

# Absolute encoders - singleturn

Compact optical

Sendix F3653 / F3673 (shaft / hollow shaft)

SSI / BiSS + incremental



The Sendix F36 singleturn with the patented Intelligent Scan Technology™ and SSI or BiSS interface boasts exceptional ruggedness and compact dimensions.

With a size of just 36 x 42 mm it offers a through hollow shaft of up to 8 mm or a blind hollow shaft of up to 10 mm. Its high-precision optical sensor technology can achieve a resolution of up to 17 bits.



Safety-Lock™



Temperature range  
-40°...+90°C



High protection level  
IP



High shaft load capacity



Shock / vibration resistant



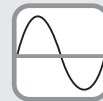
Magnetic field proof



Short-circuit proof



Reverse polarity protection



SinCos



Intelligent Scan Technology™



Surface protection salt spray-tested optional

## Reliable and magnetically insensitive

- Sturdy bearing construction in Safety-Lock™ design for resistance against vibration and installation errors.
- Ideal for use outdoors thanks to IP67 protection and wide temperature range from -40°C up to +90°C.
- Patented Intelligent Scan Technology™ with all singleturn and multiturn functions on one single OptoASIC - offering highest reliability, a high resolution up to 17 bits and 100 % magnetic field insensitiveness.

## Optimized performance

- High-precision with a data refresh rate of the position value ≤ 1µs.
- High-resolution feedback in real-time via incremental outputs SinCos and RS422.
- Short control cycles, clock rate with SSI up to 2 MHz / with BiSS up to 10 MHz.

## Order code

### Shaft version

8.F3653 . XXXX . XX 12

Type

a

b

c

d

e

f

If for each parameter of an encoder the underlined preferred option is selected, then the delivery time will be 10 working days for a maximum of 10 pieces. Qts. up to 50 pcs. of these types generally have a delivery time of 15 working days.



### a Flange

- 1 = clamping flange, IP67, ø 36 mm [1.42"]
- 3 = clamping flange, IP65, ø 36 mm [1.42"]
- 2 = synchro flange, IP67, ø 36 mm [1.42"]
- 4 = synchro flange, IP65, ø 36 mm [1.42"]

### b Shaft (ø x L), with flat

- 1 = ø 6 x 12.5 mm [0.24 x 0.49"]
- 3 = ø 8 x 15 mm [0.32 x 0.59"]
- 5 = ø 10 x 20 mm [0.39 x 0.79"]
- 2 = ø 1/4" x 12.5 mm [0.49"]
- 4 = ø 3/8" x 5/8"

### c Interface / power supply

- 1 = SSI, BiSS / 5 V DC
- 2 = SSI, BiSS / 10 ... 30 V DC
- 3 = SSI, BiSS + 2048 ppr. SinCos / 5 V DC
- 4 = SSI, BiSS + 2048 ppr. SinCos / 10 ... 30 V DC
- 5 = SSI, BiSS / 5 V DC, with sensor output
- 6 = SSI, BiSS + 2048 ppr. SinCos / 5 V DC, with sensor output
- 7 = SSI, BiSS + 2048 ppr. RS422 / 5 V DC
- 8 = SSI, BiSS + 2048 ppr. RS422 / 10 ... 30 V DC

### d Type of connection

- 1 = tangential cable, 1 m [3.28] PUR
- 3 = tangential cable, 5 m [16.40] PUR
- F = tangential cable, special length PUR \*)
- 8 = axial M12 connector, 8-pin <sup>1)</sup>

\*) Available special lengths (connection type F):  
2, 3, 8, 10, 15 m [6.56, 9.84, 26.25, 32.80, 49.21']  
order code expansion .XXXX = length in dm  
ex.: 8.F3653.432F.G312.0030 (for cable length 3 m)

### e Code

- B = SSI, binary
- C = BiSS, binary
- G = SSI, gray

### f Resolution

- A = 10 bit
- 2 = 12 bit
- 3 = 13 bit
- 4 = 14 bit
- 7 = 17 bit

### Optional on request

- surface protection salt spray tested
- other resolutions

1) Only with output circuits 1 and 2.

