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ELGO ELECTRONIC

Operating Instructions

SERIES *CMAX2*

Magnetic absolute length and angle measurement
for linear and rotary applications

Published by ELGO Electronic GmbH & Co. KG

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1 Table of contents

2 General information

2.1 Information on the operating instructions

These operating instructions provide important information on handling the unit.
For your own safety and operational reliability, observe all warnings and instructions!

Compliance with the specified safety instructions and handling instructions is a basic requirement for safe working.
In addition, the local accident prevention regulations and general safety regulations applicable at the place of use of the unit must be observed.

The operating instructions must be read carefully before starting any work.
They are an integral part of the product and must be kept in the immediate vicinity of the appliance and accessible to personnel at all times. The illustrations in this manual are not necessarily to scale and may differ slightly from the actual design.

2.2 Terms and abbreviations

Abbreviation/ Term	Meaning
MPC	Number of pole pairs of the master track (**M**aster **P**eriod **C**ount)
OD	Outer diameter of the magnet ring (**O**uter **D**iameter)
ID	Inner diameter of the magnet ring (**I**nner **D**iameter)
FRR	Frequency at which the values are read in (**F**rame **R**epetition **R**ate)
MRR	Measuring standard for magnetic measurement (**m**agnetic **r**ing **r**adial)
MRA	Measuring standard for magnetic measurement (**m**agnetic **r**ing **a**xial)

2.3 Explanation of symbols

Special instructions are marked with symbols in these operating instructions.
The instructions are introduced with signal words, which express the extent of the hazard.
Always comply with the instructions and act prudently to prevent accidents, personal injury and property damage.

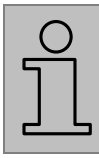
Warnings:

	DANGER This symbol in connection with the signal word 'Danger' means an imminent danger to life and health. Failure to follow these instructions will result in serious health-related effects, including life-threatening injuries.
	WARNING This symbol in connection with the signal word 'Warning' means a possible imminent danger to life and health. Failure to follow these instructions can result in serious health-related effects, including life-threatening injuries.
	CAUTION This symbol in connection with the signal word 'Caution' means indicates possibly dangerous situation. Failure to observe these warnings may lead to injuries or to damage to property.

Special safety instructions:

	DANGER This symbol in connection with the signal word 'Danger' means an imminent danger to life and health due to a hazardous voltage. Failure to follow these instructions will result in serious health-related effects, including life-threatening injuries. The work to be performed may only be carried out by a qualified electrician.

Tips and recommendations:

	NOTE ... provides useful tips and recommendations, as well as information for efficient and fault-free operation.

References:

(☞ 1.2)	Indicates a reference to section 1.2 of these operating instructions
(🕮 DOK 3.4)	Indicates a reference to section 3.4 within the document *DOC*

2.4 Warranty provisions

The warranty provisions can be found as a separate document in the sales documentation.

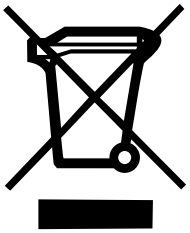
Warranty:
The manufacturer guarantees the functionality of the applied process technology and the designated performance parameters. The warranty period of one year begins on the date of delivery.

2.5 Disassembly and disposal

If no return or disposal agreement has been made, disassemble the unit properly in accordance with the safety instructions in this operating manual and dispose of it in an environmentally friendly manner.

Before disassembly:
Switch off the power supply and make sure it cannot be switched on again, then physically disconnect power supply lines and discharge any stored residual energy.
Remove operating and auxiliary materials as well as residual processing materials.

For disposal:
Disassembled components should be disposed of as follows:



- metallic components to metal scrap
- electronic components to electrical scrap
- plastic parts for recycling
- dispose of other components sorted according to the kind of material

CAUTION
Incorrect disposal can cause environmental damage.
Electrical scrap, electronic components, lubricants and other auxiliary materials are subject to special waste treatment and may only be disposed of by authorised specialist companies.

Local authorities and waste management companies provide information on environmentally sound disposal methods.

3 Safety

NOTE
Please read the operating instructions carefully before using the unit. The installation instructions must be observed. Only operate the unit if you have understood the operating instructions.

The operator is obliged to take and implement appropriate safety-related measures.
The unit may only be commissioned by qualified personnel authorised and instructed by the operator.

3.1 General hazards

This section provides an overview of all important safety aspects for optimum protection of the personnel as well as safe and trouble-free operation.
Considerable risks can arise if the handling and safety instructions provided in these instructions are not observed.

3.2 Personal protective equipment

Personal protective equipment must be worn when assembling the unit to minimise health hazards.

Therefore:
Before starting any work, put on each item of specified protective equipment properly and wear it during work. It is essential to observe any additional signs for personal protective equipment in the work area.

The following must be worn at all times during work:

PROTECTIVE WORK CLOTHING
Close fitting work clothing, with snug sleeves and without projecting parts. It is mainly used to protect against being caught by moving machine parts.
Wear no rings, chains or other jewellery.

PROTECTIVE GLOVES
To protect the hands from grazes, abrasions or similar superficial injuries to the skin.

HELMET
To protect the head from injury.

3.3 Intended use

The product described in this manual has been developed to perform metrological functions as part of an overall system or machine. It is the responsibility of the manufacturer of a system or machine to ensure the correct overall function. The ELGO device is designed exclusively for the purpose described here.

The CMAX2 - ELGO - angle and length measuring system is used exclusively to measure angles or distances.

WARNING
Danger due to improper use!

Any use of the device beyond the intended use and / or different use can lead to dangerous situations.

Therefore:

- Use the device only as intended
- Adhere strictly to all specifications in these operating instructions

In particular, refrain from the following unintended uses of the device:

- Modification, conversion or alteration of the design or individual parts of the equipment with the aim of changing the area of application or the usability of the unit.

Claims of any kind for damage resulting from non-intended use are excluded. The user of the device is solely liable for all damage in case of non-intended use.

4 Transport and storage

4.1 Safety instructions for transport, unpacking and loading

CAUTION
Transport packaging (cardboard box, pallet, etc.) properly, do not throw, bump or tilt.

4.2 Handling packaging materials

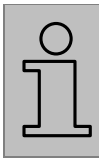
Information on proper disposal: ☞ 2.5.

4.3 Transport inspektion

Check deliveries immediately on receipt for completeness and transport damage.

Where there is externally visible transport damage:

- Do not accept the delivery or accept with reservations only.
- Indicate the extent of damages on the transport documentation or on the delivery note
- Initiate a claim immediately.



NOTE
Submit a claim for any defect as soon as it is recognized. Claims for compensation may only be asserted within the applicable claim periods.

4.4 Storage

Store the unit only under the following conditions:

- Do not store outdoors
- Store in a dry, dust-free place
- Do not expose to any corrosive substances
- Protect against sunlight
- Avoid mechanical shocks
- The storage temperature (☞ 6 Technical data) must be maintained
- Do not exceed the relative humidity (☞6 Technical data)
- If stored for more than three months, regularly check the general condition of all parts and packaging

5 Product features

The CMAX2 is a magnetic absolute sensor system designed for linear measuring lengths up to 192 mm or for rotary applications with a diameter up to 61 mm. The sensor system with integrated evaluation electronics is installed in a compact plastic housing. The data is output at the connector in BiSS-C interface format.
The sensor system processes travel speeds of up to 19 m/s in linear applications using a coded magnetic tape. Speeds of up to 24,000 rpm (depending on resolution and number of poles) can be processed in the rotary range using a coded magnetic ring.

The features at a glance:

- Magnetic absolute measurement with up to 20-bit resolution
- For linear and rotary applications
- Space-saving installation solution
- Non-contact, wear-free measuring principle
- Communication via BiSS-C or SSI
- Additional incremental output signals (ABZ quadrature signals, 5 V TTL)

5.1 Linear measurement with magnetic tape

For linear measuring tasks, the two-track absolutely encoded magnetic tape is stuck onto a flat base surface using the adhesive tape supplied. The absolute measuring system is operated with a reading distance of up to 0.5 mm depending on the pole width (see Table 1 or Table 6). The width of the magnetic tape is usually 10 mm.

5.2 Rotary application with magnetic ring

A magnetic tape is connected to a steel ring for radial or axial measuring tasks. This 'magnetic ring' contains 32, 64 or 128 individual poles, depending on the vernier pattern and diameter selected. It is assembled on the axle either by thermal fitting or gluing.

5.3 Operating principle

A master track and a vernier track, each consisting of an alternating north/south pole magnetisation, are encoded on a magnetic tape and on a magnetic ring, respectively. The two tracks have the same start and end point. For example, 64 periods (one north and one south pole each, MPC = 64) are encoded on the master track. One pole pair less than on the master track is always encoded on the vernier track. As a result, the pole length of the individual poles on the vernier track is greater than the pole length of the master track. The difference between the two tracks or the pole boundaries allows a clear position to be determined. There is always a defined phase offset between the individual magnetic tracks. It is possible to clearly assign the absolute position based on the combination of the phase position of the two magnetic tracks.
The pole pitch can be either 1.28 mm or 1.50 mm.
For illustration purposes, an example of the vernier principle is shown below using a section of the 64/63 vernier pattern.

