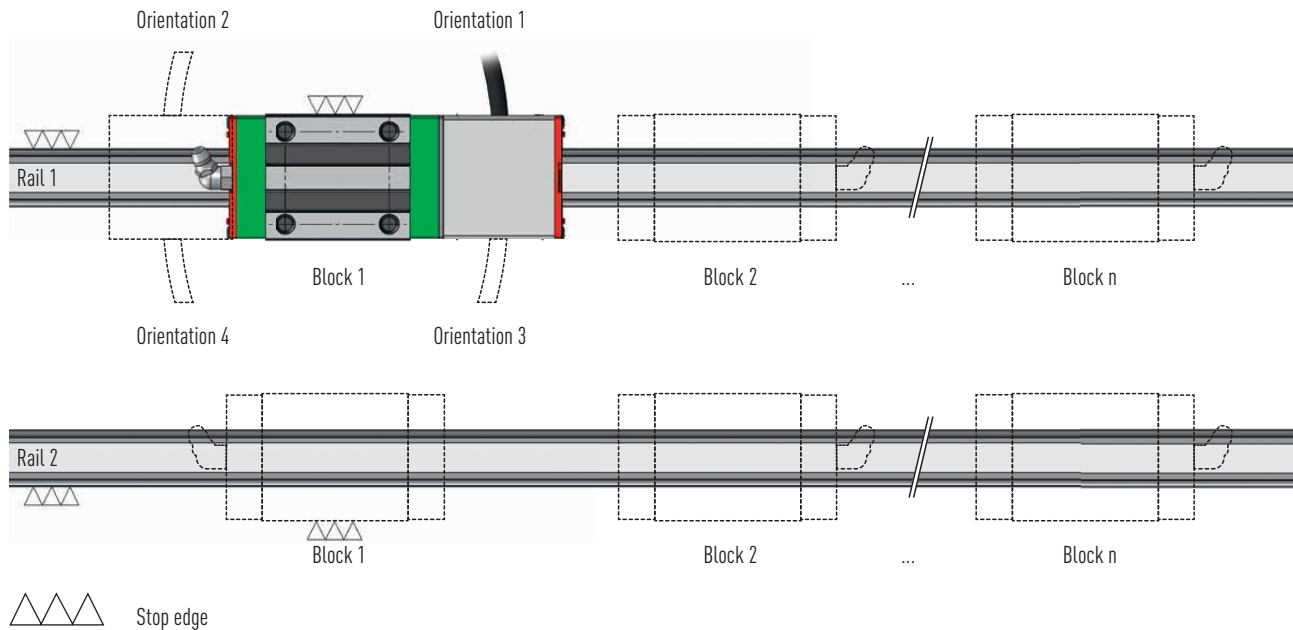


Fig. 7.5 Orientation of the HIWIN MAGIC-PG encoder

#### 7.3.2 Dimensions

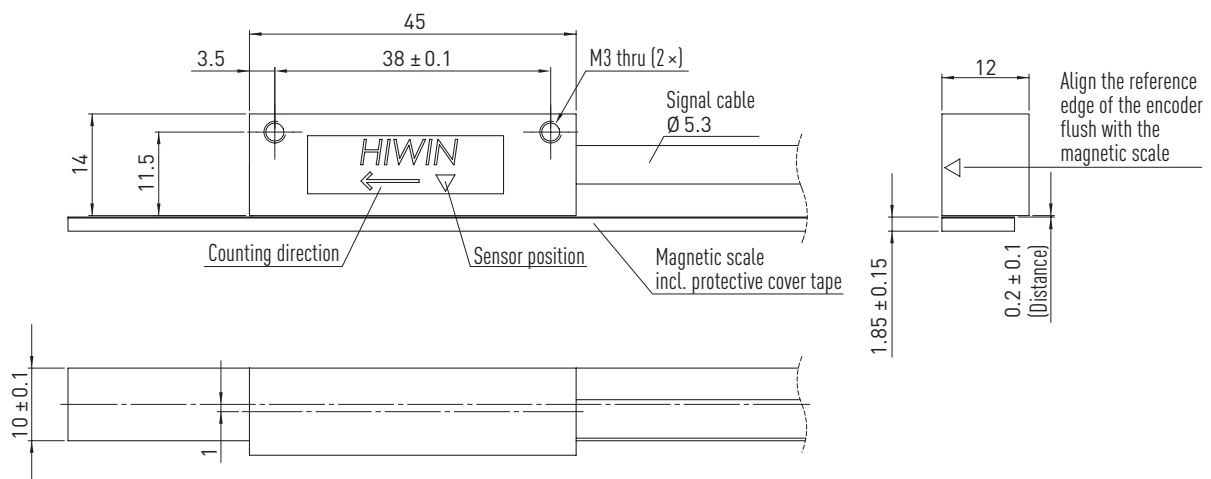


Fig. 7.6 Scale drawing of HIWIN MAGIC encoder

