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# Absolute Angle Encoder

# “GMI-ANGLE” Series

## based on the

## Giant Magneto Impedance (GMI) principle

## Technical Datasheet

2024-02 - rev.05

www.flux.gmbh

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# 1. GMI-ANGLE encoders

The **GMI-ANGLE** series of axial, absolute, frameless, angle encoders from FLUX GmbH offers motor feedback solutions for a wide range of applications, fitting optimally in designs that require precise positioning with exact velocity and torque control.

The **GMI-ANGLE** series of axial encoders incorporates the FLUX patented GMI (Giant Magneto Impedance) position sensor to deliver high performance feedback as part of a closed loop motion control system.

The GMI position sensor technology and encoder architecture, developed and manufactured by FLUX, are the result of 40+ years experience in encoder development and manufacturing. It addresses in a purposeful and compact manner motion control feedback design requirements calling for:

### High Accuracy:

- Better than ± 4 arc sec guaranteed accuracy
- Accuracy achievable even with as much as 0.20 mm (0.008”) mechanical run-out

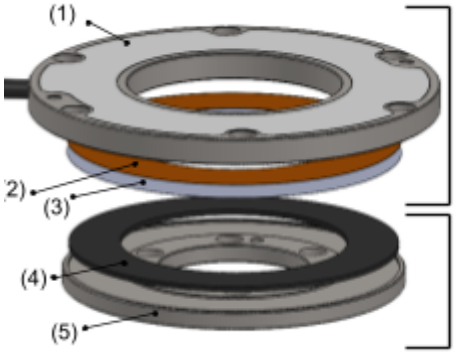
### Ease of Installation:

- Air gap between Ring Scale (Rotor) and Encoder Head (Stator): 0.30 ± 0.25mm (0.012 ±0.010”)
- Ring Scale can be installed directly onto the Rotary Table Mounting Hub with screws. No special heating, cooling or press-fitting required.
- There are two dowel pin holes in each device, rotor and stator, for quick and easy centering and mounting. Alternatively, the fit of the inner or outer diameter can be used. The air gap between stator and rotor can be adjusted by using a 0.30 mm spacer foil.
- Status LED light informs installer of GOOD/BETTER/BEST alignment
- No special electronics required to verify proper Encoder installation.
- Does not require any signal- or accuracy calibration. High Accuracy and High Performance achieved via 360° sensing of the Ring Scale grating and dynamic signal compensation.

### Simple Field Service:

- Ring Scale and Encoder Head do not need to be matched as a set. Replacement of one does not require replacement of both.
- In-field service can be done as simply as described above without any special electronic tools

## 1.1. Giant Magneto Impedance principle (simplified)




GMI Angle Encoder Stator: GAS
(1) Stainless steel housing and evaluation electronic
(2) Absolute GMI Sensor
(3) GMI layer

GMI Angle Encoder Rotor: GAR
(4) Absolut magnetic ring
(5) Stainless steel carrier

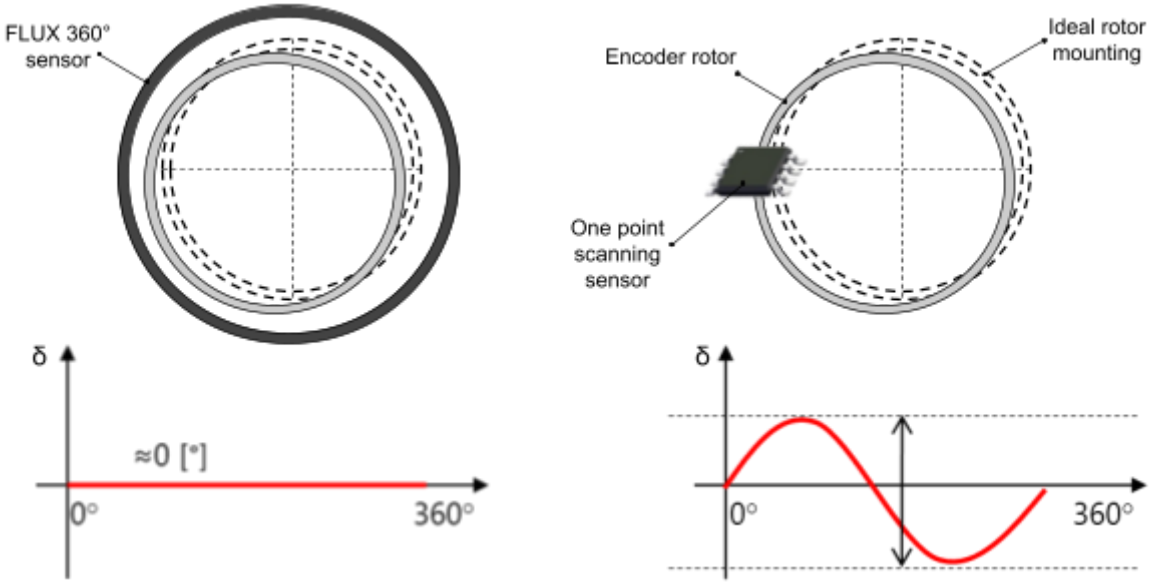
**HOW THE GMI TECHNOLOGY WORKS**

The magnetic field produced by the absolute magnet ring (4) induces variable electrical a.c. impedance regions within the GMI layer (3). The fluctuations in the a.c. impedance generated is transformed into an electrical signal by the absolute GMI sensor (2). This GMI sensor (2) is linked to the evaluation electronic (1), which translates the electrical signal into a digital position.

## 1.2. Holistic, 360° scanning principle

FLUX encoders have a holistic scanning principle, meaning that they scan and read 360° around the encoder rotor. By comparison, many other rotary encoder technologies (magnetic xMR, Hall, optical, etc.) use segment or “one point” scanning.

360° scanning has many advantages, including improved signal quality, error averaging, and, most importantly, the reduction of the eccentricity error.
Eccentricity [e] is the displacement between the geometrical center of an encoder rotor and the rotation axis. The dotted disk in the figure below is the ideal position, and the gray disk shows the eccentric location of the encoder rotor.




Sensor geometry causes FLUX encoders to inherently average out eccentricity across the circumference of the rotor, resulting in significant reduction in eccentricity error. However, a sensor with a "one-point" scanning capability will exhibit eccentricity errors [δ] over a complete rotation in the form of a sinusoidal wave.

The eccentricity error [δ] for an “one-point” encoder can be calculated using the following formula:

$$\delta['] = \pm 412 \times \frac{e\ [\mu m]}{D\ [mm]}$$

with:

- δ … encoder eccentricity error in arcseconds
- e … eccentricity (half of the runout) in µm
- D … encoder diameter in mm

The eccentricity may occur both statically as a result of manufacturing or mounting tolerances as well as dynamically as the result of external forces acting on the mechanical parts during operation.

A "one-point" scanning approach could partially correct the statical eccentricity with additional effort and expensive calibration procedures, but there is no possibility of correcting the dynamical eccentricity.
As a result of the 360° scanning approach of the FLUX encoders, they inherently compensate for both statically and dynamically eccentricities .

Eccentricity error is a significant source of additional error in applications that require accuracy. Using an "one-point" encoder can reduce the overall performance of the machine even for eccentricities under 20 µm. Using different sizes of encoder, a comparison of additional errors to the positioning system is presented in the following tables for both 10 and 20 µm eccentricities.

**Additional error is the error exclusively generated by eccentricity and added to the error in the product inspection/calibration chart.**

| **Additional error δ for e = 10 µm** | | |
|---|---|---|
| **Diameter *D*** | **FLUX GMI-ANG** | **One-Point** |
| 96 mm | <± 1” | ± 43” |
| 160 mm | <± 1” | ± 26” |
| 180 mm | <± 1” | ± 23” |
| 250 mm | <± 1” | ± 16” |

| **Additional error δ for e = 20 µm** | | |
|---|---|---|
| **Diameter *D*** | **FLUX GMI-ANG** | **One-Point** |
| 96 mm | <± 2” | ± 86” |
| 160 mm | <± 1” | ± 52” |
| 180 mm | <± 1” | ± 46” |
| 250 mm | <± 1” | ± 32” |

## 1.3. Environmental and EMC immunity

FLUX angle encoders based on Giant Magnetic Impedance (GMI) offer exceptional immunity to environmental and electromagnetic perturbations.

**GMI-ANGLE** encoders come standard with an IP67 rating. Moreover, the angle encoder can work in extreme environmental conditions, and its performance is not compromised by dust, condensation, or solvents.

# 2. GMI-ANGLE encoder specification

**GMI-ANGLE-160 (size 160mm)*

| **GMI-ANGLE size (OD)** | **96 mm** | **160 mm** | **180 mm** | **250 mm** |
|---|---|---|---|---|
| **System data** | | | | |
| **Type** | Axial, frameless, true absolute **Giant Magneto Impedance encoder GMI Technology** - FLUX GmbH proprietary | | | |
| **Standard resolution** | 23 bits | 24 bits | 24 bits | 25 bits |
| **High accuracy**[1] *(option "C")* | ± 8" | ± 5.5" | ± 5.5" | ± 3" |
| | ± 40 µrad | ± 26 µrad | ± 26 µrad | ± 16 µrad |
| **Standard accuracy** | ± 14" | ± 7" | ± 7" | ± 4" |
| | ± 70 µrad | ± 35 µrad | ± 35 µrad | ± 20 µrad |
| **Hysteresis** | none | | | |
| **Repeatability** | 1 resolution count | | | |
| **Position update rate and signal latency** | Real-time | | | |
| **Standard maximum speed** | 2'000 rpm *(higher on request)* | | | |
| **Power-up time** | max. 0.8 sec | | | |

[1] Achievable accuracy at nominal air-gap, while tolerances for runout, lateral displacement as well as perpendicularity of stator and rotor to the axis of rotation are all better than 20µm.

| **Electrical data** | |
|---|---|
| **Supply voltage**<br>*(at encoder connector)* | **Recommended for new projects:**<br>**Option AV:** min. 4.35 Vdc. max. 36 Vdc<br><br>***Available for back compatibility. Do not order for new projects:***<br>***Option 5V:*** *min. 4.35 Vdc. max. 6 Vdc*<br>***Option 24V:*** *min. 6 Vdc. Max. 30 Vdc* |
| **Reverse polarity protection** | Yes |
| **Current Consumption**<br>*(w/o output terminations)* | max. 150 mA @ 5 Vdc<br>max. 40 mA @ 24 Vdc |

| **GMI-ROT size (OD)** | **96 mm** | **160 mm** | **180 mm** | **250 mm** |
|---|---|---|---|---|
| **Mechanical Data** | | | | |
| **Stator base material** | Stainless steel CTE ~ 10 ppm/°C | | | |
| **Stator weight**[(1)] | 220 g | 440 g | 520 g | 760 g |
| **Rotor base material** | Stainless steel CTE ~ 10 ppm/°C | | | |
| **Rotor weight**[(1)] | 115 g | 320 g | 320 g | 490 g |
| **Vibration** | EN 60068-2-6, 20 g, 55 .. 2000 Hz | | | |
| **Shock** | EN 60068-2-27, 200 g, 6 ms | | | |

[(1)] Guiding values, without cable

| **Mounting tolerances** | |
|---|---|
| **Nominal axial air-gap** | 0.30 mm |
| **Axial tolerance**<br>*(air-gap)* | ±0.25 mm |
| **Radial tolerances**<br>*(runout / lateral displacement)* | 0.20 mm |