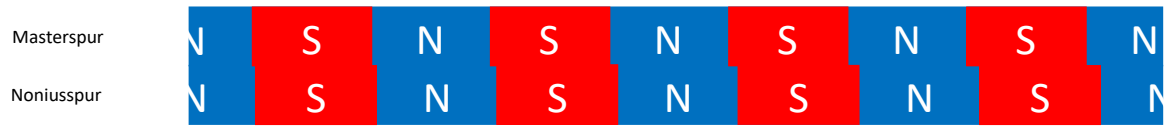


Figure 1: Illustration of vernier principle

5.4 The absolute measurement principle

With the absolute measurement principle, the absolute position is known at any time and at any point. At each (re)start, the absolute position is determined based on the existing magnetic information without any movement.

When installed, the measuring system must be calibrated before it is put into operation for the first time. This enables the mechanical tolerances of the components of the measuring system to be adjusted to each other thus avoiding errors during normal operation. For more information on the calibration process, see the section on calibrating the CMAX2 (see 7.5).

See Figure 2 for an explanation of the absolute measurement principle based on the vernier principle. It contains an example of a vernier pattern with six periods, i.e. six pole pairs on the master track and five periods on the vernier track. The marked measuring points (1) serve here as an example position. This position is clear and absolute in the period. However, viewed over the entire pattern, this position occurs six times. In order to achieve a clear position allocation across the entire pattern, the vernier track is added. In order to determine an unambiguous and absolute position, a period of the vernier track is notionally divided into as many parts as the master track has periods. In this example, six sections are defined. The position of the master track is combined with another segment of the vernier track. Combining both tracks makes it possible to determine an unambiguous and absolute position.

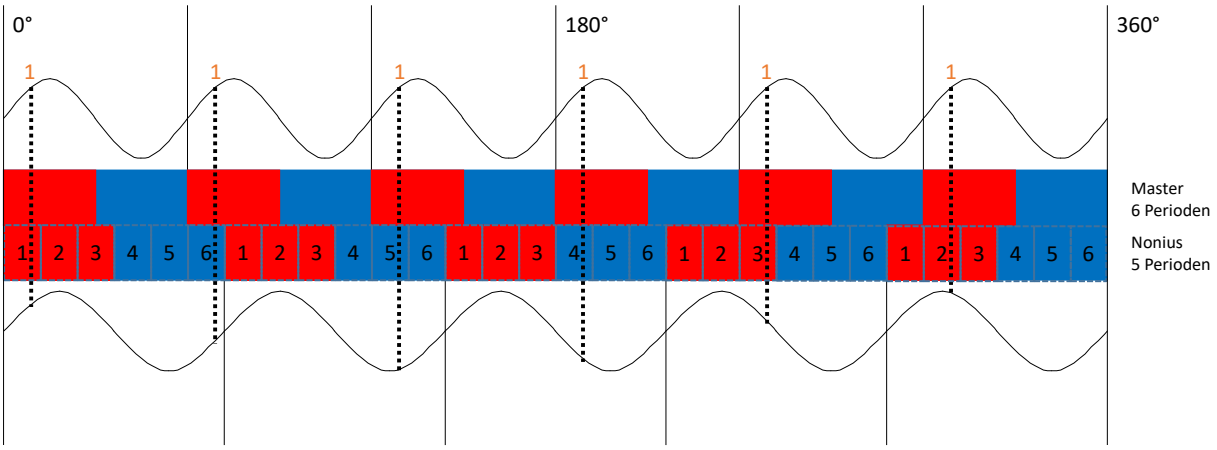


Figure 2: Absolute measurement principle on the vernier

This principle can be applied to any number of vernier patterns. As the number of periods on the individual tracks increases, the phase difference becomes significantly smaller. The decreasing phase difference also requires more and more accurate measurement and less and less interference (mechanical). As a result, the requirements for mechanical accuracy increase with the number of periods.
A third track can be used as soon as the phase difference becomes too small. This procedure does not apply to the CMAX2 and is not described further.

6 Technical data

6.1 Identification

The type plate is used for precise identification of the unit. It is located on the housing of the encoder and provides information about the exact type designation (= type code, see section 11.1).
The type plate also contains the manufacturing date (D) , a unique traceable serial number (S), the item number) associated with the type code, installation information, as well as additional information in the QR code).
To make it easier for you to get the support you need, please feel free to contact us with these details and your questions.

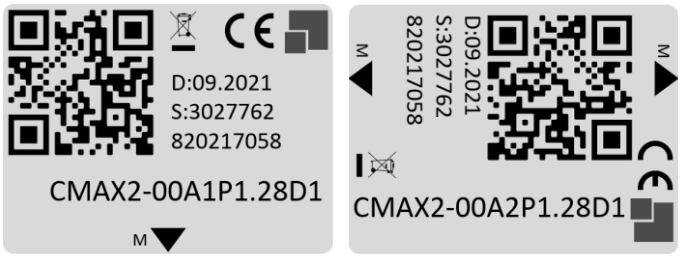


Figure 3: Type plates for identification of the encoder

The arrows with the adjacent 'M' mark point to the centre of the magnetic pattern in the direction of measurement. The 'M' mark shows the side of the master track. This is relevant for correctly aligning the encoder on the magnetic pattern and for the exact function.

6.2 Encoder dimensions

Dimensions in mm:

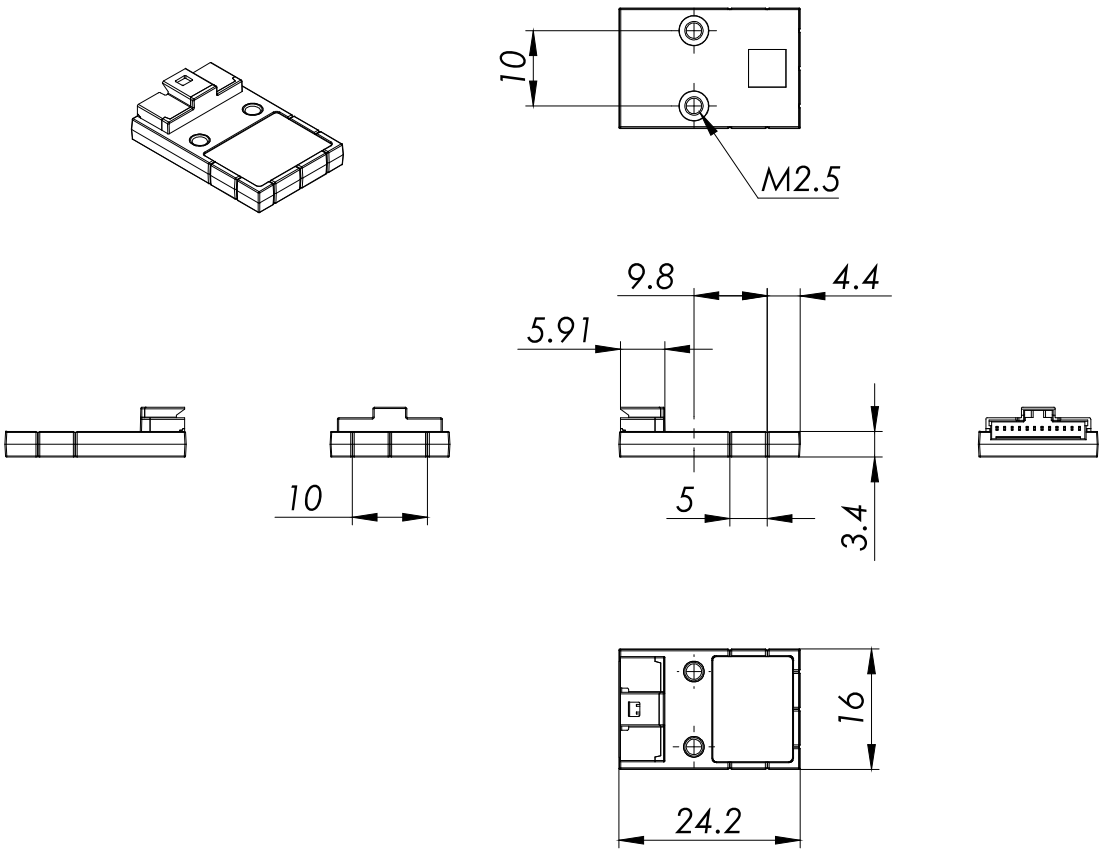


Figure 4: CMAX2 encoder dimensions

6.3 Encoder technical data

Table 1: Technical data

CMAX2 (Standard version)	
Mechanical data	
Measurement principle:	Absolute
Measurement method:	Linear, rotary
Repeatability:	±1 increment
System accuracy at 20 °C:	±20 µm
Encoder distance to the magnetic tape:	P1.28: 0.4 mm P1.50: 0.5 mm
Housing material:	Hotmelt
Housing dimensions:	L x W x H = 24.2 x 16 x 6.6 mm³
Required magnetic tape:	Vernier, 2-track
Maximum measuring length:	P1.28: 163.84 mm P1.50: 192 mm
Connection type:	12 pin socket, Molex (series: Pico-Clasp, 501568-1207)

