ACTIS

Absolute angle encoders of embedded design for demanding environments

LENZ Encoders are non-contact bearingless absolute angle encoders. Two parts design is perfect to match wide variety of control and measurements applications with limited space. Precise position data up to 24 bits and reliable fast feedback in harsh environments.

LENZ encoders are inductive position sensors based on the physical principles of electromagnetic induction. Our encoders combine easy installation, low integration cost, high accuracy, stability over time, are extremely robust.

LENZ encoders are insensitive to electromagnetic fields, permanent magnets, power lines, parasitic capacitance, metallic parts and electrical noises.

Features:

- Robust ultra-lightweight design
- True absolute
- Resolution up to 24 bits
- Non-contact and bearingless
- Reliable feedback
- Simple installation
- Extended lifetime
- High speed operation
- Vast variety of sizes

Applications variety:

- Space-saving solution by virtue of compact size
- Meets high accuracy requirements
- Suitable for high-speed control
- High reliability due to non-contact operating
- Compatibility with every BiSS C systems
- Cost-effective simple installation
- Extended temperature range –40 to +105 °C
- Wide variety of applications with electromagnetic field insensitivity

Selection table:

Part Number	Resolution	Noise-free Resolution	Rotor Outer Diameter	Rotor Inner Diameter	Stator Outer Diameter	Accuracy after Rotation Calibration E_V	Repeatability	RMS Noise	Max Operating Speed	Weight
SAB039	19 bits	17 bits	39 mm	15 mm	49 mm	±50″	±13″	1.5″	12 000 rpm	7.8 g
SAB049	19 bits	17 bits	49 mm	25 mm	59 mm	±44″	±11″	1.3″	11 000 rpm	10.2 g
SAB064	20 bits	18 bits	64 mm	40 mm	74 mm	±34″	±9″	1.0″	8 200 rpm	13.9 g
SAB080	20 bits	18 bits	80 mm	55 mm	90 mm	±22″	±6″	0.7″	5 500 rpm	16.7 g
SAB115	21 bits	19 bits	115 mm	90 mm	125 mm	±17″	±4″	0.5″	4 000 rpm	20.8 g
SAB150	21 bits	19 bits	150 mm	125 mm	163 mm	±12″	±3″	0.3″	3 000 rpm	28.0 g

Notes:

- The high resolution of the encoders is suitable for smoother operation of control loops.
- Accuracy after rotation calibration E_V is the accuracy of the encoder system after the calibration procedure during constant rotation. See section ”Accuracy of the encoder system”.
- Repeatability is the repeatability of the encoder’s angle code.

Each encoder supports the following functions:

- Zero position setting
- Rotation direction setting (code increment)
- Arbitrary angle shift setting
- Encoder signal amplitude calibration
- Accuracy calibration using an external reference
- Accuracy calibration in constant rotation mode

Technical specifications:

Resolution, bits	see selection table
Output angle code RMS noise, not exceeding	
Max operating speed, rpm	
Accuracy of the encoder after calibration during constant rotation	
Repeatability	
Total (nominal) height, mm	8.25
Supply voltage, V	4.6 … 12
Current consumption	45 … 70 mA, max 110 mA (no load on outputs)
ESD HBM (valid only on connector; do not touch components)	±15 kV
Ready time, ms	50
Angle sample rate, kHz	82
Interface	BiSS® C
Operating and storage temperature	–40 to +105 °C
Relative humidity	not exceeding 98 % non-condensing
Warranty	2 years

Handling:

The encoder consists of two parts: a stator and a rotor. Mounting screws, nuts, and the counterpart mating connector are not included.

When handling the encoder, take precautions to protect it from electrostatic discharge (ESD). Use ESD anti-static gloves or a grounded ESD wristband. Avoid touching any exposed electronic components or circuits on the stator. Store the stator in the antistatic bag or the specially designed shipping container in which you received it. Use the antistatic bag and special shipping container when you need to return the encoder. Also follow other standard ESD precautions.

It is recommended to use gloves for handling the encoder. Hands or gloves should be clean and dry.

To achieve stability and accuracy of the position data, mounting tolerances should be maintained according to the specific drawing.

Mounting:

Screws used for mounting the rotor and stator must be made of corrosion-resistant steel. **The use of screws made of carbon steel or non-ferrous metals is not allowed.** The recommended screw type is DIN 965 A2/A4.

Accuracy of the encoder system:

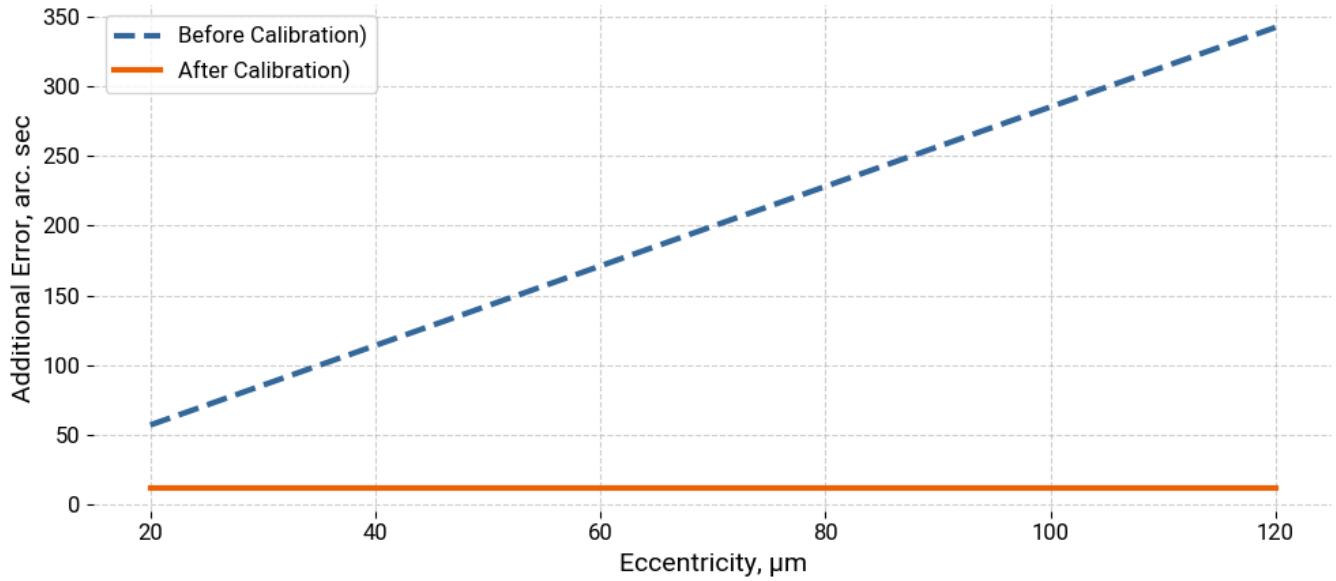
The dominant contribution to the overall encoder accuracy comes from the mounting, which is determined by the following parameters: the concentricity of the rotor and stator with reference to the datum axis of rotation, the axial runout of the end faces for the rotor and stator measured parallel to the datum axis of rotation. The distance between the faces provides the necessary air gap between the rotor and stator. To compensate for these deviations and improve the encoder's accuracy, three calibration methods are available:

- **Amplitude auto-calibration**. Performed during one full rotation of the encoder rotor. Initiated by a command sent to the BiSS register.
- **Calibration during continuous rotation**. Performed during one full rotation of the encoder. The calibration is carried out using the LENZ FlashTool programmer and specialized software.
- **Eccentricity calibration**. Performed using two stators mounted on a single rotor with a 180° offset. The procedure is carried out using the LENZ FlashTool programmer and specialized software.

