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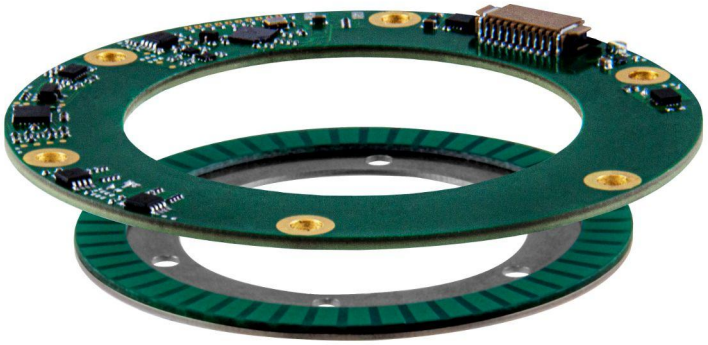
Absolute Rotary Encoder

“INDUCTIVE-ROTARY” Series

based on the

inductive measurement principle



Technical Datasheet

2023-03 - rev.03

www.flux.gmbh

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1. INDUCTIVE-ROTARY Encoders

The **INDUCTIVE-ROTARY** series of rotary encoders from FLUX GmbH offers motor feedback solutions for a wide range of applications, fitting optimally in designs that require precise positioning with exacting velocity and torque control.

The **INDUCTIVE-ROTARY** series of rotary encoders incorporates the FLUX inductive position sensor (patent pending) to deliver high performance feedback as part of a closed loop motion control system.

The 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:

- Precise position feedback
- Hollow shaft implementation
- High positioning accuracy
- High position stability / low noise
- Zero backlash / hysteresis
- Insensitivity to external electrical and magnetic noise
- Low signal latency

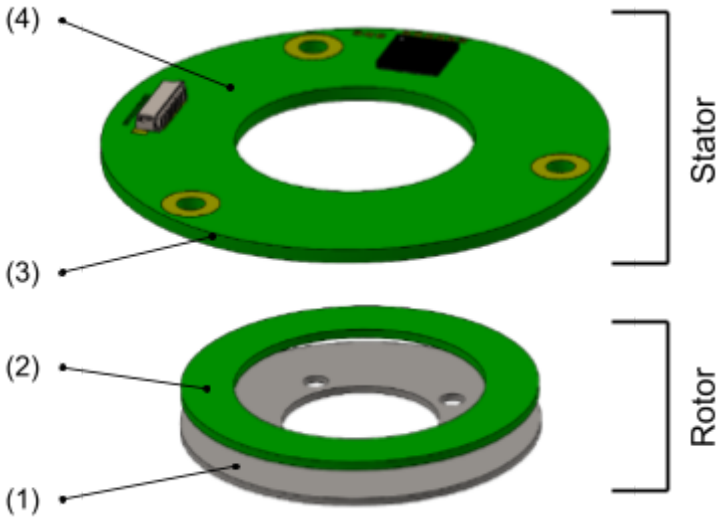
INDUCTIVE-ROTARY series performance achievements:

- Resolution up to 20 bits / revolution
- Accuracy to ± 0.012° (± 45 arc seconds)
- Liberal mounting tolerance; to axial ± 0.30 mm and to radial ± 0.30 mm
- Axial stack-up as small as 8mm including air-gap
- High ratio of inner diameter (through hole) to outer diameter

INDUCTIVE-ROTARY series is the ideal choice for a wide range of applications including:

- semiconductor manufacturing
- cobots and robotics
- satcomm
- medical
- gimbals
- motors (torque, direct drive, servo, DC brushless)
- gearbox integration
- automated guided vehicles (AGV)

1.1. Inductive principle (simplified)



Encoder rotor
(1) Metall carrier
(2) Absolute ring
Encoder stator
(3) Absolute sensor
(4) Evaluation electronic

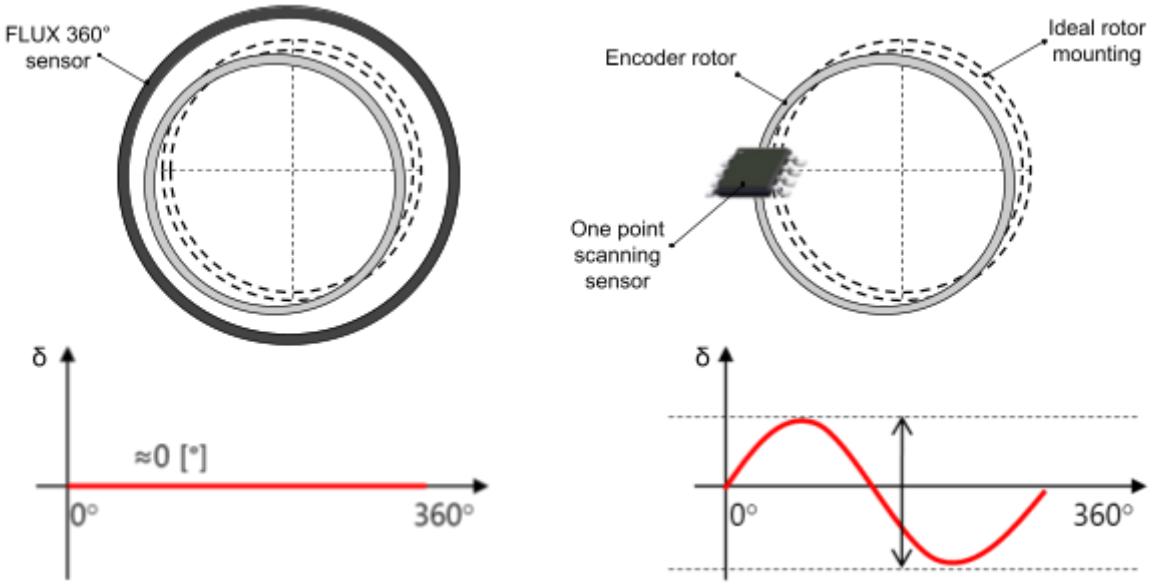
HOW IT WORKS

The absolute inductive sensor (3) scans the variable electrical impedance of the absolute ring (2) and generates an electrical signal. The inductive sensor (3) is connected to the evaluation electronic (4) which converts the electrical signal in digital position. Absolute position is generated through the FLUX built up (patent pending) of the sensor and the pattern of the absolute ring.

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 IND-ROT**	**One-Point**
55 mm	<± 8”	± 75”
69 mm	<± 6”	± 60”
80 mm	<± 6”	± 52”
96 mm	<± 5”	± 43”

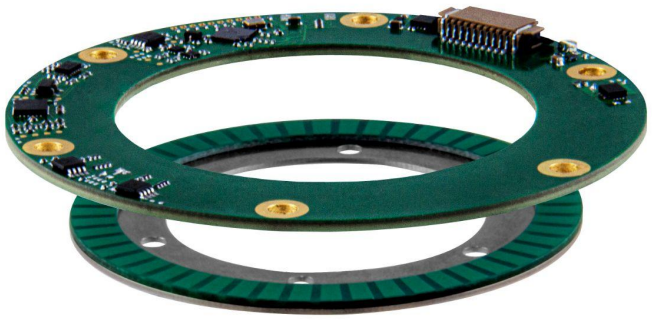
Additional error δ for e = 20 µm		
Diameter *D*	**FLUX IND-ROT**	**One-Point**
55 mm	<± 16”	± 150”
69 mm	<± 12”	± 119”
80 mm	<± 12”	± 103”
96 mm	<± 10”	± 86”

1.3. Environmental and EMC immunity

FLUX inductive rotary encoders offer exceptional immunity to environmental and electromagnetic perturbations.

INDUCTIVE-ROTARY is a very robust encoder for an IP00 rating, not being sensitive to dust or condensation.

2. Encoder Specification



**INDUCTIVE-ROTARY-080 (size 80mm)*

IND-ROTARY size / OD	**55 mm**	**69 mm**	**80 mm**	**96 mm**
System data				
Type	Axial, frameless, true absolute **INDUCTIVE encoder** **INDUCTIVE-ROTARY** - FLUX GmbH (patent pending)			
Maximum Resolution *(non binary on request)*	19 bits		20 bits	
	131’072 ppr (before x4) 524’288 cpr (after x4)		262’144 ppr (before x4) 1’048’576 cpr (after x4)	
Standard accuracy *(no calibration required)*	± 0.025°	± 0.020°	± 0.018°	± 0.012°
	± 90”	± 75”	± 65”	± 45”
	± 450 µrad	± 350 µrad	± 320 µrad	± 210 µrad
Hysteresis	none			
Repeatability	1 count			
Position update rate	Real-time			
Maximum speed	6’000 rpm (higher on request)			
Power-up time	max. 0.8 sec			

Electrical data	
Supply voltage *(at encoder connector)*	**Option 5V:** typ. 5 Vdc Min. 4.35 Vdc. Max. 6 Vdc
Reverse polarity protection	Yes
Current Consumption *(w/o output terminations)*	max. 150 mA @ 5 Vdc (**Option 5V**)

IND-ROTARY size / OD	55 mm	69 mm	80 mm	96 mm
Mechanical Data				
Stator base material	FR4 (CTE ~ 18 ppm/°C)			
Stator weight[(1)]	7 g	9 g	10 g	12 g
Rotor base material	Stainless steel (CTE ~ 10 ppm/°C)			
Rotor weight[(1)]	7 g	12 g	14 g	18 g
Vibration	EN 60068-2-6, 20 g, 55 .. 2000 Hz			
Shock	EN 60068-2-27, 200 g, 6 ms			

(1) Guiding values. Values can vary with the rotor mounting option.