Unit: mm

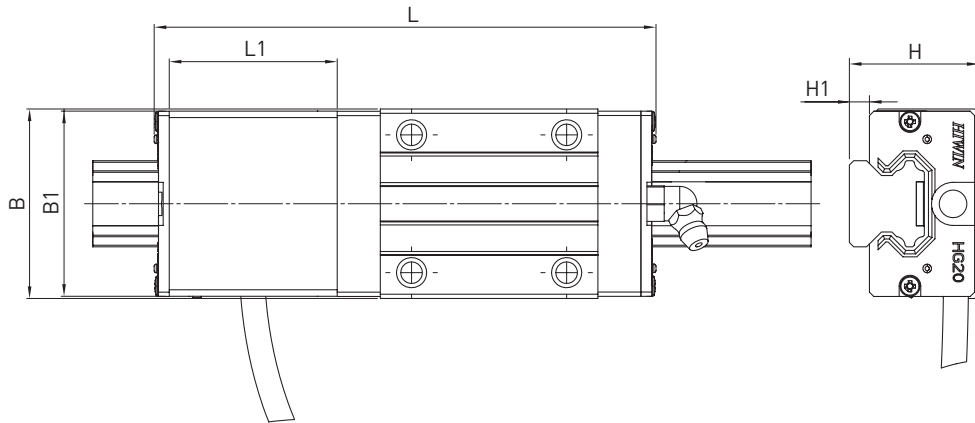


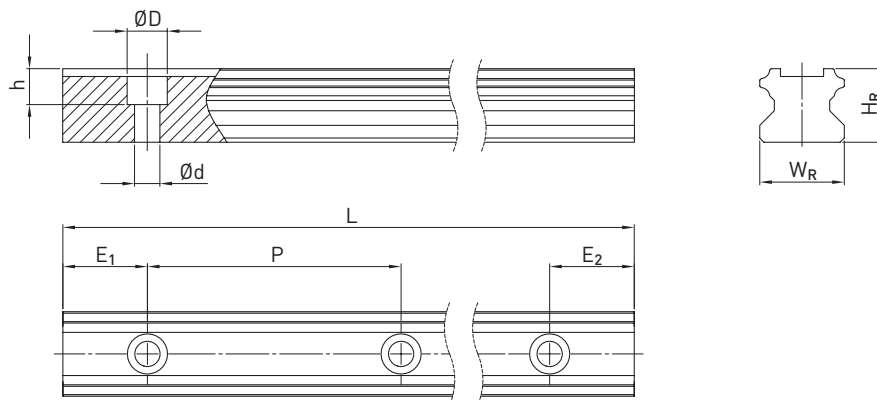
Fig. 7.7 Scale drawing of the HGH20CA block including the MAGIC-PG housing