Encoder cable (optional):	1 m standard length, shielded, twisted pair, control cable (others on request, max. 3 m)
Encoder weight:	Approx. 2.7 g without cable
Electrical data	
Supply voltage:	+5 V_{DC} ±5%
Residual ripple:	< 10%
Current consumption:	Approx. 65 mA @ 5 V_{DC}
Interfaces:	BiSS-C, SSI, ABZ
Output levels:	Absolute: RS485/RS422 Incremental: Push-Pull
Reverse polarity protection:	Not integrated
Protection of the outputs/interfaces:	Not short-circuit proof
Resolution (absolute):	Up to 18 Bit @ MPC = 16 Up to 19 Bit @ MPC = 32 Up to 20 Bit @ MPC = 64
Resolution (incremental):	4 to 262144 increments (in steps of four)
Max. operating speed	Up to 19 m/s (depending on pole pitch and configuration)
Environmental conditions	
Operating temperature:	-20 °C to +60 °C
Storage temperature:	-40 °C to +80 °C
Relative humidity:	Max. 95%, non-condensing*
Protection class:	IP60 (when plugged in; according to EN 60529)
EMC Interference emission / interference immunity:	According to EN 61000

*preliminary

6.4 Magnetic tape technical data

The magnetic tape consists of two components:

- The actual magnetic tape that carries the position information
- A stainless steel mechanical backstrap

Table 2: Magnetic tape specification

Magnetic tape AB30-AAAAA-10-2-R-EE-EPSxx *(see section 11.2.2 for examples with type code)*	
Coding:	Vernier, dual-track system
Pole pitch:	1.28 mm/1.50 mm
Operating temperature processed:	-20 °C to +65 °C (-20 °C to +80 °C when used without adhesive tape, option 'B' or 'D')
Storage temperature unprocessed:	Short term: -10 °C to +60 °C Medium term: 0 °C to +40 °C Long term: +18 °C (-20 °C to +80 °C when used without adhesive tape, option 'B' or 'D')
Adhesion temperature:	+18 °C to +30 °C
Relative humidity:	Max. 95%, non-condensing
Accuracy at 20 °C in mm:	+/- (0.025 + 0.02 x L[m]) (L = measuring length in metres)
Carrier tape material:	Precision strip steel 1.4310 / X10CrNi 18-8 (EN 10088-3)
Double-sided adhesive tape:	3M-9088 (observe processing instructions), others on request
Dimensions:	→ Without adhesive tape: 10 mm (+/- 0.1) x 1.35 mm (+/- 0.11) → With adhesive tape (excl. carrier): 10 mm (+/- 0.1) x 1.56 mm (+/- 0.13) → With adhesive tape (incl. carrier): 10 mm (+/- 0.1) x 1.63 mm (+/- 0.14)
Coefficient of linear expansion:	$\alpha \approx 16 \times 10^{-6}$ 1/K
Thermal linear expansion:	$\Delta L[m] = L[m] \times \alpha[1/K] \times \Delta\vartheta[K]$ (L = tape length in metres, $\Delta\vartheta$ = relative temperature change)
Bending radius:	At least 150 mm (at least 50 mm when used without tape, option 'B' or 'D')
Available lengths:	Up to 192 mm
Magnetic tape weight:	Approx. 62 g/m (including adhesive tape + cover foil)
Tape print:	ELGO Standard, print color black, character height ≥ 5 mm
Extraneous magnetic influence:	Extraneous magnetic fields must not exceed 64 mT (640 Oe; 52 kA/m) at the magnetic tape surface as this may damage or destroy the magnetic tape encoding.
Protection class:	Stainless steel carrier strip

6.5 Magnetic ring technical data

The magnetic ring consists of two components:

- A mechanical ring
- An elastomeric band that carries the position information

Table 3: Magnetic ring specification

Magnetic ring MRR/MRA-00-CCC-DDD-EE-FFFF	
Coding:	Vernier, dual-track system
Pole pitch:	1.28 mm/1.5 mm
Operating temperature processed:	-40 °C to +85 °C

Relative humidity:	Max. 95%, non-condensing
Dimensions:	Depending on the type (see Table 4)
Thermal linear expansion:	$\Delta L[m] = L[m] \times \alpha[1/K] \times \Delta\vartheta[K]$ (L = tape length in metres, $\Delta\vartheta$ = relative temperature change)
Available dimensions:	Up to 59.3 mm
Imprint:	ELGO Standard, print color black, character height ≥ 5 mm
Extraneous magnetic influence:	Extraneous magnetic fields must not exceed 64 mT (640 Oe; 52 kA/m) at the magnetic tape surface as this may damage or destroy the magnetic tape encoding.

Table 4: Dimension (AD) MRA CMAX2 vernier rings

Pole pitch	Number of pole pairs 16		Number of pole pairs 32		Number of pole pairs 64	
	OD	ID	OD	ID	OD	ID
1.28 mm	16 mm	2.8 mm	29 mm	15.9 mm	55 mm	42 mm
1.50 mm	18.3 mm	5 mm	33.6 mm	20.3 mm	64.1 mm	50.9 mm

Table 5: Dimension (AD) MRR CMAX2 vernier rings

Pole pitch	Number of pole pairs 16	Number of pole pairs 32	Number of pole pairs 64
1.28 mm	11.4 mm	24.5 mm	50.6 mm
1.50 mm	13.5 mm	28.8 mm	59.3 mm

7 Installation and commissioning

NOTE
Please read the operating instructions carefully before using the unit. The installation instructions must be observed.
In the event of damage caused by non-observance of these operating instructions, the warranty claim becomes invalid.

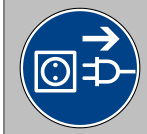
ELGO accepts no liability for consequential damage. We also accept no liability for personal injury, property damage or financial loss.

The operator is obliged to take and implement appropriate safety-related measures.

The unit may only be commissioned by qualified personnel authorised and instructed by the operator.

7.1 Operating environment

WARNING
Do not use the unit in explosive or corrosive environments.
The unit must not be installed next to sources of strong inductive or capacitive interference or which have strong electrostatic fields.



CAUTION
Electrical connections must be made by suitably qualified personnel in accordance with local regulations.

The unit is intended for panel mounting, if applicable. When working on the control panel, all components must be de-energised if there is a risk of touching live parts.
(Protection cover)

Wiring work must only be carried out without voltage supply.

Fine cable strands must be fitted with wire end ferrules.

Before switching on, check all connections and plug connections.

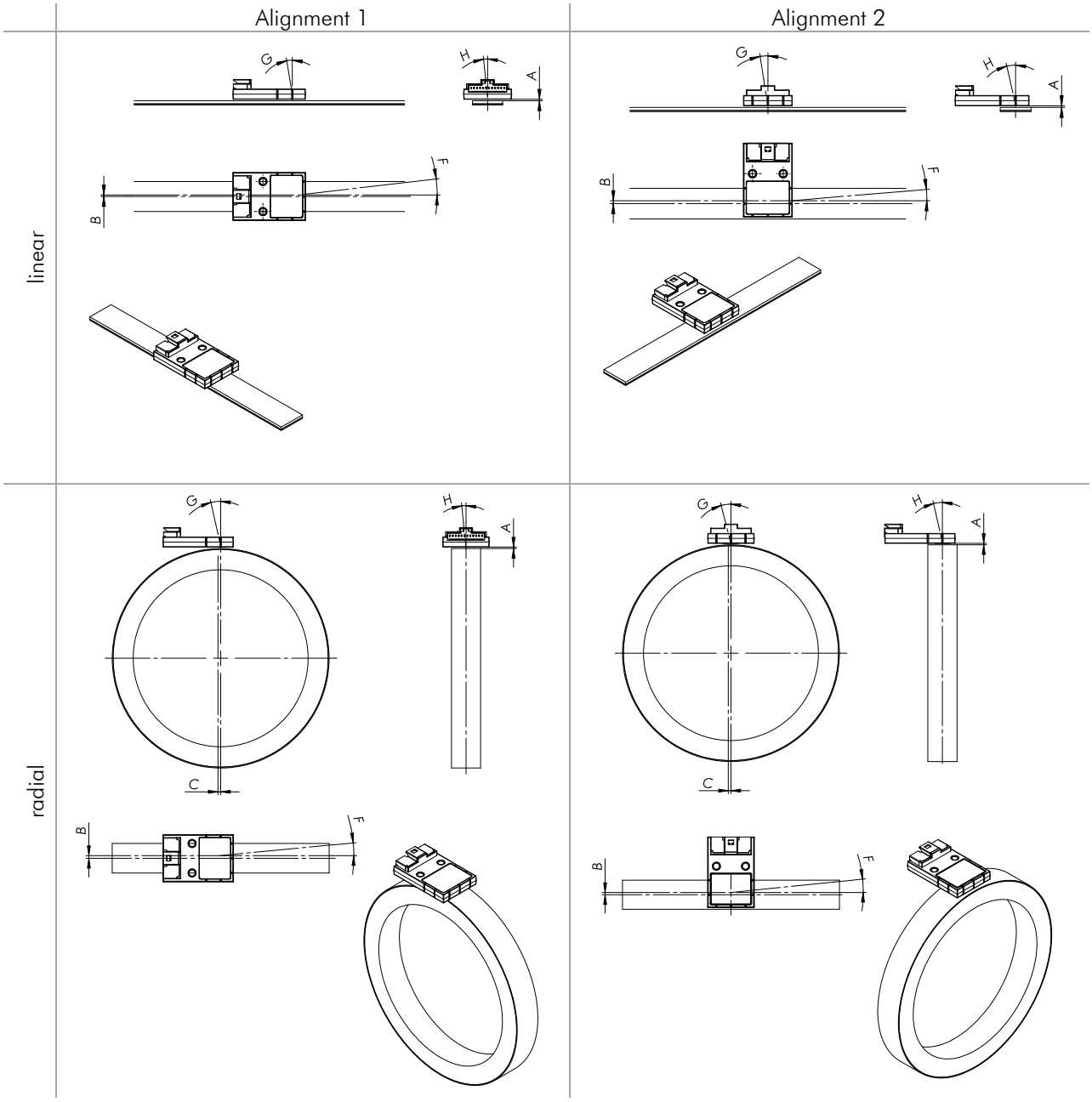
The device must be assembled in such a way that it is protected against harmful environmental influences e.g. splash water, solvents, vibrations, impacts and heavy soiling and that the operating temperature is also maintained.