Mounting tolerances	
Nominal Axial Air-Gap	0.5 mm
Axial tolerances	±0.3 mm
Radial Tolerance	±0.3 mm

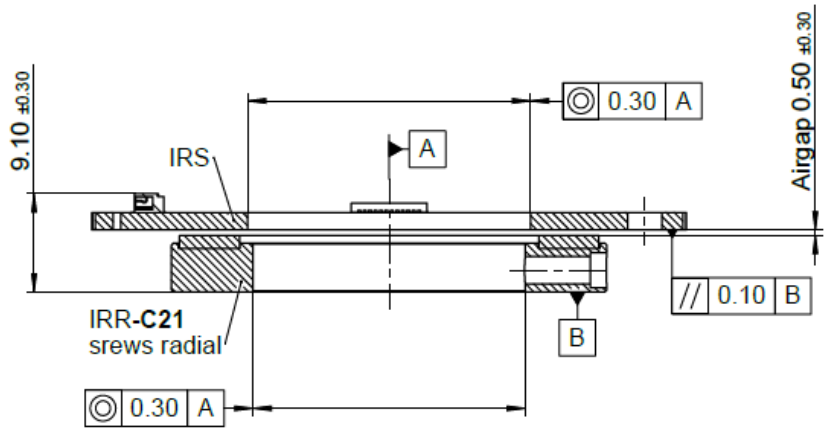
Environmental data	
Temperature range - Standard (*no additional option in order code*)	
Operating	-20°C .. +85°C
Storage	-20°C .. +85°C
Temperature range - Extended (*contact FLUX for more details*)	
Operating	-40°C .. +105°C
Storage	-55°C .. +125°C
Ingress Protection	IP00
EMC immunity	complies with EN IEC 61000-6-2
EMC emission	complies with EN IEC 61000-6-4

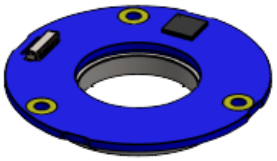
Output interfaces (See Chap.5)	
Absolute: **SSI**	SSI00, SSI01, SSI02
Absolute: **BiSS/C**	BIS00, BIS10 *(recommended for new designs)*
Incremental: **A/B/Z**	INCxx
Absolute: **SPI**	*contact FLUX for more details*
Other synchronous or asynchronous	*contact FLUX for more details*

3. Mechanical dimensions and mounting tolerances

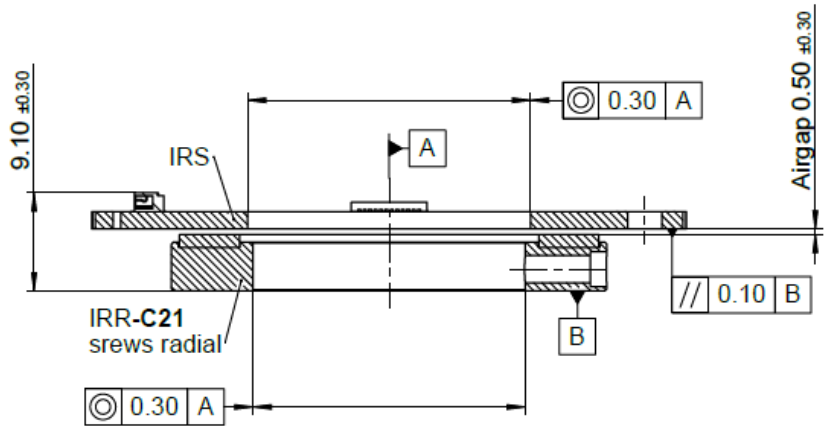
3.1. INDUCTIVE-ROTARY Series - Mounting tolerances

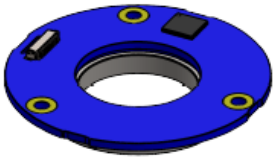
Rotor mounting with screws inside grating (Rotor option "**-A21**"):





Rotor mounting with radial set screws (Rotor option "**-C21**"):

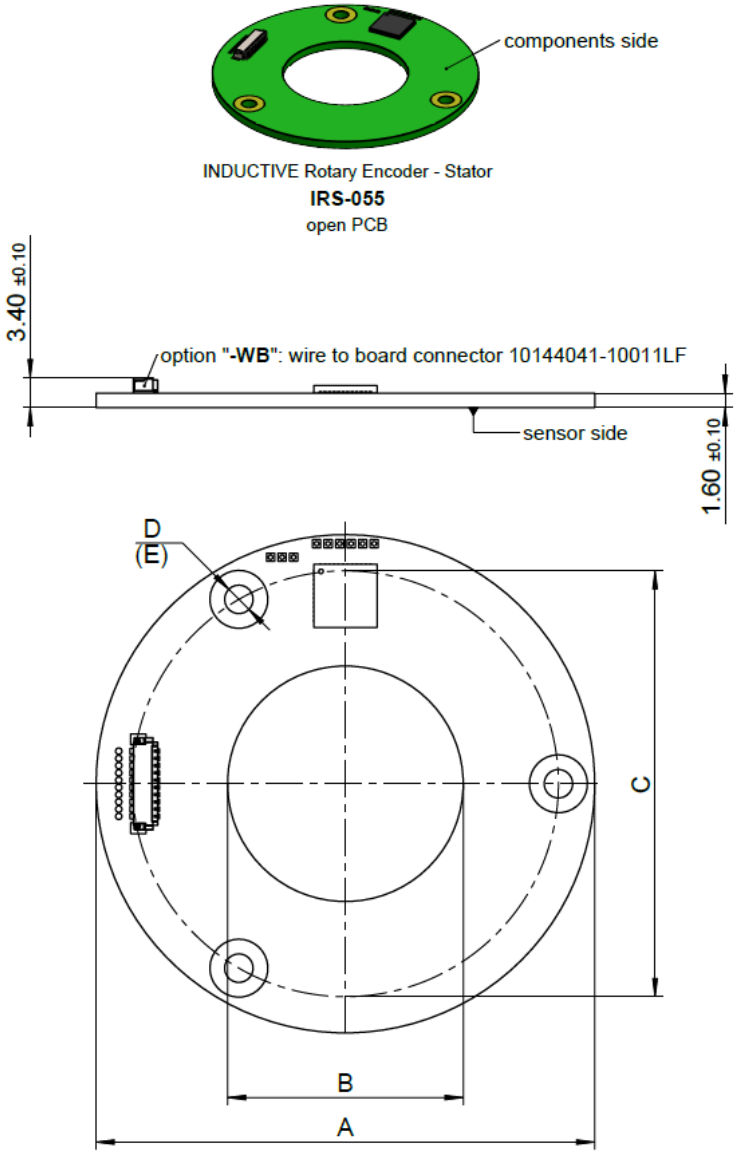




A ... axis of rotation
max. total runout IRS + IRR = 0.30mm | ⌯ | IRS + IRR | 0.30 | A |
Dimensions are mm.

3.2. **I**nductive **R**otary Encoder - **S**tator: **IRS**

3.2.1. Stator for IND-ROT-055: **IRS-055**

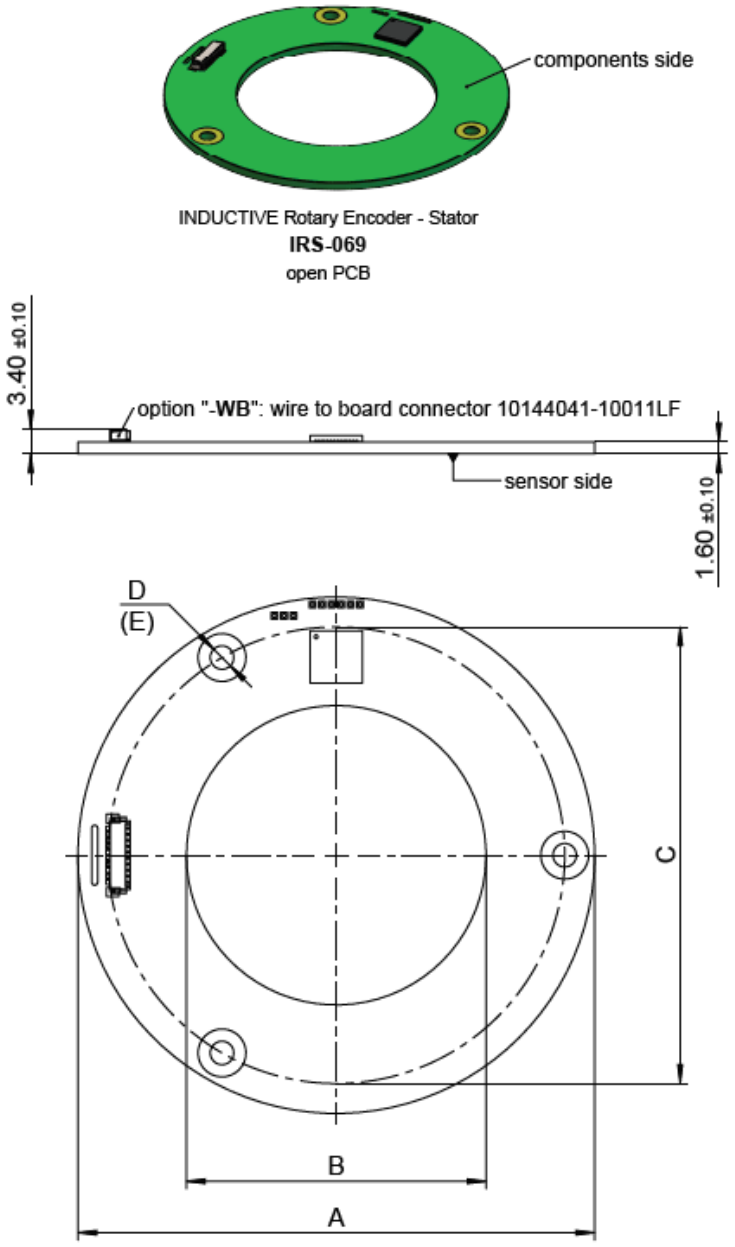


Size comparison table. The 055 mm size is highlighted.