Fig. 7.7 shows an HGH20CA/HGH25CA block. It is also possible to use the modules with HG\_20, HG\_25, QH\_20, QH25, CG\_20 and CG\_25 block sizes (long type and flange type, see the "Linear Guideways" catalogue). The overall dimensions then change accordingly. The dimensions of all block sizes are shown in Table 7.1.

| Table 7.1 Dimensions of the block including MAGIC-PG housing |        |         |        |         |        |         |
|--------------------------------------------------------------|--------|---------|--------|---------|--------|---------|
| Series/size                                                  | L [mm] | L1 [mm] | B [mm] | B1 [mm] | H [mm] | H1 [mm] |
| HG_20C                                                       | 118.0  | 41.5    | 44     | 43.0    | 30     | 4.6     |
| HG_20H                                                       | 132.7  | 41.5    | 44     | 43.0    | 30     | 4.6     |
| HG_25C                                                       | 124.5  | 41.5    | 48     | 46.4    | 40     | 5.5     |
| HG_25H                                                       | 145.1  | 41.5    | 48     | 46.4    | 40     | 5.5     |
| QH_20C                                                       | 117.2  | 41.5    | 44     | 43.0    | 30     | 4.6     |
| QH_20H                                                       | 131.9  | 41.5    | 44     | 43.0    | 30     | 4.6     |
| QH_25C                                                       | 123.9  | 41.5    | 48     | 46.4    | 40     | 5.5     |
| QH_25H                                                       | 144.5  | 41.5    | 48     | 46.4    | 40     | 5.5     |
| CG_20C                                                       | 121.4  | 44.0    | 44     | 43.0    | 30     | 4.6     |
| CG_20H                                                       | 137.4  | 44.0    | 44     | 43.0    | 30     | 4.6     |
| CG_25C                                                       | 130.5  | 44.0    | 48     | 47.0    | 40     | 6.1     |
| CG_25H                                                       | 147.9  | 44.0    | 48     | 47.0    | 40     | 6.1     |

### 7.3.2.1 Dimensions of PG rail

Rail with groove, mounting from above (series HG/QH)



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Table 7.2 Dimensions HGR\_R G1

| Series/<br>Sizes | Mounting bolt for<br>rail [mm] | Dimensions of rail [mm] |       |     |     |     |    | Max. length<br>[mm] | Max. length<br>$E_1 = E_2$ [mm] | $E_{1/2}$ min<br>[mm] | $E_{1/2}$ max<br>[mm] | Weight<br>[kg/m] |
|------------------|--------------------------------|-------------------------|-------|-----|-----|-----|----|---------------------|---------------------------------|-----------------------|-----------------------|------------------|
|                  |                                | $W_R$                   | $H_R$ | D   | h   | d   | P  |                     |                                 |                       |                       |                  |
| HGR20R G1        | M5 × 16                        | 20                      | 17.5  | 9.5 | 8.5 | 6.0 | 60 | 4,000               | 3,900                           | 7                     | 53                    | 2.05             |
| HGR25R G1C       | M5 × 20                        | 23                      | 22.0  | 9.5 | 8.5 | 6.0 | 60 | 4,000               | 3,900                           | 7                     | 53                    | 3.05             |

Rail with groove, mounting from below (series HG/QH)