7.2 Assembly/installation of the encoder

The dimensions of the CMAX2 encoder are described in section 6.2. The screw-on sockets are designed for M2.5 screws.
The CMAX2 encoder must be assembled within the tolerances given below in relation to the magnetic target (ring or tape).

7.2.1 Installation tolerances and assembly instructions

The following illustrations show the individual tolerances depending on the installation situation.
The housing has markings distributed on the side surfaces that are intended to assist in aligning the measuring head. There are markings for the outer edges as well as the center of the magnetic tape (with a width of 10 mm).



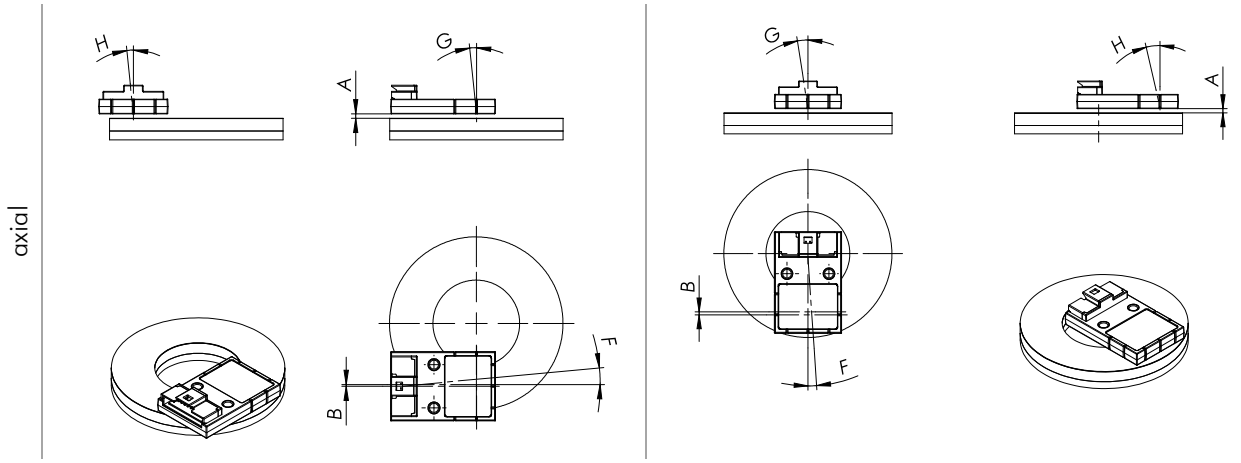


Table 6: Assembly tolerances

Assembly tolerances	
A	P1.28: 0.4 mm ±0.1 mm P1.50: 0.5 mm ±0.1 mm
B	0.5 mm
C	0.5 mm
F	1°
G	1°
H	1°

7.2.2 Alignment options

The different alignments are decisive when selecting the encoder variant, as the installation situation depends on them. The position of the encoder in relation to the magnetic tracks is relevant here. The magnetic tracks are firmly defined in their position in relation to the encoder, as shown in Figure 5.

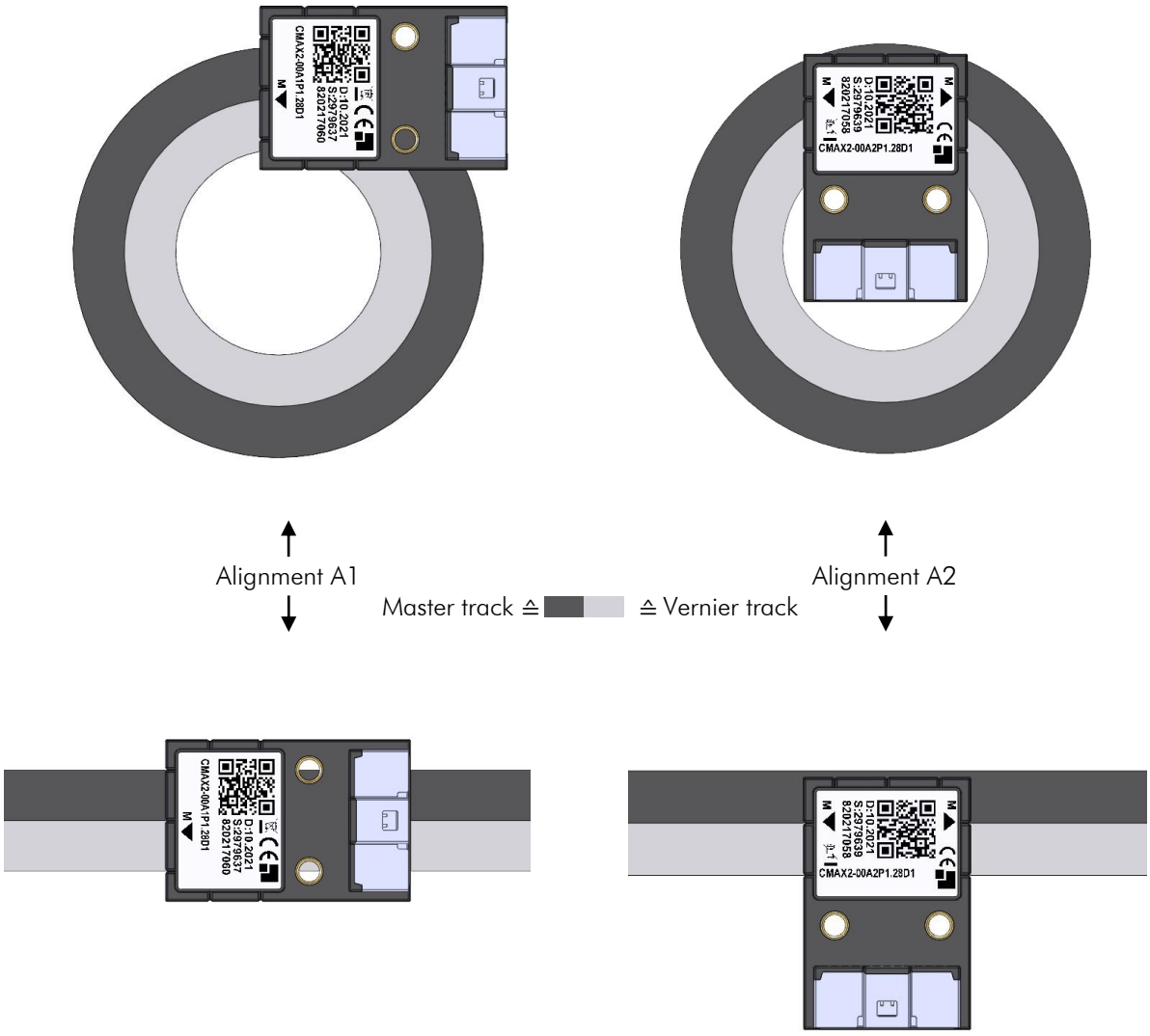


Figure 5: Alignment options

7.3 Installation of the magnetic tape

For information on the installation of the magnetic tape, the data sheet for the magnetic tapes is available in the download area.

7.4 Assembly/installation of the magnetic ring

For information on the installation of the magnetic rings, the data sheet for the magnetic rings is available in the download area.

7.5 Set-up process

	ATTENTION Before operating the encoder, application-related settings must be made and a calibration process must be performed.

7.5.1 Equipment

The following equipment is required for calibration:

- Computer/laptop (Windows)
  - LabView Run-Time Engine (RTE) is required
- Programming interface
  - USB-Mini B cable
  - Connecting cable D-SUB9 to CMAX2 (KABEL BG CMAX2-DSUB-PROG)
- Encoder CMAX2 in assembly position

Download link:

- Evaluation software CMAX2 with RTE (approx. 283 MB)
- Evaluation software CMAX2 (approx. 31 MB)

Preparations for the calibration process

1. Install the software and USB drivers required for using the programming interface.
2. Confirm all cable accessories are on-hand.
3. Install the encoder in its final operating position within the specified tolerances.