IRS-xxx	A	B	C	D	E
055	**ø55 +0.0 /-0.2**	**ø26 +0.2 /-0.0**	**ø47**	**3 x ø3.20 (120°)**	**M3**
069	ø69 +0.0 /-0.2	ø40+0.2 /-0.0	ø61	3 x ø3.20 (120°)	M3
080	ø80 +0.0 /-0.2	ø51+0.2 /-0.0	ø72	6 x ø3.20 (60°)	M3
096	ø96 +0.0 /-0.2	ø67+0.2 /-0.0	ø88	6 x ø3.20 (60°)	M3

Dimensions are in mm.
Screw hole dimensions for fastener according ISO 7380-1.
E ... screw size

3.2.2. Stator for IND-ROT-069: **IRS-069**

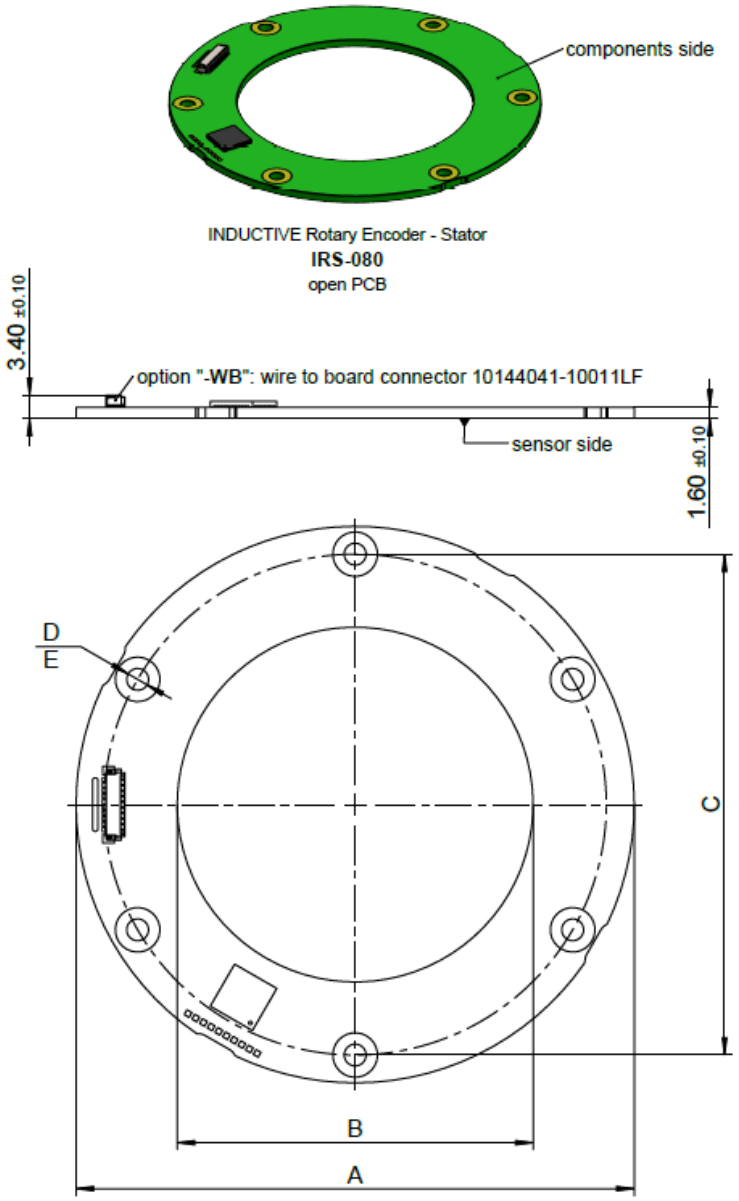


Size comparison table. The 069 mm size is highlighted in blue.

IRS-xxx	A	B	C	D	E
055	ø55 +0.0 /-0.2	ø26 +0.2 /-0.0	ø47	3 x ø3.20 (120°)	M3
069	**ø69 +0.0 /-0.2**	**ø40+0.2 /-0.0**	**ø61**	**3 x ø3.20 (120°)**	**M3**
080	ø80 +0.0 /-0.2	ø51+0.2 /-0.0	ø72	6 x ø3.20 (60°)	M3
096	ø96 +0.0 /-0.2	ø67+0.2 /-0.0	ø88	6 x ø3.20 (60°)	M3

Dimensions are in mm.
Screw hole dimensions for fastener according ISO 7380-1.
E ... screw size

3.2.3. Stator for IND-ROT-080: **IRS-080**

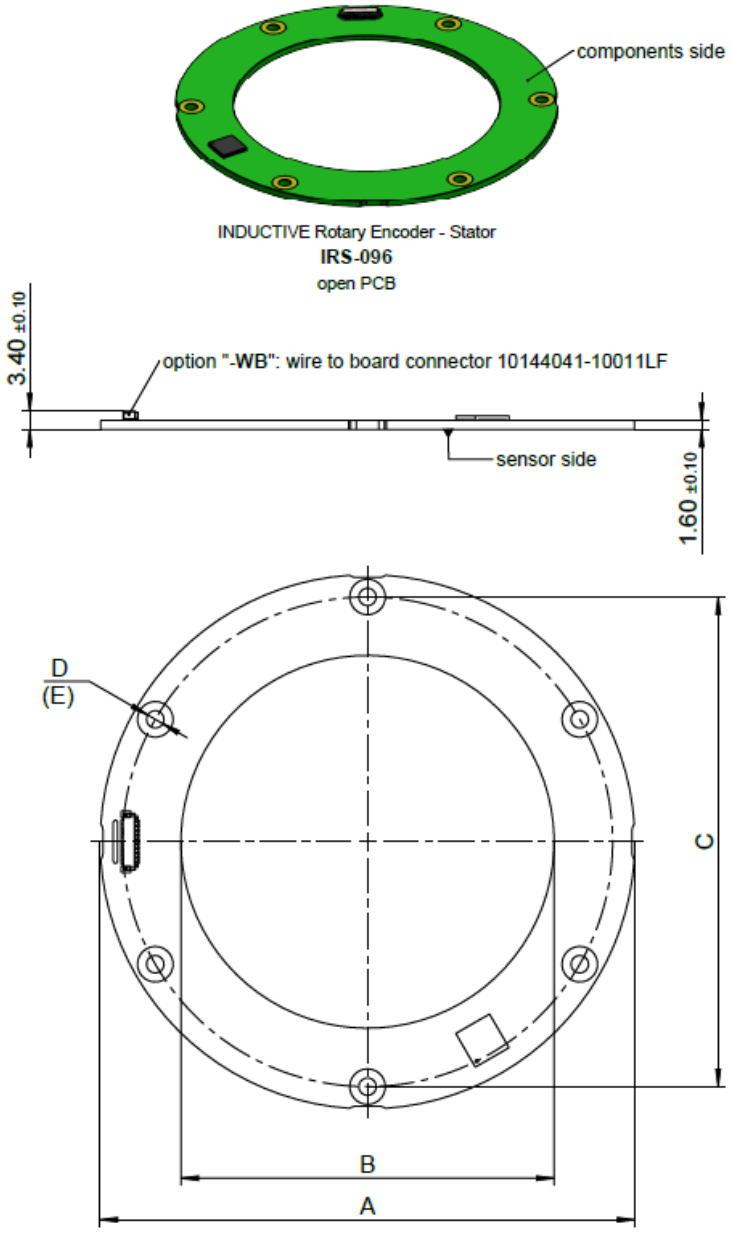


Size comparison table. The 080 mm size is highlighted in blue.

IRS-xxx	A	B	C	D	E
055	ø55 +0.0 /-0.2	ø26 +0.2 /-0.0	ø47	3 x ø3.20 (120°)	M3
069	ø69 +0.0 /-0.2	ø40+0.2 /-0.0	ø61	3 x ø3.20 (120°)	M3
080	**ø80 +0.0 /-0.2**	**ø51+0.2 /-0.0**	**ø72**	**6 x ø3.20 (60°)**	**M3**
096	ø96 +0.0 /-0.2	ø67+0.2 /-0.0	ø88	6 x ø3.20 (60°)	M3

Dimensions are in mm.
Screw hole dimensions for fastener according ISO 7380-1.
E ... screw size

3.2.4. Stator for IND-ROT-080: **IRS-096**



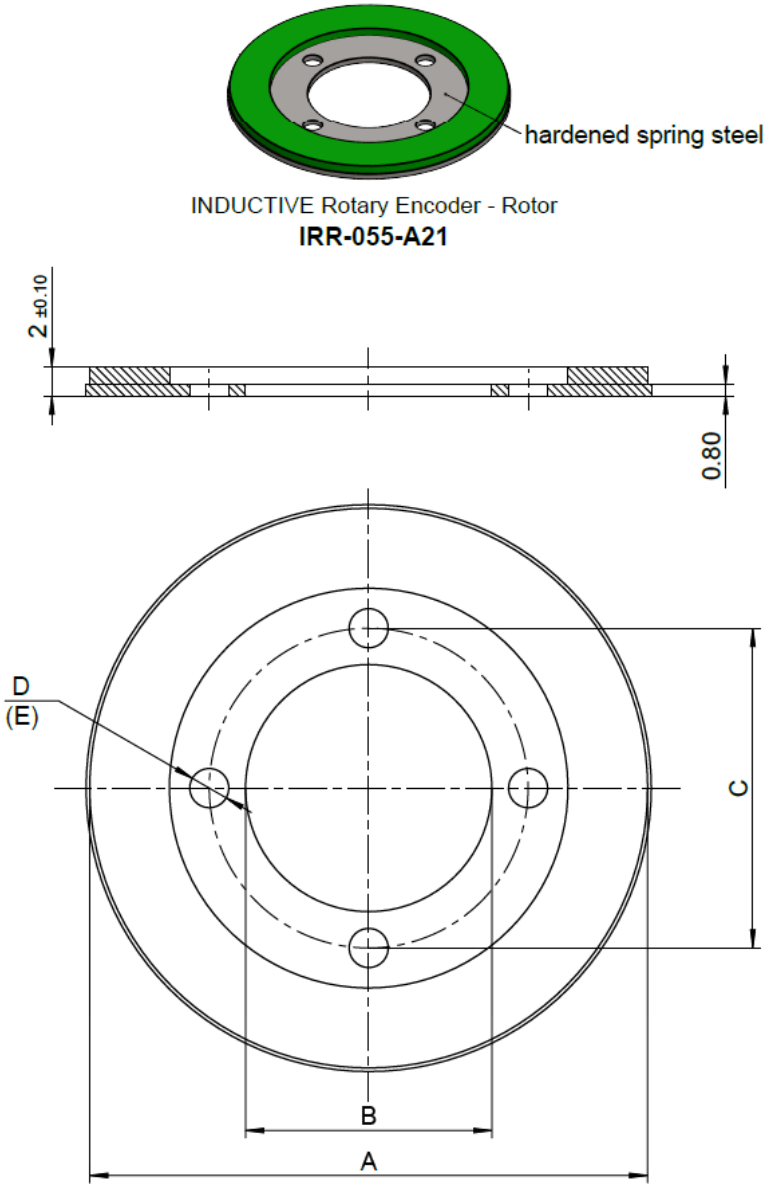
Size comparison table. The 055 mm size is highlighted in blue.

