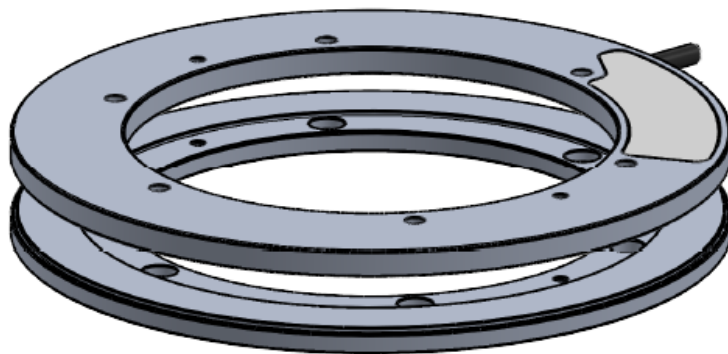


Absolute Rotary Encoder

“IND-MAX”

based on the inductive measuring principle



Technical Datasheet

2023-12 - rev07

www.flux.gmbh

Table of contents:

1. IND-MAX Encoder specifications	3
2. Mechanical dimensions and mounting tolerances	6
2.1. IND-MAX Encoder size 125: IND-MAX-125	6
2.1.1. Stator for IND-MAX-125: IMS-125	7
2.1.2. Rotor for IND-MAX-125: IMR-125	8
2.2. IND-MAX Encoder size 160: IND-MAX-160	9
2.2.1. Stator for IND-MAX-160: IMS-160	10
2.2.2. Rotor for IND-MAX-160: IMR-160	11
2.3. IND MAX Encoder size 180: IND-MAX-180	12
2.3.1. Stator for IND-MAX-180: IMS-180	13
2.3.2. Rotor for IND-MAX-180: IMR-180	14
2.4. IND MAX Encoder Size 250: IND-MAX-250	15
2.4.1. Stator for IND-MAX-250: IMS-250	16
2.4.2. Rotor for IND-MAX-250: IMR-250	17
3. Interface description	18
4. Commissioning and Debugging	19
4.1. Mounting and commissioning	19
4.2. Debugging	19
5. Optional features	20
5.1. Multi-turn position (memory saved)	20
5.2. Setting zero position and counting direction	20
6. Cable Specification	21
6.1. Option "K01" - Cable	21
6.2. Option "K02" - Cable	22
7. Ordering code	23
8. Accessories	25
8.1. Mounting Screws	25
8.2. Dowel Pins	26
9. Revision history	27

1. IND-MAX Encoder specifications

IND-MAX size (OD)		125 mm
System data		
Type		axial, frameless, true absolute, inductive measuring principle
Resolution	Grade B Grade C Grade D Grade E	max. 15 bits max. 17 bits max. 19 bits max. 21 bits
Accuracy (better than)	Grade B Grade C Grade D Grade E	$\pm 0.056^\circ$ $\pm 200''$ $\pm 960 \mu\text{rad}$ $\pm 0.028^\circ$ $\pm 100''$ $\pm 480 \mu\text{rad}$ $\pm 0.014^\circ$ $\pm 50''$ $\pm 240 \mu\text{rad}$ $\pm 0.007^\circ$ $\pm 25''$ $\pm 120 \mu\text{rad}$

IND-MAX size (OD)		160 mm	180 mm	250 mm
System data				
Type		axial, frameless, true absolute, inductive measuring principle		
Resolution	Grade B Grade C Grade D Grade E Grade F Grade G	max. 16 bits max. 18 bits max. 20 bits max. 22 bits		max. 18 bits max. 20 bits max. 22 bits max. 23 bits max. 23 bits
Accuracy (better than)	Grade B Grade C Grade D Grade E Grade F Grade G	$\pm 0.040^\circ$ $\pm 144''$ $\pm 700 \mu\text{rad}$ $\pm 0.020^\circ$ $\pm 72''$ $\pm 350 \mu\text{rad}$ $\pm 0.010^\circ$ $\pm 36''$ $\pm 175 \mu\text{rad}$ $\pm 0.005^\circ$ $\pm 18''$ $\pm 90 \mu\text{rad}$		$\pm 0.020^\circ$ $\pm 72''$ $\pm 350 \mu\text{rad}$ $\pm 0.010^\circ$ $\pm 36''$ $\pm 175 \mu\text{rad}$ $\pm 0.005^\circ$ $\pm 18''$ $\pm 90 \mu\text{rad}$ $\pm 0.003^\circ$ $\pm 11''$ $\pm 48 \mu\text{rad}$ $\pm 0.002^\circ$ $\pm 7''$ $\pm 35 \mu\text{rad}$
Hysteresis		none		
Repeatability		1 resolution count		
Position update rate and signal latency		Real-time		
Standard maximum speed		6'000 rpm (<i>higher on request</i>)		

Electrical data	
Supply voltage (at encoder connector)	min. 4.35 Vdc. max. 36 Vdc
Reverse polarity protection	Yes
Current Consumption (w/o output terminations)	max. 150 mA @ 5 Vdc max. 50 mA @ 24 Vdc

IND-MAX size (OD)	125 mm	160 mm	180 mm	250 mm
Mechanical Data				
Stator base material	Anodized aluminum CTE ~ 24 ppm/°C			
Stator weight⁽¹⁾	140 g	180 g	200 g	275 g
Rotor base material	Anodized aluminum CTE ~ 24 ppm/°C			
Rotor weight⁽¹⁾	80 g	110 g	110 g	165 g
Shock	200 g, 6 ms			
Vibration	20 g, 55 .. 2000 Hz			

⁽¹⁾ Guiding values, without cable

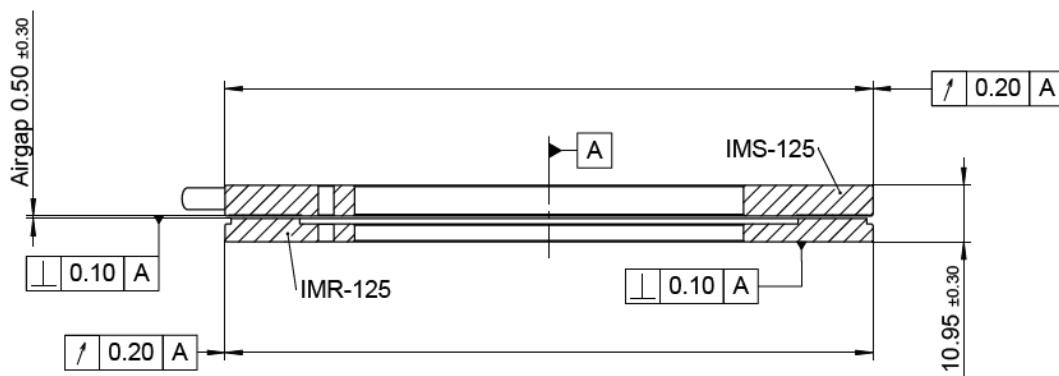
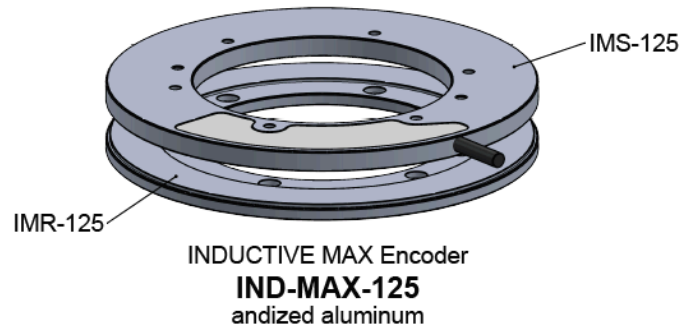
Mounting tolerances	
Nominal Axial Air-Gap	For grades B / C / D / E 0.50 mm For grade F / G 0.35 mm
Functional Range tolerances	
Axial tolerances	0.20 to 0.8 mm
Radial Tolerance	±0.20 mm