7.5.2 Calibration process

The calibration process consists of the following steps. Every single step must be followed exactly to ensure that the full calibration process is successful. All steps or parameters described here for setting are decisive for the error-free function of the encoder. Parameters that are NOT dealt with in this manual must NOT be changed. Changing these parameters can result in malfunctions or failure of the encoder.

7.5.2.1 Start software

Run the software via the desktop icon or via the start menu under 'iC-Haus':

Figure 6: Desktop Icon

7.5.2.2 Select chip version

After starting the software, a chip version (Figure 8) must be chosen once, depending on pole width:

- CMAX2-00AxP1.28Dx → iC-MU Y2 – (0x07)
- CMAX2-00AxP1.50Dx → iC-MU150 1 – (0x11)

Select and press OK to confirm.

A repeated queries can be suppressed via the check box.

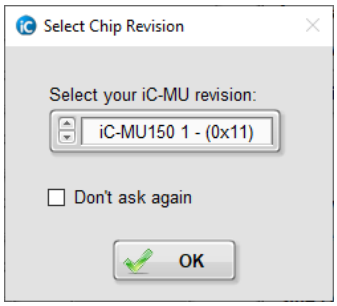


Figure 7: chip version selection

7.5.2.3 Establish connection

The connection is established via the button 'Disconnected' (red marking). A green background of the button and the labelling 'Connected" indicates a successfully established connection.

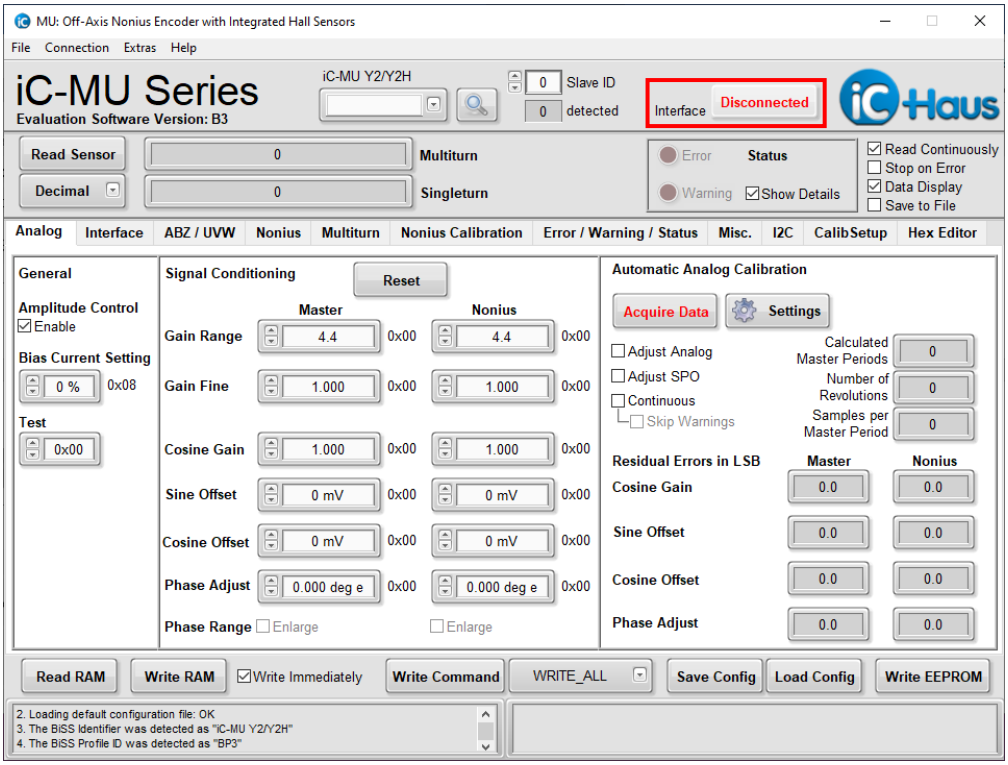


Figure 8: Establish the connection

7.5.2.4 Calibration settings

Before the calibration steps may be carried out, some general settings must be adjusted, depending on the application. These are as followed:

Menu 'Settings':
Depending on the speed of rotation or travel, it is advised to adjust the duration of the calibrations in the 'Settings' menu.

- 'Acquisition Time': Describes the duration of the calibration process. The entire measuring length for intented operation must be accounted for during calibration.

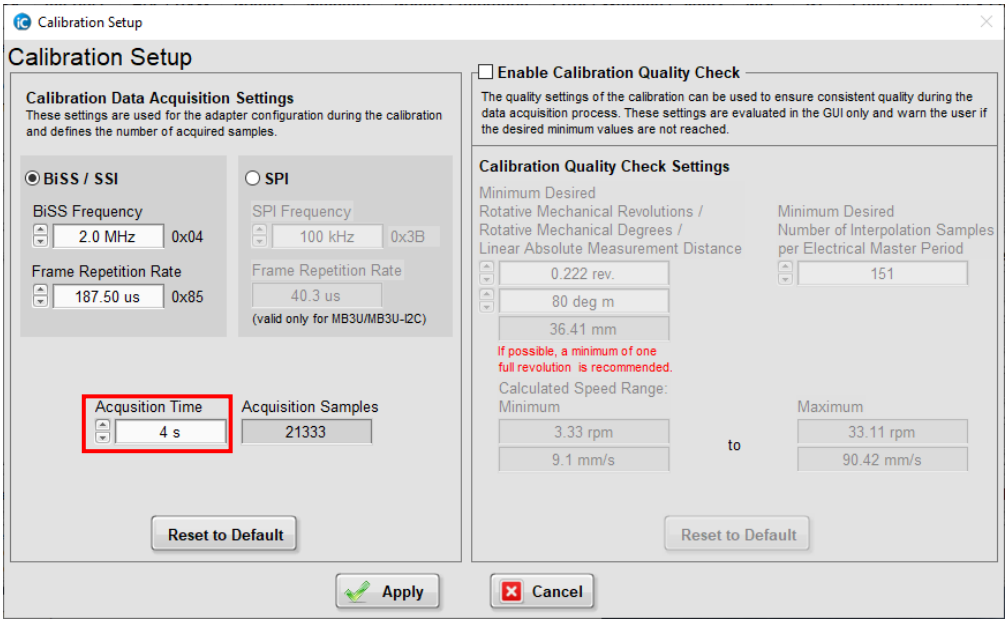


Figure 9: Einstellung FRR/Kalibrierdauer

'Analogue' tab:

Signal Conditioning: Before calibrations, the signal conditioning values stored in the CMAX2 may be reset (the values shown are the default values). This is required if the position of the encoder with regard to the magnetic target has been adjusted.

- Reset: Reset Gain/Offset/Phase Adjust Parameter

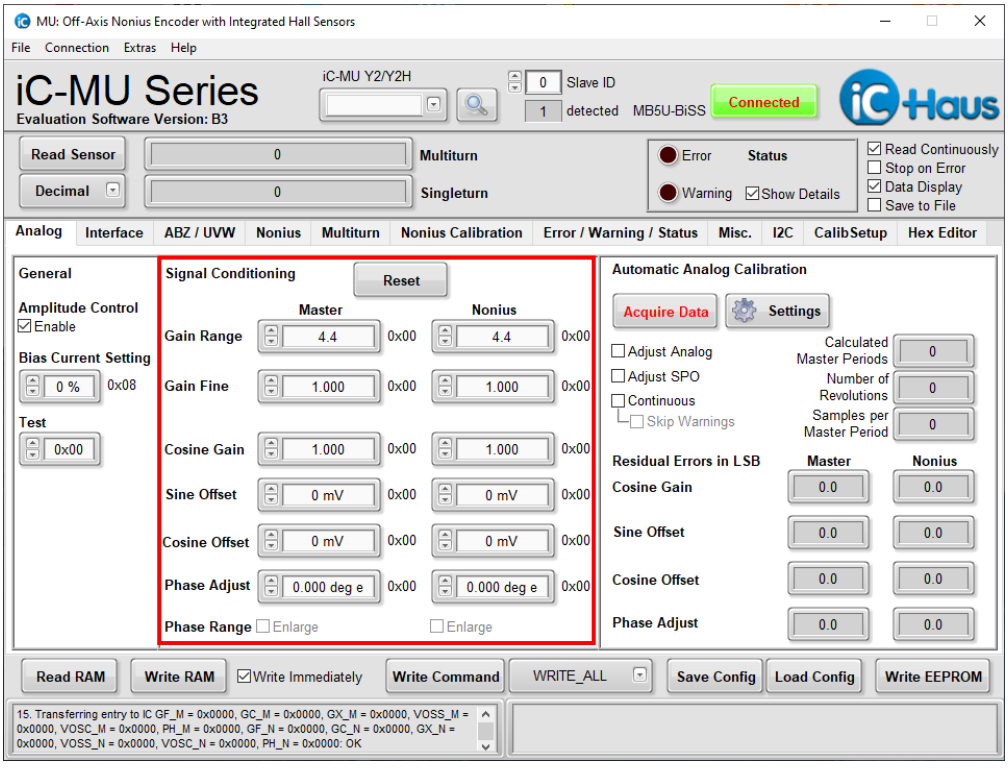


Figure 10: Resetting the calibration values

7.5.2.5 Parameter setting

'Nonius' tab:

Select the correct setting according to the type of magnetic target:

- Rotary (axial): With axial magnetic ring
- Linear/rotary (radial) : With linear magnetic tape/radial magnetic ring
- Master Period Count :

- 16 with 16/15 vernier pattern
- 32 with 32/31 vernier pattern
- 64 with 64/63 vernier pattern

Figure 11: Setting the application-specific parameters

'ABZ / UVW' tab:

The desired resolution for the incremental signal may be selected via the 'Resolution' parameter:

- Resolution
  - 4 to 262.144
  - freely selectable in steps of 4
  - E.g.: With a selected resolution of 10,000, exactly the same number of periods of incremental signals per complete revolution are available at the output. If four-edge evaluation is used, the number of increments is equal to four times the resolution.