IRS-xxx	A	B	C	D	E
055	ø55 +0.0 /-0.2	ø26 +0.2 /-0.0	ø47	3 x ø3.20 (120°)	M3
069	ø69 +0.0 /-0.2	ø40+0.2 /-0.0	ø61	3 x ø3.20 (120°)	M3
080	ø80 +0.0 /-0.2	ø51+0.2 /-0.0	ø72	6 x ø3.20 (60°)	M3
096	**ø96 +0.0 /-0.2**	**ø67+0.2 /-0.0**	**ø88**	**6 x ø3.20 (60°)**	**M3**

Dimensions are in mm.
Screw hole dimensions for fastener according ISO 7380-1.
E ... screw size

3.3 **I**nductive **R**otary Encoder - **R**otor: **IRR-A21 screws axial**

3.3.1. Rotor for IND-ROT-055: **IRR-055-A21**

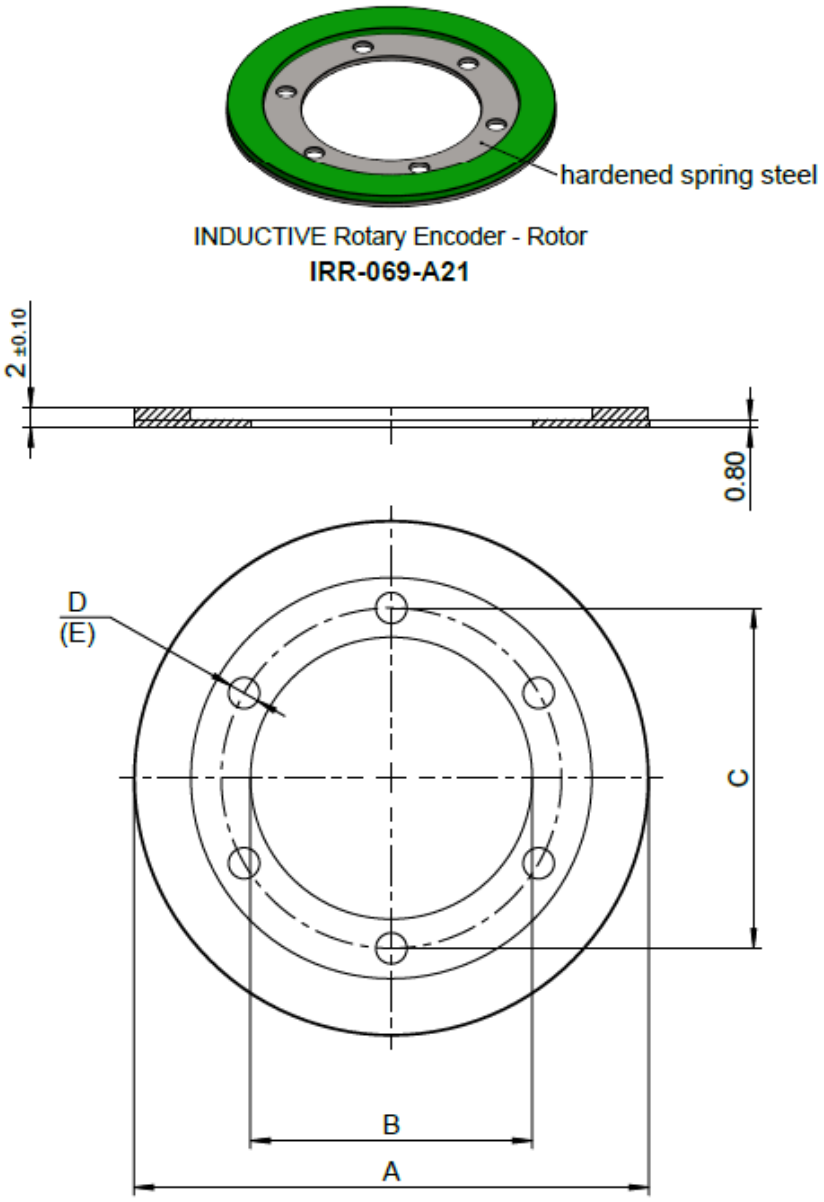


Size comparison table. The 055 mm size is highlighted in blue.

IRR-xxx	A	B	C	D	E
055-A21	**ø39 +0.00/-0.05**	**ø17 +0.05/-0.00**	**ø22**	**4 x ø2.70 (90°)**	**M2.5**
069-A21	ø53 +0.00/-0.05	ø29 +0.05/-0.00	ø35	6 x ø3.40 (60°)	M3
080-A21	ø64 +0.00/-0.05	ø40 +0.05/-0.00	ø46	6 x ø3.40 (60°)	M3
096-A21	ø80 +0.00/-0.05	ø56 +0.05/-0.00	ø62	6 x ø3.40 (60°)	M3

Dimensions are in mm.
Screw hole dimensions for fastener according ISO 7380-1.
E ... screw size

3.3.2. Rotor for IND-ROT-069: **IRR-069-A21**

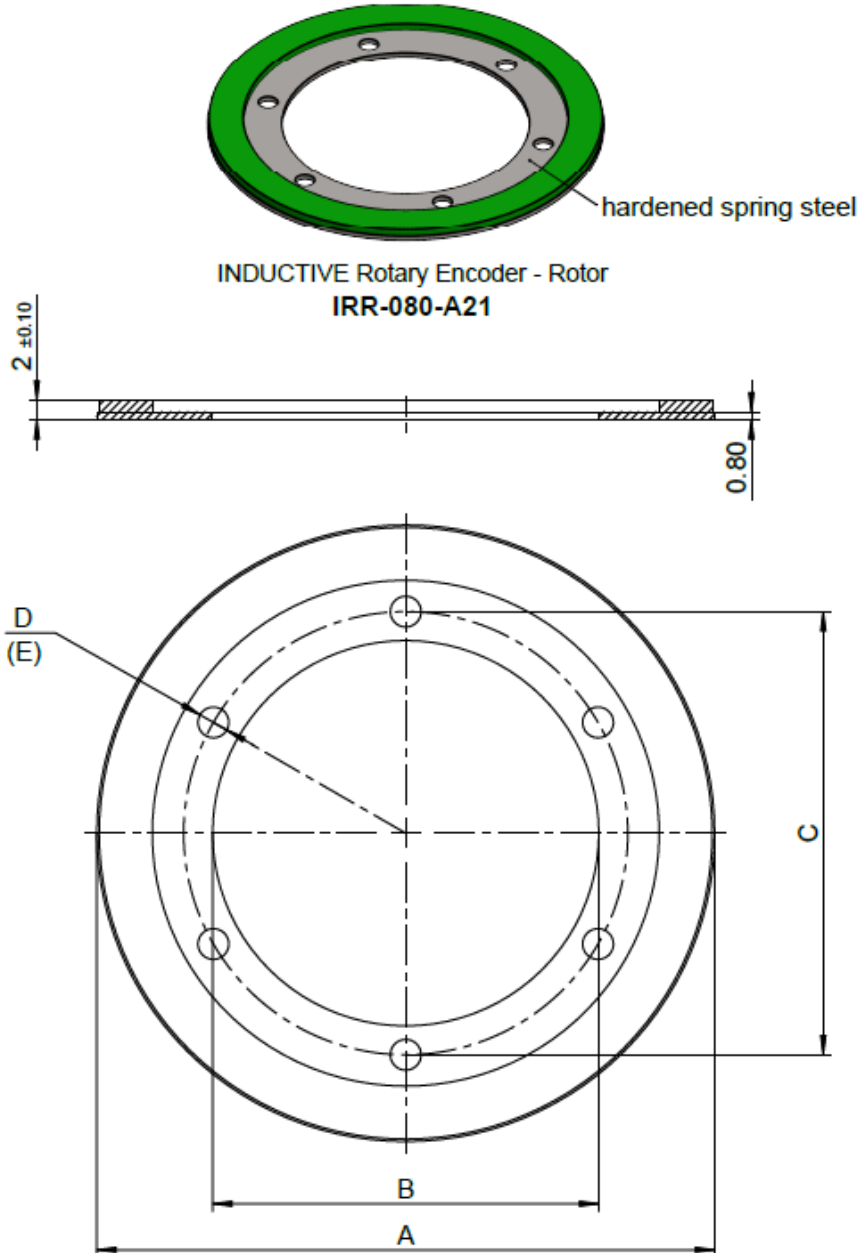


Size comparison table. The 069 mm size is highlighted in blue.

IRR-xxx	A	B	C	D	E
055-A21	ø39 +0.00/-0.05	ø17 +0.05/-0.00	ø22	4 x ø2.70 (90°)	M2.5
069-A21	**ø53 +0.00/-0.05**	**ø29 +0.05/-0.00**	**ø35**	**6 x ø3.40 (60°)**	**M3**
080-A21	ø64 +0.00/-0.05	ø40 +0.05/-0.00	ø46	6 x ø3.40 (60°)	M3
096-A21	ø80 +0.00/-0.05	ø56 +0.05/-0.00	ø62	6 x ø3.40 (60°)	M3

Dimensions are in mm.
Screw hole dimensions for fastener according ISO 7380-1.
E ... screw size