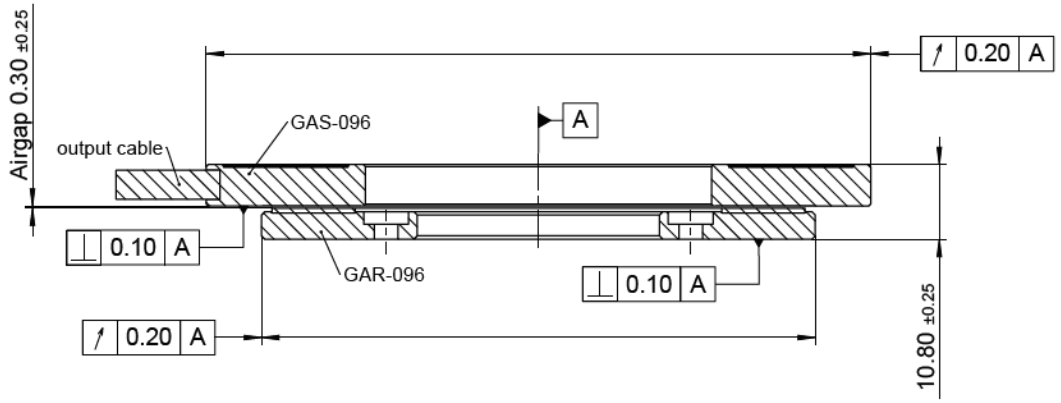
| **Environmental data** | |
|---|---|
| **Temperature range - Standard** *(no additional option in order code)* | |
| **Operating** | -20°C .. +85°C |
| **Storage** | -20°C .. +85°C |
| **Temperature range - Extended** *(contact FLUX for more details)* | |
| **Operating** | -40°C .. +105°C |
| **Storage** | -55°C .. +125°C |
| **Ingress Protection** | IP67 |
| **EMC immunity** | complies with EN IEC 61000-6-2 |
| **EMC emission** | complies with EN IEC 61000-6-4 |

| **Output interfaces**<br>(See ***FLUX Encoders Interface Guide*** for complete description- www.flux.gmbh/downloads) | |
|---|---|
| Absolute: **BiSS/C** | BIS10, BIS20, BIS21, BIS00 |
| Absolute: **SSI** | SSI00, SSI01, SSI02, SSI03, SSI04 |
| Incremental: **A/B/Z** | INC00, INC01, INC02, INC03 |
| Absolute: **SPI** | *contact FLUX for more details* |
| Absolute: **Asynchronous** | UAT00, UAT10 |

# 3. Mechanical dimensions and mounting tolerances

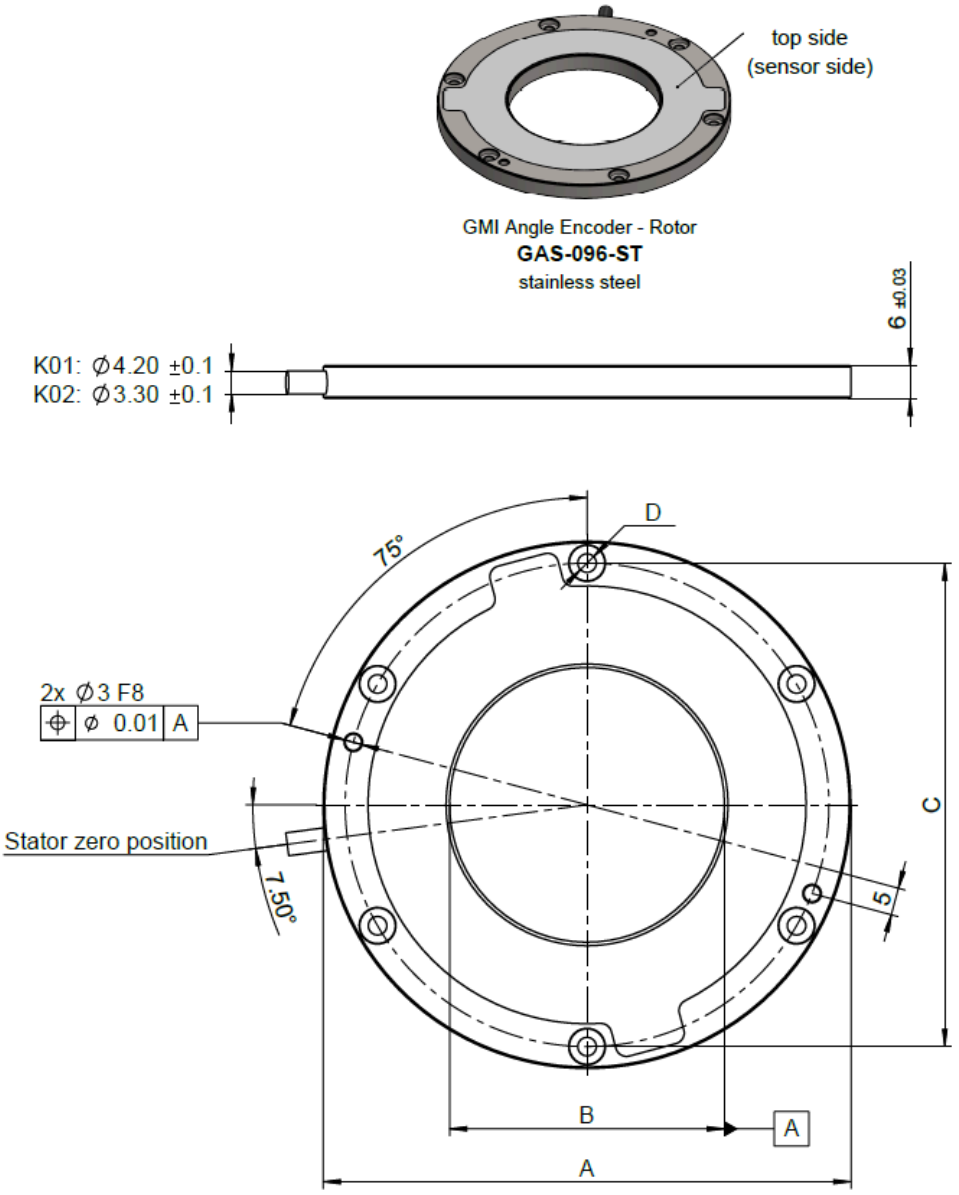
## 3.1. GMI-ANGLE encoder size 96 mm: GMI-ANG-096


GMI Angle Encoder: Stator Size 96mm
**GMI-ANG-096-ST**
stainless steel




A ... axis of rotation
max. total runout tolerance GAS + GAR = 0.20mm | GAS + GAR | 0.20 | A |
max. total perpendicularity tolerance GAS + GAR = 0.20mm | GAS + GAR | 0.20 | A |
Dimensions are mm.

## 3.1.1. Stator for GMI-ANG-096: **GAS-096**

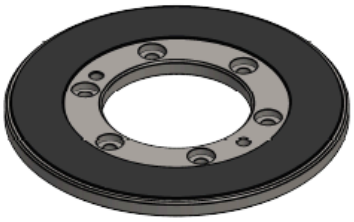



Size comparison table. The 096 mm size is highlighted.

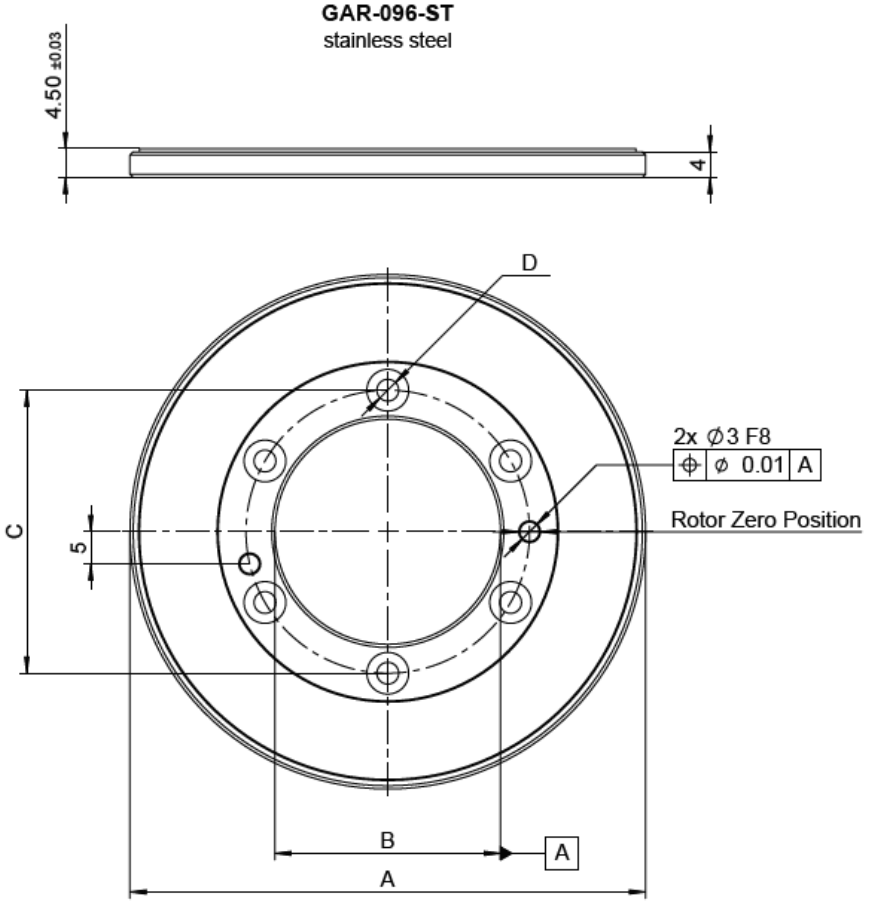
| GAS-xxx | A | B | C | D |
|---|---|---|---|---|
| **096** | **ø96 h7** | **ø50 H7** | **ø88** | **6 x ø3.40 (6x60°)** |
| 160 | ø160 h7 | ø110 H7 | ø121.50 | 6 x ø4.50 (6x60°) |
| 180 | ø180 h7 | ø130 H7 | ø169 | 6 x ø4.50 (6x60°) |
| 250 | ø250 h7 | ø200 H7 | ø239 | 8 x ø4.50 (8x45°) |

Dimensions are in mm.
Screw hole dimensions for fastener according ISO 7380-1.
A set of mounting screws according to Section 11.1. is included with the product.

## 3.1.2. Rotor for GMI-ANG-096: **GAR-096**



GMI Angle Encoder - Rotor
**GAR-096-ST**
stainless steel



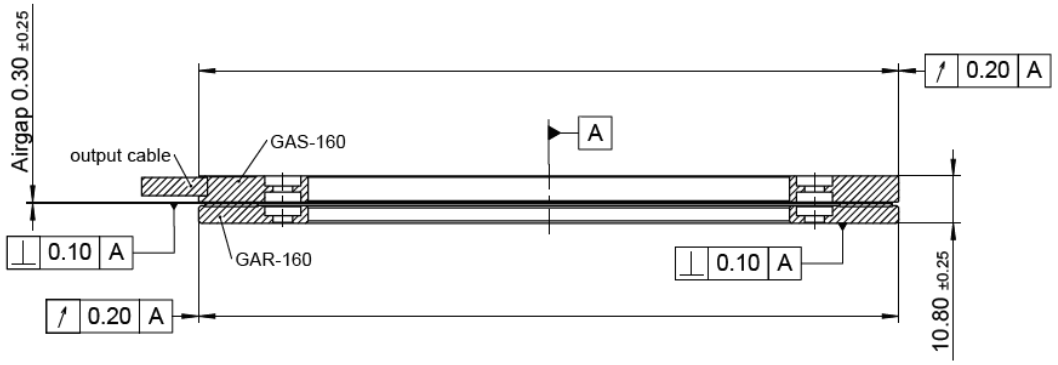

Size comparison table. The 096 mm size is highlighted.

| GAR-xxx | A | B | C | D |
|---|---|---|---|---|
| **096** | **ø80 h7** | **ø35 H7** | **ø44** | **6 x ø3.40 (6x60°)** |
| 160 | ø160 h7 | ø110 H7 | ø121.50 | 6 x ø4.50 (6x60°) |
| 180 | ø160 h7 | ø110 H7 | ø121.50 | 6 x ø4.50 (6x60°) |
| 250 | ø230 h7 | ø180 H7 | ø191.50 | 8 x ø4.50 (8x45°) |

Dimensions are in mm.
Screw hole dimensions for fastener according ISO 7380-1.
A set of mounting screws according to Section 11.1. is included with the product.

