

Absolute Encoder Multiturn



Features

- Resolution: Singleturn: up to 16,384 (**14 Bit**) steps per revolution
Multiturn: up to 16,777,216 (**24 Bit**) revolutions
- Interface: **SSI** (synchron serial interface) or
BiSS® (bidirectional serial synchron)
SPI (serial peripheral interface)
- Output: RS 422 transceiver
- Maximum shaft diameter: **8.00 mm**
- Rotation speed: up to **10.000 rpm**



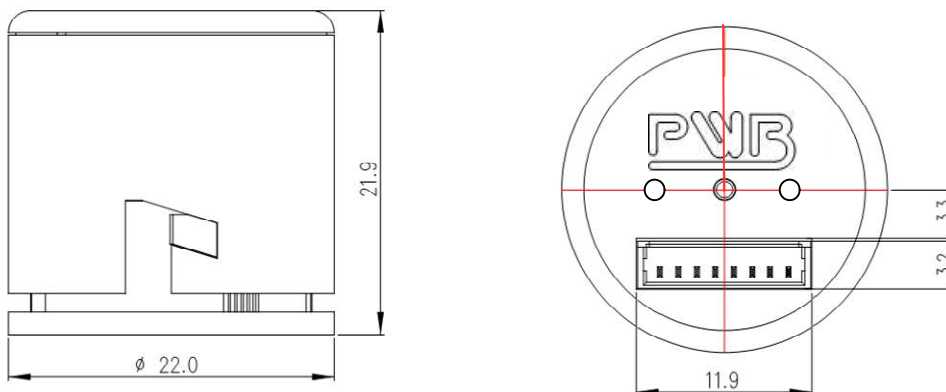
Description

The **MEM 22** is available as an absolute **multiturn** encoder in the execution of a kit system. It consists a magnetic hub, a housing unit (including the PCB) and a cable unit. The MEM 22 is a reliable low cost hollow shaft encoder that can be fixed quickly and easily on different sizes of motor shafts.

The **multiturn** encoder is developed for absolute positioning applications, for brushless motors or servo motors and steppers. The MEM 22 is a real time system for high speed applications and rough environments. The encoder is available with three different interfaces: SSI, BiSS ® or SPI. Power supply and signals are provided by a 8 pin Molex connector.

The absolute position is detected by means of an electronic gear. The storage of the position data is done using the outsourced backup battery. The cable is thus an existential part of the encoder. Alternatively, the buffering of position data of the encoder can also be done by the customer control.

Dimensions



Main characteristics

- Absolute rotary encoder
- Magnetic sensing
- Multiturn by electronic gear
- Error monitoring
- Hollow shaft encoder
- High performance in compact size
- Robust plastic housing
- Quick and easy assembly
- Maximum shaft diameter: 8 mm
- Operating temperature range -40 °C to +85 °C
- Compliant EU-directive 2011/65/EU (RoHS)

Recommended operating conditions

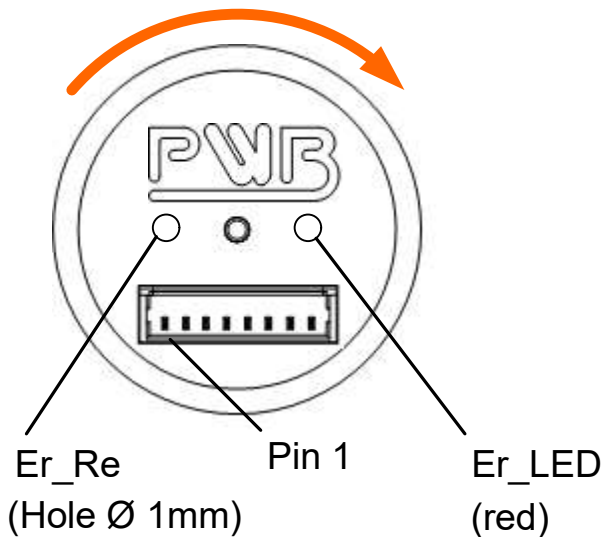
Typical values at 25 °C.