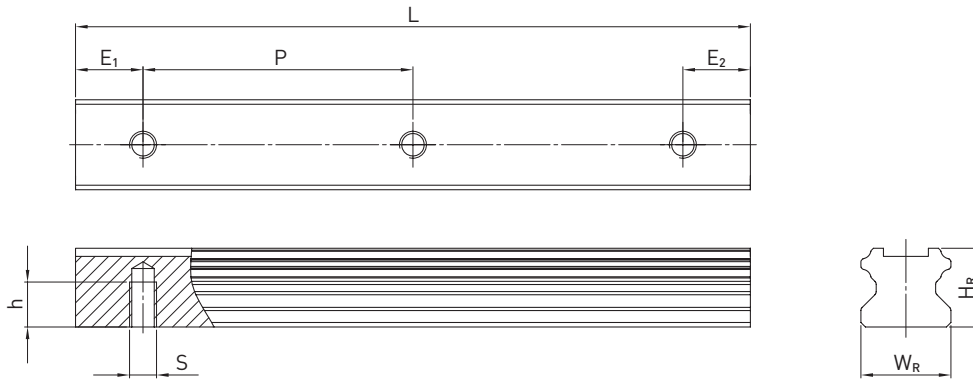


Table 7.3 Dimensions HGR\_T G1

| Series/<br>Size | Dimensions of rail [mm] |       |    |    |    | Max. length<br>[mm] | Max. length<br>$E_1 = E_2$ [mm] | $E_{1/2}$ min<br>[mm] | $E_{1/2}$ max<br>[mm] | Weight<br>[kg/m] |
|-----------------|-------------------------|-------|----|----|----|---------------------|---------------------------------|-----------------------|-----------------------|------------------|
|                 | $W_R$                   | $H_R$ | S  | h  | P  |                     |                                 |                       |                       |                  |
| HGR20T G1       | 20                      | 17.5  | M6 | 10 | 60 | 4,000               | 3,900                           | 7                     | 53                    | 2.13             |

Rail with groove, mounting from above (series CG)

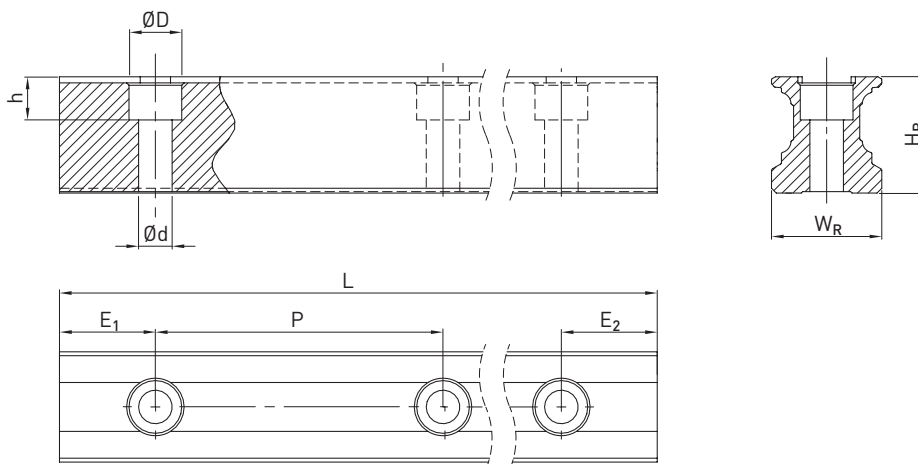


Table 7.4 Dimensions of CGR\_R G1

| Series/<br>size | Dimensions of rail [mm] |       |      |     |     |    | Max. length<br>[mm] | Max. length<br>$E_1 = E_2$ [mm] | $E_{1/2}$ min<br>[mm] | $E_{1/2}$ max<br>[mm] | Weight<br>[kg/m] |
|-----------------|-------------------------|-------|------|-----|-----|----|---------------------|---------------------------------|-----------------------|-----------------------|------------------|
|                 | $W_R$                   | $H_R$ | D    | h   | d   | P  |                     |                                 |                       |                       |                  |
| CGR20R G1       | 20                      | 20.55 | 9.5  | 8.5 | 6.0 | 60 | 4,000               | 3,900                           | 7                     | 53                    | 2.05             |
| CGR25R G1       | 23                      | 24.25 | 11.0 | 9.0 | 7.0 | 60 | 4,000               | 3,900                           | 8                     | 52                    | 3.05             |