3.3.3. Rotor for IND-ROT-080: **IRR-080-A21**

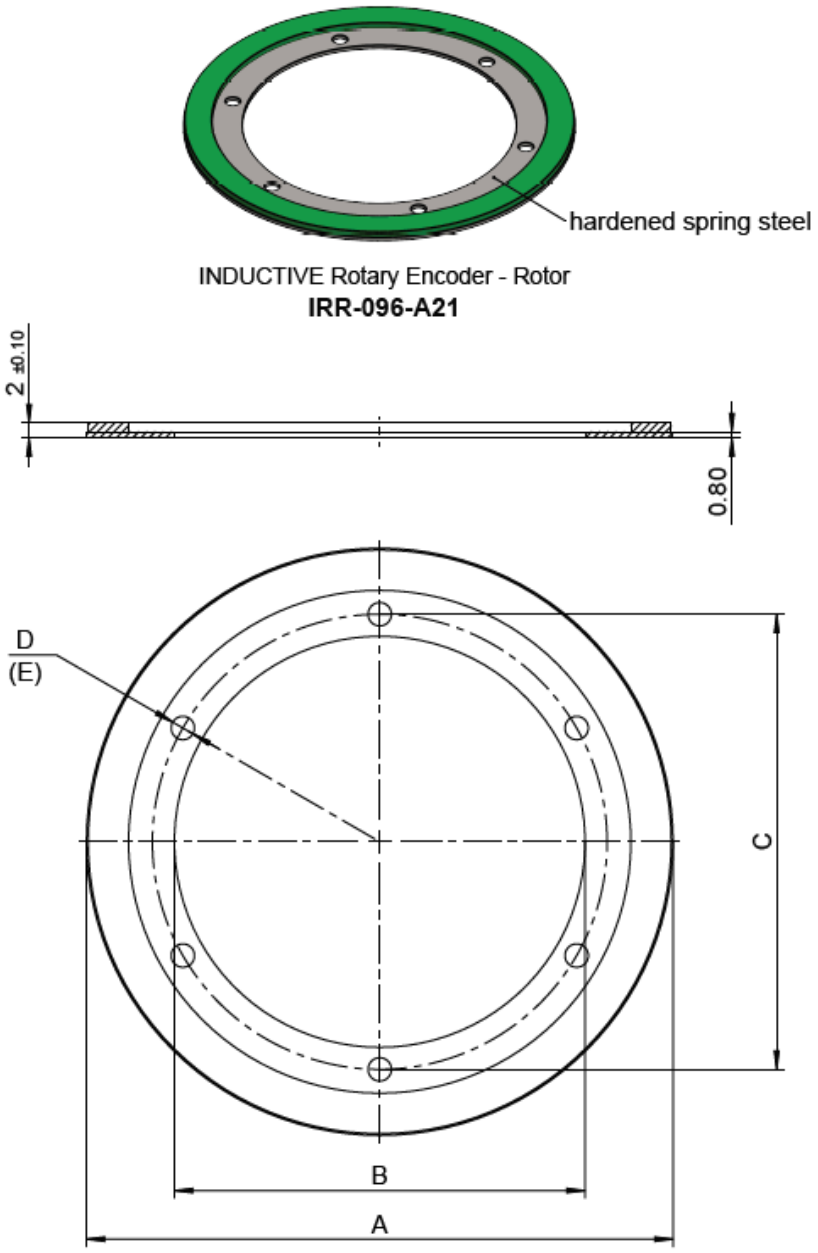


Size comparison table. The 080 mm size is highlighted in blue.

IRR-xxx	A	B	C	D	E
055-A21	ø39 +0.00/-0.05	ø17 +0.05/-0.00	ø22	4 x ø2.70 (90°)	M2.5
069-A21	ø53 +0.00/-0.05	ø29 +0.05/-0.00	ø35	6 x ø3.40 (60°)	M3
080-A21	**ø64 +0.00/-0.05**	**ø40 +0.05/-0.00**	**ø46**	**6 x ø3.40 (60°)**	**M3**
096-A21	ø80 +0.00/-0.05	ø56 +0.05/-0.00	ø62	6 x ø3.40 (60°)	M3

Dimensions are in mm.
Screw hole dimensions for fastener according ISO 7380-1.
E ... screw size

3.3.4. Rotor for IND-ROT-096: **IRR-096-A21**



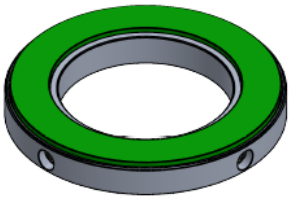
Size comparison table. The 096 mm size is highlighted in blue.

IRR-xxx	A	B	C	D	E
055-A21	ø39 +0.00/-0.05	ø17 +0.05/-0.00	ø22	4 x ø2.70 (90°)	M2.5
069-A21	ø53 +0.00/-0.05	ø29 +0.05/-0.00	ø35	6 x ø3.40 (60°)	M3
080-A21	ø64 +0.00/-0.05	ø40 +0.05/-0.00	ø46	6 x ø3.40 (60°)	M3
096-A21	**ø80 +0.00/-0.05**	**ø56 +0.05/-0.00**	**ø62**	**6 x ø3.40 (60°)**	**M3**

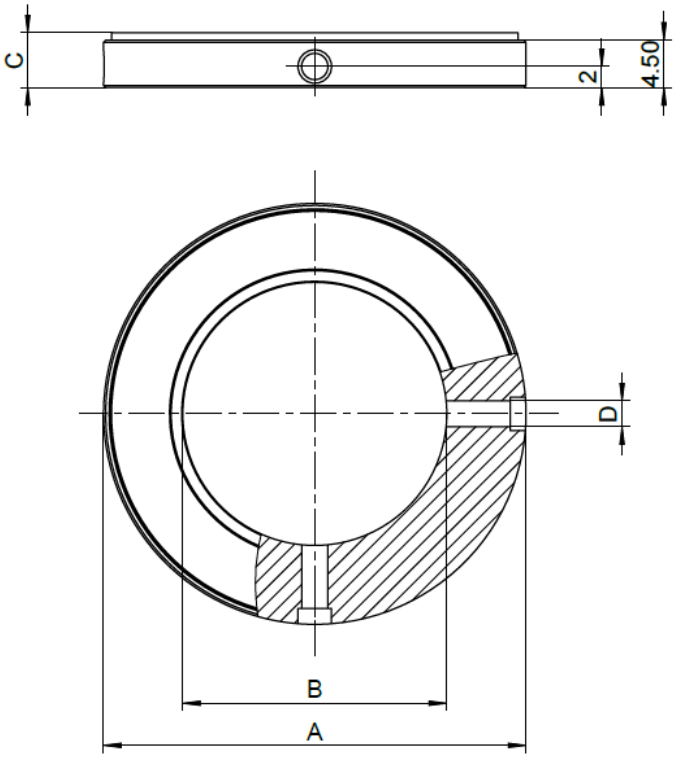
Dimensions are in mm.
Screw hole dimensions for fastener according ISO 7380-1.
E ... screw size

3.4. **I**nductive **R**otary Encoder - **R**otor: **IRR-C21 screws radial**

3.4.1. Rotor for IND-ROT-055: **IRR-055-C21-AL**



INDUCTIVE Rotary Encoder - Rotor
IRR-055-C21-AL
aluminum



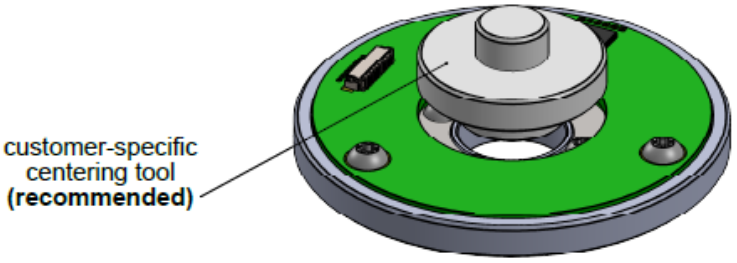
Size comparison table. The 055 mm size is highlighted in blue.

IRR-xxx	A	B	C	D
055-C21	**ø42 h7**	**ø25 H7**	**5.20 ± 0.1**	**2 x M3 (90°)**
069-C21	We offer customized rotors based on the application requirements. Please send your requirements at sales@flux.gmbh			
080-C21				
096-C21				

Dimensions are in mm.
Screw hole dimensions for fastener according ISO 7380-1.
E ... screw size

4. Mounting recommendations

4.1 Stator IRS sensor-side mounting



INDUCTIVE Rotary Encoder
IRS sensor side mounting

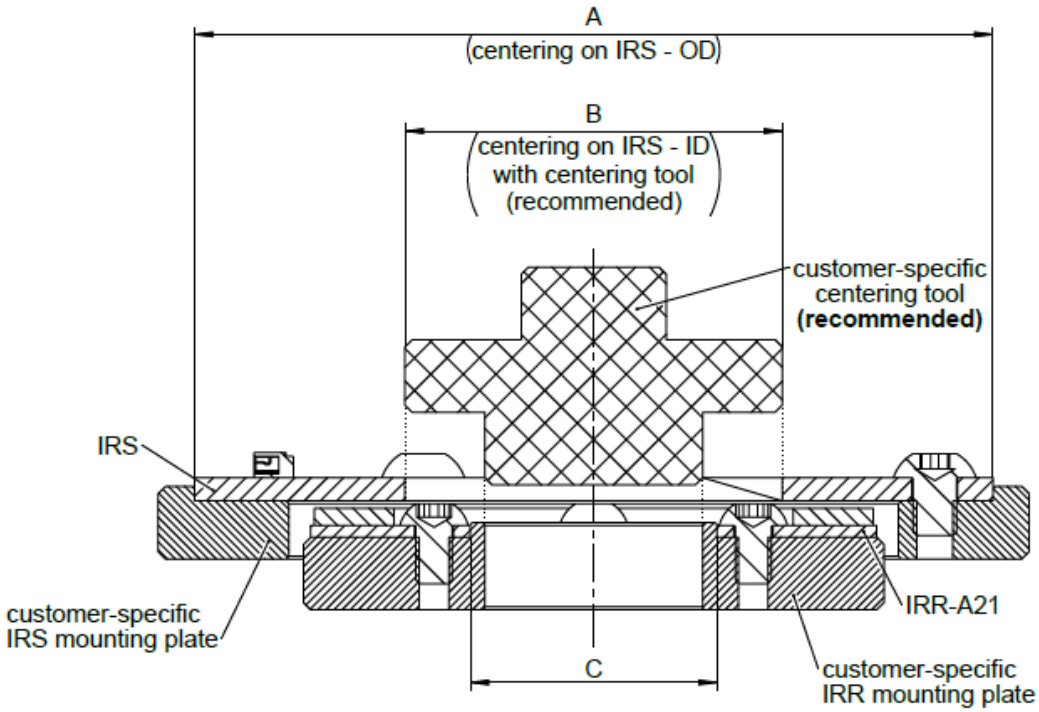


Fig. 4.1.: INDUCTIVE Rotary Encoder: IRS sensor-side mounting and centering.

IRS and IRR mounting must be adapted accordingly to its application. The customer-specific mounting plate in this visualization serves only as an illustration.