Environmental data	
Standard temperature rang	
Operating	-20°C .. +85°C
Storage	-20°C .. +85°C
Extended temperature range: Option "E"	
Operating	-40°C .. +105°C
Storage	-55°C .. +125°C
Ingress Protection	Standard: IP65 Option "W": IP67
Operation pressure	Standard: 0.05 to 7 bars Option "H": 0.05 to 200 bars
EMC immunity	complies with EN IEC 61000-6-2
EMC emission	complies with EN IEC 61000-6-4

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

2. Mechanical dimensions and mounting tolerances

2.1. IND-MAX Encoder size 125: **IND-MAX-125**



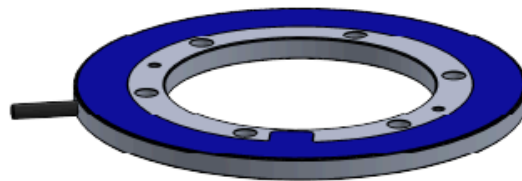
A ... axis of rotation

max. total runout IMR + IMS = 0.20mm $\text{IRMS} \text{ IMR + IMS } 0.20 \text{ A}$

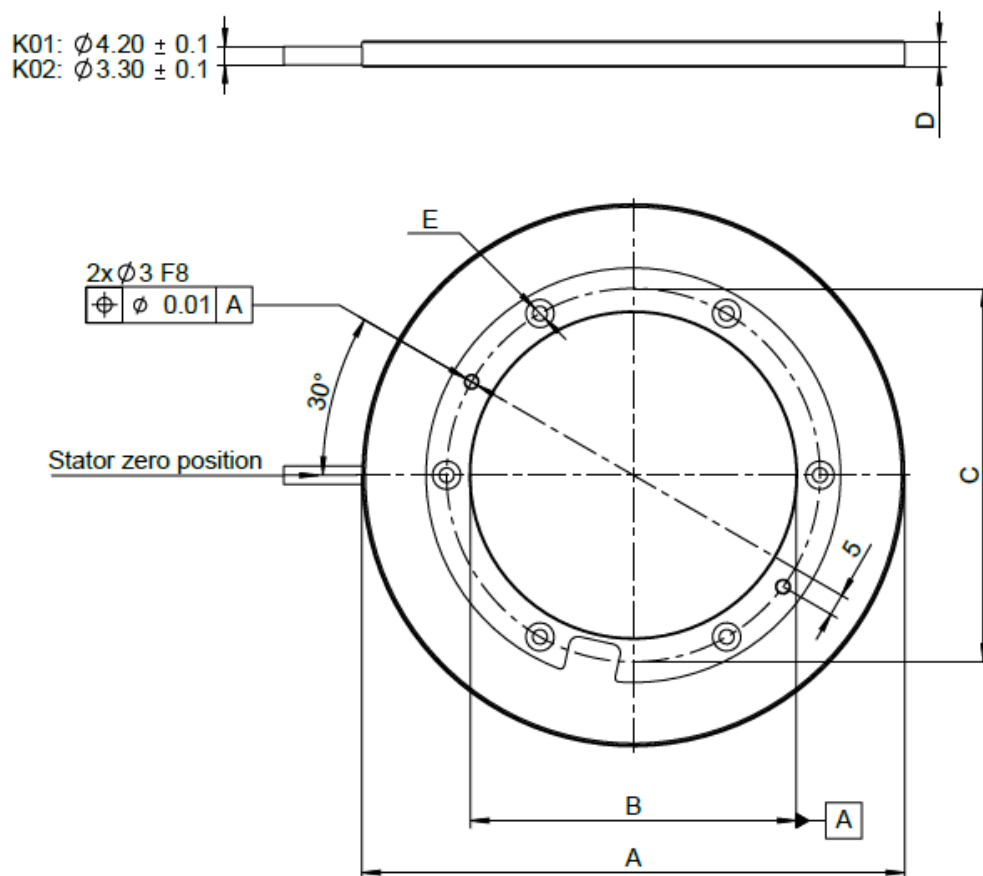
max. total perpendicularity tolerance IMS + IMR = 0.20mm $\text{IMR + IMS } 0.20 \text{ A}$

Dimensions are mm.

2.1.1. Stator for IND-MAX-125: **IMS-125**



Inductive MAX Encoder - Stator
IMS-125
anodized aluminum



Size comparison table. The size 125 mm is highlighted.

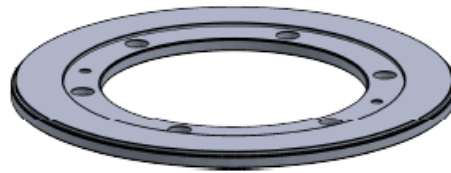
IND-MAX-xxx	A	B	C	D	E
125	$\varnothing 125$ h7	$\varnothing 75$ H7	$\varnothing 86$	5.95 ± 0.05	6 x $\varnothing 3.40$ (6x60°)
160	$\varnothing 160$ h7	$\varnothing 110$ H7	$\varnothing 121.50$	5.95 ± 0.05	6 x $\varnothing 4.50$ (6x60°)
180	$\varnothing 180$ h7	$\varnothing 130$ H7	$\varnothing 169$	5.95 ± 0.05	6 x $\varnothing 4.50$ (6x60°)
250	$\varnothing 250$ h7	$\varnothing 200$ H7	$\varnothing 239$	5.95 ± 0.05	8 x $\varnothing 4.50$ (8x45°)

Dimensions are in mm.

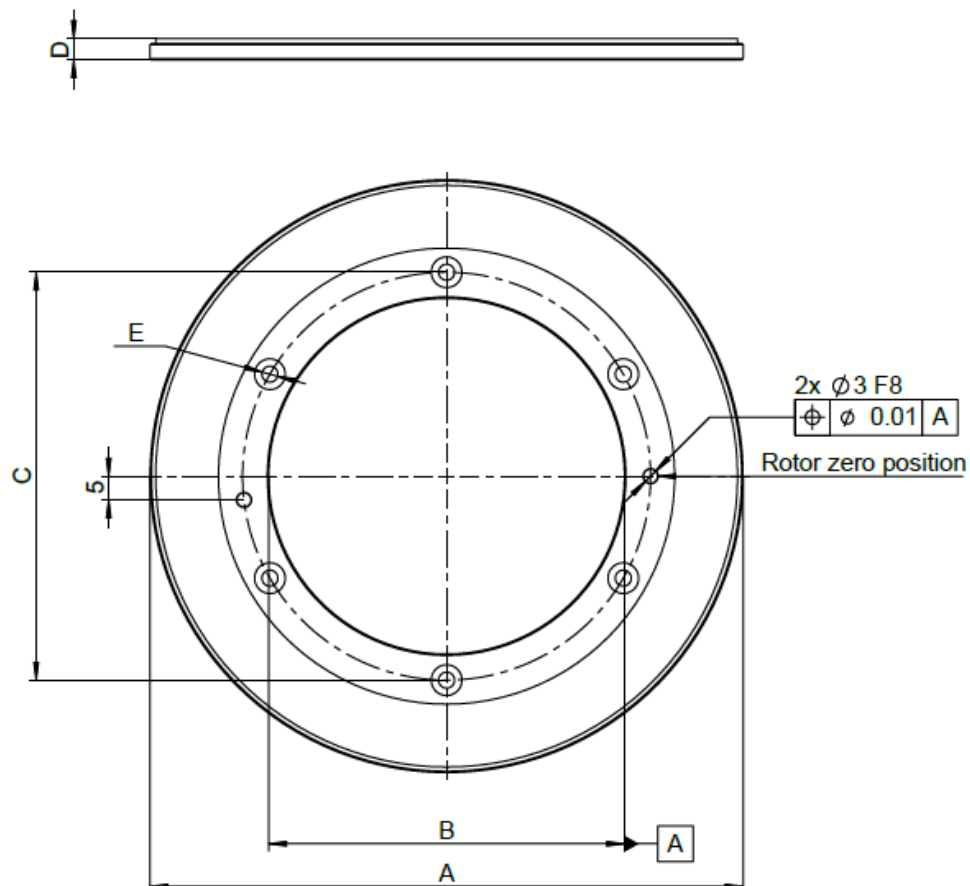
Screw hole dimensions for mounting screws according ISO 7380-1.