### 7.3.3 Specifications of the distance measuring system HIWIN MAGIC and HIWIN MAGIC-PG

Table 7.5 Electrical and mechanical properties of HIWIN MAGIC and HIWIN MAGIC-PG

|                                | 1 V <sub>PP</sub> (analogue)                                             | TTL (digital)                    |
|--------------------------------|--------------------------------------------------------------------------|----------------------------------|
| Electrical properties          |                                                                          |                                  |
| Output signal specification    | sin/cos, 1 V <sub>PP</sub> (0.85 V <sub>PP</sub> – 1.2 V <sub>PP</sub> ) | Quadrature signal acc. to RS-422 |
| Resolution                     | Infinite, signal period 1 mm                                             | 1 µm                             |
| Repeatability bidirectional    | 0.003 mm                                                                 | 0.002 mm                         |
| Absolute accuracy              | ± 20 µm/m                                                                |                                  |
| Reference signal <sup>1)</sup> | Periodic index impulse at a distance of 1 mm                             |                                  |
| Phase angle                    | 90° ± 0.1° el                                                            | 90°                              |
| DC component                   | 2.5 V ± 0.3 V                                                            | —                                |
| Distortion factor              | Typ. < 0.1 %                                                             | —                                |
| Operating voltage              | 5 V ± 5 %                                                                |                                  |
| Power consumption              | Typ. 35 mA, max. 70 mA                                                   | Typ. 70 mA, max. 120 mA          |
| Max. measurement speed         | 10 m/s                                                                   | 5 m/s                            |
| EMC class                      | 3, according to IEC 801                                                  |                                  |
| Mechanical properties          |                                                                          |                                  |
| Housing material               | Aluminium alloy, encoder bottom made of stainless steel                  |                                  |
| Cable length <sup>2)</sup>     | PGH/PGQ: 5,000 mm; PGC: 1,000 mm                                         |                                  |
| Min. bending radius cable      | 40 mm                                                                    |                                  |
| Protection class               | IP67                                                                     |                                  |
| Operating temperature          | 0 °C to +50 °C                                                           |                                  |
| Weight of MAGIC encoder        | 80 g                                                                     |                                  |
| Weight of MAGIC-PG encoder     | 80 g                                                                     |                                  |
| MAGIC-PG suitable for blocks   | HG_20, HG_25, QH_20, QH_25, CG_20, CG_25                                 |                                  |

<sup>1)</sup> Can be used e.g. with reference switch

<sup>2)</sup> For the use in energy chains we recommend our pre-assembled encoder cable with a pre-mounted round connector M17 (coupling, female) on one side, which matches the optional round plug connector M17 (male) of the encoder. For details, please contact your HIWIN technician.

Table 7.6 Properties of the magnetic scale

| Properties                                                                 | MAGIC-PG                     | MAGIC          |
|----------------------------------------------------------------------------|------------------------------|----------------|
| <b>Accuracy class<sup>1)</sup></b>                                         | ± 20 µm/m                    |                |
| <b>Linear expansion coefficient</b>                                        | 11.5 × 10 <sup>-6</sup> m/K  |                |
| <b>Period</b>                                                              | 1 mm                         |                |
| <b>Thickness magnetic scale</b>                                            | 1.70 ± 0.10 mm               |                |
| <b>Thickness magnetic scale with stainless steel protective cover tape</b> | —                            | 1.85 ± 0.15 mm |
| <b>Width</b>                                                               | 10.05 ± 0.10 mm              |                |
| <b>Maximum length</b>                                                      | 24 m                         |                |
| <b>Magnetic remanence</b>                                                  | > 240 mT                     |                |
| <b>Pole pitch (distance north/south pole)</b>                              | 1 mm                         |                |
| <b>Single reference marks</b>                                              | Optional                     |                |
| <b>Material</b>                                                            | Elastomers, nitrile and EPDM |                |
| <b>Temperature range</b>                                                   | 0 °C to +50 °C               |                |
| <b>Weight</b>                                                              | 70 g/m                       |                |

<sup>1)</sup> at 20 °C

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## 7.4 Connection analogue and digital variant

### 7.4.1 Cable assignment (analogue and digital variant)

A high-quality, 8-core cable, each V1+, V1–, V2+, V2– and V0+, V0– (or A,  $\bar{A}$ , B,  $\bar{B}$  and Z,  $\bar{Z}$  for the digital variant), is used twisted in pairs.