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|                        |  |                                 |
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|                               |   |  |  |  |   |
|-------------------------------|---|--|--|--|---|
| <b>Order code</b>             | <b>8.F3673</b>  | <b>.XXXXX</b>  | <b>.XX12</b>   | <p>If for each parameter of an encoder the <u>underlined preferred option</u> is selected, then the delivery time will be 10 working days for a maximum of 10 pieces.<br/>Qts. up to 50 pcs. of these types generally have a delivery time of 15 working days.</p> |   |
| <b>Hollow shaft</b>           | Type  | a b c d  | e f  |  |   |
| <b>a Flange</b>               | 1 = with spring element, short, IP65<br>3 = with spring element, long, IP65<br><u>2 = with stator coupling, IP65, ø 46 mm [1.81"]</u> | <b>c Interface / power supply</b>  | 1 = SSI, BiSS / 5 V DC<br><u>2 = SSI, BiSS / 10 ... 30 V DC</u><br>3 = SSI, BiSS + 2048 ppr. SinCos / 5 V DC<br>4 = SSI, BiSS + 2048 ppr. SinCos / 10 ... 30 V DC<br>5 = SSI, BiSS / 5 V DC, with sensor output<br>6 = SSI, BiSS + 2048 ppr. SinCos / 5 V DC, with sensor output<br>7 = SSI, BiSS + 2048 ppr. RS422 / 5 V DC<br>8 = SSI, BiSS + 2048 ppr. RS422 / 10 ... 30 V DC | <b>e Code</b>  | B = SSI, binary<br>C = BiSS, binary<br><u>G = SSI, gray</u>               |
| <b>b Through hollow shaft</b> | 1 = ø 6 mm [0.24"]<br>3 = ø 8 mm [0.32"]<br>2 = ø 1/4"<br><i>Blind hollow shaft</i><br>(insertion depth max. 14.5 mm [0.57"])         | <b>d Type of connection</b>  | <u>1 = tangential cable, 1 m [3.28] PUR</u><br>3 = tangential cable, 5 m [16.40] PUR<br>F = tangential cable, special length PUR *)<br>8 = axial M12 connector, 8-pin <sup>1)</sup>  | <b>f Resolution</b>  | A = 10 bit<br>2 = 12 bit<br><u>3 = 13 bit</u><br>4 = 14 bit<br>7 = 17 bit |
| <b>4 = ø 10 mm [0.39"]</b>    |   | *) Available special lengths (connection type F):<br>2, 3, 8, 10, 15 m [6.56, 9.84, 26.25, 32.80, 49.21']<br>order code expansion .XXXX = length in dm<br>ex.: 8.F3673.242F.G312.0030 (for cable length 3 m) |  | <i>Optional on request</i><br>- surface protection<br>salt spray tested<br>- other resolutions   |   |

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| Mounting accessory for shaft encoders   | Order no.                   |
|---|-----------------------------|
| <b>Coupling</b><br>bellows coupling ø 19 mm [0.75"] for shaft 8 mm [0.32"]                              | <b>8.0000.1102.0808</b>     |
| Mounting accessory for hollow shaft encoders  | Order no.                   |
| <b>Cylindrical pin, long</b><br>for flange with spring element<br>(flange type 1 + 3)                   | <b>8.0010.4700.0000</b>     |
|   |                             |
| Connection technology   | Order no.                   |
| <b>Cordset, pre-assembled</b><br>M12 female connector with coupling nut, 8-pin<br>2 m [6.56'] PUR cable | <b>05.00.6051.8211.002M</b> |
| <b>Connector, self-assembly (straight)</b><br>M12 female connector with coupling nut, 8-pin             | <b>05.CMB 8181-0</b>        |

Further accessories can be found in the accessories section or in the accessories area of our website at: [www.kuebler.com/accessories](http://www.kuebler.com/accessories).  
Additional connectors can be found in the connection technology section or in the connection technology area of our website at: [www.kuebler.com/connection\\_technology](http://www.kuebler.com/connection_technology).