A set of mounting screws according to Section 8.1. is included with the product.

2.1.2. Rotor for IND-MAX-125: IMR-125



Inductive MAX Encoder - Rotor
IMR-125
anodized aluminum



Size comparison table. The size 125 mm is highlighted.

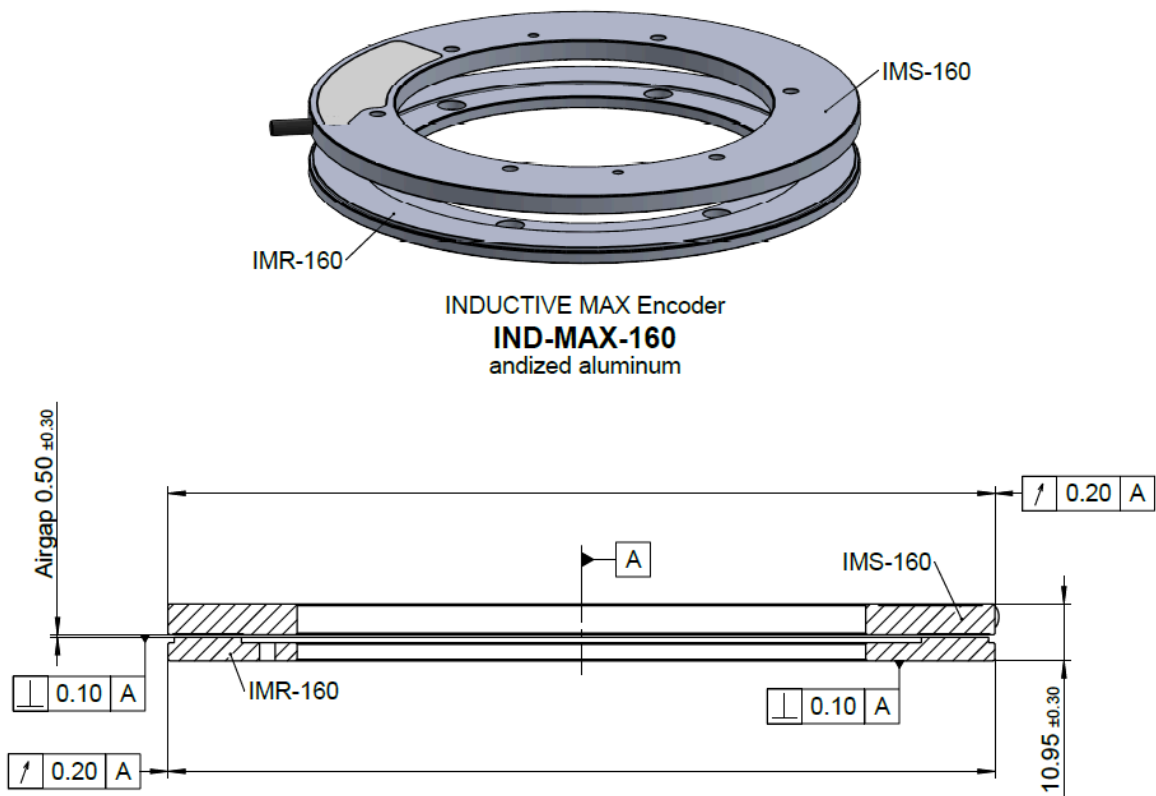
IND-MAX-xxx	A	B	C	D	E
125	$\varnothing 125 \text{ h7}$	$\varnothing 75 \text{ H7}$	$\varnothing 86$	4.50 ± 0.03	$6 \times \varnothing 3.40 \text{ (6x60°)}$
160	$\varnothing 160 \text{ h7}$	$\varnothing 110 \text{ H7}$	$\varnothing 121.50$	4.50 ± 0.03	$6 \times \varnothing 4.50 \text{ (6x60°)}$
180	$\varnothing 160 \text{ h7}$	$\varnothing 110 \text{ H7}$	$\varnothing 121.50$	4.50 ± 0.03	$6 \times \varnothing 4.50 \text{ (6x60°)}$
250	$\varnothing 230 \text{ h7}$	$\varnothing 180 \text{ H7}$	$\varnothing 191.50$	4.50 ± 0.03	$8 \times \varnothing 4.50 \text{ (8x45°)}$

Dimensions are in mm.

Screw hole dimensions for mounting screws according ISO 7380-1.

A set of mounting screws according to Section 8.1. is included with the product.