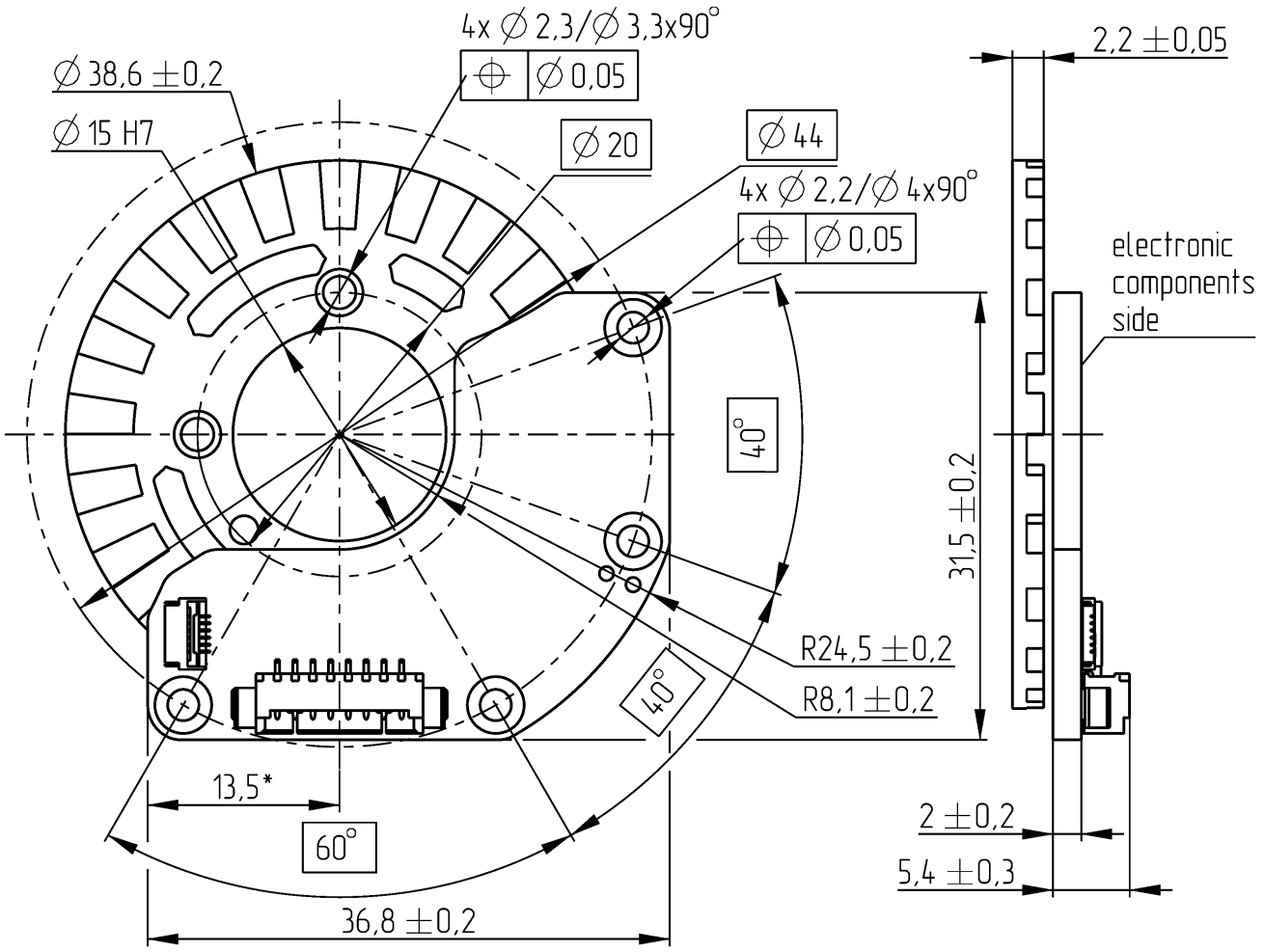
Impact of mounting on the encoder accuracy:

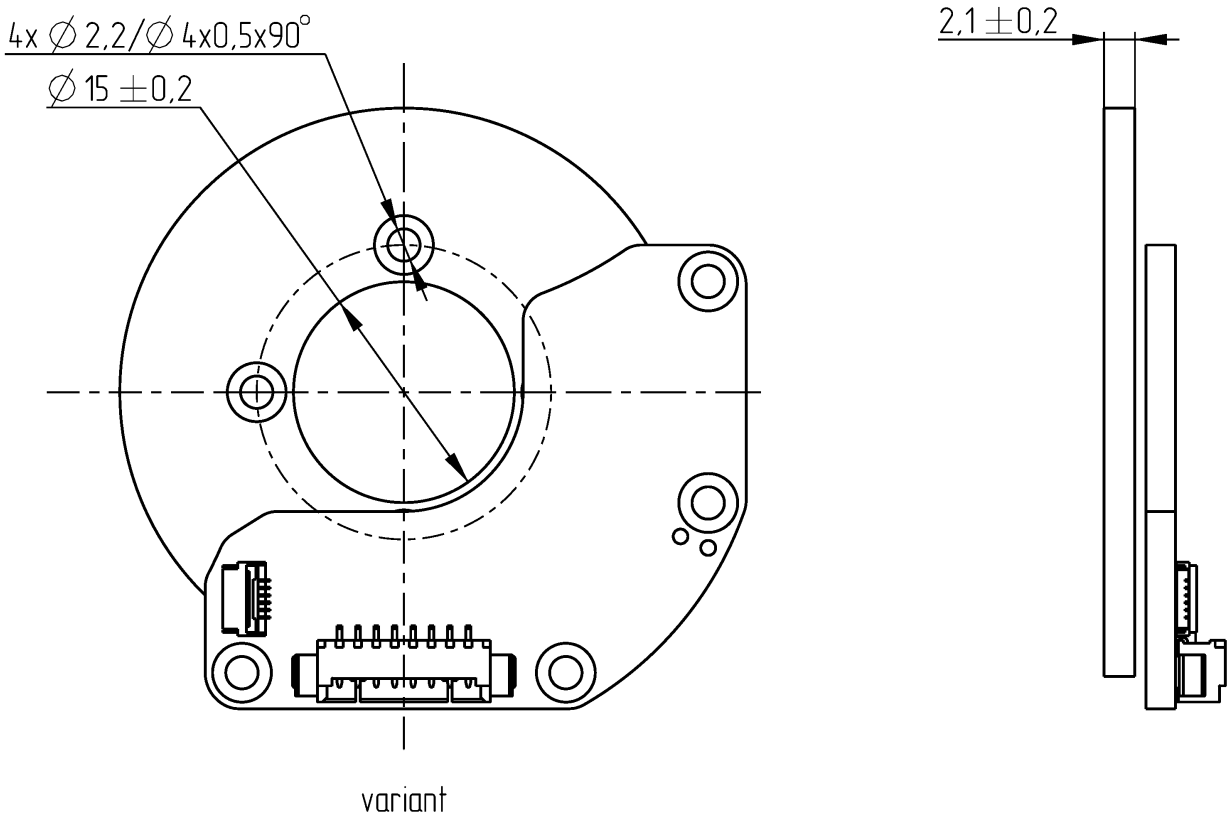
	Encoder accuracy, arcsec					
	SAB039	SAB049	SAB064	SAB080	SAB115	SAB150
H7/g6 best case	±230	±200	±150	±100	±75	±55
H7/g6 worst case	±356	±325	±290	±270	±190	±185
After amplitude auto-calibration	±150	±130	±100	±65	±50	±36
After calibration during continuous rotation	±50	±44	±34	±22	±17	±12
Additional error caused by eccentricity	±12.3	±9.5	±7.0	±5.5	±3.4	±2.8

The graph illustrates the impact of eccentricity on encoder error using the SAB150 model as an example. This error can be eliminated by using the two-stator calibration method.

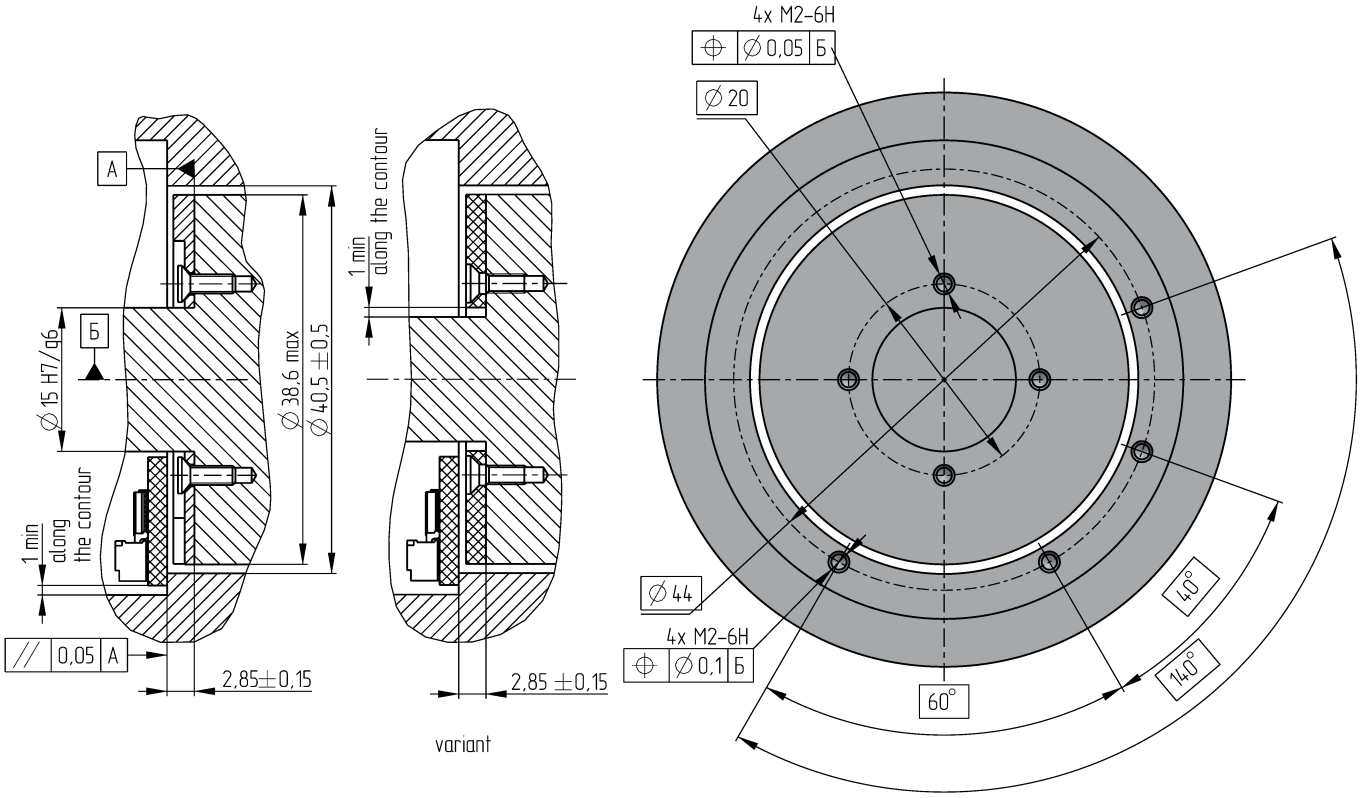


Mechanical dimensions SAB039:





Mounting SAB039:



The drawings show two versions of the rotor:

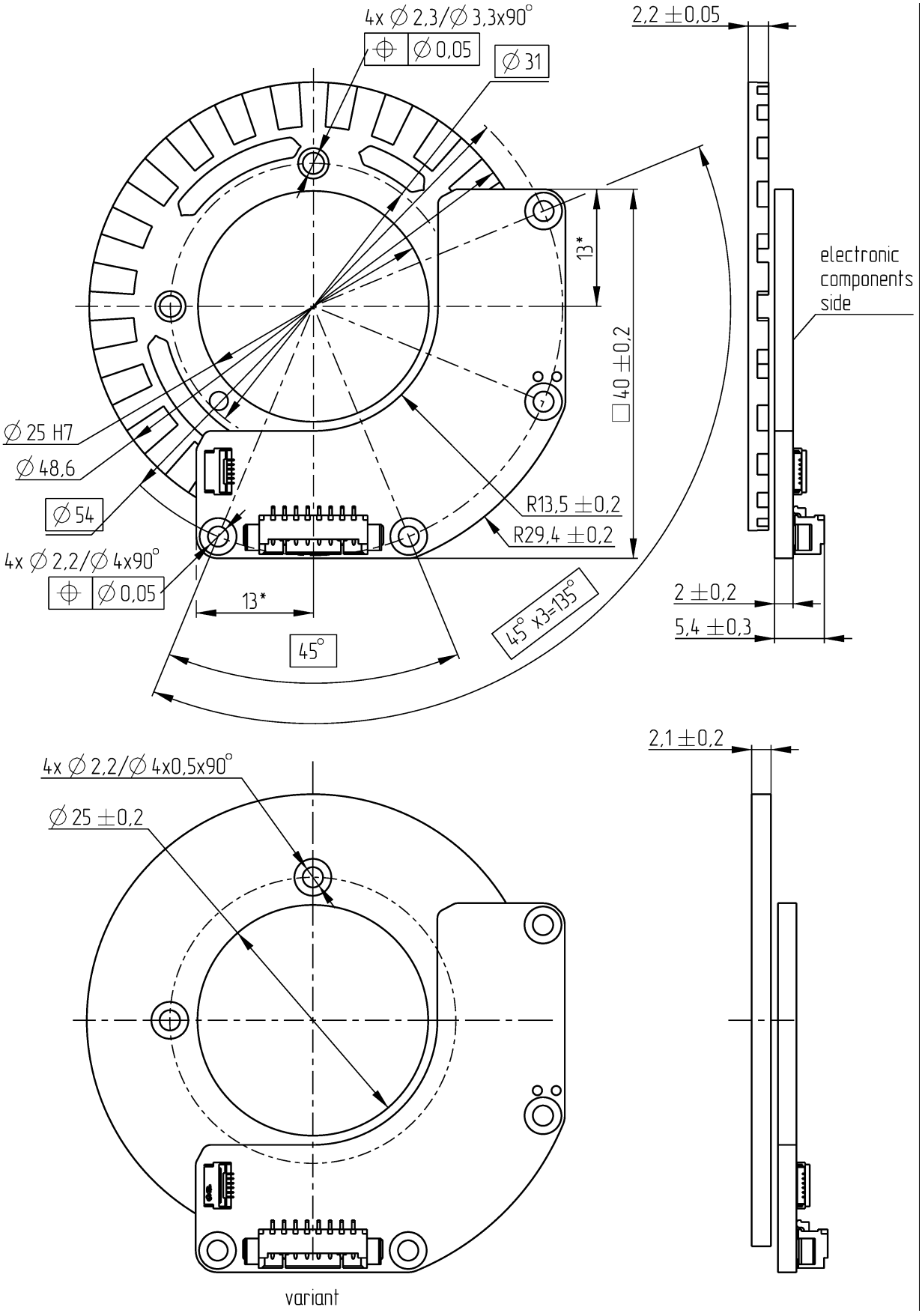
- made of aluminum alloy (rotor designation A)
- made on a printed circuit board (PCB) — ”variant” in the drawing, rotor designation P .

The concentricity of the rotor and stator of the SAB039 encoder is ensured by:

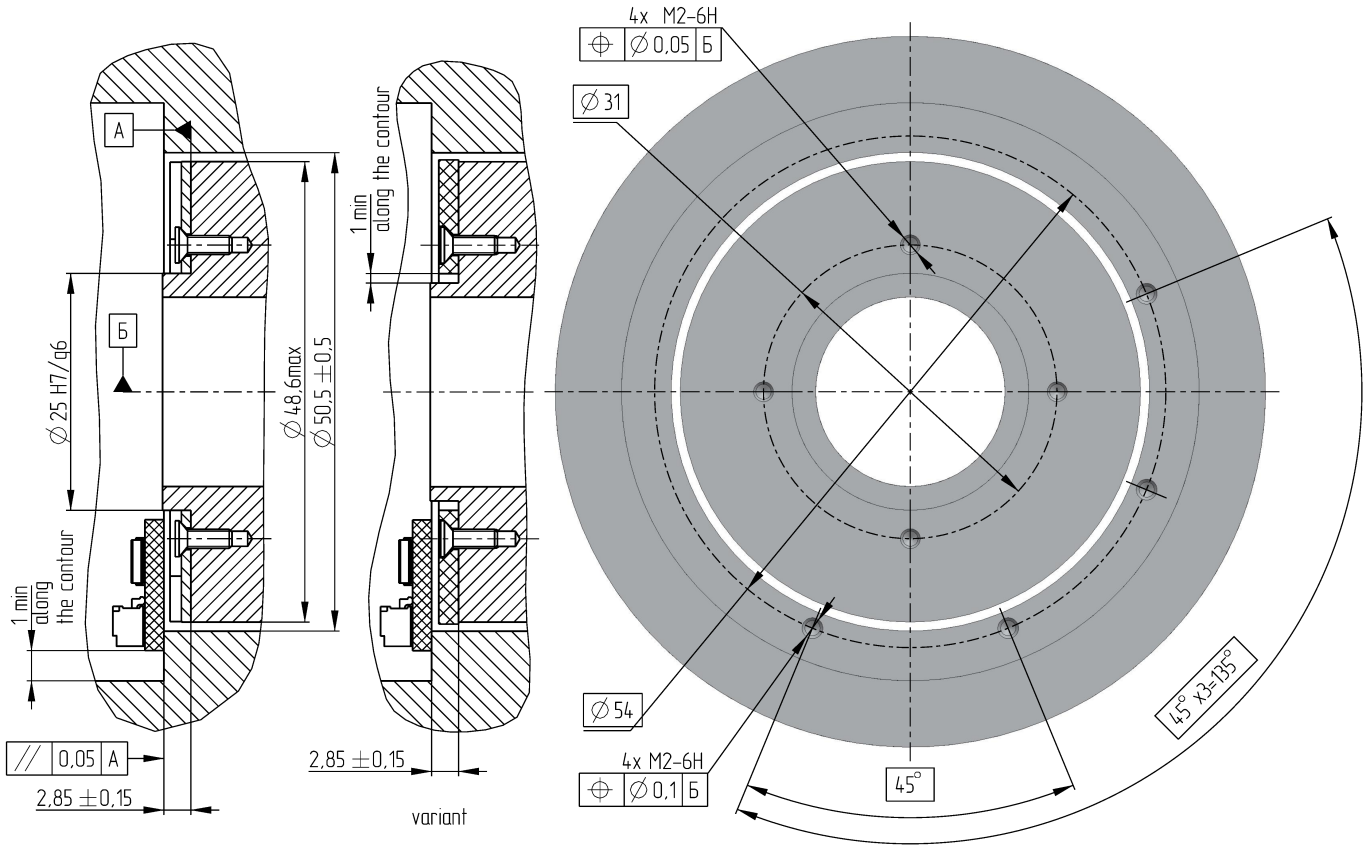
- for metal rotors A , an H7/g6 fit is used;
- for PCB rotors P , positional tolerances of the holes for the screws relative to the axis of rotation are ±0.025 mm (0.05 mm in diametrical terms).

For the stator, positional tolerances relative to the datum axis of rotation are ±0.05 mm (0.1 mm in diametrical terms).