In energy chains, we generally recommend our pre-assembled extension cables, which are designed especially for such use. The extension cables are supplied with a M17 round plug connector on one end (female coupling) or customised.

### 7.4.2 Formats and outputs

#### Signal format of sine/cosine 1 V<sub>PP</sub> output (analogue)

Electrical signals after the differential input of the downstream electronic components. The sinus/cosinus 1 V<sub>PP</sub> interface of HIWIN MAGIC-PG is strictly based on the Siemens specifications. The period length of the sinus output signal is 1 mm. The period length of the reference signal is 1 mm.

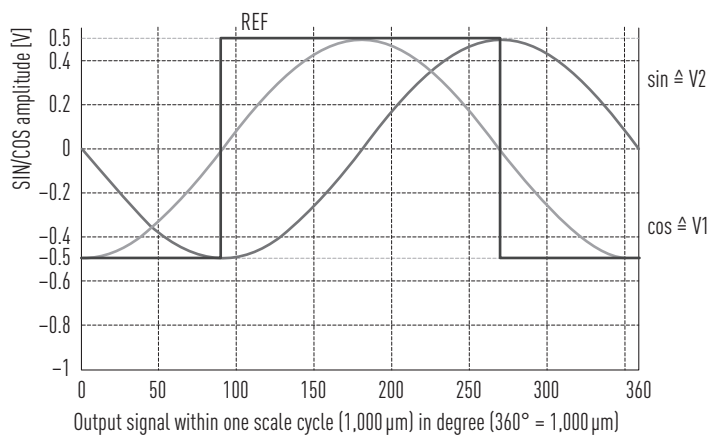


Fig. 7.8 Electrical signals after the differential input of the downstream electronic components (analogue version)

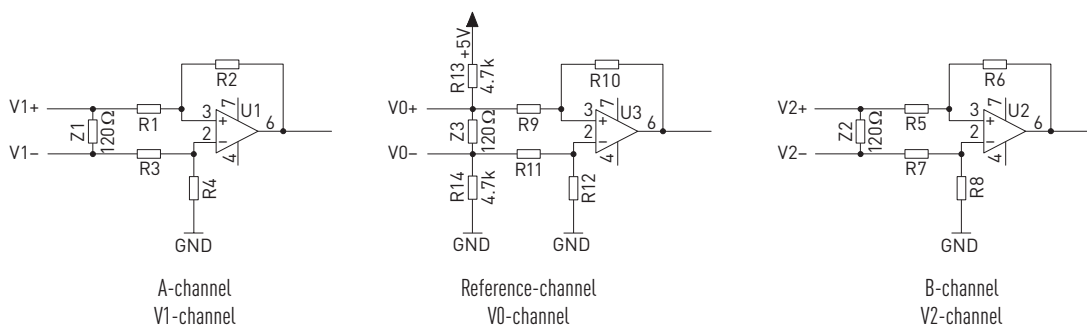


Fig. 7.9 Recommended switching of the subsequent electronic components for sin/cos 1 V<sub>PP</sub> output

#### TTL-output (digital)

The signals on A and B channels have a 90° phase shift (according to RS-422 specification in DIN 66259). Recommended terminal resistance  $Z = 120 \Omega$ . Output signals: A,  $\bar{A}$ , B,  $\bar{B}$  and Z,  $\bar{Z}$ . Individual reference pulse (optional) and definition of a minimum pulse duration are possible as an option.