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Notes |
|-----------------------------|----------------|------|----------|--------|---------------------|-------------------------------|
| Supply voltage | U_B | 4.5 | 5.0 | 5.5 | V_{DC} | |
| Supply current | I_{UB} | 40 | 60 | 80 | mA | no load |
| Reverse polarity protection | U_B | -6.0 | | 0 | V_{DC} | |
| Start up time | t_T | | | 2 | ms | |
| Absolute accuracy | | | +/- 0.8 | | ° | (after calibration via SW) |
| Relative accuracy | | | +/- 1,5 | | LSB | (after calibration via SW) |
| Rotation speed | RPM | | | 10,000 | U/min | |
| Acceleration | α_{max} | | | 160 | 10^3°/s^2 | |
| ESD voltage | U_{ESD} | | | 2 | kV | discharged over 1,5k Ω |
| SSI / BiSS / SPI | | | | | | |
| Clock frequency | f | 80 | | 10000 | kHz | |
| High level output voltage | V_{oH} | 2.0 | 3.0 | 5.5 | V_{DC} | $R_L = 120\Omega$ |
| Low level output voltage | V_{oL} | | | 0.8 | V_{DC} | $R_L = 120\Omega$ |
| High level input voltage | V_{iH} | 2.0 | | 5.5 | V_{DC} | |
| Low level input voltage | V_{iL} | | | 0.8 | V_{DC} | |
| Output current per channel | I_{out} | -1.0 | 30 | 50 | mA | overload protection |
| Scan ratio of T | | 40 | | 50 60 | % | |
| Monoflop time | t_m | | 20 + T/2 | | μs | adaptive Encoder Timeout |
| BiSS | | | | | | |
| CRC Polynomial | | | 0x43 | | hex | $x^6 + x^1 + x^0$ |
| CRC Start Value | | | 0x0000 | | hex | |
| CRC Bits | | | 6 | | | |
| CDM | | | | | | inverted |
| Environment | | | | | | |
| Operating temperature | T_A | -40 | 25 | 85 | °C | optional 100°C |
| Storage temperature | T_S | -40 | | 85 | °C | |
| Humidity exposure | | | | 90 | % RH | not condensing |
| Vibration | | | | 2000 | Hz | 20 g |

The angular accuracy of the datasheet can only be guaranteed by a single calibration after the mechanical assembly (with the PWB encoders Software and the USB converter box).

Electrical interface

Rotation direction clockwise (count up)

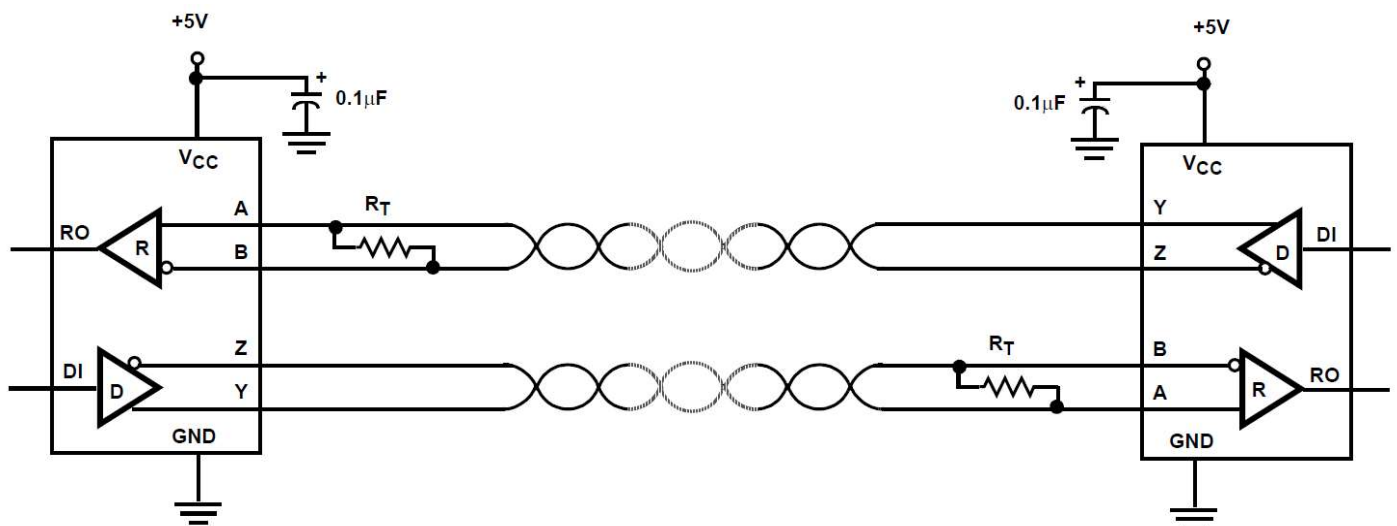


Interface SSI & BiSS

| Connector Pin | Connector Signal | Cable color of wire |
|---------------|------------------|---------------------|
| 1 | Backup + | white |
| 2 | UB | red |
| 3 | GND | blue |
| 4 | Data + | pink |
| 5 | Data - | grey |
| 6 | Clock - | yellow |
| 7 | Clock + | green |
| 8 | Backup - | brown |