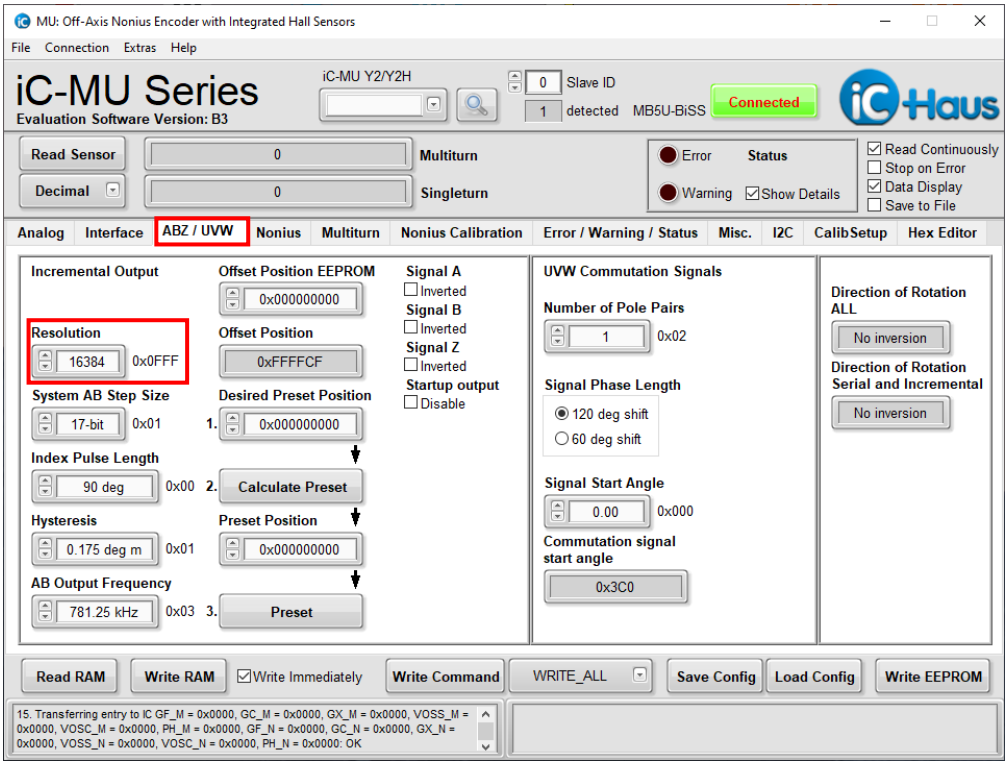


Figure 12: Setting the resolution

7.5.2.6 Calibrations

The calibration, which serves to compensate for the mechanical misalignemnt of the encoder and the magnetic target, consists of two sub-steps:

1. Analogue calibration
2. Vernier calibration

During analogue calibration, the individual tracks (master and vernier track) are evaluated.
With vernier calibration, the two tracks are evaluated against each other. The measuring distance that is in use during intended operation must be travelled during calibration in order to avoid errors during normal operation.
During the individual calibration steps, the magnetic target must move or rotate. The travel or rotation speed should be selected so that the complete vernier pattern can be traversed in the selected 'Acquisition Time'. If you have any questions, please do not hesitate to contact ELGO Support.
Note: During the calibration processes, two windows with progress bars appear successively. The rotation/movement must not be interrupted during this time. Change of direction (especially for linear applications) is permitted.

8

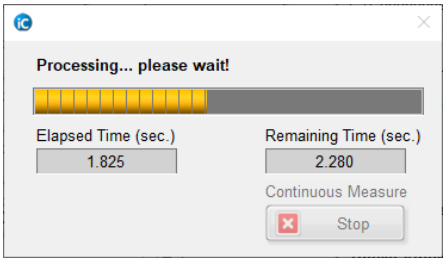


Figure 13: Window with progress bar

7.5.3 Analogue calibration

'Analogue' tab:
Pressing the button 'Acquire Data' initiates analogue as well as vernier calibration. The individual steps of the entire calibration are then automatically performed by the software. The magnetic target must rotate/travel during this process, however change in direction or speed is permitted as this is accounted for by the software.

- If the box 'Adjust Analog' is checked, analogue calibration will be performed. Otherwise, the analogue values will be measured only.
- If the box 'Adjust SPO' is checked, vernier calibration will be performed. Otherwise, the SPO values will be measured only.
- Optional: in the 'Settings' menu, the duration of the calibration may be adjusted if needed

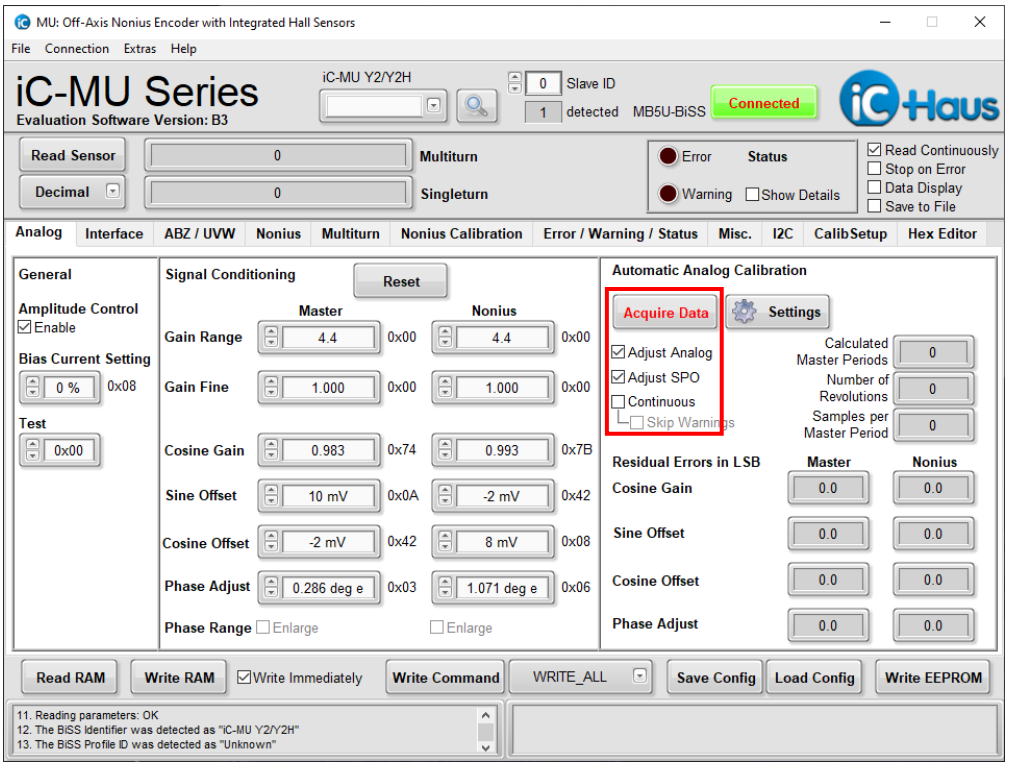


Figure 14: Starting the analogue and vernier calibration

7.5.3.1 Vernier calibration

'Vernier calibration' tab:

Once the vernier calibration is complete, the result is displayed in the chart area. The uncalibrated graph is shown in red. The green curve shows the calibrated measurement results. This curve (more specifically: the resulting offset values) are used for normal operation.

A successful calibration can be recognised by the green 'In Range' indicators. The lower these values, the better the calibration result. Values of less than 90% are interpreted as successful calibration. Depending on the result, an adjustment of the measuring position may be necessary. In this case, analogue calibration must be repeated as well. If you have any questions about your calibration result, please feel free to contact support.

Note 1: The button 'Acquire Data' performs the same function in both tabs ('Analog' and 'Nonius Calibration')

Note 2: In linear applications, the entire measuring length may not be traversable during calibration. In the example shown in Figure 16 it is apparent, that no values were measured between 152° and 181°. This is permitted as long as the concerned segment is not part of the intended use range.