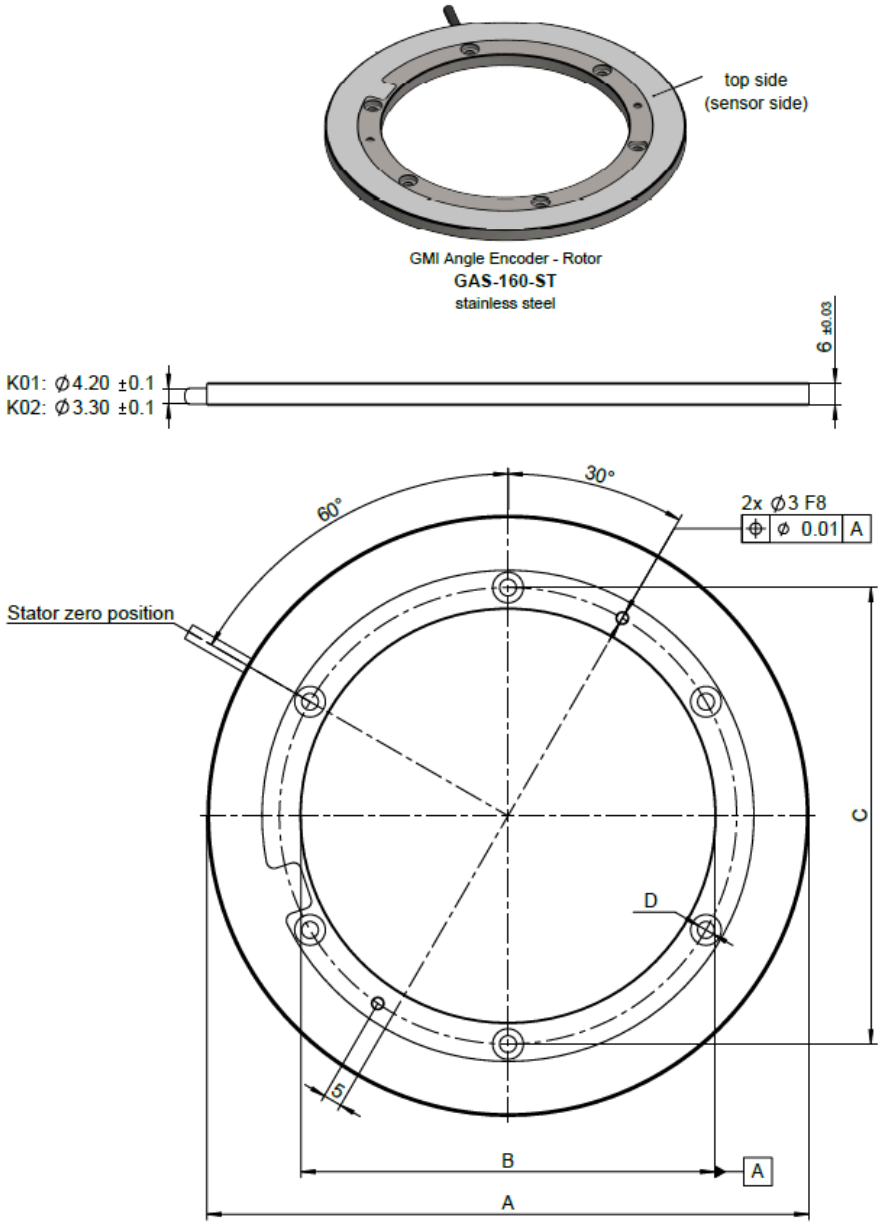
## 3.2. GMI-ANGLE encoder size 160 mm: **GMI-ANG-160**


GMI Angle Encoder: Stator Size 160mm
**GMI-ANG-160-ST**
stainless steel




A ... axis of rotation
max. total runout tolerance GAS + GAR = 0.20mm | GAS + GAR | 0.20 | A |
max. total perpendicularity tolerance GAS + GAR = 0.20mm | GAS + GAR | 0.20 | A |
Dimensions are mm.

## 3.2.1. Stator for GMI-ANG-160: **GAS-160**



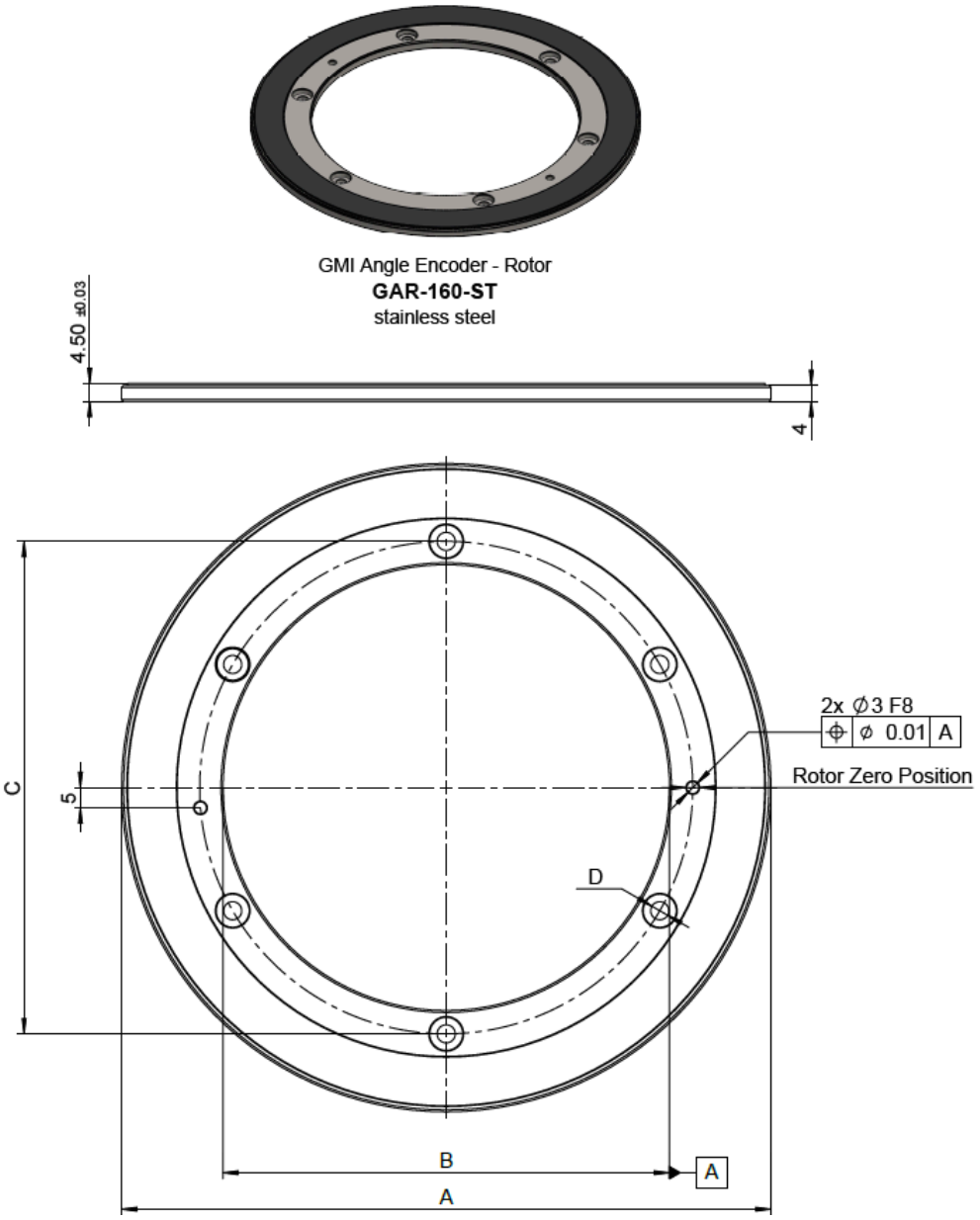

**For the legacy version “5V supply voltage” the cable output is at 45° instead of 60°.**

Size comparison table. The 160 mm size is highlighted.

| GAS-xxx | A | B | C | D |
|---|---|---|---|---|
| 096 | ø96 h7 | ø50 H7 | ø88 | 6 x ø3.40 (6x60°) |
| **160** | **ø160 h7** | **ø110 H7** | **ø121.50** | **6 x ø4.50 (6x60°)** |
| 180 | ø180 h7 | ø130 H7 | ø169 | 6 x ø4.50 (6x60°) |
| 250 | ø250 h7 | ø200 H7 | ø239 | 8 x ø4.50 (8x45°) |

Dimensions are in mm.
Screw hole dimensions for fastener according ISO 7380-1.
A set of mounting screws according to Section 11.1. is included with the product.

## 3.2.2. Rotor for GMI-ANG-160: **GAR-160**



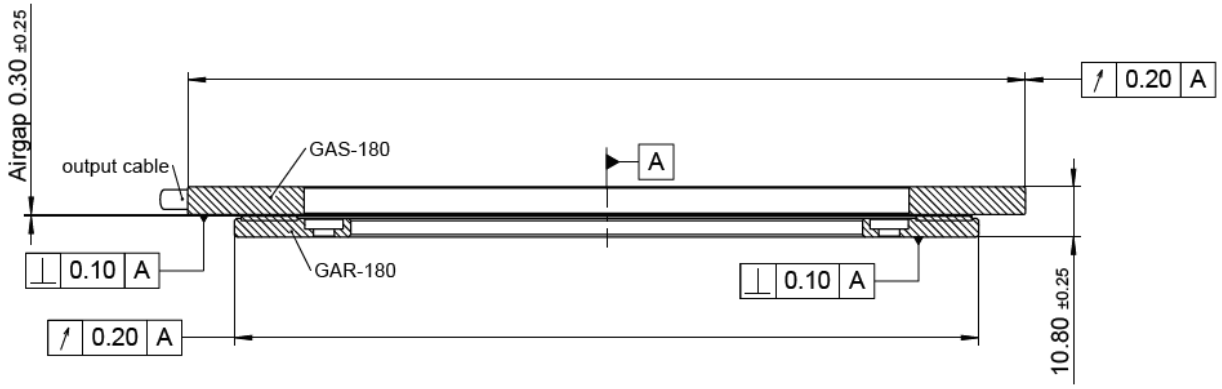

Size comparison table. The 160 mm size is highlighted.

| GAR-xxx | A | B | C | D |
|---|---|---|---|---|
| 096 | ø80 h7 | ø35 H7 | ø44 | 6 x ø3.40 (6x60°) |
| **160** | **ø160 h7** | **ø110 H7** | **ø121.50** | **6 x ø4.50 (6x60°)** |
| 180 | ø160 h7 | ø110 H7 | ø121.50 | 6 x ø4.50 (6x60°) |
| 250 | ø230 h7 | ø180 H7 | ø191.50 | 8 x ø4.50 (8x45°) |

Dimensions are in mm.
Screw hole dimensions for fastener according ISO 7380-1.
A set of mounting screws according to Section 11.1. is included with the product.