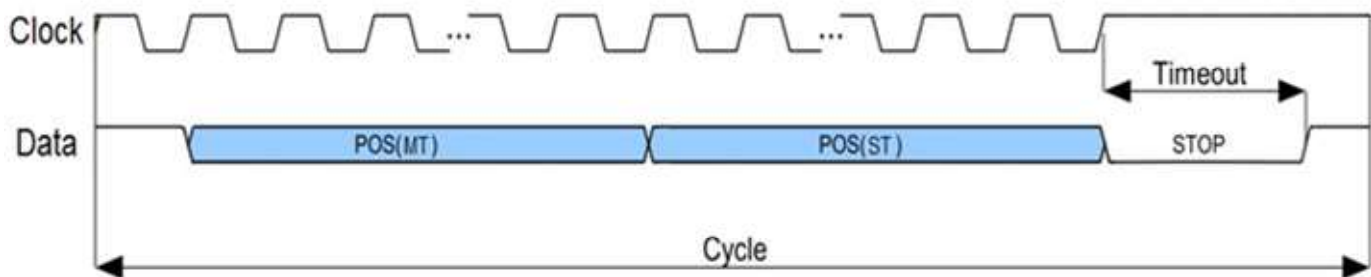
After assembly by the customer and after power on, the encoder can indicate an error (magnet lost). This is caused by missing the magnet during the shipment and the assembly. For erasing the error, press Er_Re in the encoder with a blunt thin object (e.g. office clip) by a unique impulse ($\geq 100\text{ms}$). Then reboot the encoder by interrupting the power supply.

Typical operating circuit (SSI & BiSS)



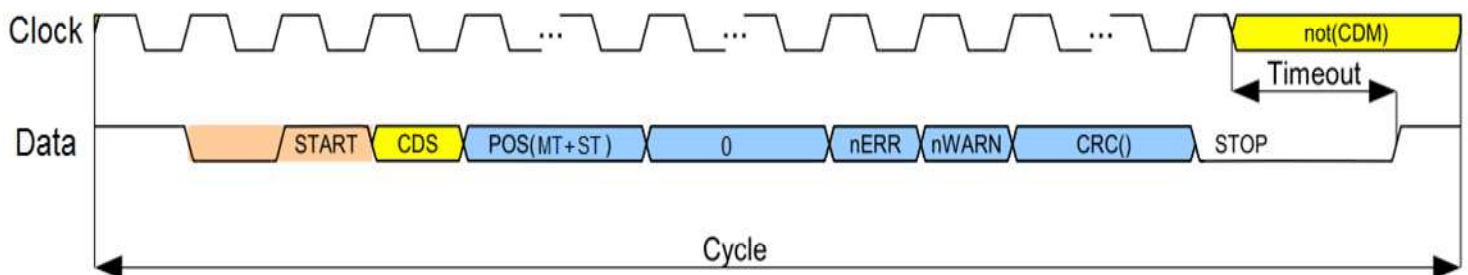
Interface:

Data transfer: SSI Gray-Code



The position data increases when the shaft rotates in the direction of clockwise

Data transfer: BiSS (C-Mode) Binary-Code



0: These are additional bits to refill the singleturn bit length to 12 bit respectively 16 bit. The number of Zero-bits is depended of the Ordering code (see below). The value of these bits is low.