| Technical data                                   |   |
|--|---|
| Mechanical characteristics                       |   |
| <b>Maximum speed</b>                             | shaft version without shaft seal (IP65) 12000 min <sup>-1</sup><br>or blind hollow shaft version 10000 min <sup>-1</sup> (continuous) |
|  | shaft version with shaft seal (IP67) 10000 min <sup>-1</sup><br>or hollow shaft version 8000 min <sup>-1</sup> (continuous)           |
| <b>Starting torque at 20°C [68°F]</b>            | without shaft seal < 0.007 Nm<br>with shaft seal (IP67) < 0.01 Nm   |
| <b>Shaft load capacity</b>                       | radial 40 N<br>axial 20 N   |
| <b>Weight</b>                                    | approx. 0.2 kg [7.06 oz]  |
| <b>Protection</b>                                | housing side IP67<br>acc. to EN 60529 shaft side IP65 (solid shaft version opt. IP67)   |
| <b>Working temperature range</b>                 | -40°C ... +90°C [-40°F ... +194°F]  |
| <b>Materials</b>                                 | shaft / hollow shaft stainless steel<br>flange aluminum<br>housing zinc die-cast<br>cable PUR   |
| <b>Shock resistance</b> acc. to EN 60068-2-27    | 2500 m/s <sup>2</sup> , 6 ms  |
| <b>Vibration resistance</b> acc. to EN 60068-2-6 | 100 m/s <sup>2</sup> , 55 ... 2000 Hz   |

1) Only with interfaces 1 and 2 in combination with blind hollow shaft 10 mm [0.39"].

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| Electrical characteristics                             |   |
|--|---|
| <b>Power supply</b>                                    | 5 V DC ( $\pm 5\%$ ) or 10 ... 30 V DC                |
| <b>Current consumption</b> (no load)                   | 5 V DC max. 60 mA<br>10 ... 30 V DC max. 30 mA        |
| <b>Reverse polarity protection of the power supply</b> | yes (only with 10 ... 30 V DC)                        |
| <b>Short-circuit proof outputs</b>                     | yes <sup>1)</sup>                                     |
| <b>UL approval</b>                                     | file 224618   |
| <b>CE compliant</b> acc. to                            | EMC guideline 2014/30/EU<br>RoHS guideline 2011/65/EU |

| SSI interface                     |  |
|-----------------------------------|--|
| <b>Output driver</b>              | RS485 transceiver type   |
| <b>Permissible load / channel</b> | max. +/- 30 mA   |
| <b>Signal level</b>               | HIGH typ. 3.8 V<br>LOW with $I_{Load} = 20\text{ mA}$ typ. 1.3 V   |
| <b>Resolution</b>                 | 10 ... 17 bit  |
| <b>Code</b>                       | binary or gray   |
| <b>SSI clock rate</b>             | 50 kHz ... 2 MHz   |
| <b>Data refresh rate</b>          | ST resolution $\leq 14$ bit $\leq 1\ \mu\text{s}$<br>ST resolution $\geq 15$ bit 4 $\mu\text{s}$   |
| <b>Monoflop time</b>              | $\leq 15\ \mu\text{s}$   |
| <b>Note:</b>                      | If the clock cycle starts within the monoflop time a second data transfer begins with the same data. If the clock cycle starts after the monoflop time the cycle begins with the new values. The update rate is dependent on the clock speed, data length and monoflop time. |