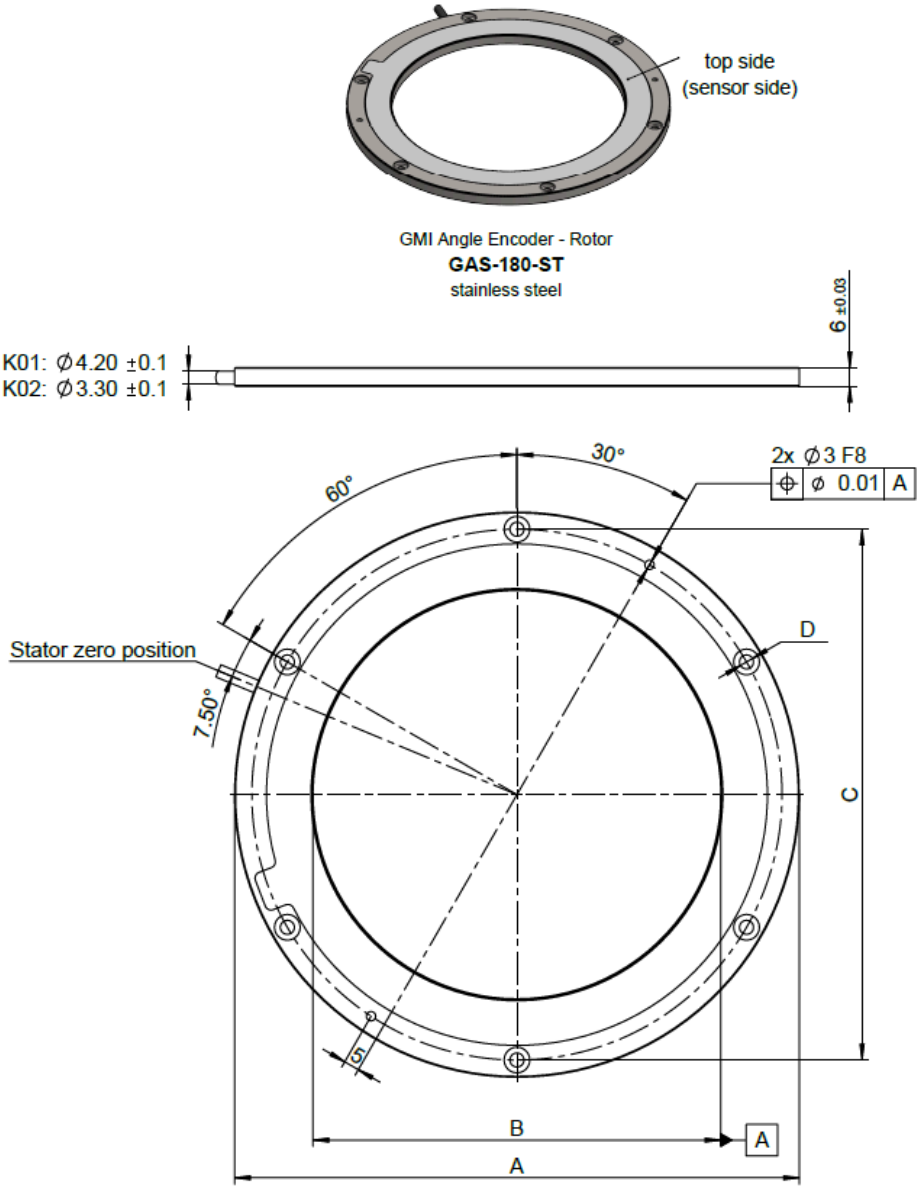
# 3.3. GMI-ANGLE encoder size 180 mm: **GMI-ANG-180**


GMI Angle Encoder: Stator Size 180mm
**GMI-ANG-180-ST**
stainless steel




A ... axis of rotation
max. total runout tolerance GAS + GAR = 0.20mm | GAS + GAR | 0.20 | A |
max. total perpendicularity tolerance GAS + GAR = 0.20mm | GAS + GAR | 0.20 | A |
Dimensions are mm.

## 3.3.1. Stator for GMI-ANG-180: **GAS-180**



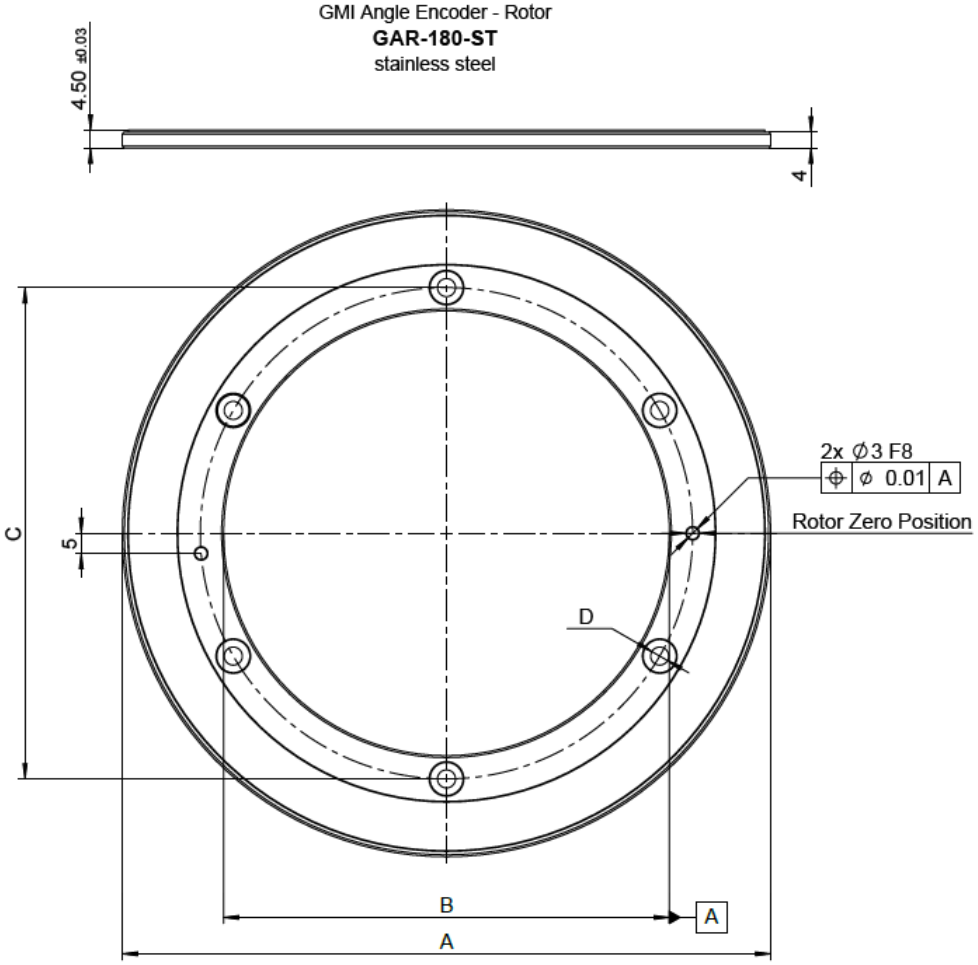

Size comparison table. The 180 mm size is highlighted.

| GAS-xxx | A | B | C | D |
|---|---|---|---|---|
| 096 | ø96 h7 | ø50 H7 | ø88 | 6 x ø3.40 (6x60°) |
| 160 | ø160 h7 | ø110 H7 | ø121.50 | 6 x ø4.50 (6x60°) |
| **180** | **ø180 h7** | **ø130 H7** | **ø169** | **6 x ø4.50 (6x60°)** |
| 250 | ø250 h7 | ø200 H7 | ø239 | 8 x ø4.50 (8x45°) |

Dimensions are in mm.
Screw hole dimensions for fastener according ISO 7380-1.
A set of mounting screws according to Section 11.1. is included with the product.

## 3.3.2. Rotor for GMI-ANG-180: **GAR-180**

GMI Angle Encoder - Rotor
**GAR-180-ST**
stainless steel



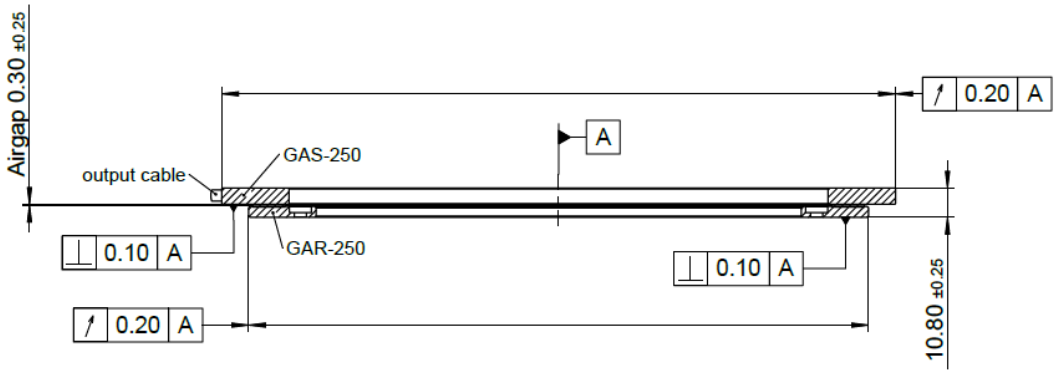

Size comparison table. The 180 mm size is highlighted.

| GAR-xxx | A | B | C | D |
|---|---|---|---|---|
| 096 | ø80 h7 | ø35 H7 | ø44 | 6 x ø3.40 (6x60°) |
| 160 | ø160 h7 | ø110 H7 | ø121.50 | 6 x ø4.50 (6x60°) |
| **180** | **ø160 h7** | **ø110 H7** | **ø121.50** | **6 x ø4.50 (6x60°)** |
| 250 | ø230 h7 | ø180 H7 | ø191.50 | 8 x ø4.50 (8x45°) |

Dimensions are in mm.
Screw hole dimensions for fastener according ISO 7380-1.
A set of mounting screws according to Section 11.1. is included with the product.

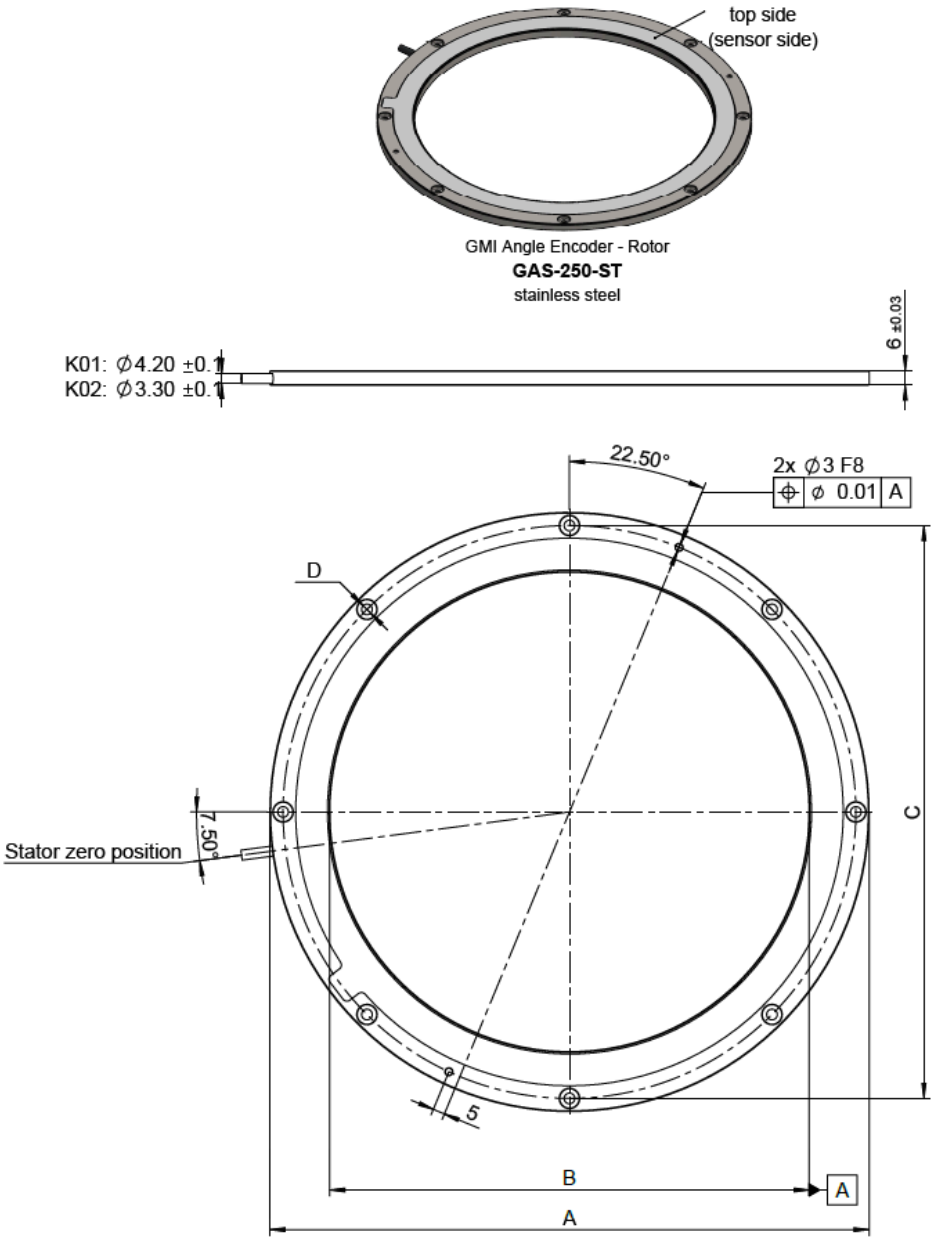
# 3.4. GMI-ANGLE encoder size 250 mm: **GMI-ANG-250**