4.2 Stator IRS connector-side mounting

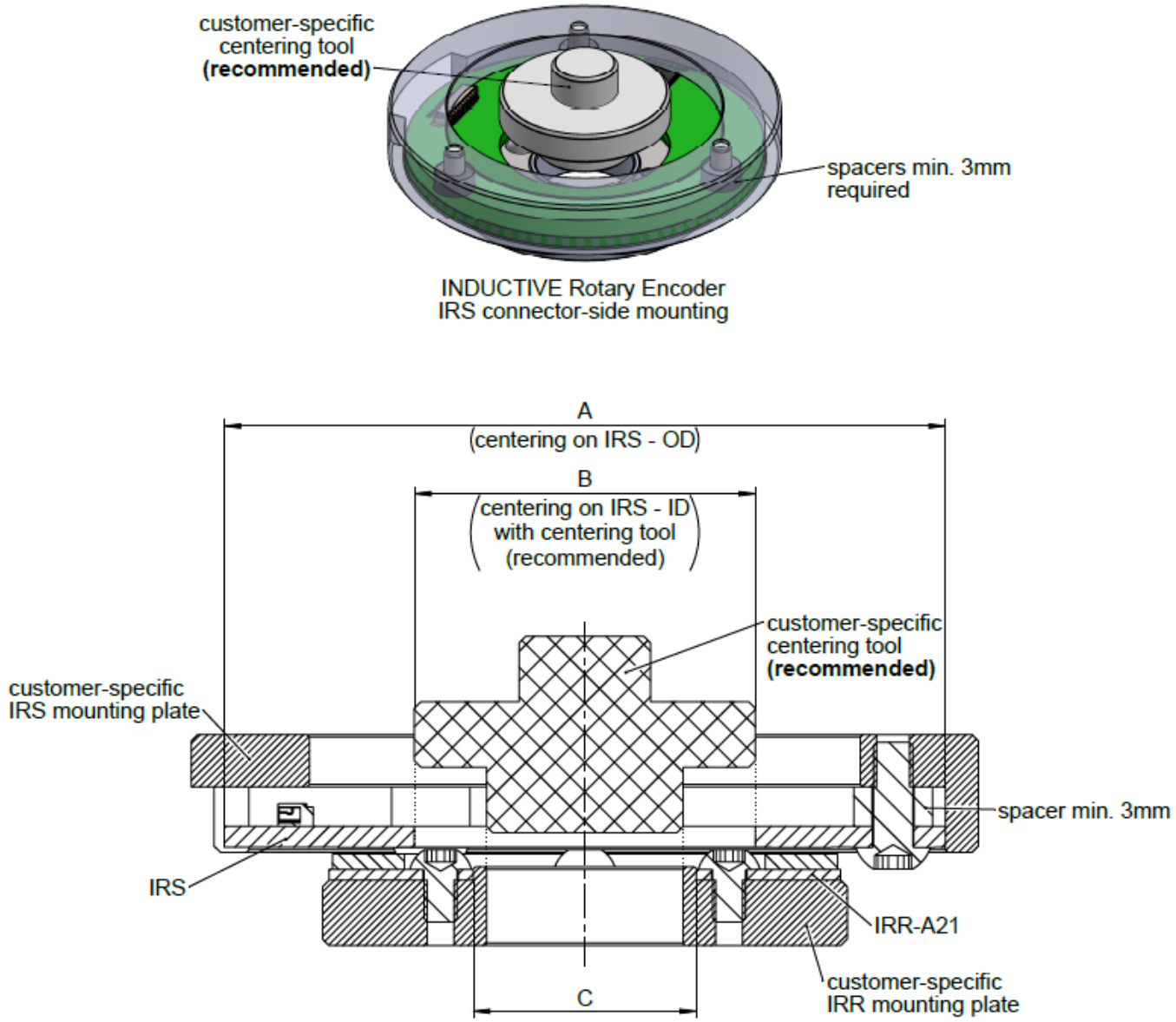


Fig. 4.2.:INDUCTIVE Rotary Encoder: IRS connector-side mounting and centering.

IRS and IRR mounting must be adapted accordingly to its application. The customer-specific mounting plate in this visualization serves only as an illustration.

5. Interface description

5.1. SSI00

The synchronous serial interface SSI is a unidirectional point to point communication channel. The transmission of the sensor output signal SSI DATA is synchronized by the common clock signal SSI CLOCK. The DATA and CLOCK signals are transmitted according to the RS-485 (EIA-485) standard, driven by RS-485 buffers.

Parameter	Note	Min.	Typ.	Max.	Unit
Clock frequency f_{clk}	data updated on rising clock edge	0.2		1.0	MHz
Monoflop time t_{mf}		30			µs
Total number for bits			28		bits
Number of data bits *N*			25		bits
Data alignment		right aligned unused MSB set LOW-"0"			
Number of status bits *S*	Error *E* (active high) Warning *W* (active high) Parity P (even)		3		bits

The data transmission and position latch starts with the first falling edge of the clock signal. The serial data update occurs on the rising clock edge.

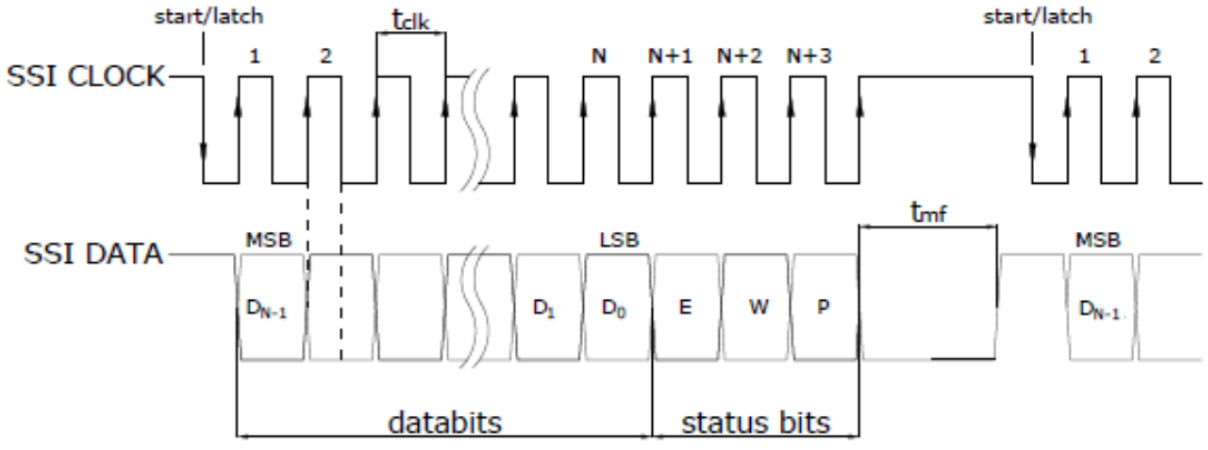


Fig. 5.1.: Time diagram for the SSI00 interface..

5.2. SSI01

The synchronous serial interface SSI is a unidirectional point to point communication channel. The transmission of the sensor output signal SSI DATA is synchronized by the common clock signal SSI CLOCK. The DATA and CLOCK signals are transmitted according to the RS-485 (EIA-485) standard, driven by RS-485 buffers.

Parameter	Note	Min.	Typ.	Max.	Unit
Clock frequency f_{clk}	data updated on rising clock edge	0.1		2.0	MHz
Monoflop time t_{mf}		20			µs
Total number for bits	only data bits transmitted		N		bits
Number of data bits *N*	only data bits transmitted		N		bits
Data alignment		not relevant			
Number of status bits *S*	no status bit is transmitted		0		bits

Data transmission and position latch starts with the first falling edge of the clock signal. The serial data update occurs on the rising clock edge.

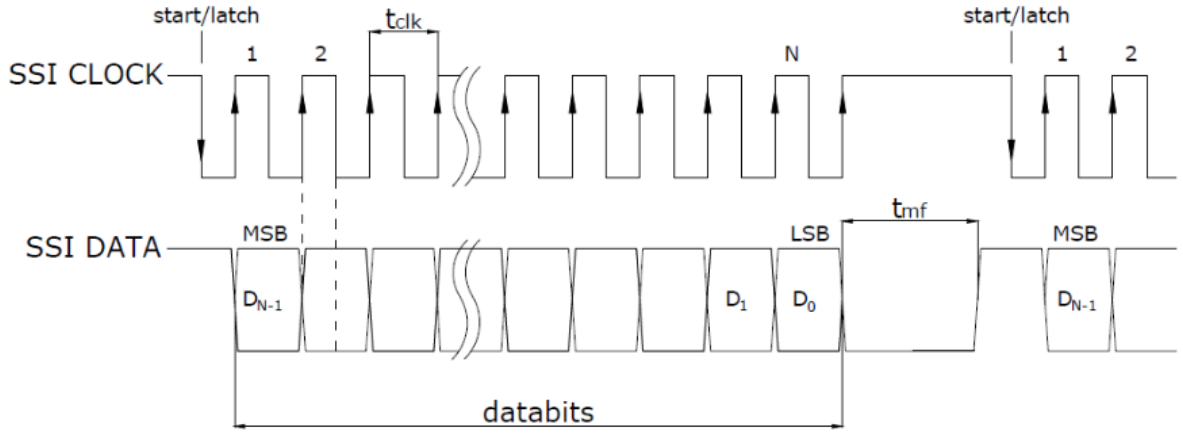


Fig. 5.2.: Time diagram for the SSI01 interface.

5.3. SSI02

The SSI02 version of the Synchronous Serial Interface SSI can be used to communicate with a Serial Peripheral Interface (SPI) controller.

The transmission of the sensor output signal SSI DATA is synchronized by the common clock signal SSI CLOCK. The DATA and CLOCK signals are transmitted according to the RS-485 (EIA-485) standard, driven by RS-485 buffers (compatible with RS-422).