| BiSS interface                    |   |
|-----------------------------------|---|
| <b>Output driver</b>              | RS485 transceiver type  |
| <b>Permissible load / channel</b> | max. +/- 30 mA  |
| <b>Signal level</b>               | HIGH typ. 3.8 V<br>LOW with $I_{Load} = 20\text{ mA}$ typ. 1.3 V  |
| <b>Resolution</b>                 | 10 ... 17 bit   |
| <b>Code</b>                       | binary  |
| <b>BiSS clock rate</b>            | 50 kHz ... 10 MHz   |
| <b>Max. update rate</b>           | $< 10\ \mu\text{s}$ , depends on the clock rate and the data length   |
| <b>Data refresh rate</b>          | ST resolution $\leq 14$ bit $\leq 1\ \mu\text{s}$<br>ST resolution 17 bit 2.4 $\mu\text{s}$   |
| <b>Note:</b>                      | <ul style="list-style-type: none"> <li>- bidirectional, factory programmable parameters are: resolution, code, direction, alarms and warnings</li> <li>- CRC data verification</li> </ul> |

| Incremental outputs (A/B)  |                                  |                                     |
|----------------------------|----------------------------------|-------------------------------------|
|                            | SinCos                           | RS422<br>TTL compatible             |
| <b>Max. frequency</b> -3dB | 400 kHz                          | 400 kHz                             |
| <b>Signal level</b>        | 1 V <sub>pp</sub> ( $\pm 20\%$ ) | HIGH: min. 2.5 V<br>LOW: max. 0.5 V |
| <b>Short circuit proof</b> | yes <sup>1)</sup>                | yes <sup>1)</sup>                   |
| <b>Pulse rate</b>          | 2048 ppr                         | 2048 ppr                            |

| Status output  |   |
|--|---|
| <b>Output driver</b>   | open collector, internal pull up resistor 22 k $\Omega$ m |
| <b>Permissible load</b>  | max. 20 mA  |
| <b>Signal level</b>  | HIGH +V<br>LOW $< 1\text{ V}$                             |
| <b>Active</b>  | LOW   |
| The status output serves to display various alarm or error messages. In normal operation the status output is HIGH (open collector with int. pull-up 22 k $\Omega$ m).   |   |
| An active status output (LOW) displays: LED fault (failure or ageing) – over-temperature – undervoltage In the SSI mode, the fault indication can only be reset by switching off the power supply to the device. |   |

| SET input   |   |
|---|---|
| <b>Input</b>  | active HIGH   |
| <b>Input type</b>   | comparator  |
| <b>Signal level</b>   | HIGH min. 60 % of +V, max: +V<br>(+V = power supply)<br>LOW max. 30 % of +V |
| <b>Input current</b>  | $< 0.5\text{ mA}$   |
| <b>Min. pulse duration</b> (SET)  | 10 ms   |
| <b>Input delay</b>  | 1 ms  |
| <b>New position data readable after</b>   | 1 ms  |
| <b>Internal processing time</b>   | 200 ms  |
| The encoder can be set to zero at any position by means of a HIGH signal on the SET input. Other preset values can be factory-programmed. The SET input has a signal processing time of approx. 1 ms, after which the new position data can be read via SSI or BiSS. Once the SET function has been triggered, the encoder requires an internal processing time of typ. 200 ms; during this time the power supply must not be switched off. |   |
| The SET function should be carried out whilst the encoder is at rest.   |   |
| If this input is not used, it should be connected to 0 V (Encoder ground GND) in order to avoid interferences.  |   |

| DIR input   |      |
|---|------|
| Direction input: A HIGH signal switches the direction of rotation from the default cw to ccw. This inverted function can also be factory-programmed. If DIR is changed when the device is already switched on, then this will be interpreted as an error. The status output will switch to LOW. |      |
| If this input is not used, it should be connected to 0 V (Encoder ground GND) in order to avoid interferences.  |      |
| <b>Response time</b> (DIR input)  | 1 ms |

| Power-ON   |  |
|--|--|
| After Power-ON the device requires a time of approx. 150 ms before valid data can be read. |  |
| Hot plugging of the encoder should be avoided.   |  |

<sup>1)</sup> Short circuit proof to 0 V or to output when power supply correctly applied.