Example:

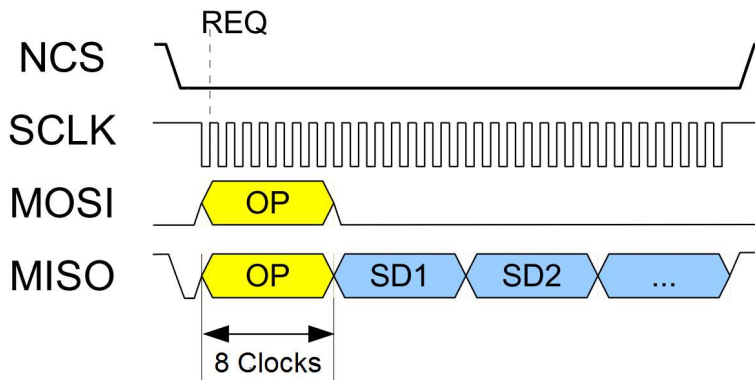
| | | | |
|----------------|--------------------------|----|---|
| Ordering code: | MEM22 - B 09 / 12 - | => | ... + 21 Position bits + 3 x 0 bits + ... |
| | MEM22 - B 10 / 12 - | => | ... + 22 Position bits + 2 x 0 bits + ... |
| | MEM22 - B 11 / 12 - | => | ... + 23 Position bits + 1 x 0 bits + ... |
| | MEM22 - B 12 / 12 - | => | ... + 24 Position bits + ... |
| | MEM22 - B 13 / 12 - | => | ... + 25 Position bits + 3 x 0 bits + ... |
| | MEM22 - B 14 / 12 - | => | ... + 26 Position bits + 2 x 0 bits + ... |

For a detailed description of the protocol, see separate interface specification.

Error Reset can also executed by command using BiSS interface

Preset and rotation direction are programmable by a BiSS command.

Data transfer: SPI



Sensor Data Transmission

Interface SPI

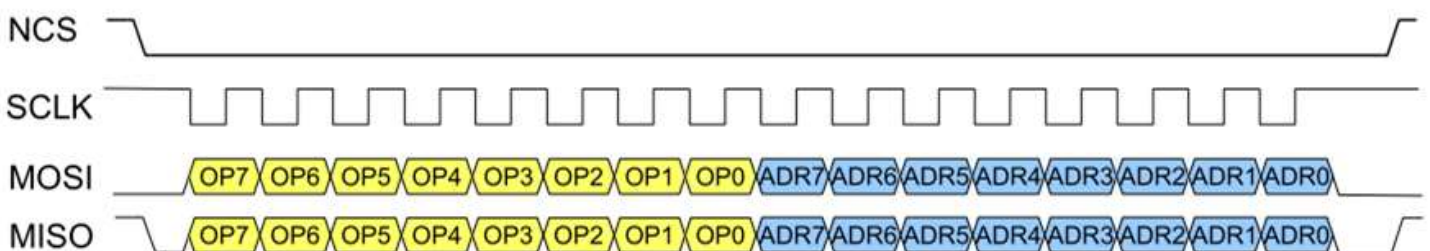
| Connector Pin | Connector Signal | Cable color of wire |
|---------------|------------------|---------------------|
| 1 | Backup + | white |
| 2 | UB | red |
| 3 | GND | blue |
| 4 | MISO | pink |
| 5 | MOSI | grey |
| 6 | NCS | yellow |
| 7 | SCLK | green |
| 8 | Backup - | brown |

| OPCODEs | |
|---------|-------------------|
| Code | Description |
| 0xB0 | ACTIVATE |
| 0xA6 | SDAD Transmission |
| 0x9C | Read STATUS |

OPCODE Table

Reading Sensor Data: The MEM22 latches the absolute position on the first rising edge at SCLK, when NCS is at zero. Because MEM22 can output the sensor data (SD) immediately, the master can transmit the SDAD Transmission command directly.

The sensor data in SPI are byte aligned. First comes 0-4 byte multiturn depending on the resolution, second are two bytes singleturn and at last one status byte including one error bit, one warning bit and six bits sign-of-life counter.