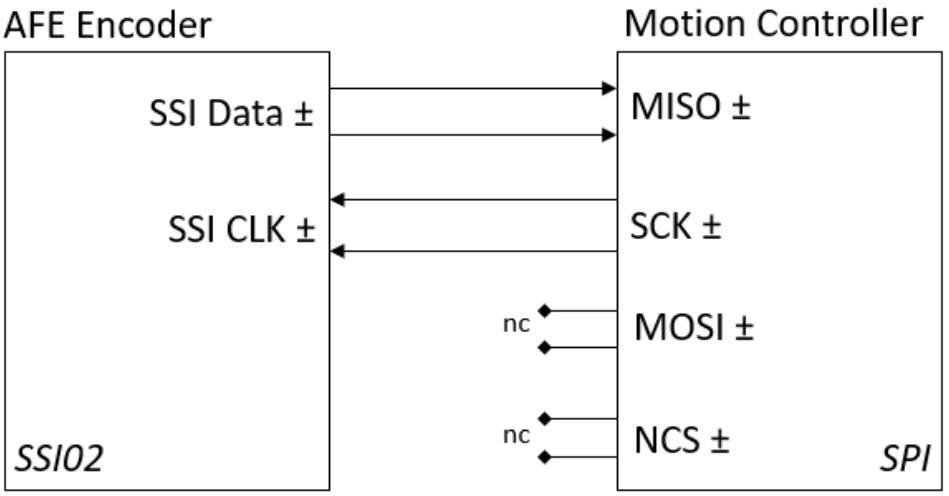


Fig.5.3.: Interfacing for SSI02 interface to the SPI master.

For interfacing the SSI02 the following connections are required:

- SSI Data must be connected to the SPI Master Input, Slave Output (MISO)
- SSI Clock must be connected to the SPI Serial Clock (SCK)
-

The SPI lines Master Output, Slave Input (MOSI) and SPI Not Chip Select (NCS) are not connected. In this configuration the encoder is continuously enabled and answers with the current position.

SPI Mode#2 is the only mode supported by SSI02. The required SPI configuration for Mode#2 is:

CPOL = '1'	SPI Clock (SCK) Idle Polarity is "1" / High
CPHA = '0'	SPI Data (MISO) is received/sampled on falling edge of the clock

Data transmission and position latch starts with the first falling edge of the clock signal. The serial data update occurs on the rising clock edge.

Parameter	Note	Min.	Typ.	Max.	Unit
Clock frequency f_{clk}	data updated on rising clock edge	0.2		1.0	MHz
Monoflop time t_{mf}		30			µs
Total number for bits	number of clock falling edges		24		bits
Number of position bits			22		bits
Data alignment		right aligned unused MSB set LOW-"0"			
Number of status bits *S*	Error *E* (active high)		1		bits

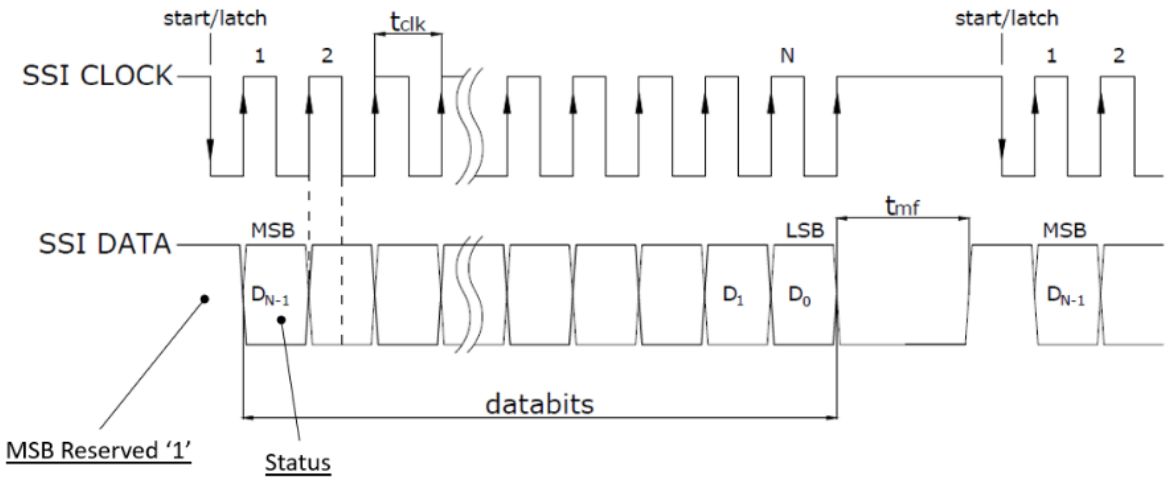


Fig.5.4.: Time diagram for the SSI02 interface.

Bits conversion for the 24 bits (23 down to 0) for the SPI master:

Bit		Description
Reserved	23 (MSB)	To be ignored. Bit always on "1"
Status	22 ($\mathbf{D_{N-1}}$)	Error bit (active high) '0' position valid / '1' encoder error
Data bits	21 … 0 (LSB)	Position, right aligned. Unused MSB bits set on '0'

5.4. INCxx

Incremental TTL output consists of two square-wave position signals – A and B – in quadrature differential format which are phase shifted 90° relative to each other. Additionally a differential square wave Reference Index pulse (Z) is delivered for homing procedure.

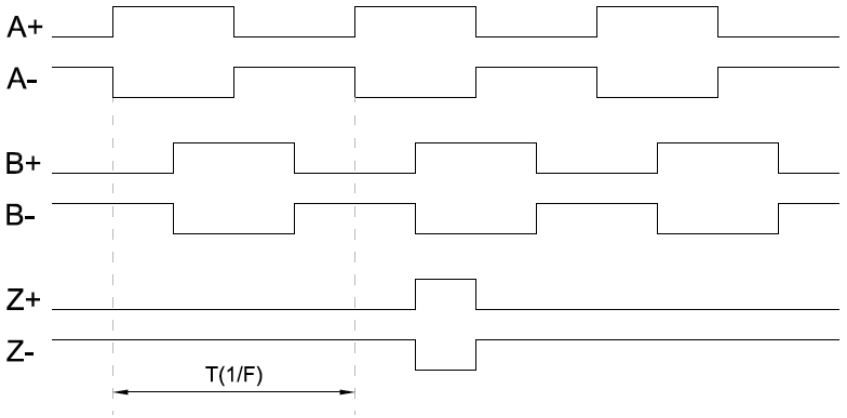


Fig.5.5.: Time diagram for interface INCxx with differential TTL quadrature signal

INCxx	Output Frequency (F=1 / T)	Counts after x4 Decoding
INC00	5.000 MHz	20.0 Mio. / sec
INC01	2.500 MHz	10.0 Mio. / sec
INC02	1.250 MHz	5.0 Mio. / sec
INC03	0.625 MHz	2.5 Mio. / sec

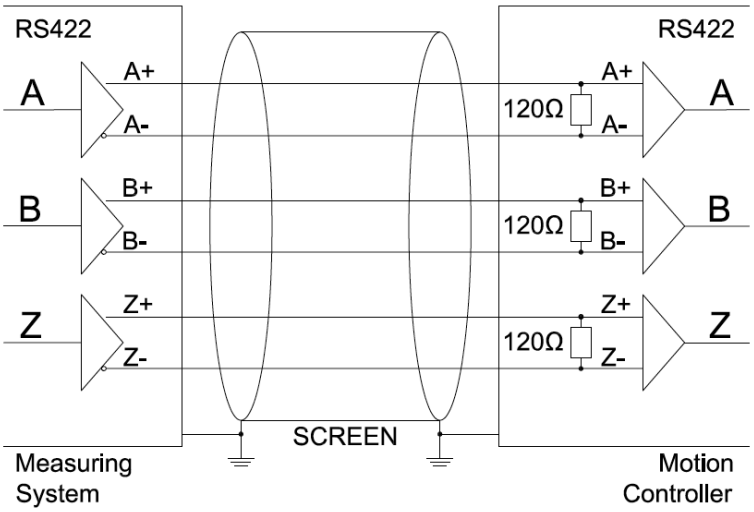


Fig.5.6.: Recommended electrical connection and buffering

The maximum operating speed of the encoder may be reduced from the standard maximum of 10 m/s due to the selection of higher resolutions or lower clock speeds. Maximum speed is computed using the following formula but is in no case more than 6000 rpm:

$$Maximum\ speed\ [rpm] = 60 \times \frac{4\ x\ Maximum\ Output\ Frequency\ [Hz]}{2^{\ Encoder\ resolution\ [bit]}\ [1/rev]}$$

To provide more information, the maximum encoder speed has been calculated for two resolutions(18 bits/rev. and 14 bits/rev.) and for various output frequencies.

Interface	Max. Frequency (before x4)	Max. Counts (after x4)	Maximum speed	
			@ 18 bits/rev	@ 14 bits/rev
INC00	5.000 MHz	20.0 Mio. / sec	4577 rpm	6000 rpm
INC01	2.500 MHz	10.0 Mio. / sec	2288 rpm	6000 rpm
INC02	1.250 MHz	5.0 Mio. / sec	1144 rpm	6000 rpm
INC03	0.625 MHz	2.5 Mio. / sec	572 rpm	6000 rpm

5.5. BIS00

The BIS00 is an implementation of the bidirectional interface BiSS/C® (registered trademark of IC-Haus GmbH) with the following main characteristics:

- data length reserved for encoder position is 32 bits
- encoder position data is right aligned (unused upper bits/MSB set on 0)

BIS00 is recommended for linear encoders. Despite being compatible with rotary encoders, it may cause compatibility issues with some motion controllers.
BIS10 is strongly recommended for rotary encoders.

Parameter	Note	Min.	Typ.	Max.	Unit
Clock frequency f_{clk}	data updated on rising clock edge	0		5.0	MHz
Processing time	not applicable, real-time encoder			0	ns
Total number for bits	n		40		bits
Number of position bits	Bits 39 down to 8		32		bits
Data alignment		right aligned unused MSB set LOW-"0"			
Number of status bits *S*	Bit 7 - not Error Bit 6 - not Warning		2		bits
CRC length	Bits 5 down to 0 Polynome: 0x43 ($X^6+X^1+X^0$) Start value: 0x00		6		bits

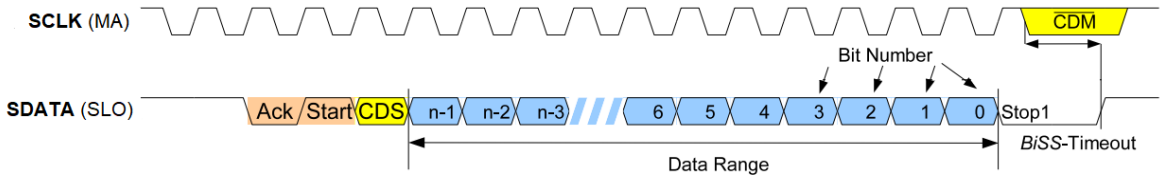


Fig.5.7.: Time diagram for interface BIS00.

"Ack" bit is always 1 Clock length for all FLUX encoders.