Mechanical dimensions SAB049:



Mounting SAB049:



The drawings show two versions of the rotor:

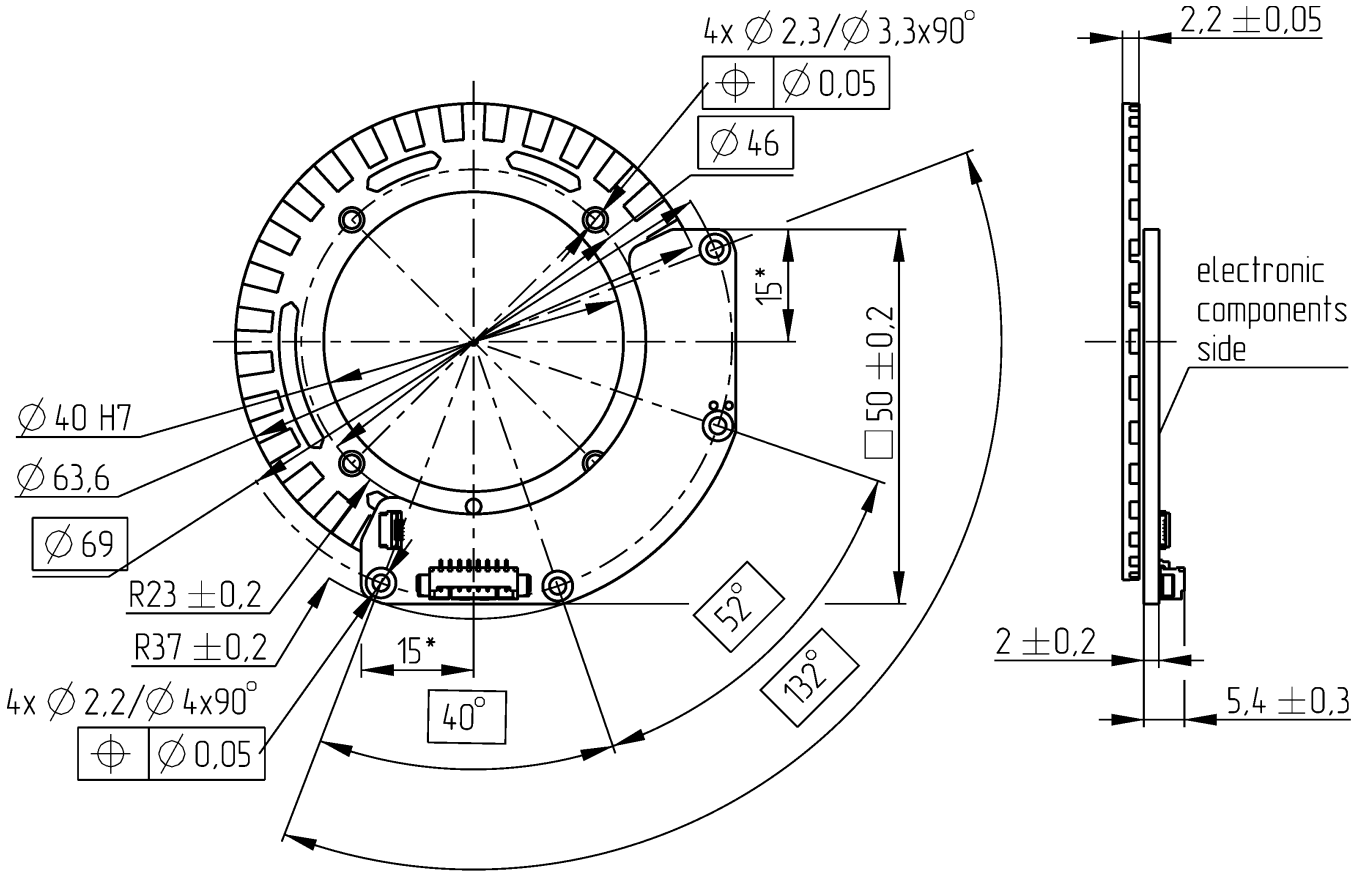
- made of aluminum alloy (rotor designation A)
- made on a printed circuit board (PCB) — ”variant” in the drawing, rotor designation P .

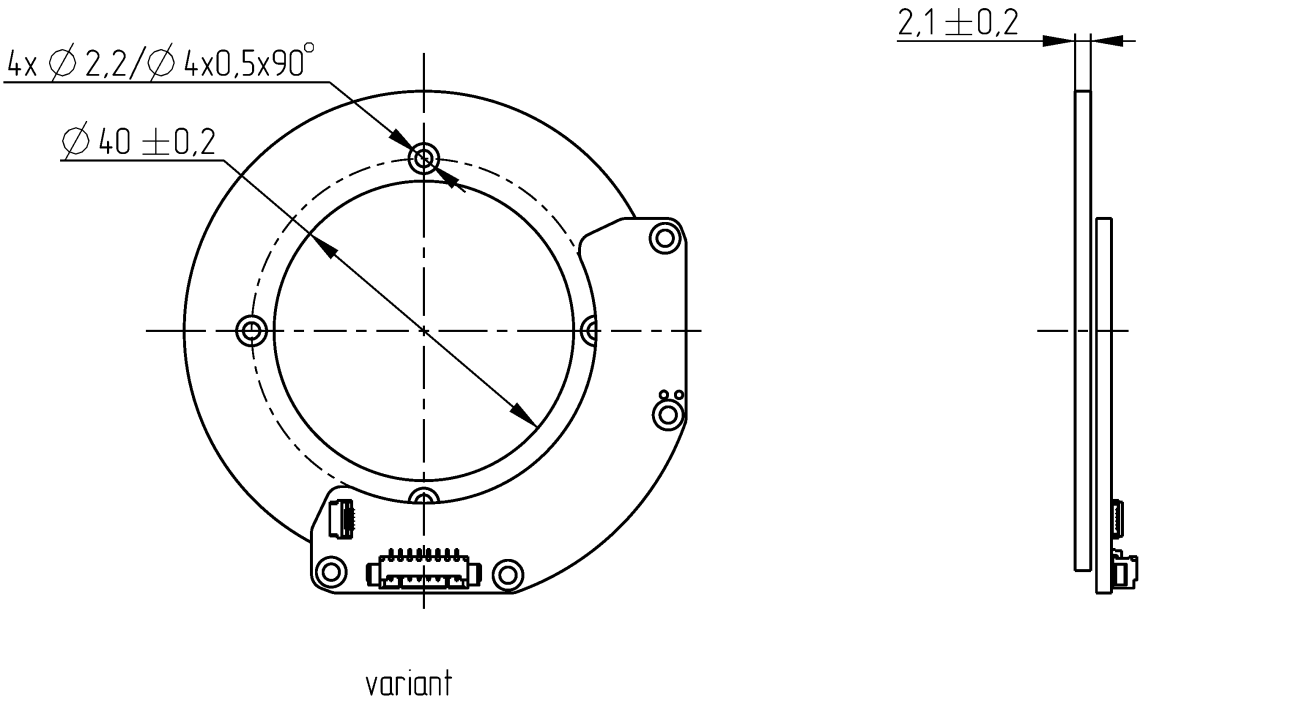
The concentricity of the rotor and stator of the SAB049 encoder is ensured by:

- for metal rotors A , an H7/g6 fit is used;
- for PCB rotors P , positional tolerances of the holes for the screws relative to the axis of rotation are ±0.025 mm (0.05 mm in diametrical terms).

For the stator, positional tolerances relative to the datum axis of rotation are ±0.05 mm (0.1 mm in diametrical terms).

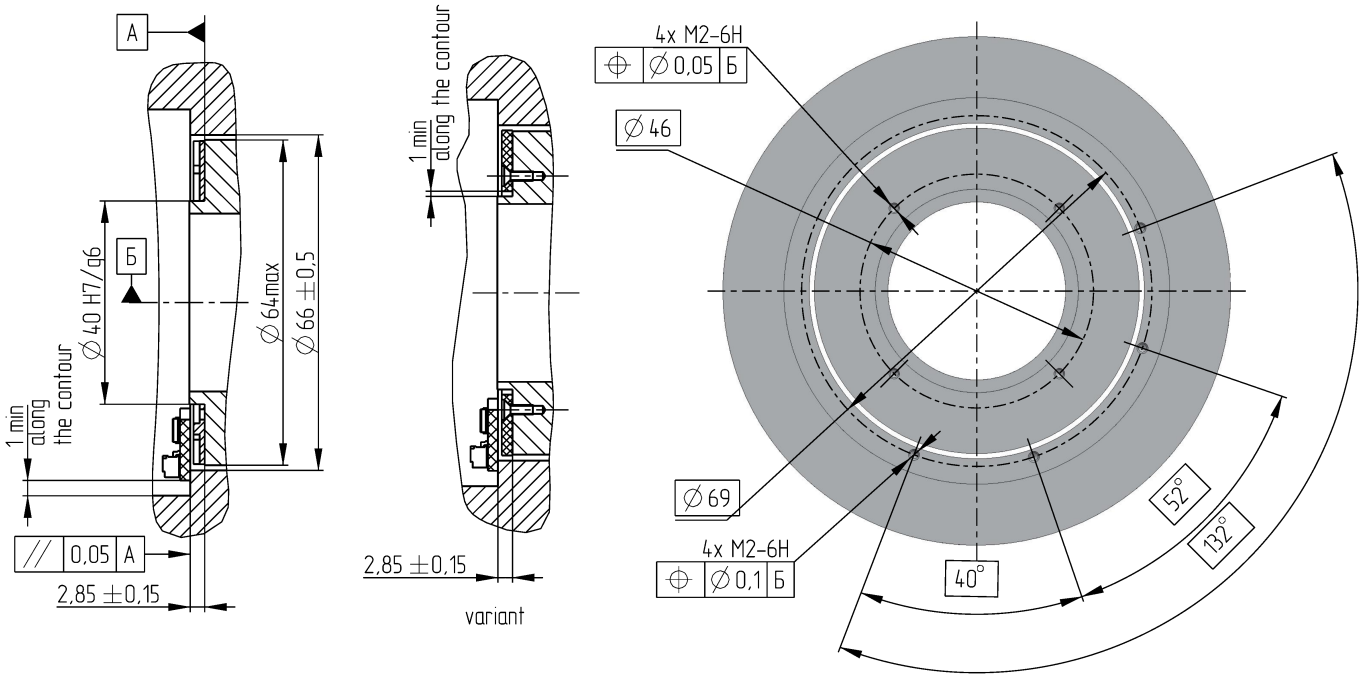
Mechanical dimensions SAB064:





variant

Mounting SAB064:



The drawings show two versions of the rotor:

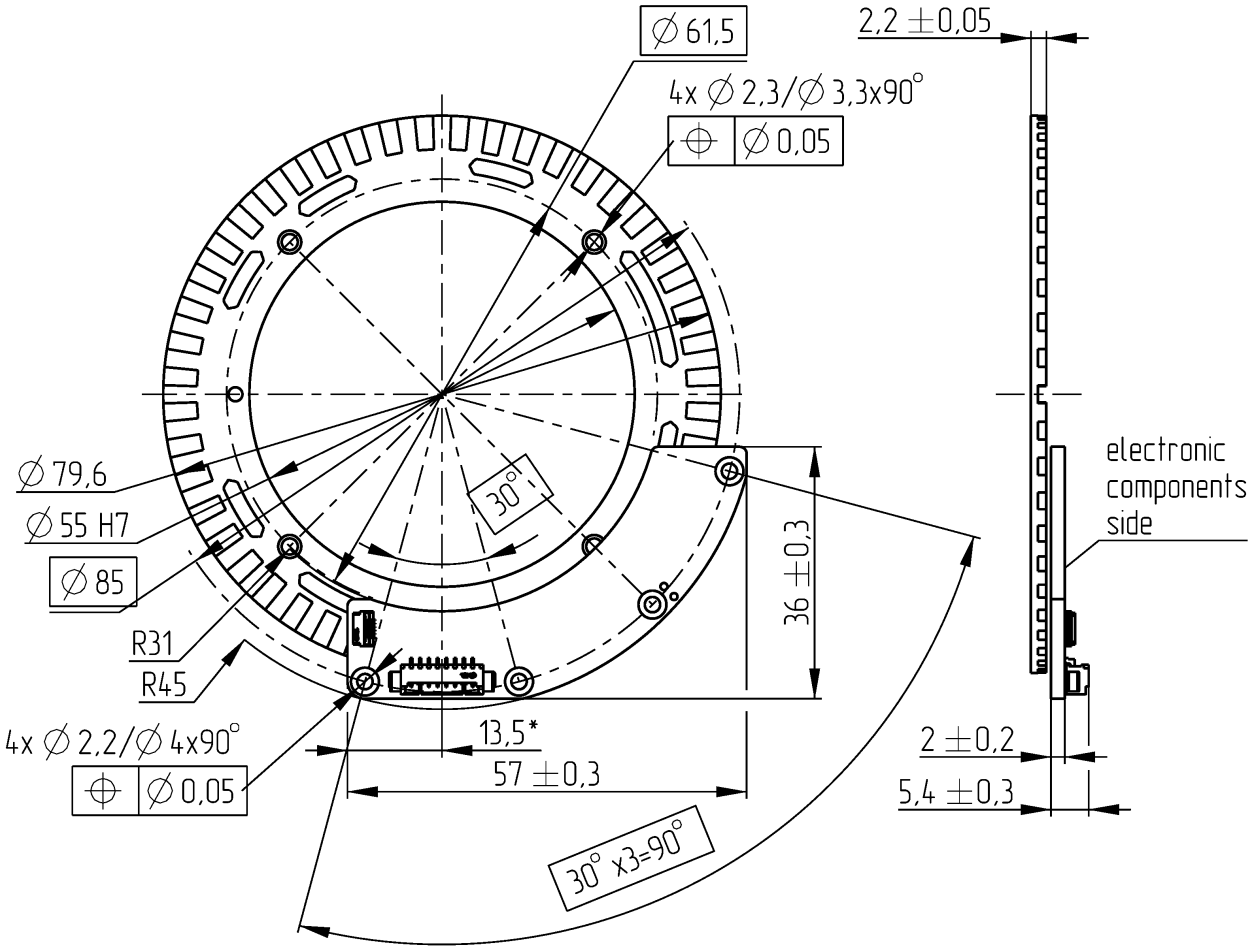
- made of aluminum alloy (rotor designation A)
- made on a printed circuit board (PCB) — ”variant” in the drawing, rotor designation P .

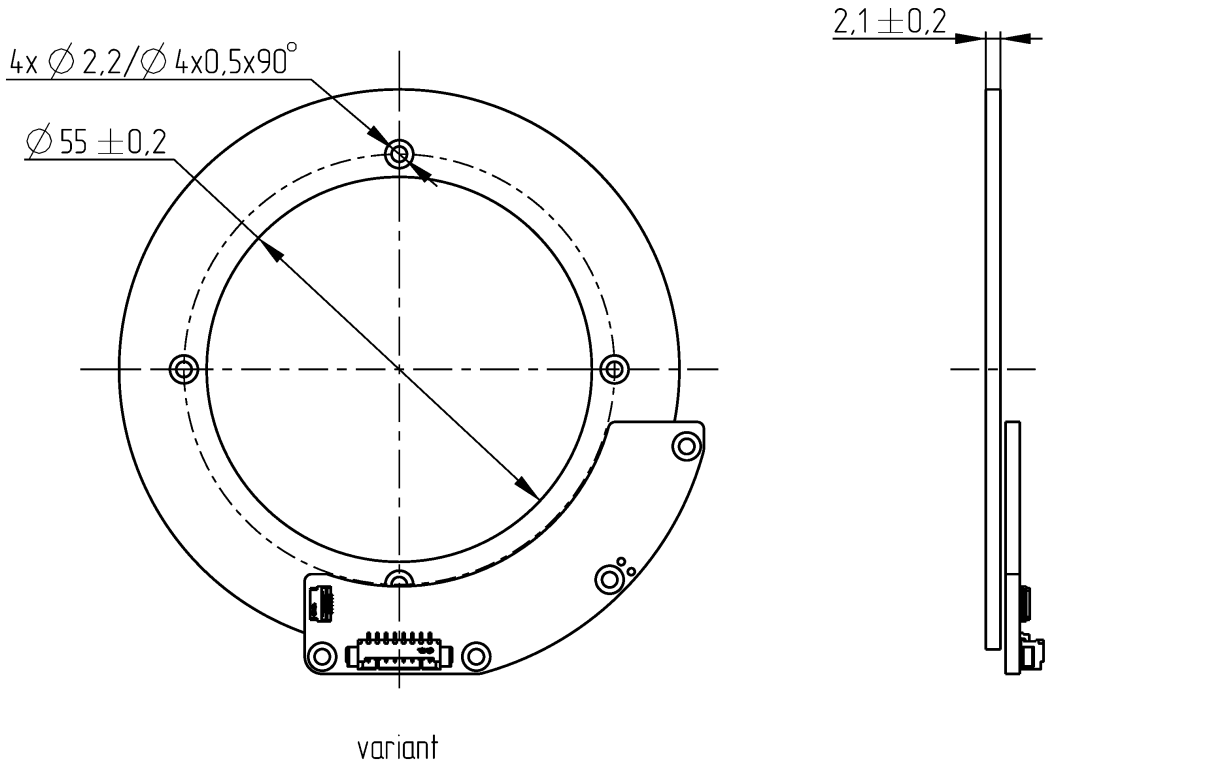
The concentricity of the rotor and stator of the SAB064 encoder is ensured by:

- for metal rotors A , an H7/g6 fit is used;
- for PCB rotors P , positional tolerances of the holes for the screws relative to the axis of rotation are ±0.025 mm (0.05 mm in diametrical terms).

For the stator, positional tolerances relative to the datum axis of rotation are ±0.05 mm (0.1 mm in diametrical terms).