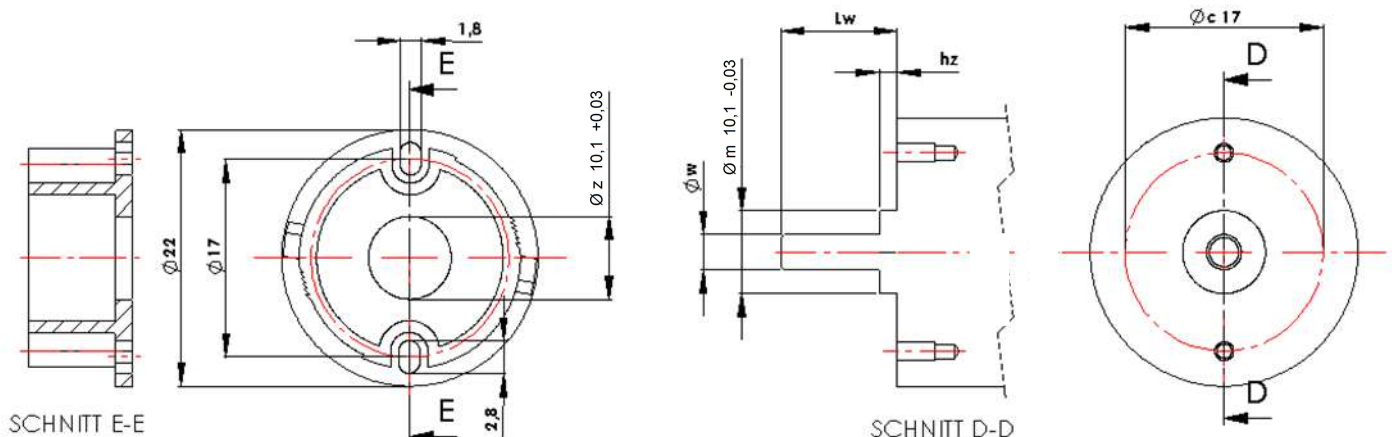
SPI Transmission

Mechanical Notes

| Parameter | Value | Tolerance | Unit |
|---|---|------------|----------------|
| Outer dimensions | Ø 22.0 x 21.9 | - | mm |
| Shaft diameter \varnothing_w | 2.0 / 2.5 / 3.0 / 4.0 / 5.0 / 6.0 / 6.35 / 8.0 | ± 0.01 | mm |
| Required shaft length L_w | 9.5 | +1.5 | mm |
| Max. allowable axial shaft play of motor | 0.2 | - | mm |
| Max. allowable radial shaft play of motor | 0.025 | - | mm |
| Mounting screw size (DIN 84) | M1.6 | - | - |
| Tightening torque of the screws | 15 | -5 | Ncm |
| Pitch circle diameter \varnothing_c | 17.0 | ± 1.0 | mm |
| Flange bore diameter diameter \varnothing_z | 10.1 | +0.03 | mm |
| Mounting boss diameter \varnothing_m | 10.1 | -0.03 | mm |
| Max. mounting boss height h_z | 1.5 | -0.1 | mm |
| Mating connector (Molex) | contact 8x 50079-8000 housing 1x 51021-0800 | - | - |
| Total weight | 15 | - | g |
| Moment of inertia of the hub with the magnet | 6.0 | ± 1.0 | gmm^2 |
| Protection grade according to DIN 40500 | IP50 | - | - |

Mounting considerations:

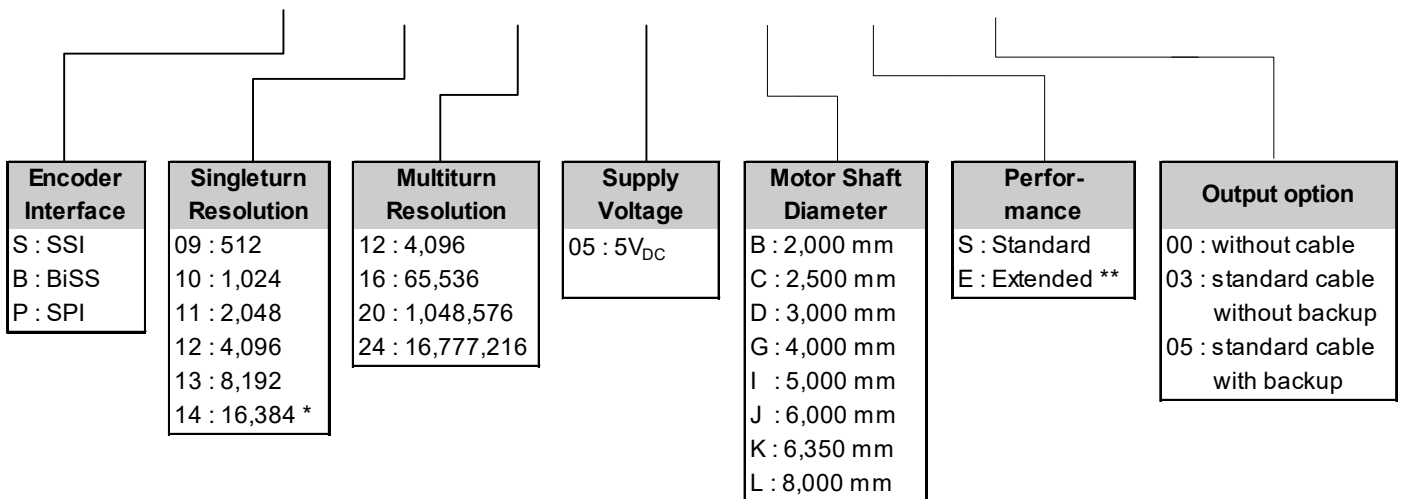
The MEM 22 encoder is designed to self align by using a mounting boss. The drawing shows the configuration of the mounting boss along with the location of the mounting screw holes. Shaft diameter and tolerances are given in the above mentioned chart.