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|------------------------|--|---------------------------------|

## Terminal assignment

| Interface | Type of connection | Features                   | Cable (isolate unused wires individually before initial start-up) |     |    |    |    |    |    |                     |                    |                     |                    |        |           |        |
|-----------|--------------------|----------------------------|---|-----|----|----|----|----|----|---------------------|--------------------|---------------------|--------------------|--------|-----------|--------|
| 1, 2      | 1, 3, F            | SET, DIR, Status           | Signal:   | 0 V | +V | C+ | C- | D+ | D- | SET                 | DIR                | Stat                | ⊥                  |        |           |        |
|           |                    |                            | Core color:   | WH  | BN | GN | YE | GY | PK | BU                  | RD                 | VT                  | shield             |        |           |        |
| 1, 2      | 8                  | SET, DIR                   | M12 connector, 8-pin  |     |    |    |    |    |    |                     |                    |                     |                    |        |           |        |
|           |                    |                            | Signal:   | 0 V | +V | C+ | C- | D+ | D- | SET                 | DIR                | ⊥                   |                    |        |           |        |
|           |                    |                            | Pin:  | 1   | 2  | 3  | 4  | 5  | 6  | 7                   | 8                  | PH                  |                    |        |           |        |
| 3, 4      | 1, 3, F            | SET, DIR, 2048 SinCos      | Cable (isolate unused wires individually before initial start-up) |     |    |    |    |    |    |                     |                    |                     |                    |        |           |        |
|           |                    |                            | Signal:   | 0 V | +V | C+ | C- | D+ | D- | SET                 | DIR                | A                   | $\bar{A}$          | B      | $\bar{B}$ | ⊥      |
|           |                    |                            | Core color:   | WH  | BN | GN | YE | GY | PK | BU                  | RD                 | BK                  | VT                 | GY-PK  | RD-BU     | shield |
| 5         | 1, 3, F            | SET, DIR, Sensor output    | Cable (isolate unused wires individually before initial start-up) |     |    |    |    |    |    |                     |                    |                     |                    |        |           |        |
|           |                    |                            | Signal:   | 0 V | +V | C+ | C- | D+ | D- | SET                 | DIR                | 0 V <sub>sens</sub> | +V <sub>sens</sub> | ⊥      |           |        |
|           |                    |                            | Core color:   | WH  | BN | GN | YE | GY | PK | BU                  | RD                 | VT                  | RD-BU              | shield |           |        |
| 6         | 1, 3, F            | 2048 SinCos, Sensor output | Cable (isolate unused wires individually before initial start-up) |     |    |    |    |    |    |                     |                    |                     |                    |        |           |        |
|           |                    |                            | Signal:   | 0 V | +V | C+ | C- | D+ | D- | 0 V <sub>sens</sub> | +V <sub>sens</sub> | A                   | $\bar{A}$          | B      | $\bar{B}$ | ⊥      |
|           |                    |                            | Core color:   | WH  | BN | GN | YE | GY | PK | BU                  | RD                 | BK                  | VT                 | GY-PK  | RD-BU     | shield |
| 7, 8      | 1, 3, F            | 2048 incr. RS422           | Cable (isolate unused wires individually before initial start-up) |     |    |    |    |    |    |                     |                    |                     |                    |        |           |        |
|           |                    |                            | Signal:   | 0 V | +V | C+ | C- | D+ | D- | A                   | $\bar{A}$          | B                   | $\bar{B}$          | ⊥      |           |        |
|           |                    |                            | Core color:   | WH  | BN | GN | YE | GY | PK | BK                  | VT                 | GY-PK               | RD-BU              | shield |           |        |

- +V: Encoder power supply +V DC
- 0 V: Encoder power supply ground GND (0 V)
- 0 V<sub>sens</sub> / +V<sub>sens</sub>: Using the sensor outputs of the encoder, the voltage present can be measured and if necessary increased accordingly.
- C+, C-: Clock signal
- D+, D-: Data signal
- A,  $\bar{A}$ : Incremental output channel A (cosine)
- B,  $\bar{B}$ : Incremental output channel B (sine)
- SET: Set input
- DIR: Direction input
- PH ⊥: Plug connector housing (shield)