2.2. IND-MAX Encoder size 160: **IND-MAX-160**



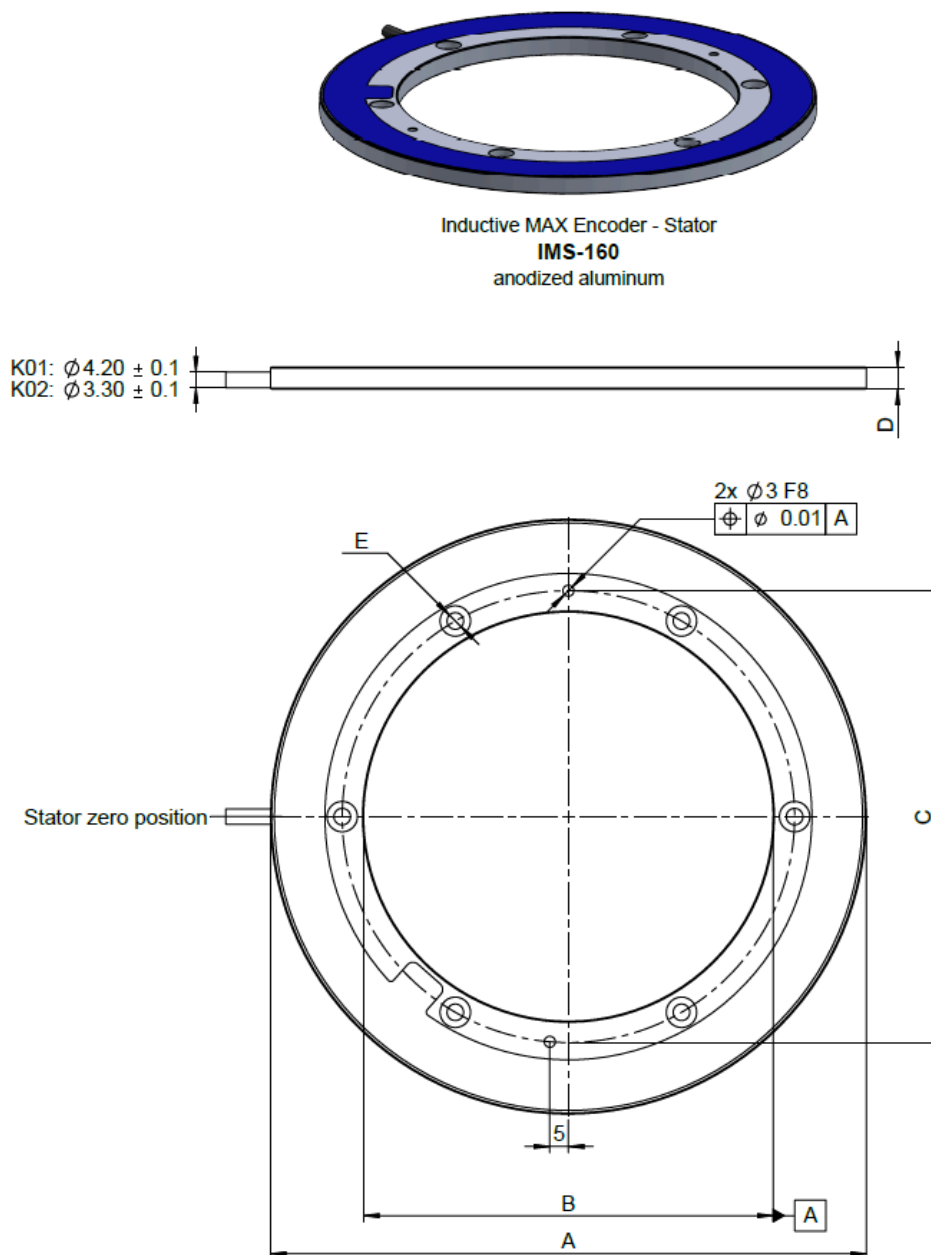
$\textcircled{A}$... axis of rotation

max. total runout IMR + IMS = 0.20mm $\textcircled{f} \text{ IMR + IMS } 0.20 \text{ A}$

max. total perpendicularity tolerance IMS + IMR = 0.20mm $\textcircled{\perp} \text{ IMS + IMR } 0.20 \text{ A}$

Dimensions are mm.

2.2.1. Stator for IND-MAX-160: **IMS-160**



Size comparison table. The size 160 mm is highlighted.

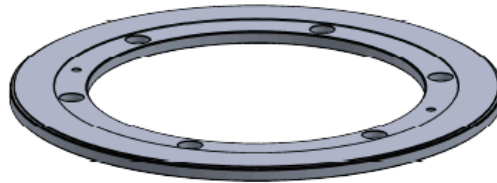
IND-MAX-xxx	A	B	C	D	E
125	$\varnothing 125$ h7	$\varnothing 75$ H7	$\varnothing 86$	5.95 ± 0.05	6 x $\varnothing 3.40$ (6x60°)
160	$\varnothing 160$ h7	$\varnothing 110$ H7	$\varnothing 121.50$	5.95 ± 0.05	6 x $\varnothing 4.50$ (6x60°)
180	$\varnothing 180$ h7	$\varnothing 130$ H7	$\varnothing 169$	5.95 ± 0.05	6 x $\varnothing 4.50$ (6x60°)
250	$\varnothing 250$ h7	$\varnothing 200$ H7	$\varnothing 239$	5.95 ± 0.05	8 x $\varnothing 4.50$ (8x45°)

Dimensions are in mm.

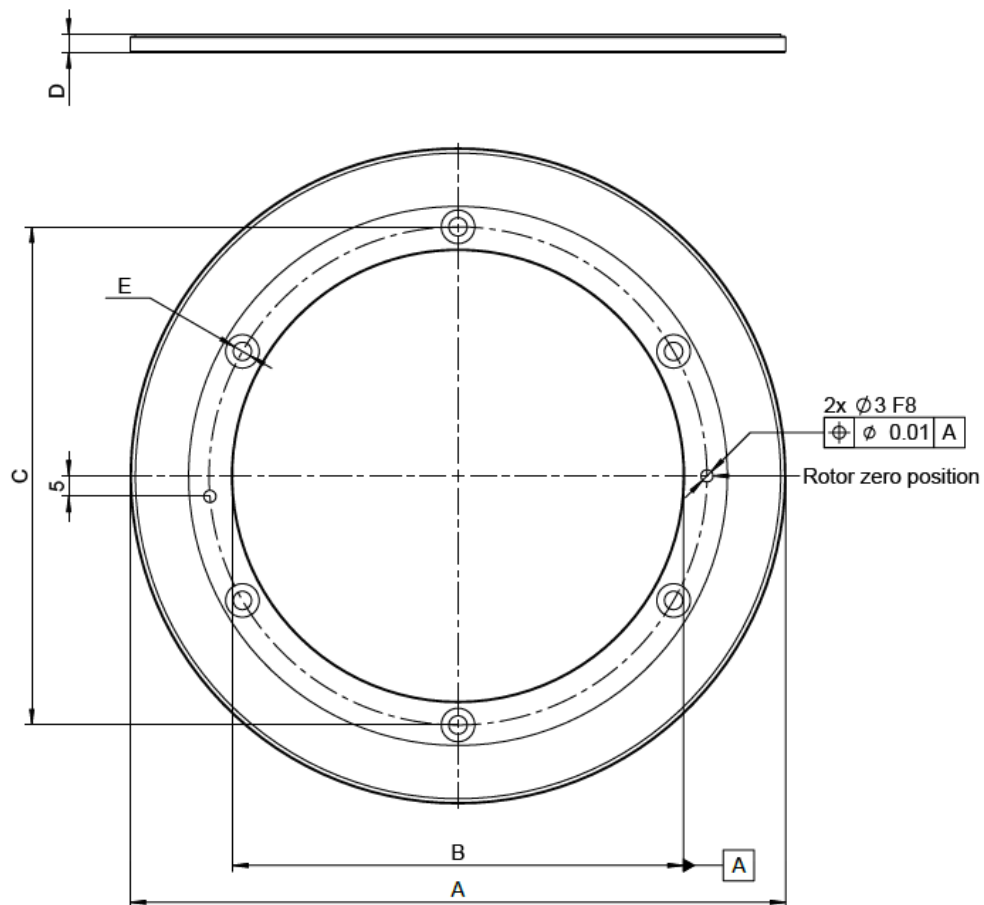
Screw hole dimensions for mounting screws according to ISO 7380-1.

A set of mounting screws according to Section 8.1. is included with the product.

2.2.2. Rotor for IND-MAX-160: **IMR-160**



Inductive MAX Encoder - Rotor
IMR-160
anodized aluminum



Size comparison table. The size 160 mm is highlighted.

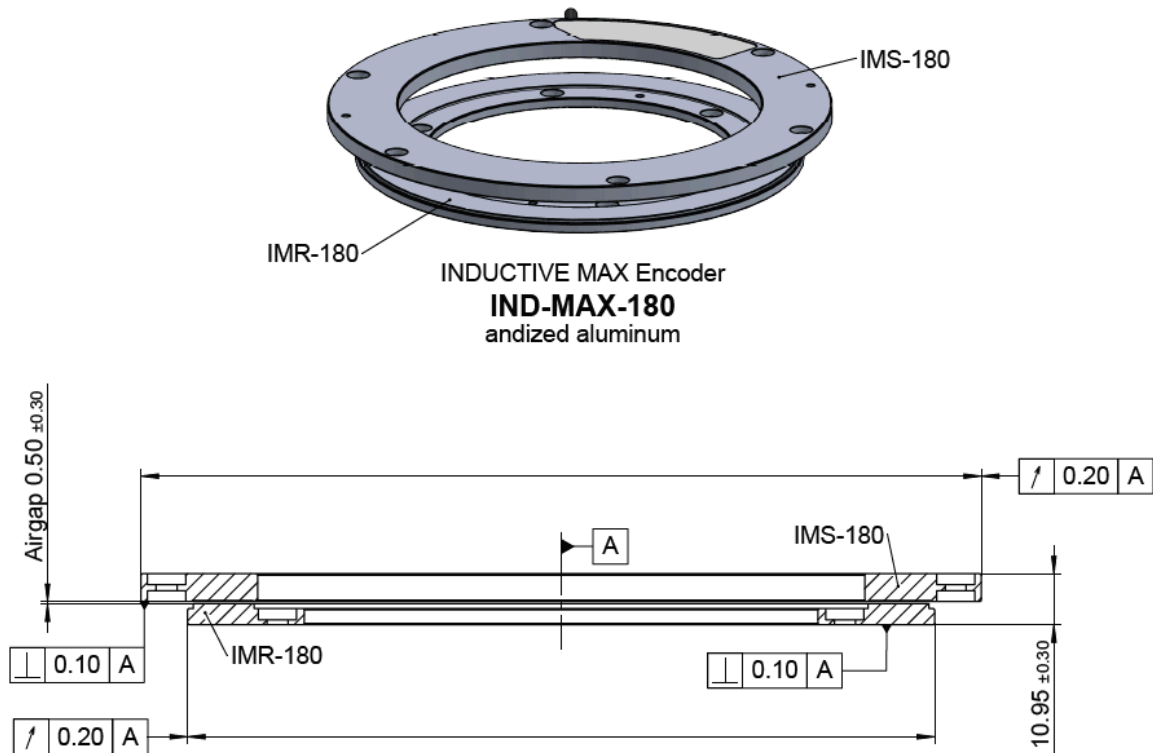
IND-MAX-xxx	A	B	C	D	E
125	ø125 h7	ø75 H7	ø86	4.50 ±0.03	6 x ø3.40 (6x60°)
160	ø160 h7	ø110 H7	ø121.50	4.50 ±0.03	6 x ø4.50 (6x60°)
180	ø160 h7	ø110 H7	ø121.50	4.50 ±0.03	6 x ø4.50 (6x60°)
250	ø230 h7	ø180 H7	ø191.50	4.50 ±0.03	8 x ø4.50 (8x45°)