GMI Angle Encoder: Stator Size 250mm
**GMI-ANG-250-ST**
stainless steel




A ... axis of rotation
max. total runout tolerance GAS + GAR = 0.20mm | GAS + GAR | 0.20 | A |
max. total perpendicularity tolerance GAS + GAR = 0.20mm | GAS + GAR | 0.20 | A |
Dimensions are mm.

## 3.4.1. Stator for GMI-ANG-250: **GAS-250**



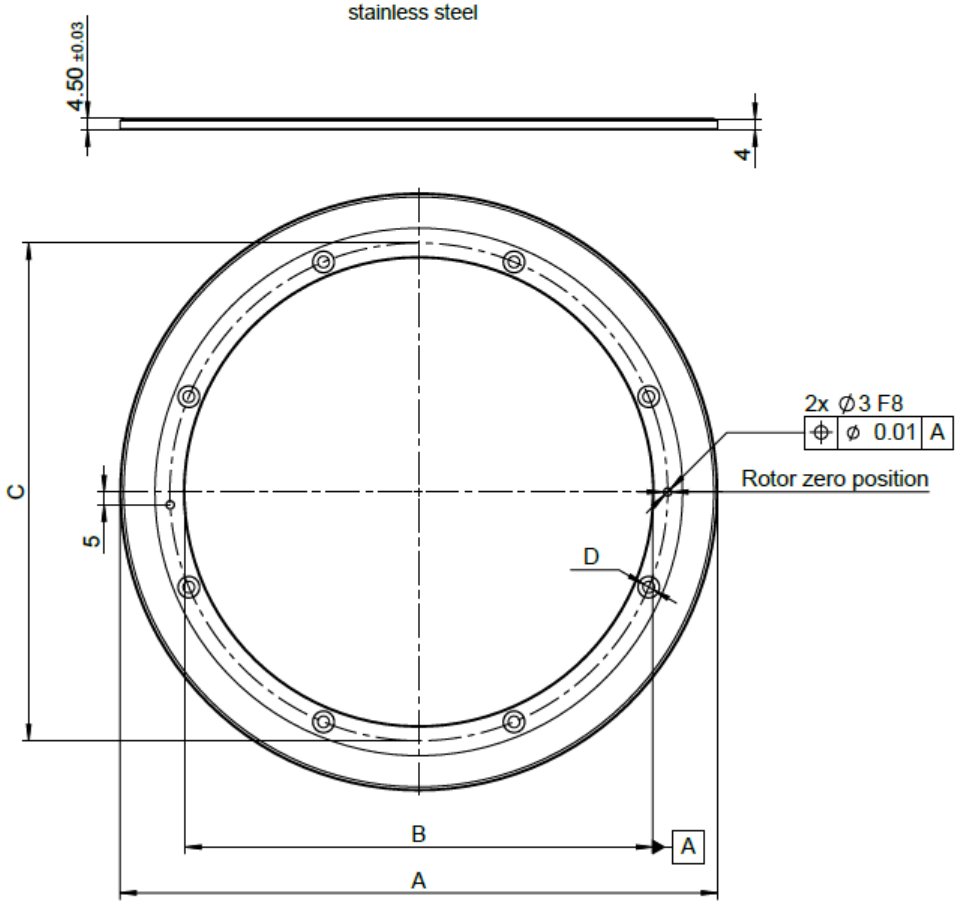

Size comparison table. The 250 mm size is highlighted.

| GAS-xxx | A | B | C | D |
|---|---|---|---|---|
| 096 | ø96 h7 | ø50 H7 | ø88 | 6 x ø3.40 (6x60°) |
| 160 | ø160 h7 | ø110 H7 | ø121.50 | 6 x ø4.50 (6x60°) |
| 180 | ø180 h7 | ø130 H7 | ø169 | 6 x ø4.50 (6x60°) |
| **250** | **ø250 h7** | **ø200 H7** | **ø239** | **8 x ø4.50 (8x45°)** |

Dimensions are in mm.
Screw hole dimensions for fastener according ISO 7380-1.
A set of mounting screws according to Section 11.1. is included with the product.

## 3.4.2. Rotor for GMI-ANG-250: **GAR-250**

GMI Angle Encoder - Rotor
**GAR-250-ST**
stainless steel




Size comparison table. The 250 mm size is highlighted.

| GAR-xxx | A | B | C | D |
|---|---|---|---|---|
| 096 | ø80 h7 | ø35 H7 | ø44 | 6 x ø3.40 (6x60°) |
| 160 | ø160 h7 | ø110 H7 | ø121.50 | 6 x ø4.50 (6x60°) |
| 180 | ø160 h7 | ø110 H7 | ø121.50 | 6 x ø4.50 (6x60°) |
| **250** | **ø230 h7** | **ø180 H7** | **ø191.50** | **8 x ø4.50 (8x45°)** |

Dimensions are in mm.
Screw hole dimensions for fastener according ISO 7380-1.
A set of mounting screws according to Section 11.1. is included with the product.

# 4. Mounting recommendation

## 4.1. Mounting using inner diameter - H7 sliding fit

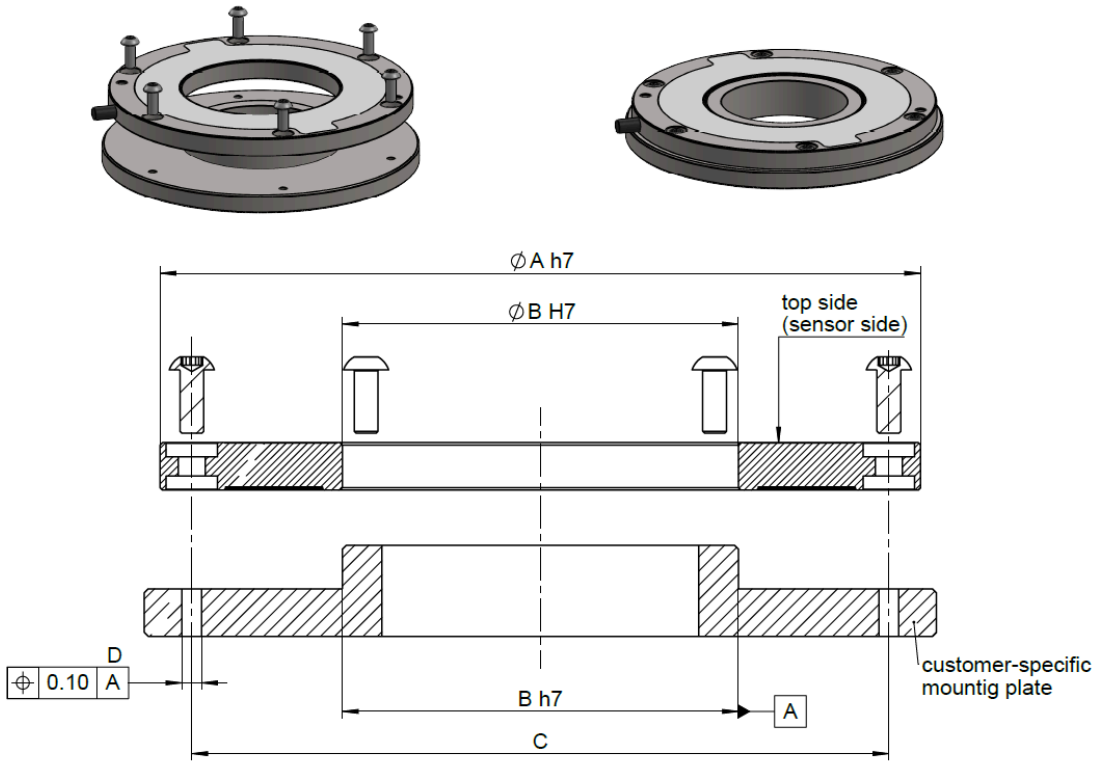
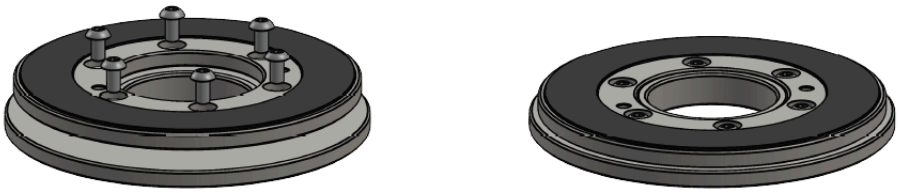



Fig.4.1.: GMI Angle Stator (GAS) mounting using ID sliding fit

| GAS-xxx | A | B | C | D |
|---|---|---|---|---|
| 096 | ø96 | ø50 | ø88 | 6 x M3 (6 x 60°) |
| 160 | ø160 | ø110 | ø121.50 | 6 x M4 (6 x 60°) |
| 180 | ø180 | ø130 | ø169 | 6 x M4 (6 x 60°) |
| 250 | ø250 | ø200 | ø239 | 8 x M4 (8 x 45°) |

Dimensions are in mm.

It is advisable to utilize a medium-strength screw retainer for a secure mounting. The installation of the GMI Angle Stator (GAS) must be adapted to suit its specific application. The customer-specific mounting plate is for illustrative purposes only.