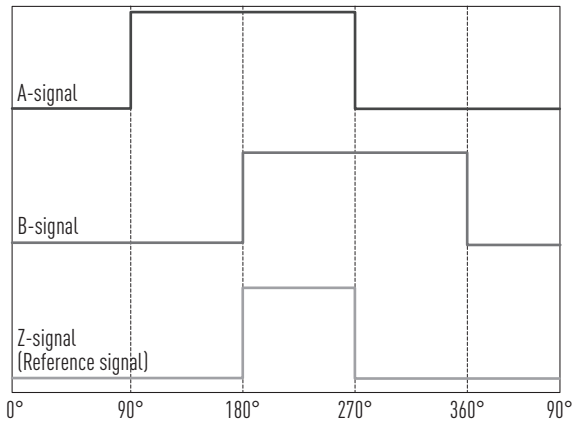


Fig. 7.10 Signals of the MAGIC encoder (TTL version)

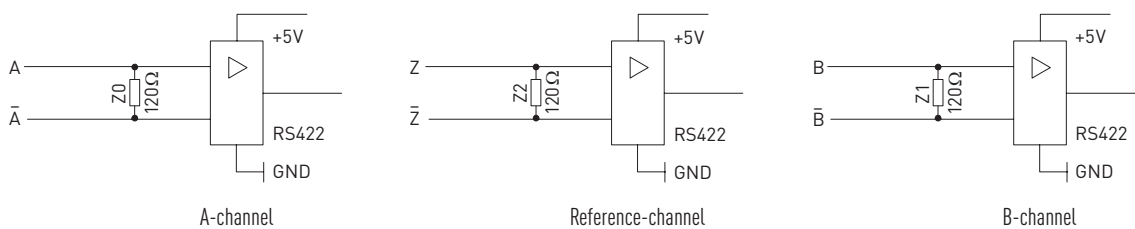


Fig. 7.11 Recommended switching of the subsequent electronic components for digital TTL output

## 7.5 PMED display

Combined with the distance measuring system HIWIN MAGIC or HIWIN MAGIC-PG the PMED display offers the possibility to display the current position of the encoder. In addition the display has 4 relay outputs and one RS-232 interface.

### Features

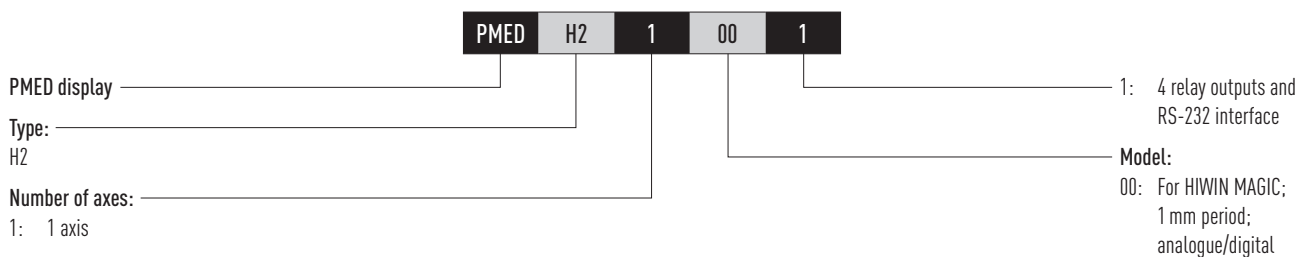
- 8-digit LED display
- For analogue and digital input signal
- Easy handling
- Compact and robust design
- Simple assembly

### Functions

- Flexible zero point adjustment
- Automatic zero point adjustment in the middle of a travel distance
- Absolute and relative counting function
- Units mm/inch
- 4 switchable relay outputs
- RS-232 interface