Dimensions are in mm.

Screw hole dimensions for mounting screws according ISO 7380-1.

A set of mounting screws according to Section 8.1. is included with the product.

2.3. IND MAX Encoder size 180: **IND-MAX-180**



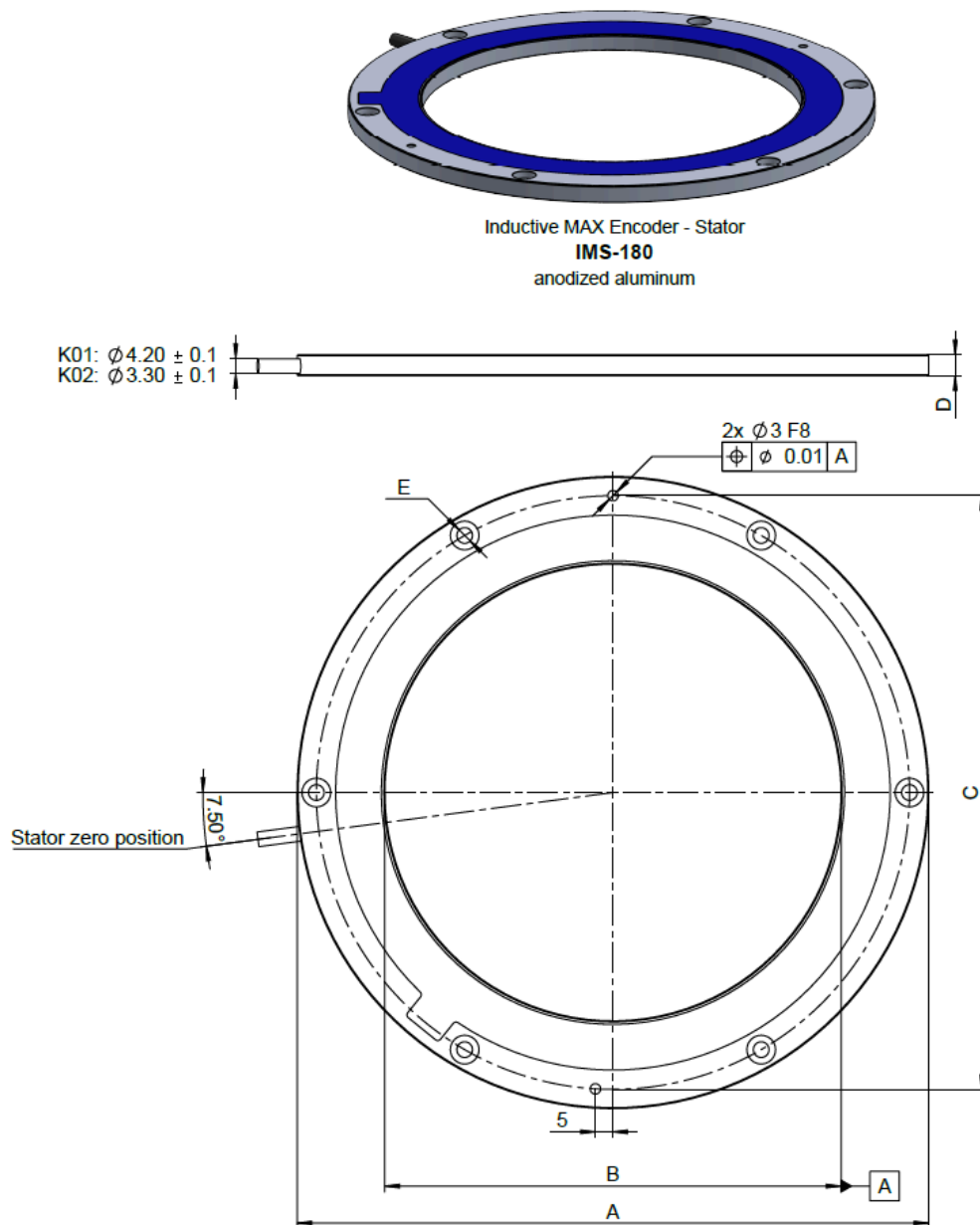
A ... axis of rotation

max. total runout IMR + IMS = 0.20mm $\text{⌀} \text{ 0.20 A}$

max. total perpendicularity tolerance IMS + IMR = 0.20mm $\text{⊥} \text{ 0.20 A}$

Dimensions are mm.

2.3.1. Stator for IND-MAX-180: **IMS-180**



Size comparison table. The size 180 mm is highlighted.

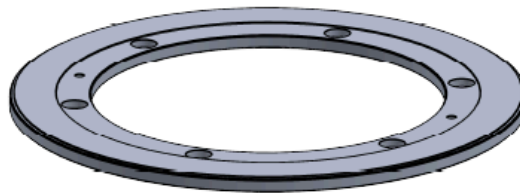
IND-MAX-xxx	A	B	C	D	E
125	$\varnothing 125 h7$	$\varnothing 75 H7$	$\varnothing 86$	5.95 ± 0.05	6 x $\varnothing 3.40$ (6x60°)
160	$\varnothing 160 h7$	$\varnothing 110 H7$	$\varnothing 121.50$	5.95 ± 0.05	6 x $\varnothing 4.50$ (6x60°)
180	$\varnothing 180 h7$	$\varnothing 130 H7$	$\varnothing 169$	5.95 ± 0.05	6 x $\varnothing 4.50$ (6x60°)
250	$\varnothing 250 h7$	$\varnothing 200 H7$	$\varnothing 239$	5.95 ± 0.05	8 x $\varnothing 4.50$ (8x45°)

Dimensions are in mm.