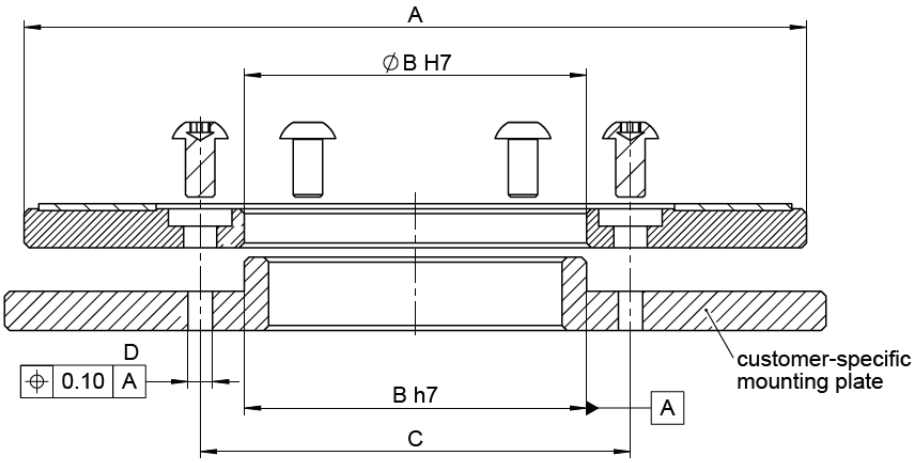


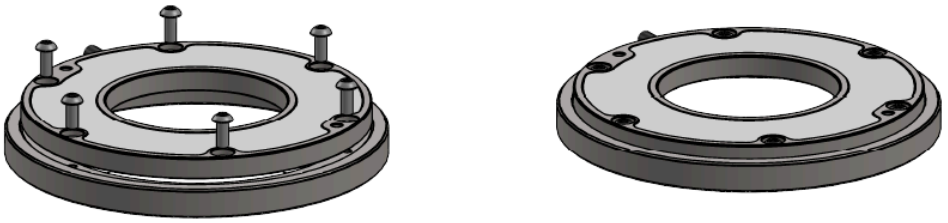

Fig.4.2.: GMI Angle Rotor (GAR) mounting using ID sliding fit

| GAR-xxx | A | B | C | D |
|---|---|---|---|---|
| 096 | ø80 | ø35 | ø44 | 6 x M3 (6 x 60°) |
| 160 | ø160 | ø110 | ø121.50 | 6 x M4 (6 x 60°) |
| 180 | ø160 | ø110 | ø121.50 | 6 x M4 (6 x 60°) |
| 250 | ø230 | ø180 | ø191.50 | 8 x M4 (8 x 45°) |

Dimensions are in mm.

It is advisable to utilize a medium-strength screw retainer for a secure mounting. The installation of the GMI Angle Rotor (GAR) must be adapted to suit its specific application. The customer-specific mounting plate is for illustrative purposes only.

## 4.2. Mounting using outer diameter h7 sliding fit



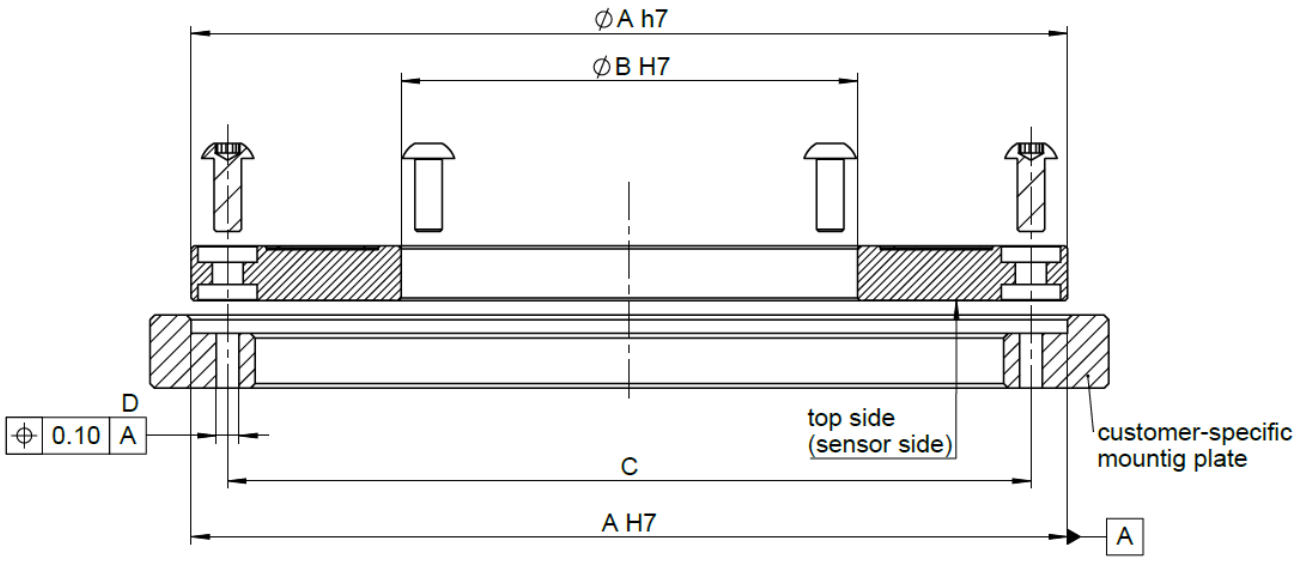



Fig.4.3.: Stator (GAS) mounting using OD sliding fit

| GAS-xxx | A | B | C | D |
|---|---|---|---|---|
| 096 | ø96 | ø50 | ø88 | 6 x M3 (6 x 60°) |
| 160 | ø160 | ø110 | ø121.50 | 6 x M4 (6 x 60°) |
| 180 | ø180 | ø130 | ø169 | 6 x M4 (6 x 60°) |
| 250 | ø250 | ø200 | ø239 | 8 x M4 (8 x 45°) |

Dimensions are in mm.

It is advisable to utilize a medium-strength screw retainer for a secure mounting. The installation of the GMI Angle Stator (GAS) must be adapted to suit its specific application. The customer-specific mounting plate is for illustrative purposes only.

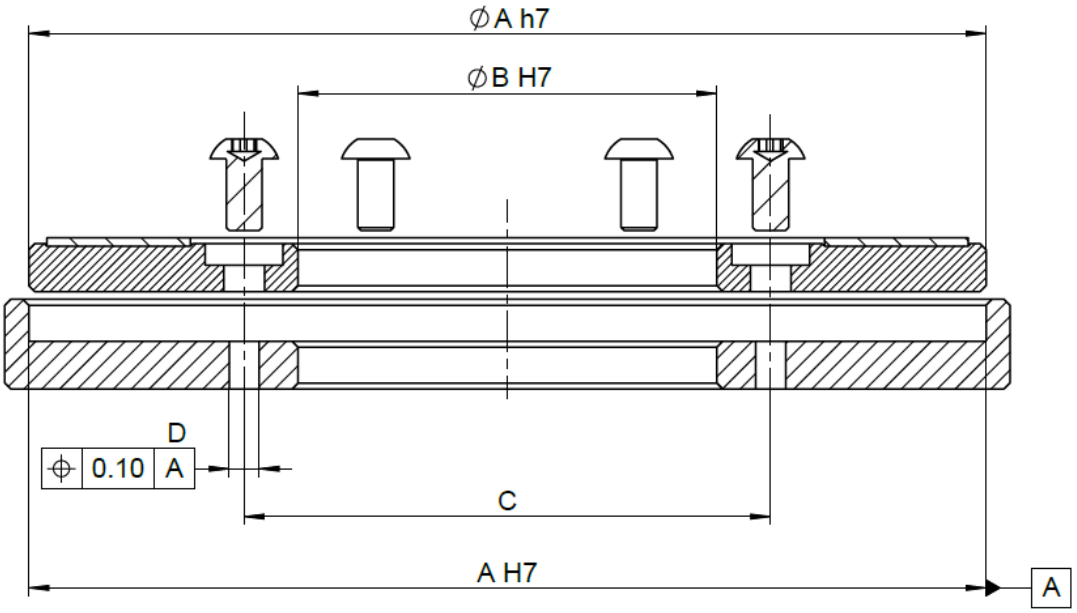



Fig.4.3.: Rotor (GAR) mounting using OD sliding fit

| GAR-xxx | A | B | C | D |
|---|---|---|---|---|
| 096 | ø80 | ø35 | ø44 | 6 x M3 (6 x 60°) |
| 160 | ø160 | ø110 | ø121.50 | 6 x M4 (6 x 60°) |
| 180 | ø160 | ø110 | ø121.50 | 6 x M4 (6 x 60°) |
| 250 | ø230 | ø180 | ø191.50 | 8 x M4 (8 x 45°) |

Dimensions are in mm.

It is advisable to utilize a medium-strength screw retainer for a secure mounting. The installation of the GMI Angle Rotor (GAR) must be adapted to suit its specific application. The customer-specific mounting plate is for illustrative purposes only.

## 4.3. Dowel-Pin mounting

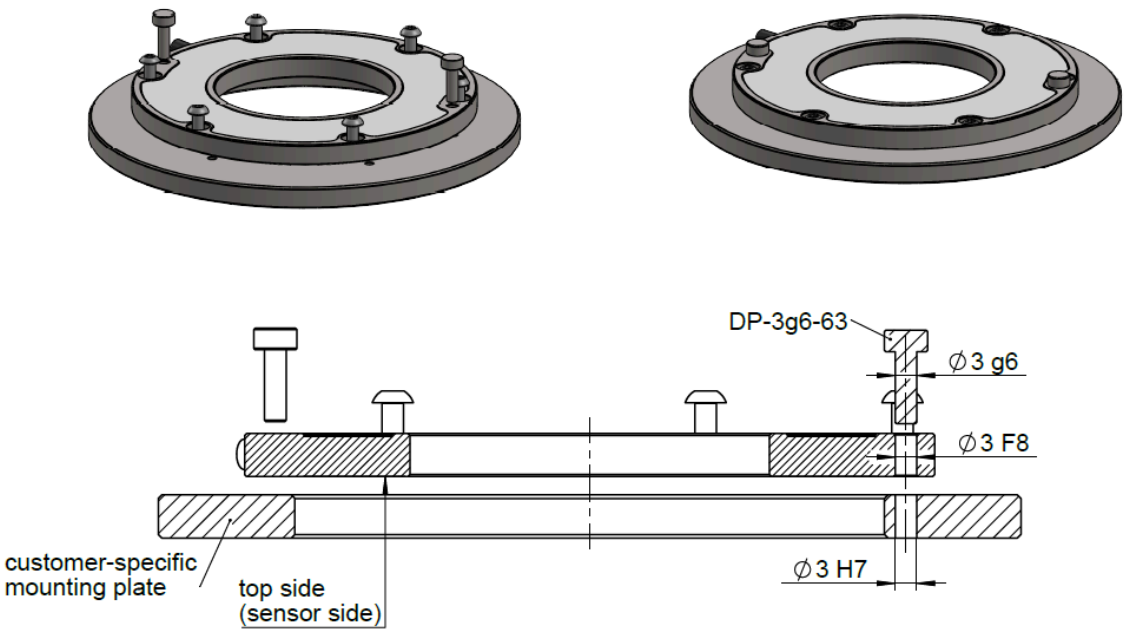



Fig.4.5.: GMI Angle Stator GAS Dowel-Pin mounting

The location of the dowel pin centering holes varies depending on the GMI Angle Stator GAS size. Please refer to Chapter 3 for detailed information.

It is advisable to utilize a medium-strength screw retainer for a secure mounting. The installation of the GMI Angle Stator (GAS) must be adapted to suit its specific application. The customer-specific mounting plate is for illustrative purposes only.