Top view of mating side, male contact base



M12 connector, 8-pin

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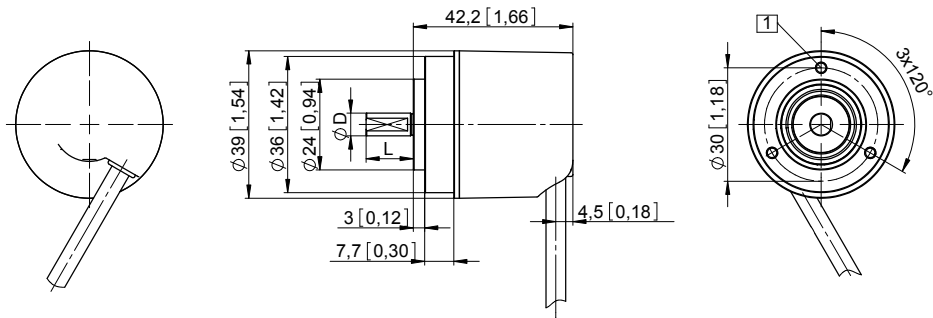
## Dimensions shaft version

Dimensions in mm [inch]

### Clamping flange, $\varnothing$ 36 [1.42]

Flange type 1 and 3

1 3 x M3, 6 [0.24] deep



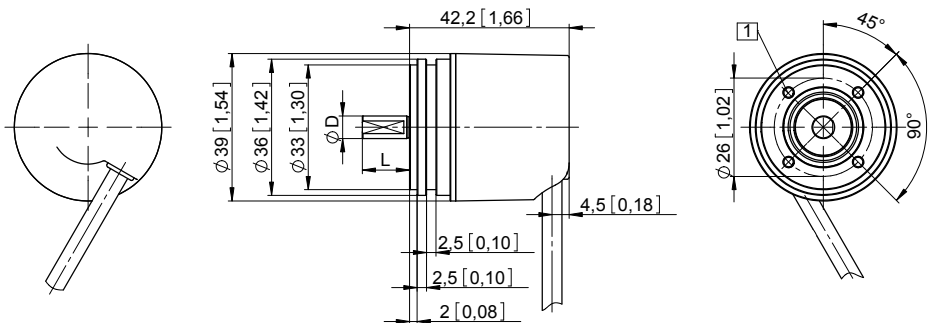
| D         | Fit | L           |
|-----------|-----|-------------|
| 6 [0.24]  | h7  | 12.5 [0.49] |
| 8 [0.32]  | h7  | 15 [0.59]   |
| 10 [0.39] | f7  | 20 [0.79]   |
| 1/4"      | h7  | 12.5 [0.49] |
| 3/8"      | h7  | 5/8"        |

### Synchro flange, $\varnothing$ 36 [1.42]

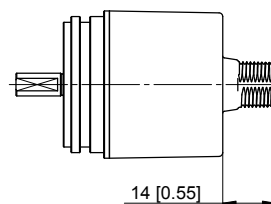
Flange type 2 and 4

(drawing with cable)

1 4 x M3, 6 [0.24] deep



| D         | Fit | L           |
|-----------|-----|-------------|
| 6 [0.24]  | h7  | 12.5 [0.49] |
| 8 [0.32]  | h7  | 15 [0.59]   |
| 10 [0.39] | f7  | 20 [0.79]   |
| 1/4"      | h7  | 12.5 [0.49] |
| 3/8"      | h7  | 5/8"        |



Drawing with M12 connector and type of connection 8

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## Dimensions hollow shaft version

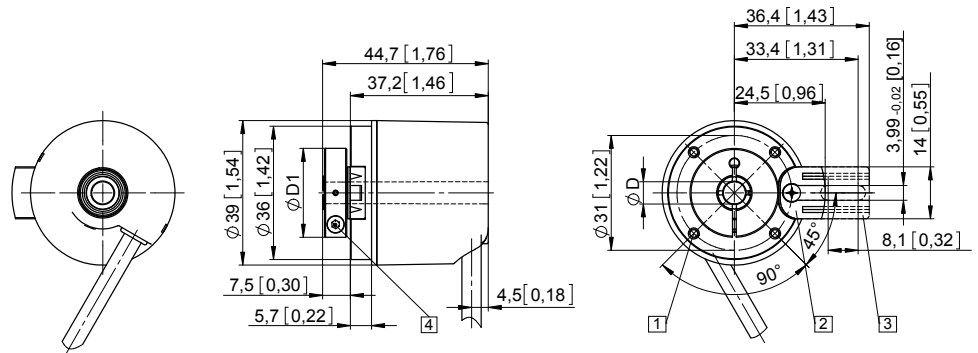
Dimensions in mm [inch]