Ordering information

Ordering code:

MEM 22 - X - XX / XX - XX - X - X - XX



* 14Bit resolution only for BiSS Interface

** customer version

SSI only with gray code

BiSS only with binary code

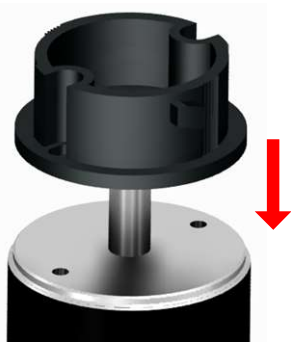
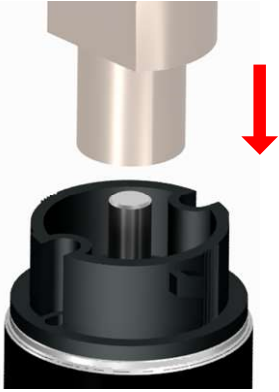


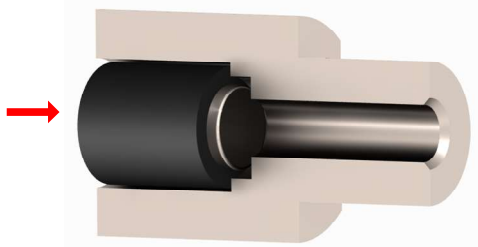
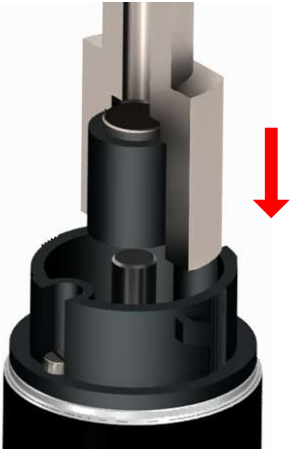
Selectable and required accessories see page 12:

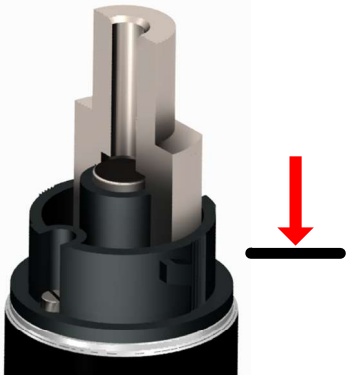




- cable 300 mm length (UL1061 / AWG28)
- cable 500 mm length (shielded, twisted pair)
- centering and assembly gauge for different motor shafts
- adapter plates for different motors
- fastening screws DIN 84 M1.6x3 or M1.6x4

PWB encoders GmbH RESTRICTED

THIS DOCUMENT AND ANY ASSOCIATED DATA CONTAIN RESTRICTED INFORMATION THAT IS PROPERTY OF PWB encoders GmbH AND MAY NOT BE DISCLOSED OR DUPLICATED FOR OTHERS EXCEPT AS AUTHORIZED BY PWB encoders GmbH

INFORMATION CONTAINED IN THIS PUBLICATION MAY BE SUPERSEDED BY UPDATES. IT IS YOUR RESPONSIBILITY TO ENSURE THAT YOUR APPLICATION MEETS WITH YOUR SPECIFICATIONS.