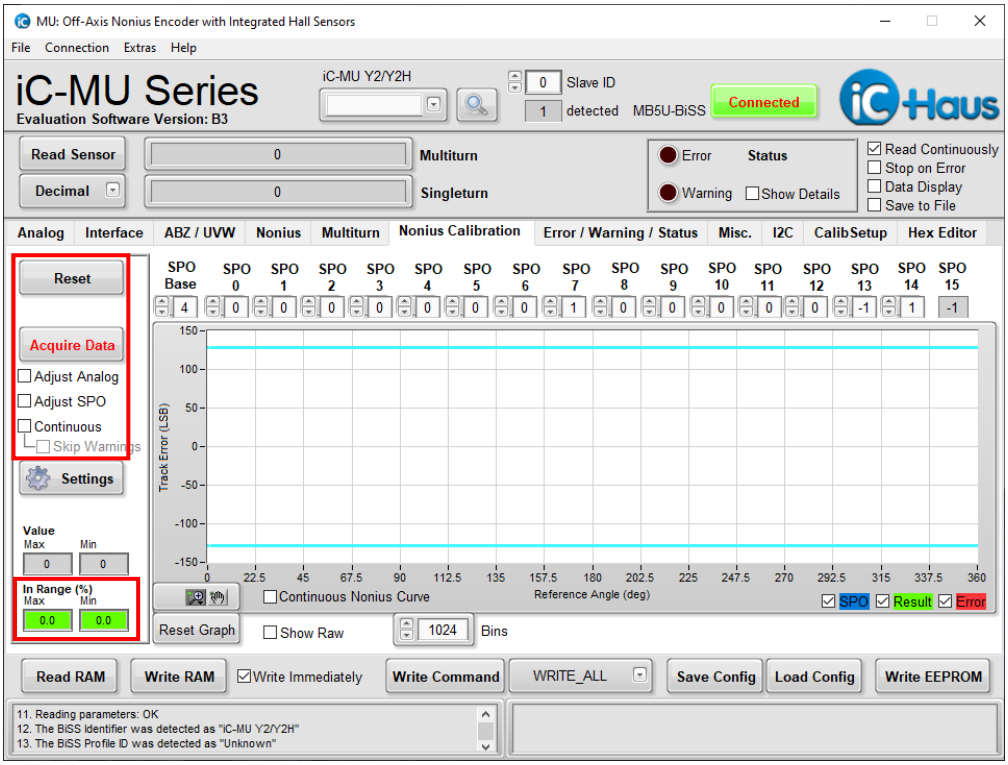


Figure 15: Analogue and vernier calibration overview

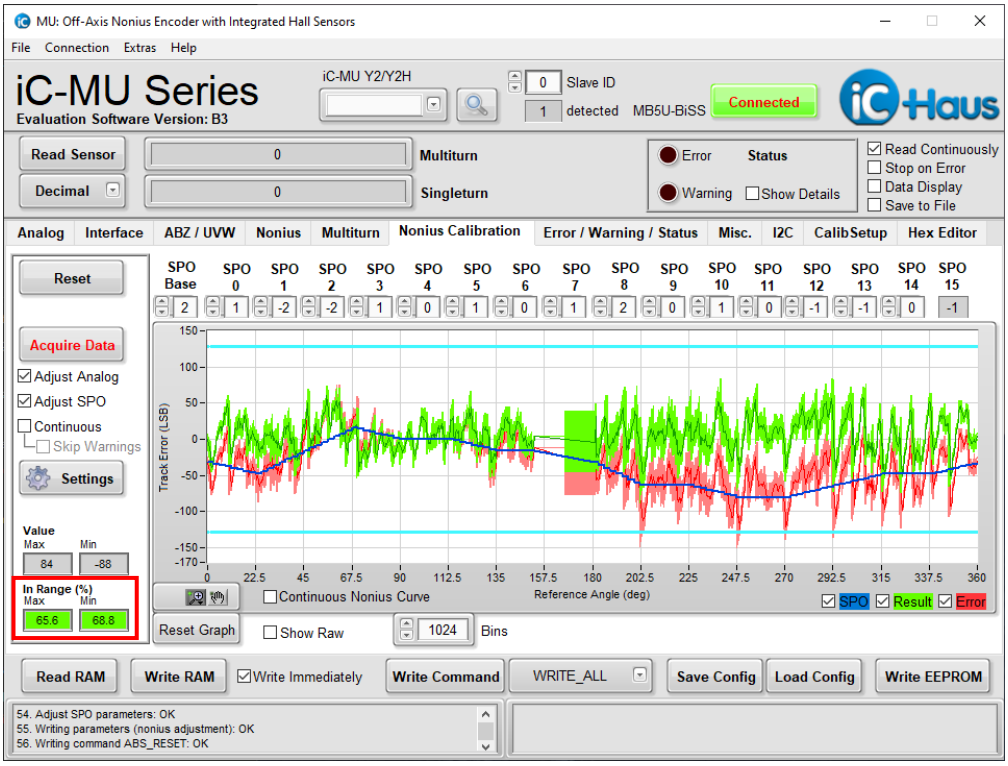


Figure 16: Example result of analogue- and vernier calibration

7.5.4 Saving the calibration

To complete the calibration process, the data must be written to the memory. The 'Write EEPROM' button (Figure 18) is used to do this.