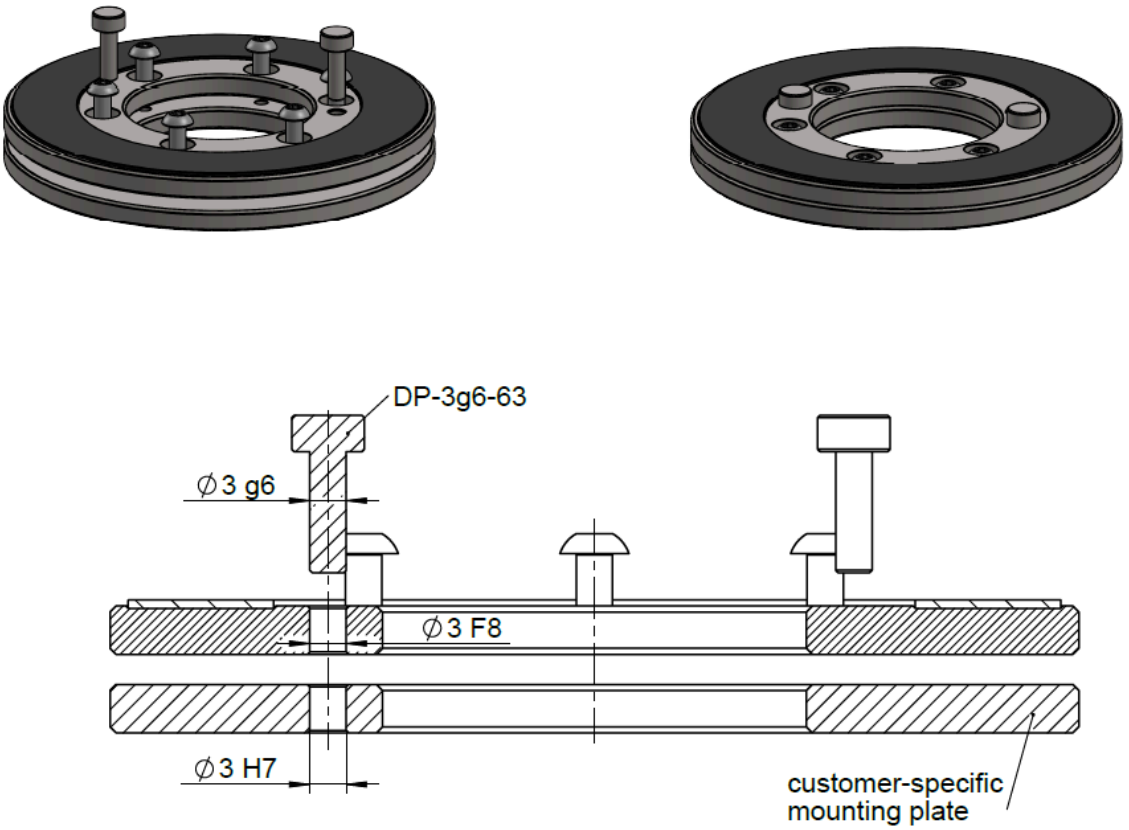



Fig.4.6.: GMI Angle Rotor GAR Dowel-Pin mounting

The location of the dowel pin centering holes varies depending on the GMI Angle Rotor GAR size. Please refer to Chapter 3 for detailed information.

It is advisable to utilize a medium-strength screw retainer for a secure mounting. The installation of the GMI Angle Rotor (GAR) must be adapted to suit its specific application. The customer-specific mounting plate is for illustrative purposes only.

# 5. Interface description

Given the extensive range of interfaces provided for our encoders, we have developed a dedicated resource called the "FLUX Encoders Interface Guide." This document provides a comprehensive and detailed description of all the interfaces. You can download the document from our website at www.flux.gmbh/downloads.

| **Output interfaces** (See ***FLUX Encoders Interface Guide*** for complete description) | |
|---|---|
| Absolute: **BiSS/C** | BIS10, BIS20, BIS21, BIS00 |
| Absolute: **SSI** | SSI00, SSI01, SSI02, SSI03, SSI04 |
| Incremental: **A/B/Z** | INC00, INC01, INC02, INC03 |
| Absolute: **SPI** | *contact FLUX for more details* |
| Absolute: **Asynchronous** | UAT00, UAT10 |
| Other synchronous or asynchronous | *contact FLUX for more details* |

# 6. Commissioning and Debugging

## 6.1. Mounting and commissioning

**GMI-ANGLE** encoders must be mounted in accordance with the mounting tolerances described in Chapter 3. The recommended mounting options are presented in Chapter 4.

The **GMI-ANGLE** encoder requires no calibration or additional commissioning.

As soon as the **GMI-ANGLE** encoders are mounted according to the specifications and powered up, they will provide high accuracy and high resolution positioning over the interface.

## 6.2. Debugging

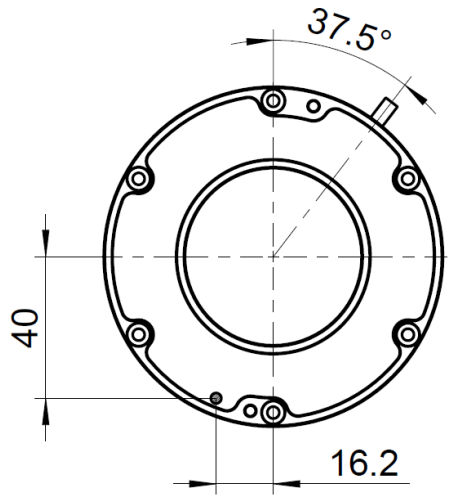
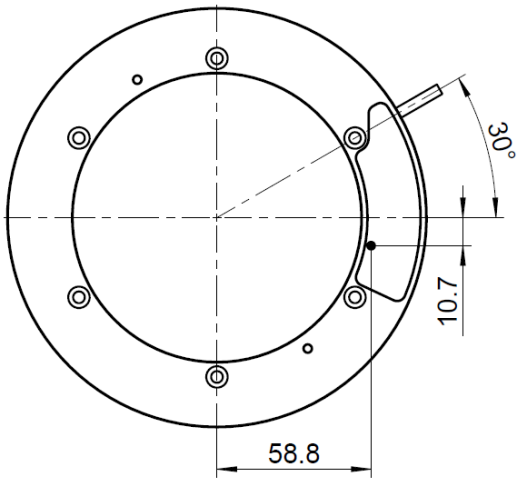
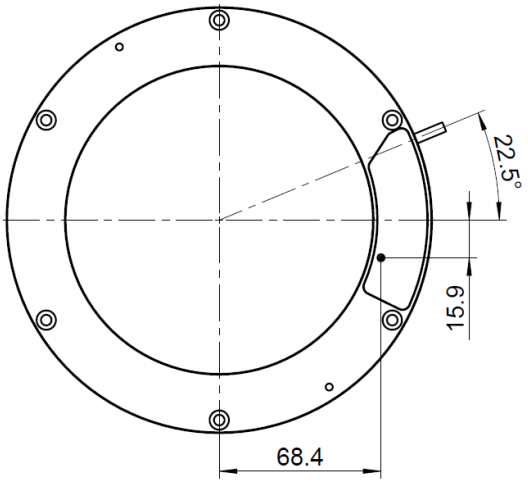
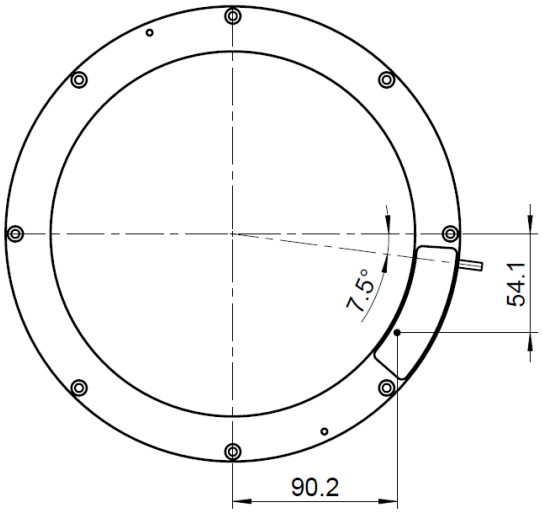
The **GMI-ANGLE** encoders are equipped with a status LED[1].

| LED Color | Status | Recommended actions |
|---|---|---|
| No color | System is not (correctly) Powered-Up. | Check wiring connection to the motion controller |
| **Red Color** | | |
| Continuous | System configuration error | Please contact FLUX |
| Fast blinking[2] | Encoder in error mode | Check encoder mounting |
| Slow blinking[3] | Out of operating range | Check encoder air-gap |
| **Yellow** | | |
| Continuous | Normal operation, but error was detected | Check encoder shielding connection<br>Check encoder mounting |
| **Green** | | |
| Continuous | Optimal performance | |
| Fast blinking[2] | Normal operation, not optimal performance | Check encoder runout |
| Slow blinking[3] | Normal operation, not optimal performance | Check encoder air gap |

[1] The LED's lifespan can significantly diminish when operated under extremely low or high temperatures. Even if the LED ceases to emit light, the encoder's functionality remains unaffected.
[2] Fast blinking ~ 0.4 sec.
[3] Slow blinking ~ 1.6 sec

## 6.3. Status LED position

The **GMI-ANGLE** encoders are equipped with a status LED. Its position for every encoder size is shown in the drawings below.

| **GAS-096** | **GAS-160** |
|---|---|
|  |  |
| **GAS-180** | **GAS-250** |
|  |  |

**NOTE:** The LED is concealed beneath the potting compound but becomes visible when the encoder is supplied with the correct voltage.

# 7. Additional features

## 7.1. Multi-turn position (memory saved)

In **GMI-ANGLE** encoders, the multi-turn position can be automatically saved at power off and restored after powering on. Therefore, even a frameless encoder such as **GMI-ANGLE** can implement a virtual multi-turn function.

The encoder does not have any mechanism for monitoring position changes when it is not powered up, so this function should only be used when movement is either not possible or restricted to less than ± 180° when power is turned off.

Please contact us at office@flux.gmbh for more information.

## 7.32. Setting zero position and counting direction

The GMI-ANGLE encoder allows setting of the zero position and changing of the counting direction.
Over the BiSS-C Interface registers, both functions can be performed.

For more details, please see the full BiSS-C Interface Manual for FLUX Encoders.

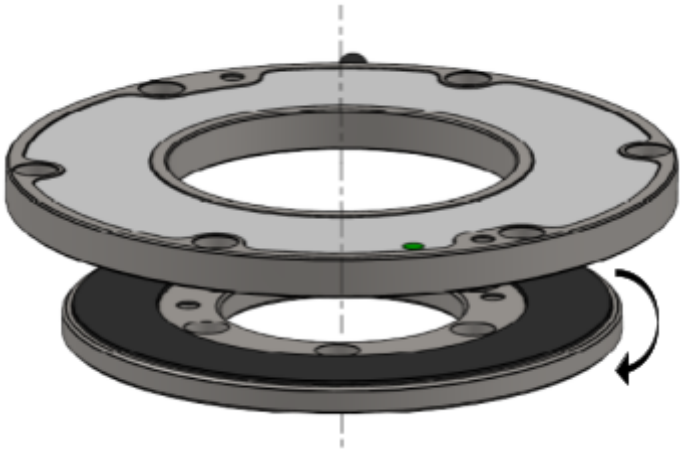


Fig. 7.1.: Visualization of the positive counting direction set by default.