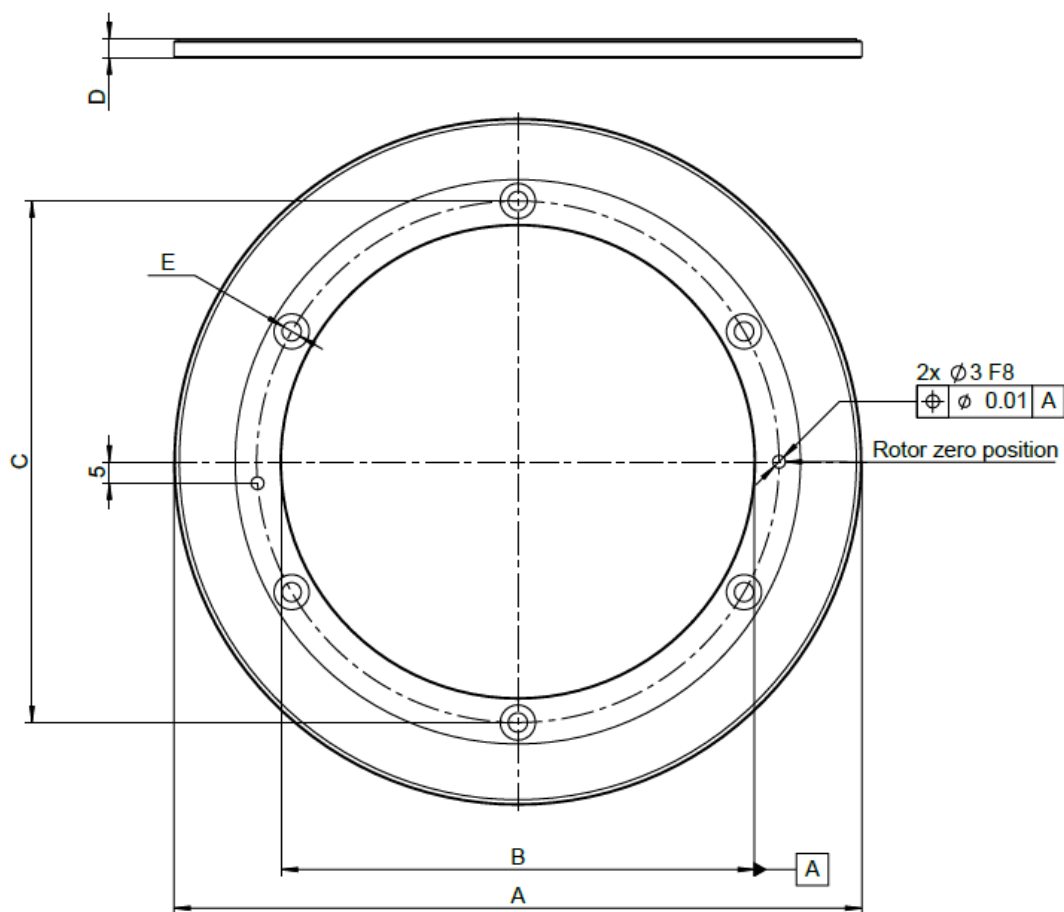
Screw hole dimensions for mounting screws according ISO 7380-1.

A set of mounting screws according to Section 8.1. is included with the product.

2.3.2. Rotor for IND-MAX-180: **IMR-180**



Inductive MAX Encoder - Rotor
IMR-180
anodized aluminum



Size comparison table. The size 180 mm is highlighted.

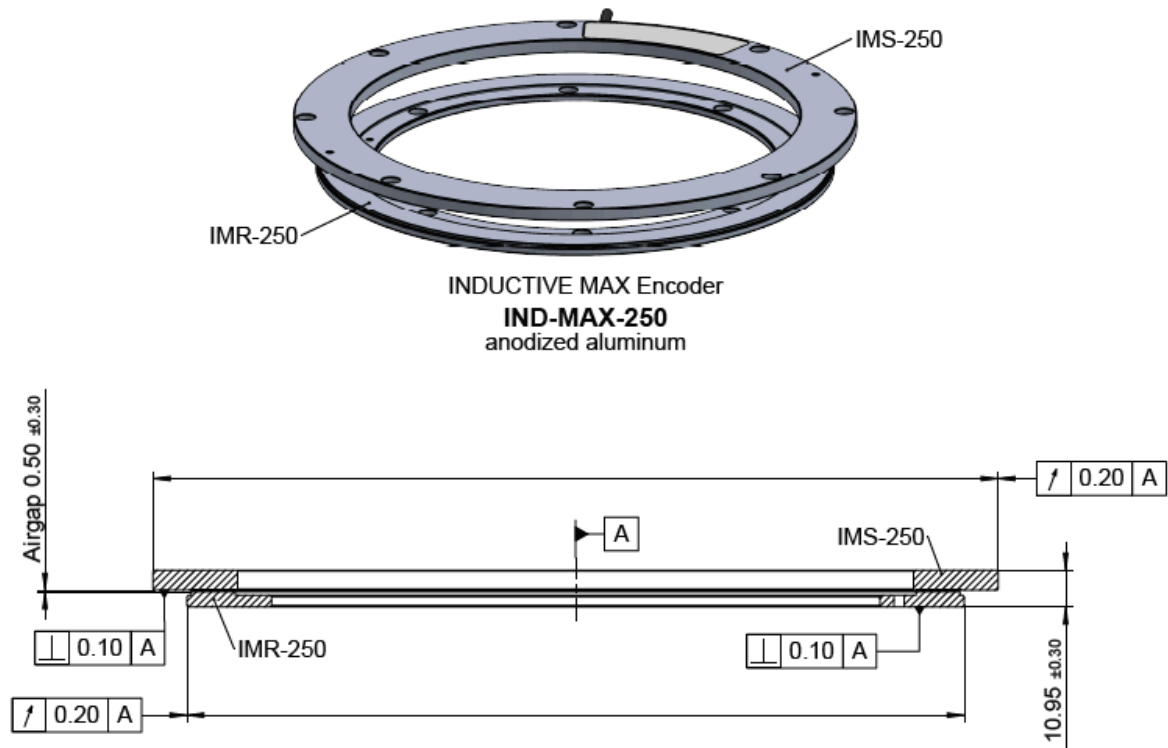
IND-MAX-xxx	A	B	C	D	E
125	Ø125 h7	Ø75 H7	Ø86	4.50 ±0.03	6 x Ø3.40 (6x60°)
160	Ø160 h7	Ø110 H7	Ø121.50	4.50 ±0.03	6 x Ø4.50 (6x60°)
180	Ø160 h7	Ø110 H7	Ø121.50	4.50 ±0.03	6 x Ø4.50 (6x60°)
250	Ø230 h7	Ø180 H7	Ø191.50	4.50 ±0.03	8 x Ø4.50 (8x45°)

Dimensions are in mm.

Screw hole dimensions for mounting screws according ISO 7380-1.

A set of mounting screws according to Section 8.1. is included with the product.