### 7.5.1 Order code for PMED display



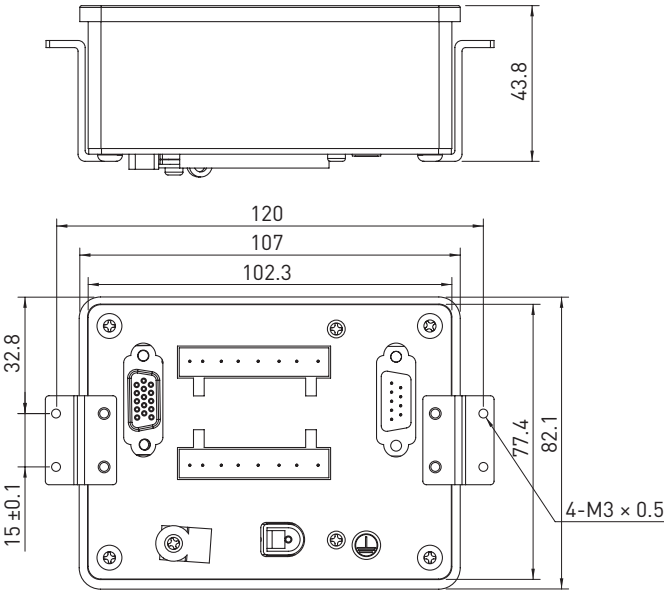


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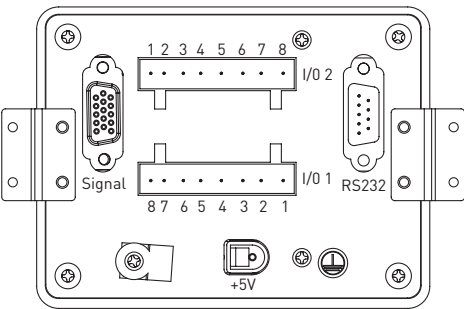
HIWIN MAGIC – magnetic distance measuring systems

## 7.5.2 Technical data of PMED display

### 7.5.2.1 Dimensions of PMED display



### 7.5.2.2 Inputs and outputs



### 7.5.2.3 Signal input connector (HD Sub-D, 15 pin)

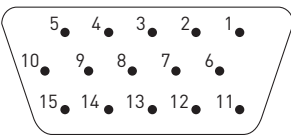


Table 7.7 Pin definition for signal input connector

| Pin No. | Signal       | Pin-No. | Signal                 | Pin No. | Signal        |
|---------|--------------|---------|------------------------|---------|---------------|
| 1       | +5V          | 6       | FG (housing shielding) | 11      | A+ (analogue) |
| 2       | GND          | 7       | Z+ (reference track)   | 12      | A- (analogue) |
| 3       | A+ (digital) | 8       | Z- (reference track)   | 13      | B+ (analogue) |
| 4       | B+ (digital) | 9       | A- (digital)           | 14      | B- (analogue) |
| 5       | Not assigned | 10      | B- (digital)           | 15      | Not assigned  |

#### 7.5.2.4 Signal output connector

Table 7.8 Pin definition for signal output connector

| Relay output I/O 1 |                     | Relay output I/O 2 |                     |
|--------------------|---------------------|--------------------|---------------------|
| Pin-No.            | Signal              | Pin-No.            | Signal              |
| 1                  | Not assigned        | 1                  | Not assigned        |
| 2                  |                     | 2                  |                     |
| 3                  | Not assigned        | 3                  | Not assigned        |
| 4                  |                     | 4                  |                     |
| 5                  | Relay 0 (channel 0) | 5                  | Relay 0 (channel 2) |
| 6                  |                     | 6                  |                     |
| 7                  | Relay 0 (channel 1) | 7                  | Relay 0 (channel 3) |
| 8                  |                     | 8                  |                     |

#### 7.6 Reference switch

To reference an axis the HIWIN reference switch can be placed at any position of the axis' travel range. The MAGIC and MAGIC-PG encoder delivers a periodic reference signal (index pulse, see Section 7.4.2). With a damped reference switch this signal can be used for the precise referencing of the axis.

##### 7.6.1 Technical data of inductive reference switch

###### 7.6.1.1 Dimensions of reference switch