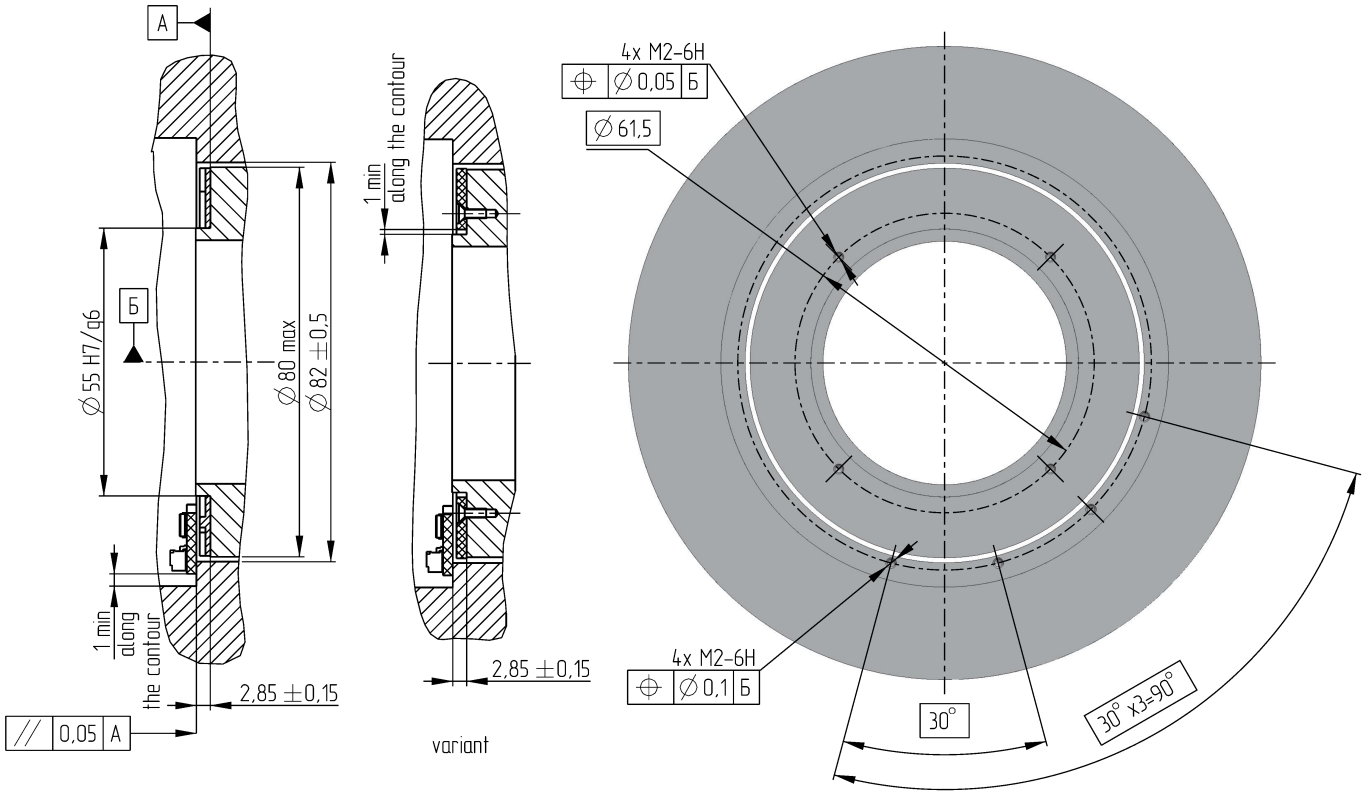
Mechanical dimensions SAB080:





variant

Mounting SAB080:



The drawings show two versions of the rotor:

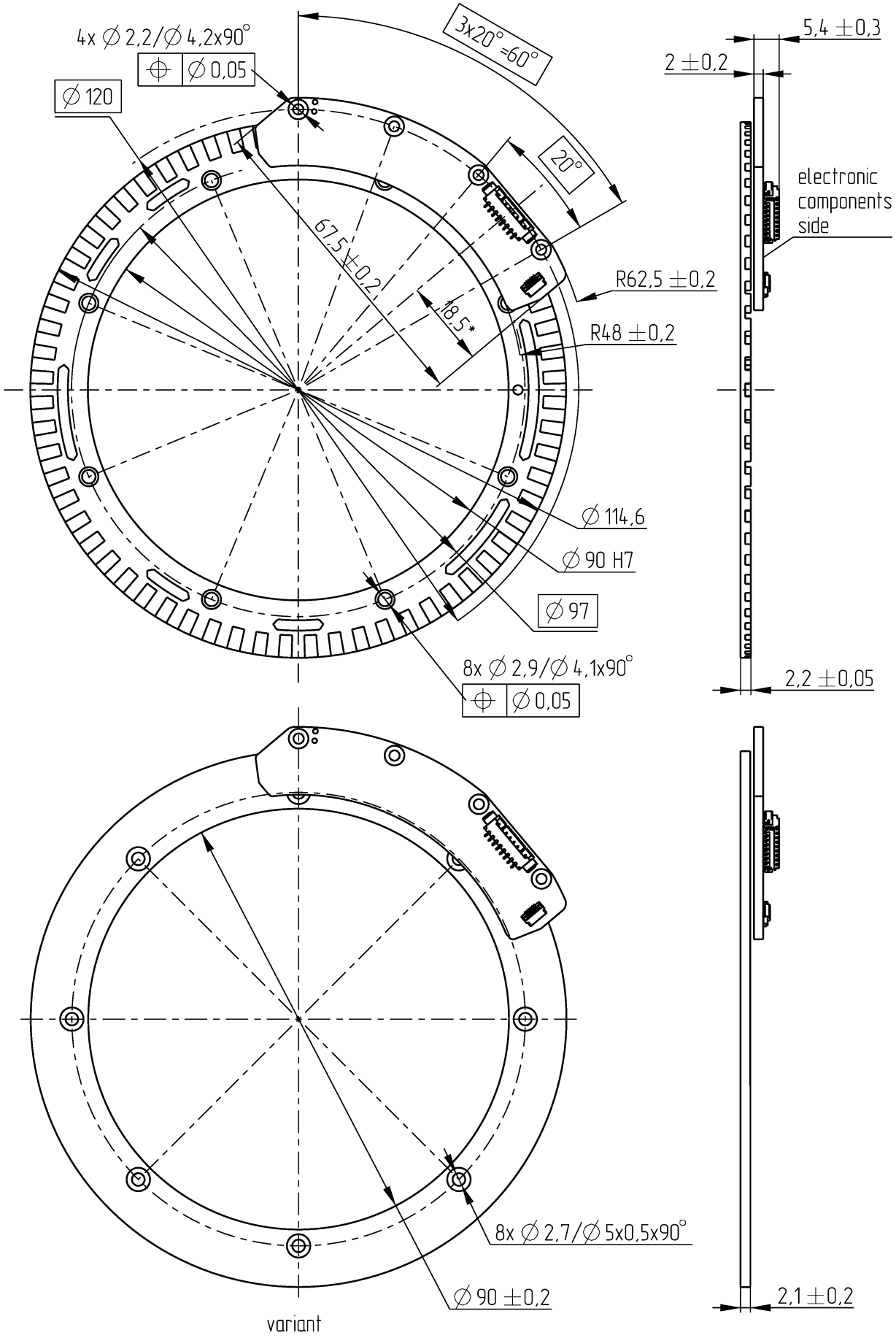
- made of aluminum alloy (rotor designation A)
- made on a printed circuit board (PCB) — ”variant” in the drawing, rotor designation P .

The concentricity of the rotor and stator of the SAB080 encoder is ensured by:

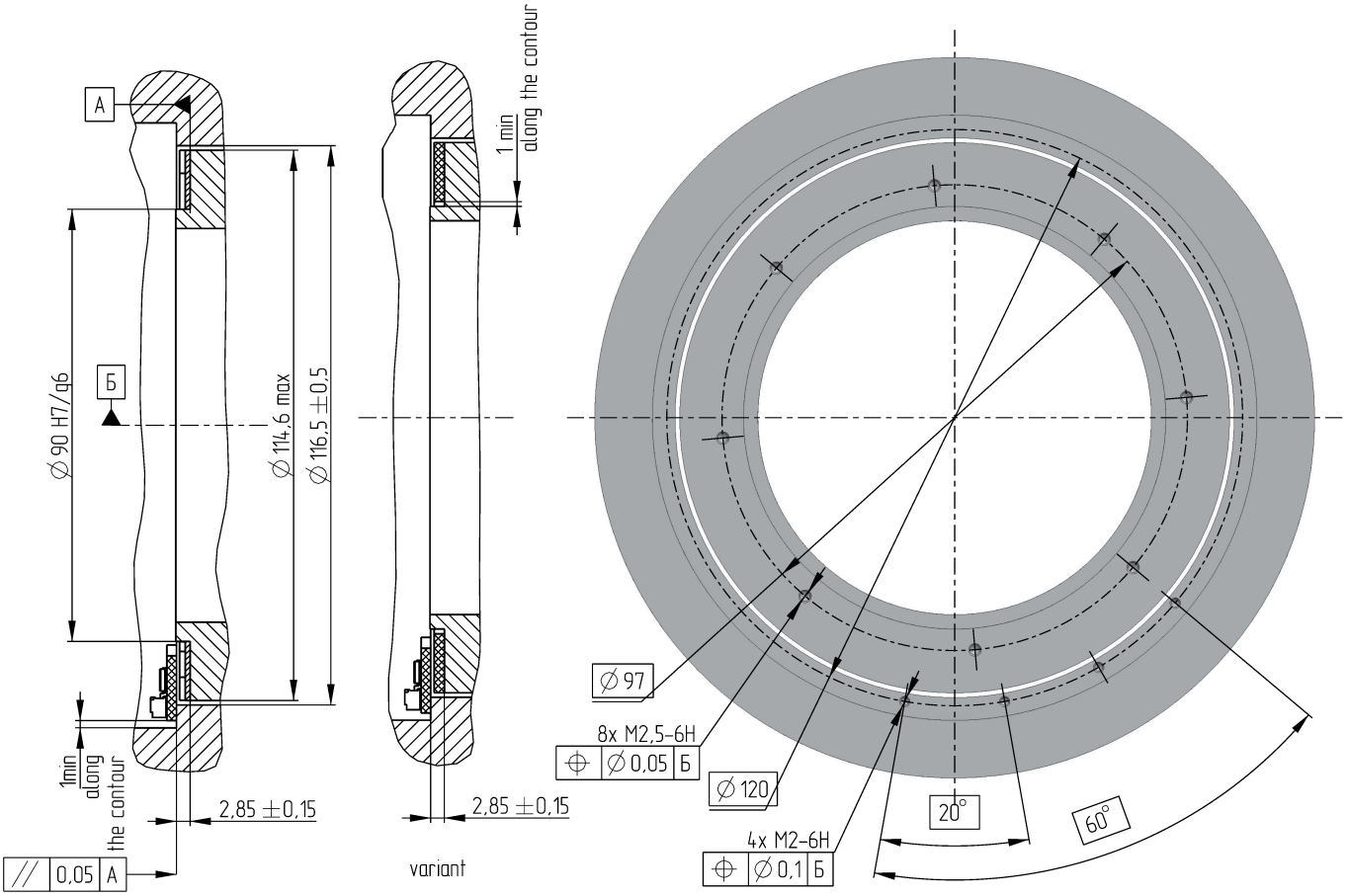
- for metal rotors A , an H7/g6 fit is used;
- for PCB rotors P , positional tolerances of the holes for the screws relative to the axis of rotation are ±0.025 mm (0.05 mm in diametrical terms).