2.4. IND MAX Encoder Size 250: **IND-MAX-250**



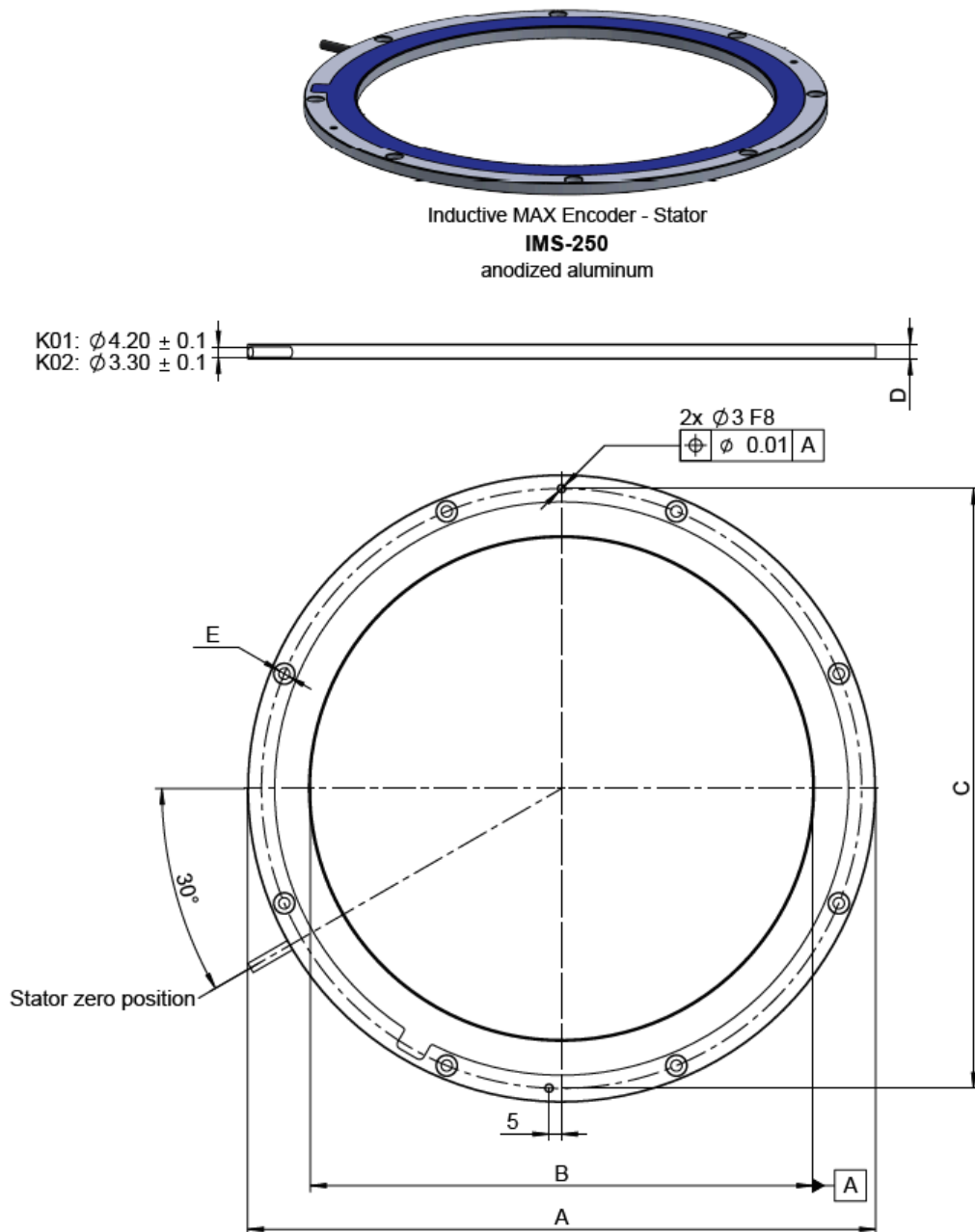
[A] ... axis of rotation

max. total runout IMS + IMR = 0.20mm $\sqrt{\text{IMS} + \text{IMR}} \ 0.20 \ A$

max. total perpendicularity tolerance IMS + IMR = 0.20mm $\perp \text{IMS} + \text{IMR} \ 0.20 \ A$

Dimensions are mm.

2.4.1. Stator for IND-MAX-250: **IMS-250**



Size comparison table. The size 250 mm is highlighted.

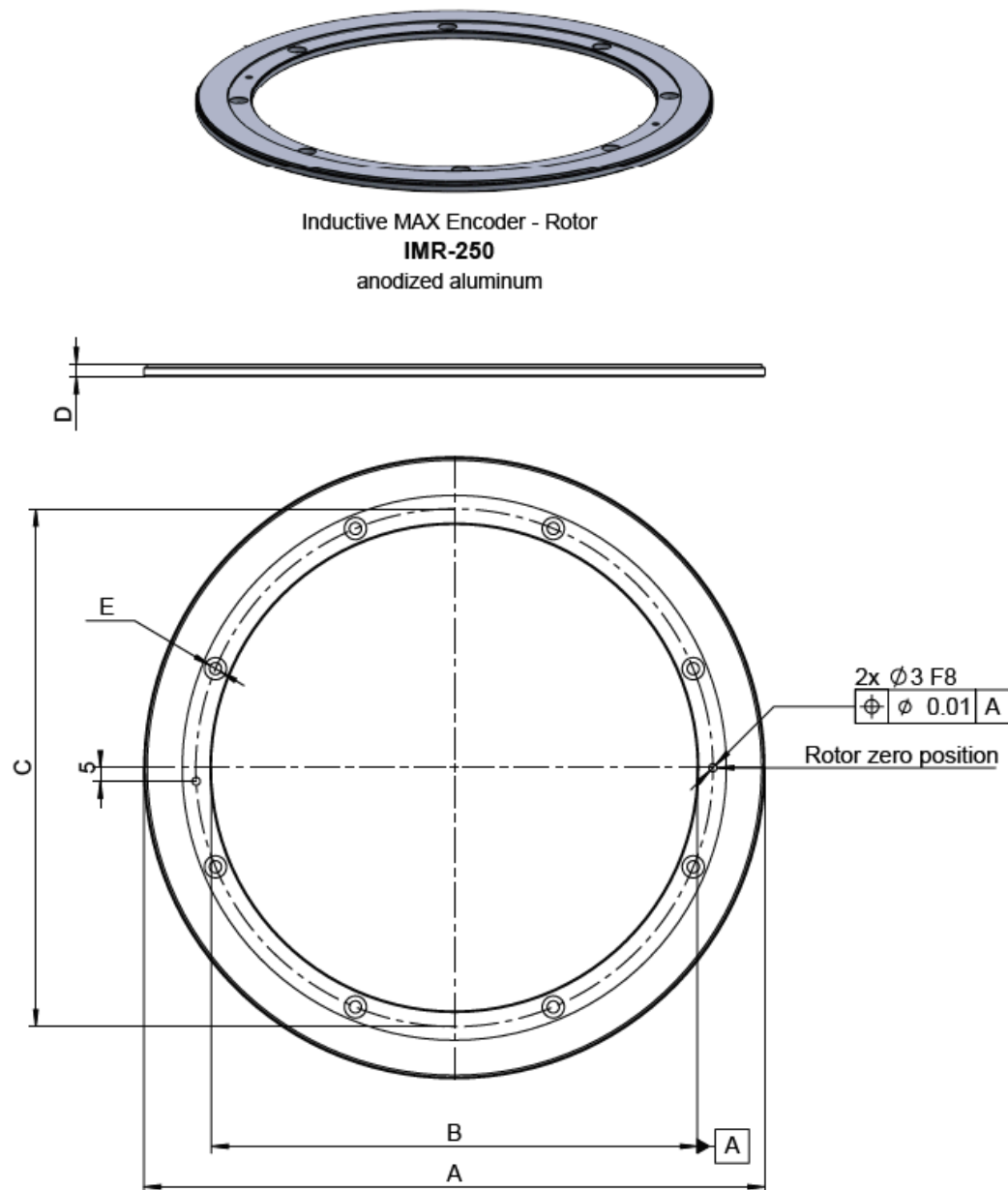
IND-MAX-xxx	A	B	C	D	E
125	$\varnothing 125$ h7	$\varnothing 75$ H7	$\varnothing 86$	5.95 ± 0.05	6 x $\varnothing 3.40$ (6x60°)
160	$\varnothing 160$ h7	$\varnothing 110$ H7	$\varnothing 121.50$	5.95 ± 0.05	6 x $\varnothing 4.50$ (6x60°)
180	$\varnothing 180$ h7	$\varnothing 130$ H7	$\varnothing 169$	5.95 ± 0.05	6 x $\varnothing 4.50$ (6x60°)
250	$\varnothing 250$ h7	$\varnothing 200$ H7	$\varnothing 239$	5.95 ± 0.05	8 x $\varnothing 4.50$ (8x45°)

Dimensions are in mm.