# 8. Cable Specification

## 8.1. Option “K01” - Cable

| | |
|---|---|
| **Type** | Encoder with integrated radial cable output  |
| **Outer jacket** | PUR, suitable for energy chains |
| **Halogen free** | IEC 60332-1-2 |
| **Applicable Standard** | UL - AWM Style 20963 80°C 30V |
| **Temperature rating** | dynamic: -40°C .. +90°C<br>static: -50°C .. +90°C |
| **Wrapping** | 4 x 2 x AWG 30 + 2 x AWG 28, TPE Isolation |
| **Shield** | Tinned copper braided. Coverage ≥ 85% |
| **Outer diameter** | 4.2 ± 0.1mm |
| **Bending radius** | 21 mm single / 42 mm continuous bending |
| **Maximum length** | 6 m |
| **Certification** | The product does not contain any SVHC candidate substances according EU REACH regulation 1907/2006 |

| No. | AWG | Color | SSI & BISS/C | A/B/Z | Comments |
|---|---|---|---|---|---|
| 1 | 28 | violet | Vdd | Vdd | Encoder Supply Voltage |
| 2 | 28 | black | GND | GND | Encoder Power Ground |
| 3 | 30 | white | Sense Line- | A+ | |
| 4 | 30 | braun | Sense Line+ | A- | |
| 5 | 30 | green | *not connected* | B+ | |
| 6 | 30 | yellow | *not connected* | B- | |
| 7 | 30 | grey | SCLK+ | Sense Line+ | |
| 8 | 30 | pink | SCLK- | Sense Line- | |
| 9 | 30 | blue | SDATA+ | Z+ | |
| 10 | 30 | red | SDATA- | Z- | |

## 8.2. Option “K02” - Cable

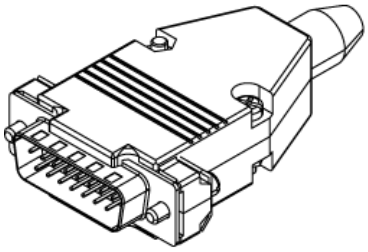
| | |
|---|---|
| **Type** | Encoder with integrated radial cable output  |
| **Recommended for:** | Extended temperature ranges. Highest cable flexibility. |
| **Not applicable for:** | Interfaces: **INCxx (A/B/Z)** |
| **Outer jacket** | Silicone rubber-based |
| **Temperature rating** | dynamic: -25°C .. +180°C<br>static: -60°C .. +180 °C |
| **Wrapping** | 3 x 2 x AWG 30, FEP Isolation |
| **Shield** | Tinned copper braided. Coverage ≥ 95 % |
| **Outer diameter** | 3.3 ± 0.1mm |
| **Bending radius** | 18 mm single / 36 mm continuous bending |
| **Maximum length** | 3 m |
| **Certification** | This product contains following SCHV candidate substances according to EU REACH regulation 1907/2006:<br>*Decamethylcyclopentasiloxane, CAS-No.: 541-02-6 > 0.1%*<br>*Dodecamethylcyclohexasiloxane (D6), CAS-No.: 540-97-6 > 0.1%*<br>*Octamethylcyclotetrasiloxane, CAS-No.: 556-67-2 > 0.1%* |

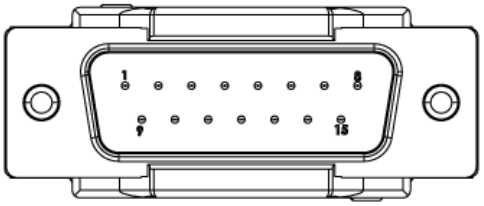
| No. | AWG | Color | SSI & BISS/C | A/B/Z | Comments |
|---|---|---|---|---|---|
| 1 | 30 | red | Vdd | n.a. | Encoder Supply Voltage |
| 2 | 30 | black | GND | | Encoder Power Ground |
| 3 | 30 | grey | SCLK+ | | |
| 4 | 30 | blue | SCLK- | | |
| 5 | 30 | green | SDATA+ | | |
| 6 | 30 | yellow | SDATA- | | |

# 9. Pinout and Wiring

## 9.1. Option “D150”

| | |
|---|---|
| **Connector Type** | DSUB, DB15, Male |
| **Number of Pins** | 15 |

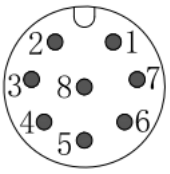





| Pin | K01 - SSI & BISS/C | | K02 - SSI & BISS/C | | K01 - Incremental A/B/Z | |
|---|---|---|---|---|---|---|
| | **Signal** | **Color** | **Signal** | **Color** | **Signal** | **Color** |
| 1 | *not connected* | | *not connected* | | A+ | white |
| 2 | Power Ground | black | Power Ground | black | Power Ground | black |
| 3 | *not connected* | | *not connected* | | B+ | green |
| 4 | Power Supply | violet | Power Supply | red | Power Supply | violet |
| 5 | *not connected* | | *not connected* | | *not connected* | |
| 6 | *not connected* | | *not connected* | | *not connected* | |
| 7 | SDATA- | red | SDATA- | yellow | Z- | red |
| 8 | SCLK+ | grey | SCLK+ | grey | Sense Line+ | grey |
| 9 | *not connected* | | *not connected* | | A- | brown |
| 10 | Sense Line- | white | *not connected* | | *not connected* | |
| 11 | *not connected* | | *not connected* | | B- | yellow |
| 12 | Sense Line+ | brown | *not connected* | | *not connected* | |
| 13 | *not connected* | | *not connected* | | *not connected* | |
| 14 | SDATA+ | blue | SDATA+ | green | Z+ | blue |
| 15 | SCLK- | pink | SCLK- | blue | Sense Line- | pink |

## 9.2. Option “M120”

| | |
|---|---|
| **Connector Type** | M12 coupler, connector, male |
| **Number of Pins** | 8 |




| Pin | K01 - SSI & BISS/C | | K02 - SSI & BISS/C | | K01 - Incremental A/B/Z | |
|---|---|---|---|---|---|---|
| | **Signal** | **Color** | **Signal** | **Color** | **Signal** | **Color** |
| 1 | Sense Line / - | white | *not connected* | | *not available* | |
| 2 | Sense Line / + | brown | *not connected* | | | |
| 3 | SDATA+ | blue | SDATA+ | green | | |
| 4 | SDATA- | red | SDATA- | yellow | | |
| 5 | Power Ground | black | Power Ground | black | | |
| 6 | SCLK- | pink | SCLK- | blue | | |
| 7 | SCLK+ | grey | SCLK+ | grey | | |
| 8 | Power Supply | violet | Power Supply | red | | |

## 9.3. Shield connection

The encoder's housing is connected to the cable shield. It is mandatory to connect the cable shield (and implicitly the housing) to the protection earth of the machine.

Users should exercise caution to ensure effective shielding across the entire machine and prevent any shielding/current loops.

In the case of a stainless steel housing, the surface is electrically conductive. When the stainless steel housing is attached to the machine body, it establishes an electrical connection between the cable shield and the machine body.

# 10. Ordering code

| GMI-ANG | -096 | -22 | -SSI00 | -AV | -K01 | -100 | -DB150 | |
|---|---|---|---|---|---|---|---|---|
| Angle encoder | Diam, [mm] | Resol- [Bits] | Output Interface | Power Supply(1) | Cable Type | Cable length | Connector Type | Optional features |
| | **096** | **19** | **BIS10** | **AV** | **K01** | **050**-0.5 m | **DB150** | See |
| | **160** | **20** | **BIS20** | | **K02** | **100**-1.0 m | **M120** | table |
| | **180** | **21** | **BIS21** | | | **200**-2.0 m | **OW**-Open wires | below |
| | **250** | **22** | **BIS00** | | | **300**-3.0 m | | |
| | | **23** | **SSI00** | | | **400**-4.0 m | | |
| | | **24** | **SSI01** | | | **500**-5.0 m | | |
| | | **25** | **SSI02** | | | | | |
| | | | **SSI03** | | | | | |
| | | | **SSI04** | | | | | |
| | | | **INC00** | | | | | |
| | | | **INC01** | | | | | |
| | | | **INC02** | | | | | |
| | | | **INC03** | | | | | |
| | | | **UAT00** | | | | | |
| | | | **UAT01** | | | | | |

For optional features, please refer to the table provided below. When placing your order, include the desired features' code without using a dash and add them at the end of the ordering code. The standard configuration is represented by a blank entry.

| Additional feature | Letter in order code |
|---|---|
| High Accuracy | C |
| Extended temperature | E |
| Multiturn (memory saved) | M |
| High Speed | S |

Recommended cable selection matrix

| | K01 | K02 |
|---|---|---|
| **Standard temperature range** | | |
| **INCxx Interfaces** | **yes** | no |
| **BiSS Interfaces** | **yes** | no |
| **SSI Interfaces** | **yes** | no |
| **Extended temperature range** | | |
| **INCxx Interfaces** | no | no |
| **BiSS Interfaces** | no | **yes** |
| **SSI Interfaces** | no | **yes** |

BiSS-C selection matrix

| | resolution up to 24 bits | resolution from 25 bits |
|---|---|---|
| **BIS00** | **not recommended** | **not recommended** |
| **BIS10** | **yes** | no |
| **BIS20** | no | **yes** |

# 11. Accessories

## 11.1. Mounting Screws

A set of mounting screws is included with the product.
**NOTE:** The use of a medium-strength screw retainer is recommended for secure mounting.

| GMI-ANG | Stator | Rotor |
|---|---|---|
| **-096** | 6x screws M3x8<br><br>TORX socket button head<br>~ISO 7380-1 | 6 x screws M3x6<br><br>TORX socket button head<br>~ISO 7380-1 |
| **-160** | 6 x screws M4x8<br><br>TORX socket button head<br>~ISO 7380-1 | 6 x screws M4x6<br><br>TORX socket button head<br>~ISO 7380-1 |
| **-180** | 6 x screws M4x8<br><br>TORX socket button head<br>~ISO 7380-1 | 6 x screws M4x6<br><br>TORX socket button head<br>~ISO 7380-1 |
| **-250** | 8 x screws M4x8<br><br>TORX socket button head<br>~ISO 7380-1 | 8 x screws M4x6<br><br>TORX socket button head<br>~ISO 7380-1 |

## 11.2. Dowel Pins

| | |
|---|---|
| **FLUX ordering code** | • **DP-3g6-63** |
| **Material** | 1.2210 |
| **Quantity** | pack of 2 pieces |
| **Compatibility** | Fit with any sizes of GMI-ANGLE encoder.<br>See Chapter 3 for dowel pin positions of every size. |

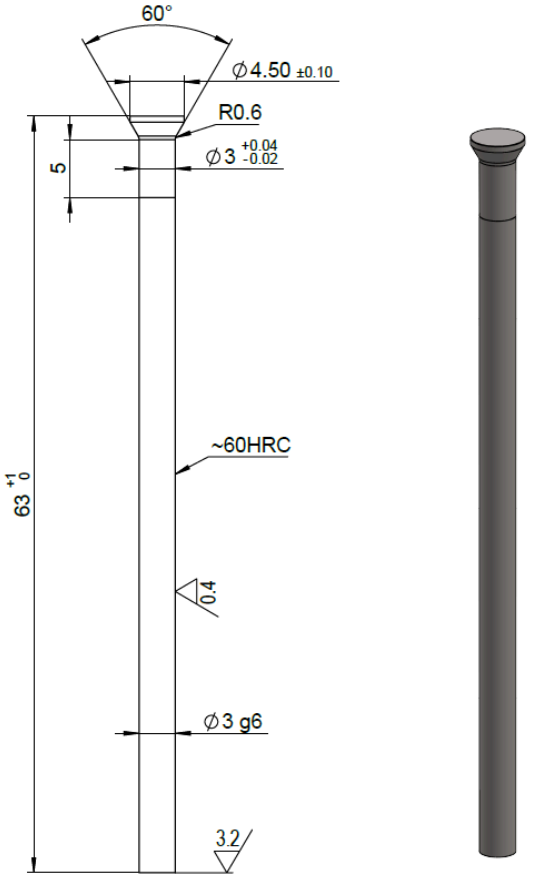



Fig.11.2.: Dowel pin DP-3g6-63 dimensions

# 12. Revision history

| Date | Version | Comments |
|---|---|---|
| 2022-05 | 00 | First built - based on the AMS datasheet |
| 2023-02 | 01 | Drawing Updates. BIS10 and BIS20 added. |
| 2023-04 | 02 | Typo corrected. Pinout and wires cable in 9.2 updated. |
| 2023-06 | 03 | Drawing Updates. Mounting screws added. |
| 2023-11 | 04 | Added: (1) New interfaces, (2) Zero point position, (3) Positive counting direction (4) Shield connection, (5) Power supply AV option<br>Removed: (1) Interface description<br>Updated: (1) Drawings updated. |
| 2024-02 | 05 | Supply voltages option 5V and 24V removed from the ordering code. Not available for new projects.Cable output for 5V vs AV versions defined. |

All technical data is subject to change without notice.

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