For the stator, positional tolerances relative to the datum axis of rotation are ±0.05 mm (0.1 mm in diametrical terms).

Mechanical dimensions SAB115:



Mounting SAB115:



The drawings show two versions of the rotor:

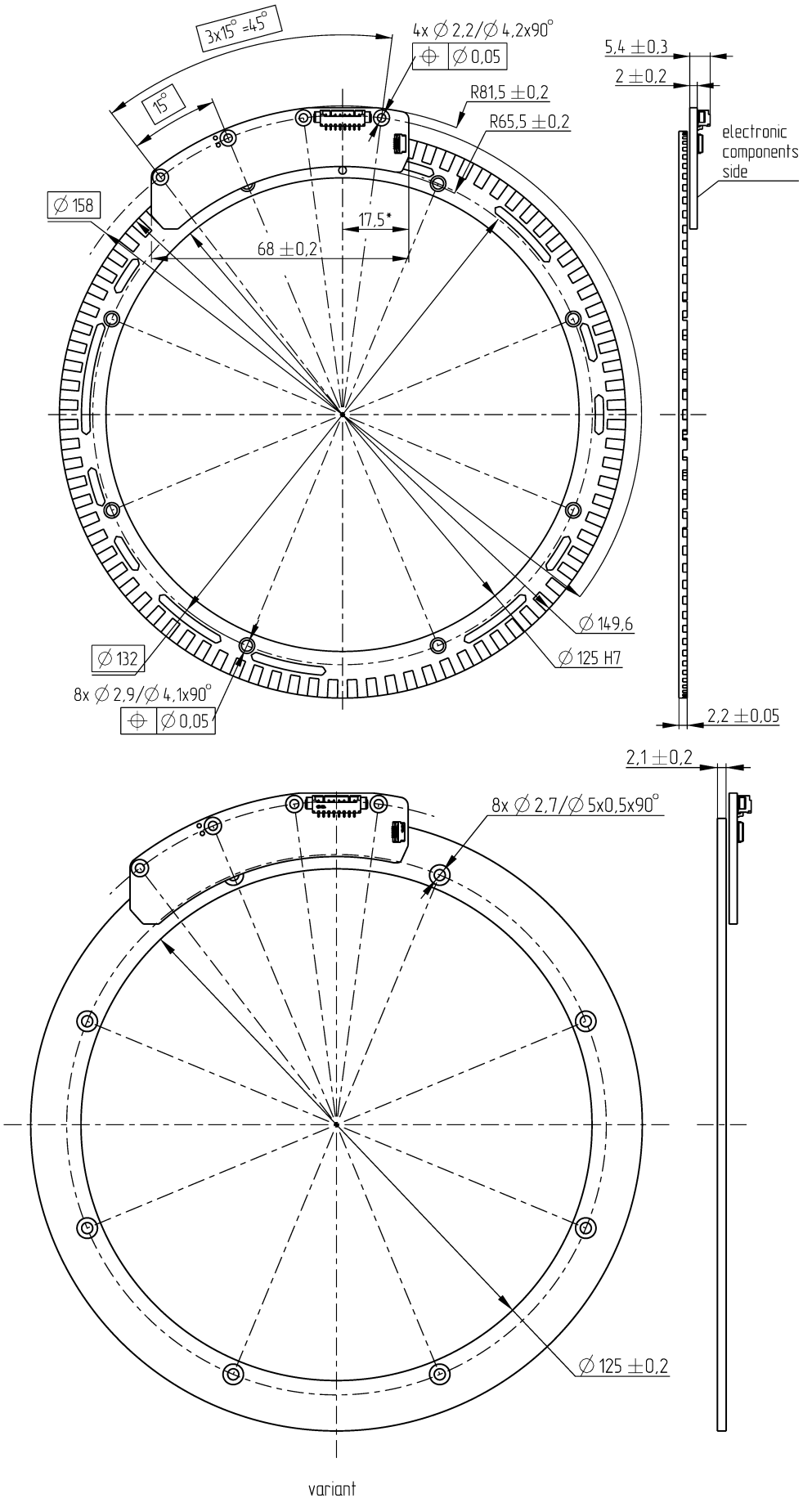
- made of aluminum alloy (rotor designation A)
- made on a printed circuit board (PCB) — ”variant” in the drawing, rotor designation P .

The concentricity of the rotor and stator of the SAB115 encoder is ensured by:

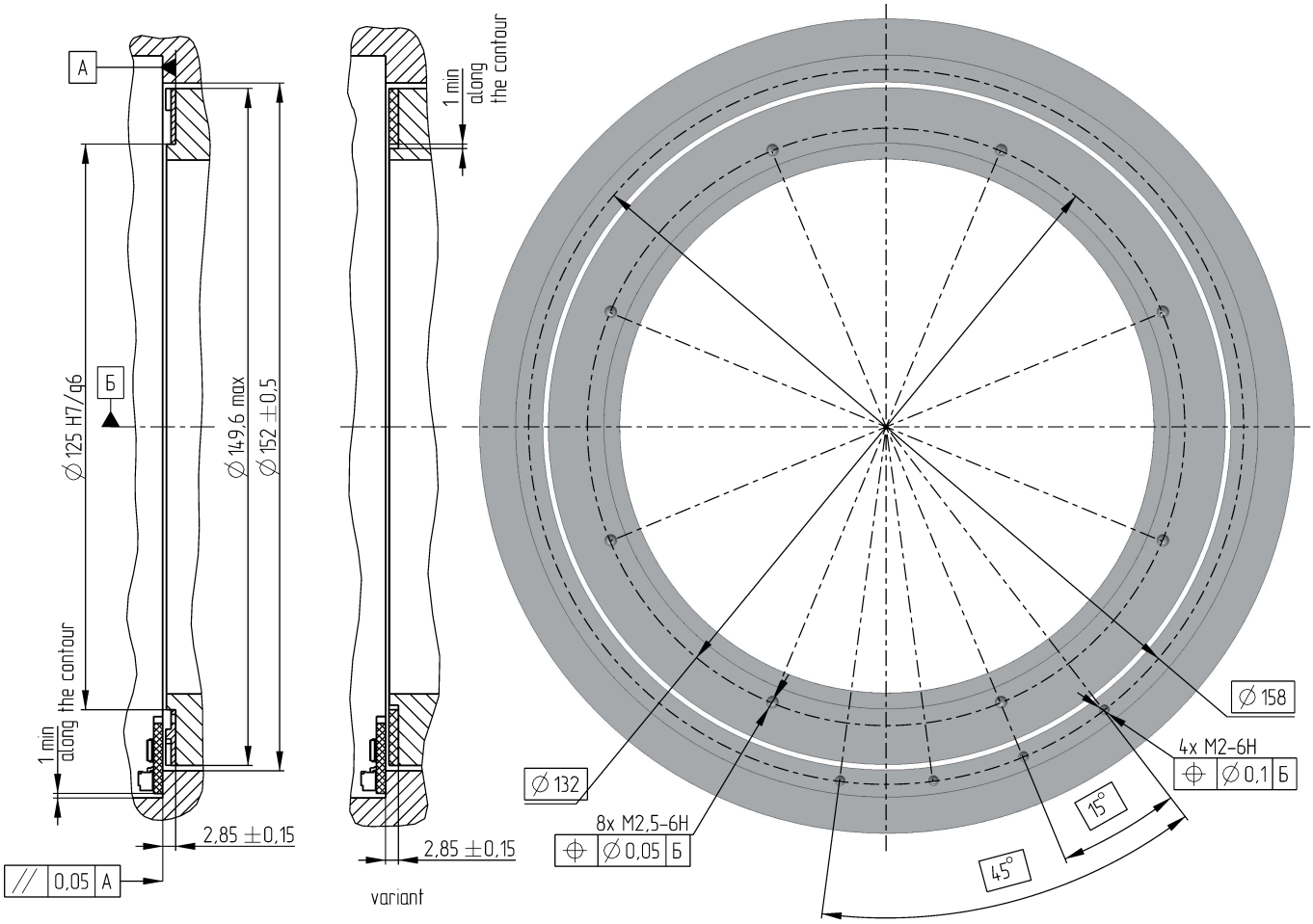
- for metal rotors A , an H7/g6 fit is used;
- for PCB rotors P , positional tolerances of the holes for the screws relative to the axis of rotation are ±0.025 mm (0.05 mm in diametrical terms).