5.6. BIS10

The BIS10 is an implementation of the bidirectional interface BiSS/C® (registered trademark of IC-Haus GmbH) with the following main characteristics:

- data length reserved for encoder position is 24 bits
- encoder position data is left aligned (unused upper bits/MSB set on 0)

BIS10 is recommended for rotary encoders with resolution up to 24 bits.

Parameter	Note	Min.	Typ.	Max.	Unit
Clock frequency f_{clk}	data updated on rising clock edge	0		5.0	MHz
Processing time	not applicable, real-time encoder			0	ns
Total number for bits	n		32		bits
Number of position bits	Bits 31 down to 8		24		bits
Data alignment		right aligned unused LSB set LOW-"0"			
Number of status bits *S*	Bit 7 - not Error Bit 6 - not Warning		2		bits
CRC length	Bits 5 down to 0 Polynome: 0x43 ($X^6+X^1+X^0$) Start value: 0x00		6		bits

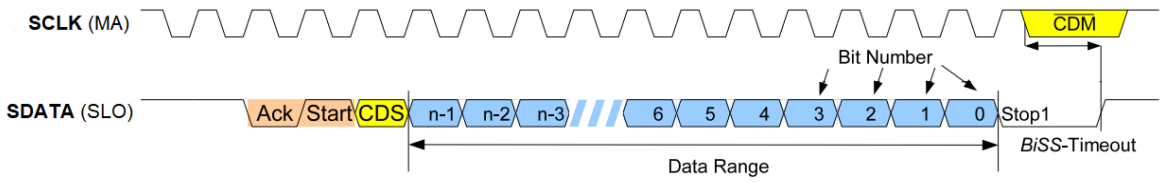


Fig.5.8.: Time diagram for interface BIS10.

"Ack" bit is always 1 Clock length for all FLUX encoders.

6. Commissioning and Debugging

6.1. Mounting and commissioning

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

The **INDUCTIVE-ROTARY** encoder requires no calibration or additional commissioning.

As soon as the **INDUCTIVE-ROTARY** 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 **INDUCTIVE-ROTARY** 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	
Fast blinking[2]	Normal operation, not optimal performance	Check encoder runout
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

7. Additional features

7.1. Multi-turn position (memory saved)

In **INDUCTIVE-ROTARY** encoders, the multi-turn position can be automatically saved at power off and restored after powering on. Therefore, even a frameless encoder such as **INDUCTIVE-ROTARY** 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 ± 90° when power is turned off.

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

7.2. Setting zero position and counting direction

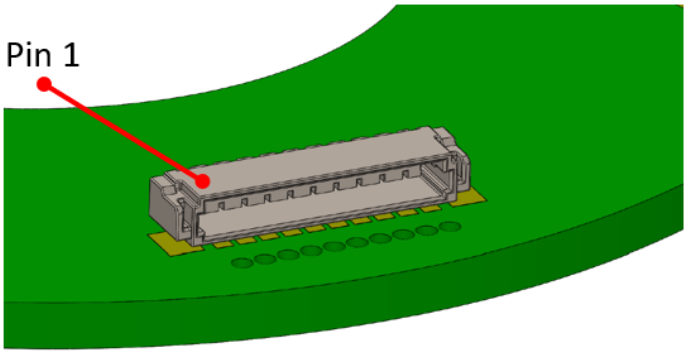
The **INDUCTIVE-ROTARY** encoder allows setting of the zero position and changing of the counting direction.
Over the BiSS-C Interface registers, both functions can be performed.

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

8. Connector and Wiring

8.1. Option “WB” - Connector

Type	Wire to Board
Manufacturer	Amphenol ICC (FCI)
Part Number	10144041-10011LF (Series Minitek® 0.80mm)
Operating temperature	-25°C .. +85°C *(contact FLUX for extended temperatures)*
Description	Connector Header Surface Mount Right Angle 10 position 0.031" (0.80mm)
Available accessories	WB0806K0200 - See Chapter Accesories



Pin	SSI & BISS/C	A/B/Z	SPI	Comments
1	Vdd	Vdd	Vdd	Encoder Supply Voltage
2	GND	GND	GND	Encoder Power Ground
3	*do not connect*	B+	NCS+	
4	*do not connect*	B-	NCS-	
5	*do not connect*	A+	SCLK+	
6	*do not connect*	A-	SCLK-	
7	SCLK+	*do not connect*	MOSI+	
8	SCLK-	*do not connect*	MOSI-	
9	SDATA+	Z+	MISO+	
10	SDATA-	Z-	MISO-	

Unused pins must not be connected.

9. Ordering code

IND-ROT	**-055**	**-A21**	**-17**	**-BIS00**	**-5V**	**-WB**	
Rotary encoder	Diameter [mm]	Rotor type	Resolution [Bits/Rev]	Output Interface	Supply Voltage	Connector Type	Other options
	055	**-A21**	**15**	**BIS10**	**5V** - 4..6Vdc	**WB** - Wire-Board	
	069	**-C21**	**16**	**BIS00**			
	080		**17**	**SSI00**			
	096		**18**	**SSI01**			
			19	**SSI02**			
			20	**INC00**			
				INC01			
				INC02			
				INC03			

10. Accessories

10.1. Spacers and Mounting Screws

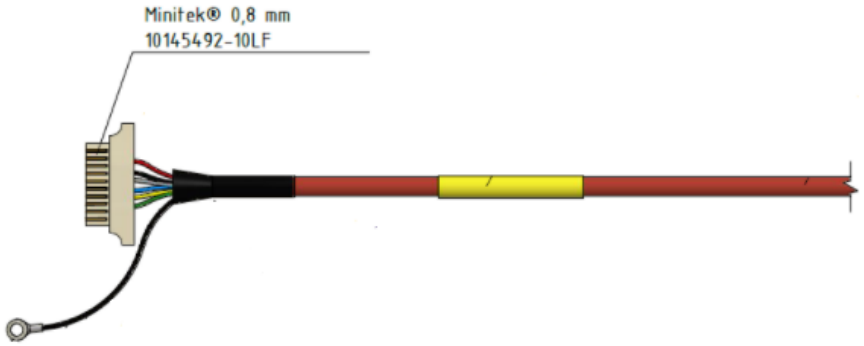
A set of spacers and mounting screws is included with the product.

IND-ROT	Stator	Rotor A21	Rotor C21
055	3x screws M3x8 TORX socket button head ~ISO 7380-1 3 x plastic spacers 3mm(1) OD 6.00mm / ID 3.20mm	4 x screws M2.5x4 TORX socket button head ~ISO 7380-1	2 x set screws M3 HEX socket set screw with flat point ISO 4026 / DIN 913
069	6 x screws M3x8 TORX socket button head ~ISO 7380-1 6 x plastic spacers 3mm(1) OD 6.00mm / ID 3.20mm	6 x screws M3x4 TORX socket button head ~ISO 7380-1	n.a.
080	6 x screws M3x8 TORX socket button head ~ISO 7380-1 6 x plastic spacers 3mm(1) OD 6.00mm / ID 3.20mm	6 x screws M3x4 TORX socket button head ~ISO 7380-1	n.a.
096	6 x screws M3x8 TORX socket button head ~ISO 7380-1 6 x plastic spacers 3mm(1) OD 6.00mm / ID 3.20mm	6 x screws M3x4 TORX socket button head ~ISO 7380-1	n.a.

(1) Stainless steel spacers available on request. Recommended for extreme temperature range.

10.2. Assembly cable 6-wires for “WB” connector

FLUX ordering code	**WB0806K0200**
Cable length	0.5 m
Left side	Connector 10145492-10LF Series Minitek® 0.80mm
Operating temperature	-25°C .. +85°C
Right side	Open wire *(connector on request)*
Cable specifications	
Outer jacket	Silicone rubber-based
Applicable standard	IEC 60754-1, IEC 60332-1-2
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

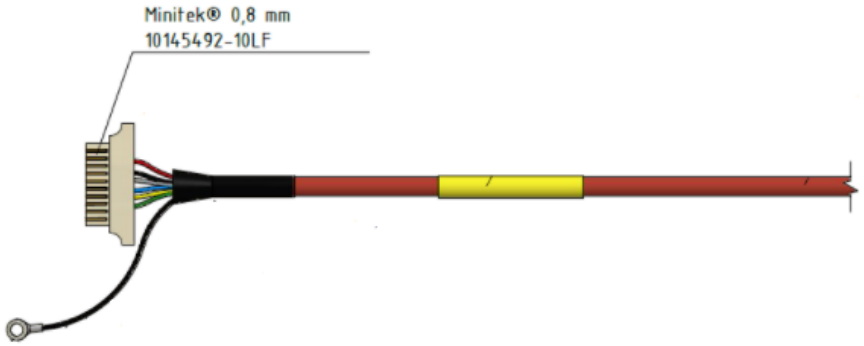


Left side connection:

No.	AWG	Color	SSI & BISS/C	A/B/Z	SPI	Comments
1	30	red	Vdd	n.a.	Vdd	Encoder Supply Voltage
2	30	black	GND		GND	Encoder Power Ground
3..6	n.a.	n.a.	n.a.		n.a.	not connected
7	30	grey	SCLK+		SCLK+	
8	30	blue	SCLK-		SCLK+	
9	30	green	SDATA+		MISO+	
10	30	yellow	SDATA-		MISO-	

10.3. Assembly cable 10-wires for “WB” connector

FLUX ordering code	**WB0210K0100**
Cable length	0.5 m
Left side	Connector 10145492-10LF Series Minitek® 0.80mm
Operating temperature	-25°C .. +85°C
Right side	Open wire *(connector on request)*
Cable specifications	
Outer jacket	PUR, suitable for energy chains
Applicable standard	UL - AWM Style 20963 80°C
Temperature rating	dynamic: -20°C .. +80°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



Left side connection:

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

11. Revision history

Date	Version	Comments
2022-04	00	First built - based on the AFE-200 datasheet
2023-01	01	SSIxx drawings bits number updated. INCxx output frequency information updated. Typo errors corrected
2023-02	02	New BiSS-C version added: BIS10
2023-03	03	Chapter 5.5 and 5.6: Frame format for BISxx added. Chapter 10.1: Spacers and screws accessories added. Chapter 10.3: Assembly cable for 10 wires added.

Technical data is subject to change without notice.

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