Screw hole dimensions for mounting screws according to ISO 7380-1.

A set of mounting screws according to Section 8.1. is included with the product.

2.4.2. Rotor for IND-MAX-250: **IMR-250**



Size comparison table. The size 250 mm is highlighted.

IND-MAX-xxx	A	B	C	D	E
125	Ø125 h7	Ø75 H7	Ø86	4.50 ±0.03	6 x Ø3.40 (6x60°)
160	Ø160 h7	Ø110 H7	Ø121.50	4.50 ±0.03	6 x Ø4.50 (6x60°)
180	Ø160 h7	Ø110 H7	Ø121.50	4.50 ±0.03	6 x Ø4.50 (6x60°)
250	Ø230 h7	Ø180 H7	Ø191.50	4.50 ±0.03	8 x Ø4.50 (8x45°)

Dimensions are in mm.

Screw hole dimensions for mounting screws according ISO 7380-1.

A set of mounting screws according to Section 8.1. is included with the product.

3. 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 <i>FLUX Encoders Interface Guide</i> 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	<i>contact FLUX for more details</i>
Absolute: Asynchronous	UAT00, UAT10
Other synchronous or asynchronous	<i>contact FLUX for more details</i>

4. Commissioning and Debugging

4.1. Mounting and commissioning

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

The **IND-MAX** encoder requires no calibration or additional commissioning.

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

4.2. Debugging

The **IND-MAX** 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 Check encoder mounting
Green		
Continuous	Optimal performance	
Slow blinking ⁽³⁾	Normal operation, not optimal performance	Check encoder air gap

⁽¹⁾ Except for extended temperature applications. Please contact FLUX for more information.

⁽²⁾ Fast blinking ~ 0.4 sec.

⁽³⁾ Slow blinking ~ 1.6 sec

5. Optional features

5.1. Multi-turn position (memory saved)

In **IND-MAX** encoders, the multi-turn position can be automatically saved at power off and restored after powering on. Therefore, even a frameless encoder such as **IND-MAX** 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 $\pm 180^\circ$ when power is turned off.

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

5.2. Setting zero position and counting direction

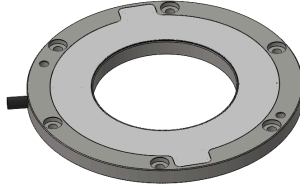
The **IND-MAX** encoder allows setting of the zero position and changing of the counting direction.

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.

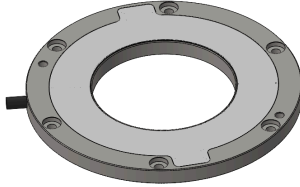
6. Cable Specification

6.1. 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 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	violett	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	<i>not connected</i>	B+	
6	30	yellow	<i>not connected</i>	B-	
7	30	grey	SCLK+	Sense Line+	
8	30	pink	SCLK-	Sense Line-	
9	30	blue	SDATA+	Z+	
10	30	red	SDATA-	Z-	

6.2. 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 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: <i>Decamethylcyclopentasiloxane</i> , CAS-No.: 541-02-6 > 0.1% <i>Dodecamethylcyclohexasiloxane (D6)</i> , CAS-No.: 540-97-6 > 0.1% <i>Octamethylcyclotetrasiloxane</i> , 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-		

7. Ordering code

IND-MAX	-160	-B	-16	-SSI01	-K01	-100	-AL	
MAX encoder	Diameter [mm]	Accuracy Grade	Resolution [Bits/Rev]	Output Interface	Cable Type	Cable length	Material	Other options
	125	B	16	BIS10	K01	050 - 0.5 m	-AL - Alu	See options in table below
	160	C	17	BIS21	K02	100 - 1.0 m		
	180	D	18	SSI00		200 - 2.0 m		
	250	E	19	SSI01		300 - 3.0 m		
		F	20	SSI02		400 - 4.0 m		
		G	21	SSI03		500 - 5.0 m		
			22	SSI04		600 - 6.0 m		
			23	INC00				
				INC01				
				INC02				
				INC03				
				UAT00				
				UAT10				

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.

No.	Additional feature	Letter in order code
1	Extended temperature	E
2	IP67	W
3	High Pressure	H
4	Multiturn (memory saved)	M
5	High Speed	S

Cable selection matrix

	K01	K02
Interface		
INCxx Interfaces	yes	no
BiSS Interfaces	yes	yes
SSI Interfaces	yes	yes
Temperature range		
Minimum static	-50°C	-60°C
Minimum dynamic	-40°C	-25°C
Maximum	90°C	180°C

8. Accessories

8.1. Mounting Screws

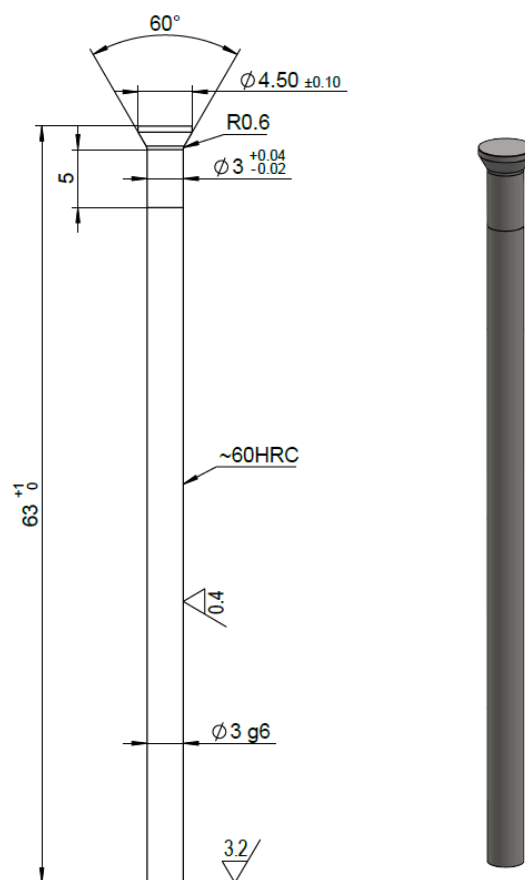
A set of mounting screws is included with the product.

NOTE: The use of a medium-strength screw retainer is recommended for secure mounting.

IND-MAX	Stator	Rotor
-125	6 x screws M3x8 TORX socket button head ~ISO 7380-1	6 x screws M3x6 TORX socket button head ~ISO 7380-1
-160	6 x screws M4x8 TORX socket button head ~ISO 7380-1	6 x screws M4x6 TORX socket button head ~ISO 7380-1
-180	6 x screws M4x8 TORX socket button head ~ISO 7380-1	6 x screws M4x6 TORX socket button head ~ISO 7380-1
-250	8 x screws M4x8 TORX socket button head ~ISO 7380-1	8 x screws M4x6 TORX socket button head ~ISO 7380-1

8.2. Dowel Pins

FLUX ordering code	• DP-3g6-63
Material	1.2210
Quantity	pack of 2 pieces
Compatibility	With any size of GMI-ANGLE encoder and stator See chapter 3. for dowel pin positions



Dowel pin DP-3g6-63 dimensions

9. Revision history

Date	Version	Comments
2023-02	00	First built
2023-05	01	Size 160 added. Interfaces updated.
2023-05	02	24V power supply option added
2023-06	03	Drawing update with dowel pins + Accessories added
2023-07	04	Dimension updates + Sizes 250 added
2023-08	05	Drawing updates on IMR-160 / IMR-180 / IMR-250
2023-10	06	Power supply upgraded to 4.35V to 32V. Options 5V and 24V removed
2023-12	07	IND-MAX with size 125mm added.

All technical data is subject to change without notice.



FLUX GmbH
Bahnhofstrasse 32
5280 Braunau am Inn, Austria
Tel: +43 7722 20764
office@flux.gmbh