### Flange with spring element

#### Flange type 1 and 3

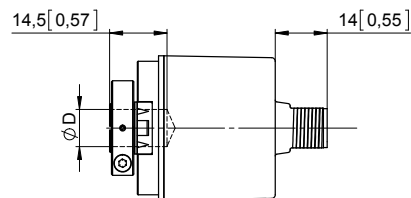
(drawing with spring element short, spring element long is shown dashed)

- 1 4 x M2.5, 5 [0.2] deep
- 2 Spring element, short recommendation: cylindrical pin DIN 7,  $\varnothing$  4 [0.16]
- 3 Spring element, long recommendation: cylindrical pin DIN 7,  $\varnothing$  4 [0.16]
- 4 Recommended torque for the clamping ring 0.7 Nm



| D            | Fit | D1          |
|--------------|-----|-------------|
| 6 [0.24]     | H7  | 24 [0.94]   |
| 8 [0.32]     | H7  | 25.5 [1.00] |
| 10 [0.39] *) | H7  | 25.5 [1.00] |
| 1/4"         | H7  | 24 [0.94]   |

\*) Blind hollow shaft, insertion depth max. = 14.5 mm [0.57"]

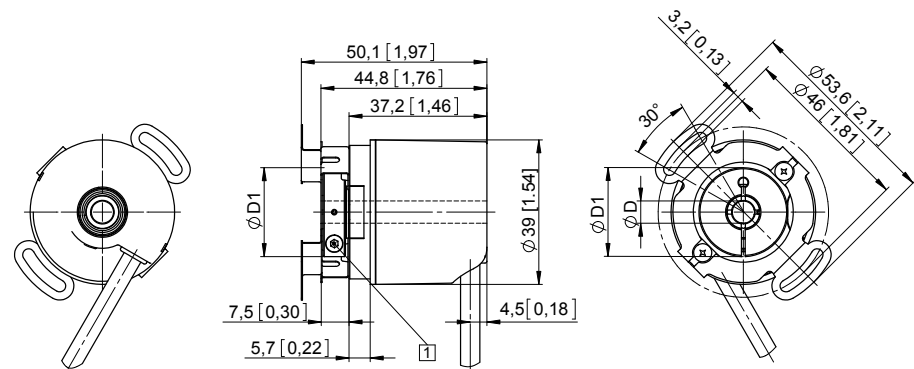


**Blind hollow shaft for D = 10**  
drawing with M12 connector and type of connection 8

### Flange with stator coupling, $\varnothing$ 46 [1.81"]

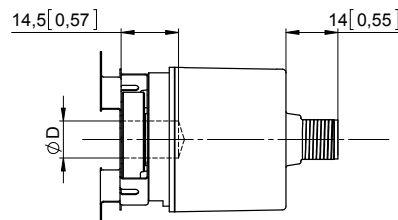
#### Flange type 2

- 1 Recommended torque for the clamping ring 0.7 Nm



| D            | Fit | D1          |
|--------------|-----|-------------|
| 6 [0.24]     | H7  | 24 [0.94]   |
| 8 [0.32]     | H7  | 25.5 [1.00] |
| 10 [0.39] *) | H7  | 25.5 [1.00] |
| 1/4"         | H7  | 24 [0.94]   |

\*) Blind hollow shaft, insertion depth max. = 14.5 mm [0.57"]



**Blind hollow shaft for D = 10**  
drawing with M12 connector and type of connection 8