For the stator, positional tolerances relative to the datum axis of rotation are ±0.05 mm (0.1 mm in diametrical terms).

Mechanical dimensions SAB150:



Mounting SAB150:



The drawings show two versions of the rotor:

- made of aluminum alloy (rotor designation A)
- made on a printed circuit board (PCB) — ”variant” in the drawing, rotor designation P .

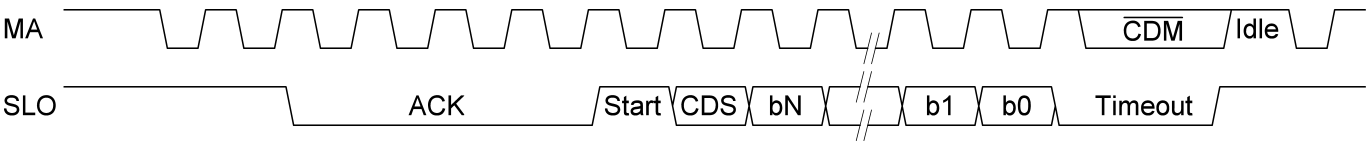
The concentricity of the rotor and stator of the SAB150 encoder is ensured by:

- for metal rotors A , an H7/g6 fit is used;
- for PCB rotors P , positional tolerances of the holes for the screws relative to the axis of rotation are ±0.025 mm (0.05 mm in diametrical terms).

For the stator, positional tolerances relative to the datum axis of rotation are ±0.05 mm (0.1 mm in diametrical terms).

LENZ BiSS® C B3 интерфейс:

The LENZ B3 interface is an implementation of the BiSS® C bidirectional isochronous point-to-point interface for fast acquiring of angular information, reading EDS (Electronic Data Sheet), and encoder configuration. More information is available on the BiSS® website: www.biss-interface.com



MA — Clock pulse output of the BiSS C master;
SLO — Data output of the BiSS C slave;
ACK — 4 TMA;
SCD — 32 bits: b31…b0;
Position data size — 24 bits: b31…b8, MSB first;
Error bit b7 — logic high when angle data is valid or not fully initialized;
Warning bit b6 — logic low when absolute position can't recover on restart or the air gap between the rotor and stator is too large;
CRC6 b5…b0 — the CRC polynomial for position, error and warning data (b31…b6) is: $x^6 + x^1 + x^0$, start 0, the CRC bits are transmitted inverted;
MA frequency: 100 kHz … 5 MHz (up to 1.5 MHz for systems without line delay control);
Timeout — pause of 13 µs.

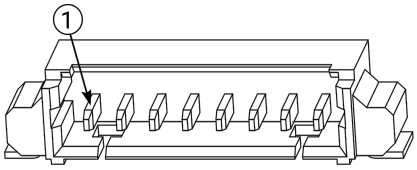
Timing information:

	Minimum	Typical	Maximum
MA clock frequency, 1/TMA, МГц	0,1		5
BISS timeout, µs	12,6	12,9	13,2
Delay MA →SL include slave, MA input and SLO output RS485 drivers delays, ns		50	
Line delay due to cable length, MA + SLO, ns/m		10	
Idle time, ns	100		
SCD request rate, kHz 1/TMA = 5 Mhz, Idle = 100 ns			47,5

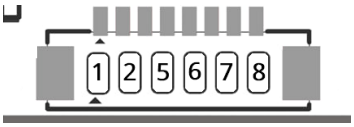
Encoder Pinout:

Pin	Circuit
1	Vcc
2	GND
3	T+
4	T-
5	MA+
6	MA–
7	SLO+
8	SLO-

Connector (designation N):

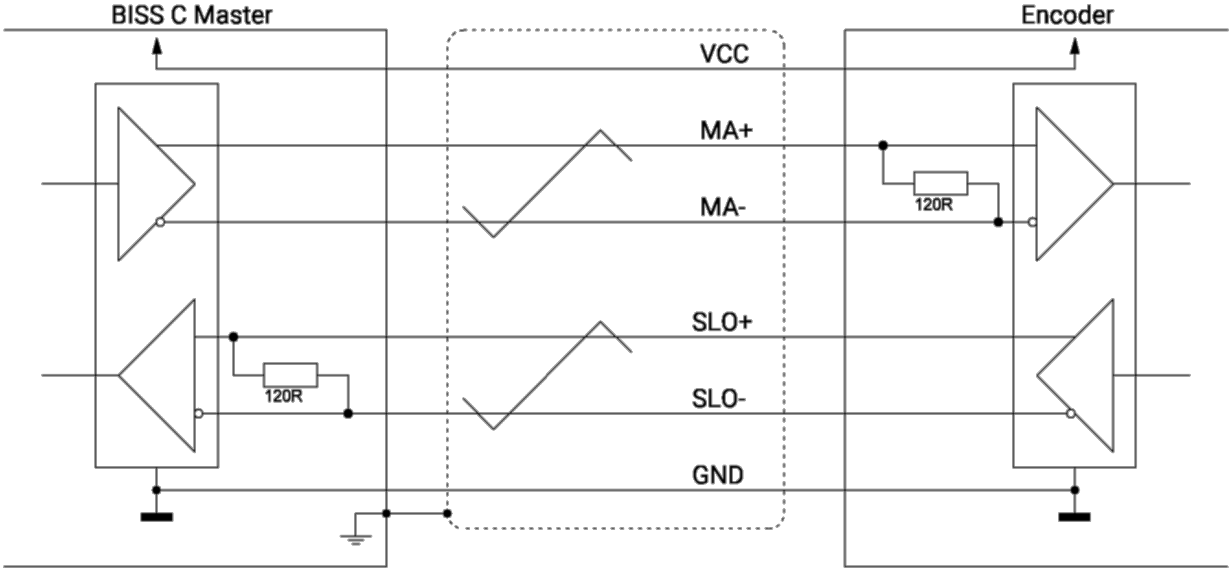


Solder pads (designation P):



The dimensions of the solder pads (designation P) are 1.2 x 2.25 mm, pitch — 1.8 mm.

Connection Diagram:



The MA and SLO lines are 5 V RS422 compatible differential pairs with termination resistor inside the encoder.

Encoder programming:

Encoders support access to BiSS registers, which allows: setting the zero position of the encoder, setting the angle offset, changing the direction of rotation, initiating amplitude auto-calibration, loading correction tables into the encoder, reading temperature, signal amplitude, supply voltage, statuse bits, and the electronic datasheet.
For more details on encoder programming, refer to the ACTIS programming guide on the website lenzencoders.com.

Stator part numbering:

Example of stator designation: **SAB 039 C 20B R P T 00**

Series

SAB	ACTIS induction encoder stator

Compatibility with rotor

039	For use with SAR039 rotor
049	For use with SAR049 rotor
064	For use with SAR064 rotor
080	For use with SAR080 rotor
115	For use with SAR0115 rotor
150	For use with SAR0150 rotor

Communication interface

C	BiSS C interface

Resolution

20B	20 bits
21B	21 bits
22B	22 bits
23B	23 bits
24B	24 bits

Design

R	Two readers on one stator board for redundancy

Connector option

P	Solder pads
N	Amphenol FCI 10114830-11108LF 8 pin connector

Temperature range

T	Extended temperature range –40...+105 °C (standard)

Special requirements

00	No special requirements (standard)

Rotor part numbering:

Example of rotor designation: **SAR 039 B 040 P S 00**

Series

SAR	ACTIS induction encoder rotor

Outer diameter and compatibility with stator

039	39 mm
049	49 mm
064	64 mm
080	80 mm
115	115 mm
150	150 mm

Thickness

B	2.0 mm

Inner diameter

040	40 mm

Material

P	PCB
A	Aluminium alloy 6061ϭ anodized

Zero marking

S	Silk

Special requirements

00	No special requirements (standard)

Contact us

Head office:

Russian Federation, Saint-Petersburg, Komsomola st., 1-3
e-mail: info@lenzencoders.com
tel. +7-921-424-9600

Telegram: @lenzencoders
Website: lenzencoders.com
GitHub: github.com/lenzencoders
3D models repository for encoders: github.com/lenzencoders/Encoders_Description/tree/main/CAD

Telegram
@lenzencoders

Website
lenzencoders.com