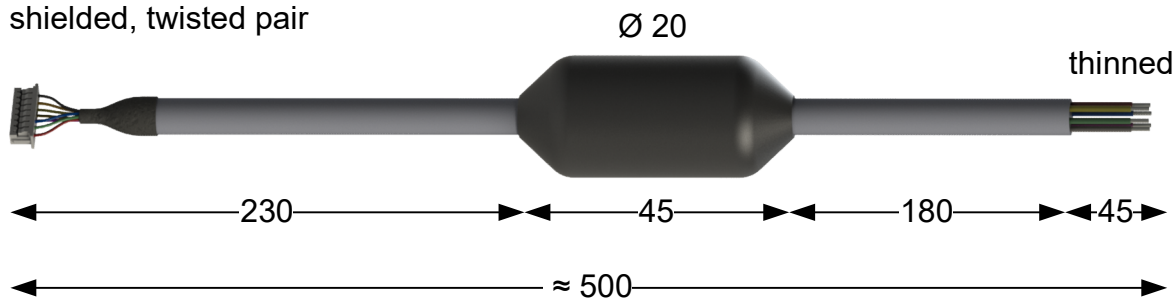
| MEM 22 MOUNTING INSTRUCTION | |
|------------------------------------|---|
| 1 |  <p style="text-align: center;">Set the base plate onto the motor</p> |
| 2 |  <p style="text-align: center;">Align the base plate to the motor shaft by using the centering gauge</p> |
| 3 |  <p style="text-align: center;">Afterwards fix the base plate to the motor flange using two screws</p> |
| 4 |  <p style="text-align: center;">Remove the centering gauge</p> |
| 5 |  <p style="text-align: center;">Set the hub with magnet into the centering gauge</p> |
| 6 |  <p style="text-align: center;">Press the hub with magnet onto the motor shaft by the centering gauge</p> |

| MEM 22 MOUNTING INSTRUCTION | |
|------------------------------------|---|
| 7 |  <p>Press the centering gauge down to the final position</p> |
| 8 |  <p>Afterwards remove the centering gauge</p> |
| 9 |  <p>Align the housing to the base plate, slide the housing onto the base plate</p> |
| 10 |  <p>Press the housing into the final position</p> |
| 11 |  <p>Turn the housing into its final position, the encoder is now ready for use</p> |
| 12 | <p style="text-align: center;"><u>WARNING</u></p>  <p style="text-align: center;">Do not rotate and pull out the encoder after assembly or when it is in operation.</p> |

ATTENTION! The encoder is so designed that it may be assembled only one time, otherwise the guarantee will be voided. Note: see IMPORTANT NOTICE (page 10)

Standard cable with backup

Connection cable 0,14mm²,
shielded, twisted pair



Attention!
Backup battery inside
No liquid permitted

Pin-out description

| Cable Signal SSI / BiSS | Cable Signal SPI | Cable color of wire |
|----------------------------|---------------------|------------------------|
| UB | UB | red |
| GND | GND | blue |
| Data + | MISO | pink |
| Data - | MOSI | grey |
| Clock + | SCLK | green |
| Clock - | NCS | yellow |

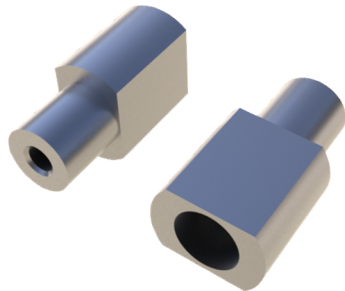
Notification:

For communication with the MEM22 in SSI or BiSS version, a USB converter box is available from PWB encoders. The software can be downloaded from the website.

This can help for the first use and for visualization of the position data. It is not necessary for operation in the customer application with the customer control.

ESD Warning: Normal handling precautions should be taken to avoid static discharge damage to the sensor.

Essential assembly tool



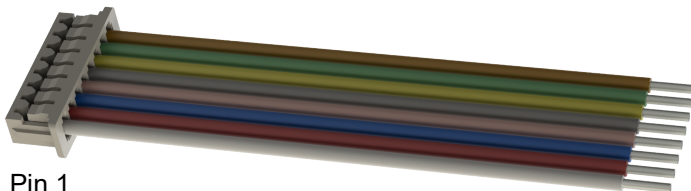
Centering and assembly gauge for centering the base plate on the motor flange or an adapter plate and also positioning the magnet

Available accessories



Customized adapter plate

Available accessories *



Pin 1

Cable without backup (length 300 mm)
[for applications with backup on customer control]

* Note: see ordering code 03



Screws DIN84 M1.6 X 3 or M1.6 X 4

IMPORTANT NOTICE

The encoder is so designed that it may be assembled only one time, otherwise the guarantee will be voided.

The guarantee will be voided by misuse, accident, modification, unsuitable physical or operating environment, operation in other than the specified operating environment, or failure caused by a product for which **PWB encoders GmbH** is not responsible.

PWB encoders GmbH reserves the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services also datasheets at any time.