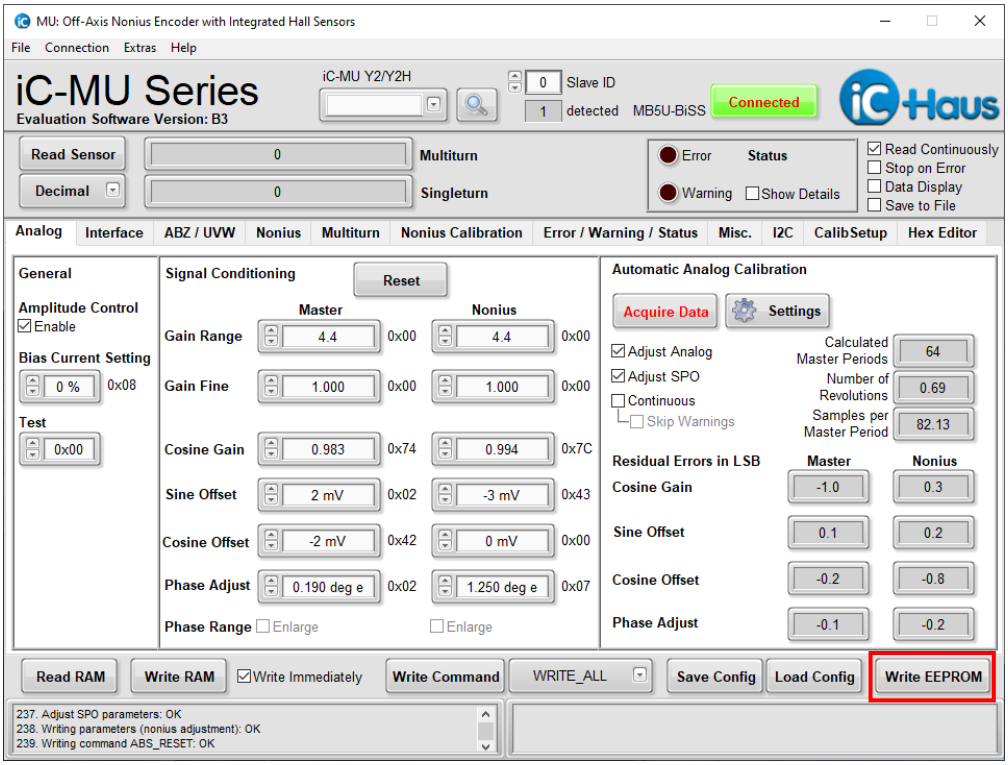


Figure 17: Saving the data

7.5.5 Flow chart of the calibration process

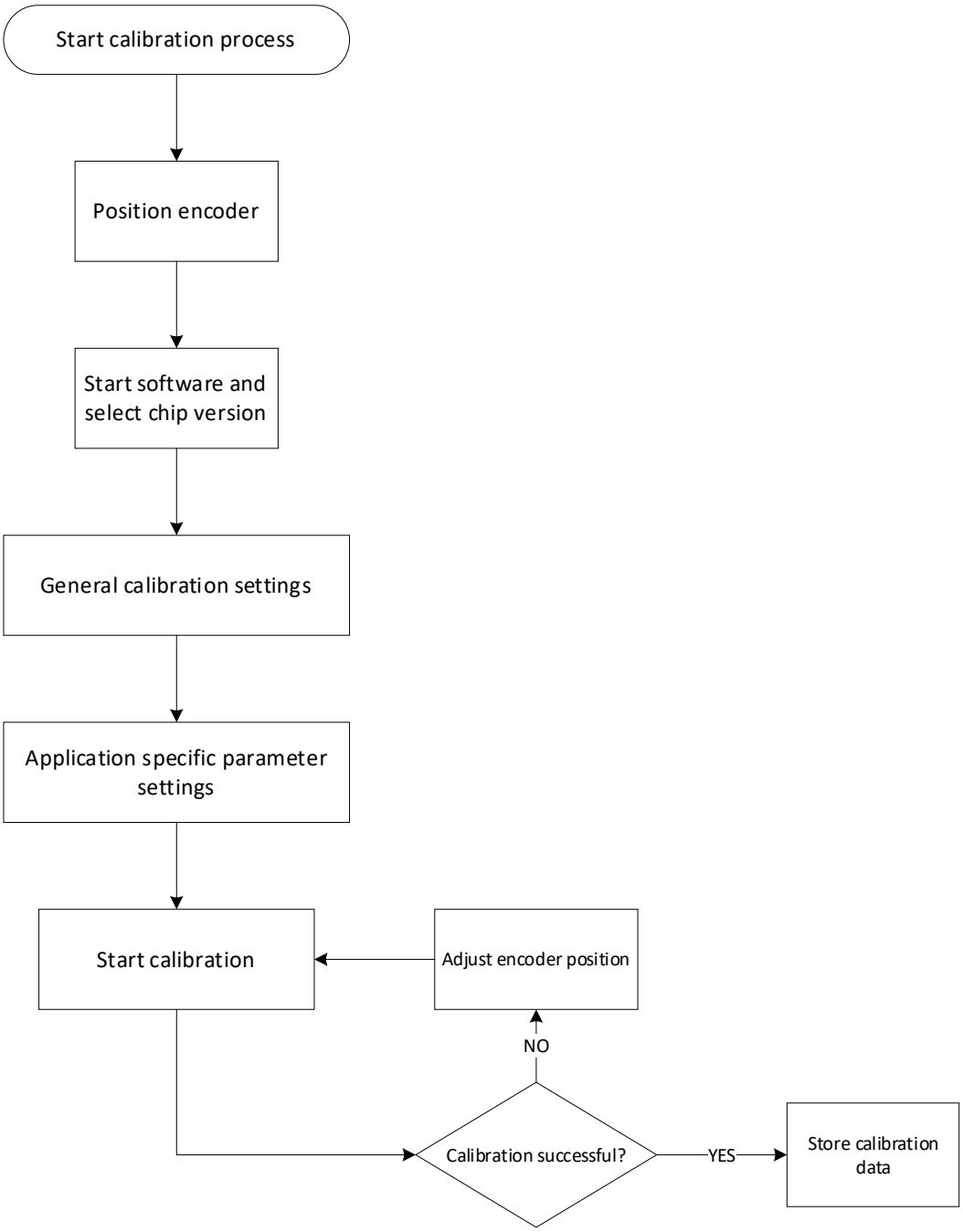


Figure 18: Calibration procedure

7.5.6 Key software functions

7.5.6.1 Report function

The report function creates a visual image of the software with all settings. A configuration file for the encoder is also created. This data helps the ELGO Support team in case of queries or can be used for your own documentation.
The report function can be called up using the key combination 'Ctrl '+'F12' or in the ribbon under 'Extras - Generate Report'.

7.5.6.2 Standard parameters

When the encoder is delivered, specific parameters in the encoder are set to predefined default values:

- Communication interface
  - Port A: BiSS-C
  - Port B: ABZ
- Incremental signal output ABZ
  - System AB Step size: 18-bit
  - Index Pulse Length: 90°
  - Hysteresis: 0.175°
  - AB Output Frequency: 6.25 MHz
- Vernier calculation
  - Filter: 51 dB

7.6 Connections and interfaces

The following section provides detailed information on the connections and interfaces.
Figure 19 shows the socket of the CMAX2 with a corresponding pin 1 marking '(P1)'.

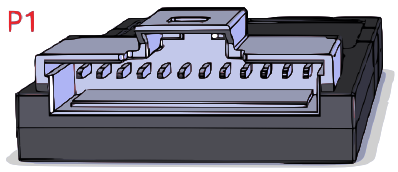


Figure 19 Illustration of plug with P1 marking

7.6.1 Power supply

Pin 6 and pin 7 are the connections for the power supply.

Pin 6 – GND
Pin 7 – 5 V

7.6.2 Absolute BiSS-C/SSI interface

The CMAX2 has an interface for transmitting the absolute position values. The various settings and calibrations are also carried out via this interface. The differential signals are present at the following connections:

Pin 4 – Data-
Pin 5 – Data+
Pin 8 – Clock-
Pin 9 – Clock+

7.6.3 Incremental signal interface

In addition, the CMAX2 has the option of outputting incremental position signals. As an option, the differential square-wave signals of A and B phase-shifted by 90° with TTL output level are available. The differential signal Z is output once per revolution.

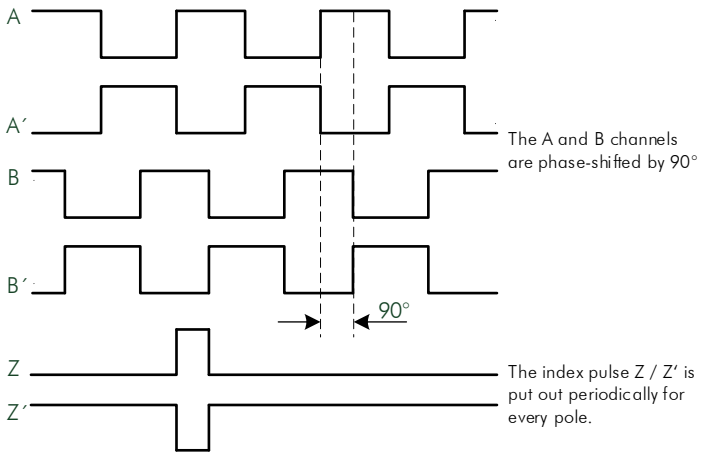


Figure 20: ABZ output timing diagram

7.6.4 Pin assignment

Table 7: Pin assignment of the interfaces

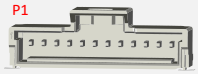
Connection type	Connection option acc. to type code	Drawing	Assignment
Molex Pico-Clasp (MPN: 501568-1207)	D1		1 - Z' 2 - Z 3 - B' 4 - Data- 5 - Data+ 6 - GND 7 - 5 V 8 - Clock- 9 - Clock+ 10 - B 11 - A' 12 - A

Table 8: Pin assignment: connecting cable - open cable ends

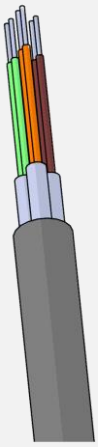
Type of connection	Drawing	Color	Function	Description
Connection cable – Open cable ends		Violet	Z'	Z signal -
		Black	Z	Z signal +
		Blue	B'	B signal -
		Red-blue	DATA-	Data -
		Pink-gray	DATA+	Data +
		White	GND	Ground
		Brown	V+ (5V)	+5 V_{DC}
		Green	CLOCK-	Cycle -
		Yellow	CLOCK+	Cycle +
		Red	B	B signal +
		Gray	A'	A signal -
		Pink	A	A signal +

Table 9: Pin assignment: programming cable - D-SUB9 socket

Type of connection	Drawing	Pin no.	Function	Description
Programming cable – D-SUB9 socket	 Figure21: D-SUB9 (view: soldering side)	2	CLOCK+	Cycle +
		3	CLOCK-	Cycle -
		4	V+ (5V)	+5 V_{DC}
		6	GND	Ground
		7	DATA+	Data +
		8	DATA-	Data -

8 Operational malfunctions

The following chapter describes possible causes of malfunctions and the measures to eliminate them. In case of increased interference, please observe the interference suppression measures under section 8.2.
In case of malfunctions that cannot be remedied by the following instructions and the interference suppression measures, please contact the manufacturer (see second page).

8.1 Interference suppression measures

CAUTION
The device, connecting cables and signal cables must not be installed next to sources of strong inductive or capacitive interference or which have strong electrostatic fields.

External interference can be avoided by suitable cable routing.

The shield of the signal output cable may only be connected to the downstream electronics on one side. The shields must not be connected to earth on both sides. Signal cables must always be laid separately from load current cables.
A safety distance of at least 0.5 m must be maintained from inductive and capacitive sources of interference such as contactors, relays, motors, switching power supplies, switched-mode controllers, etc.

If faults occur despite observing all the points described above, proceed as follows:

1. Attach RC elements via contactor coils of AC contactors (e.g. 0.1 µF / 100Ω)
2. Attach free-wheeling diodes via DC inductors
3. Attach RC links via the individual motor phases (in the terminal box of the motor)
4. Do not connect protective earth and reference potential together
5. Connect a mains filter upstream of the external power supply unit

8.2 Possible faults and their correction

The following table shows possible malfunctions and how to remedy them.

Table 10: General notes on troubleshooting

Item	Problem	Possible cause	Required action
(1)	No connection via programming unit	USB driver not present	Install USB driver
		Cable defective	Replace cable
(2)	No signal output	Fault active	Read out and rectify fault
(3)	Faulty calibration	Various	Note the error message in the software. Check alignment and installation position and correct if necessary. Check mechanical displacements due to load action

8.3 Recommissioning after troubleshooting

After rectifying the fault(s):

1. If applicable, reset device emergency stop.
2. If applicable, reset the error message on the higher-level system
3. Ensure there is nobody in the danger zone
4. Proceed according to the instructions in section 8

WARNING
Risk of injury due to incorrect troubleshooting.

Incorrect troubleshooting can lead to serious personal injury or property damage.

Therefore:

- any troubleshooting work may only be carried out by adequately qualified and instructed personnel.
- Ensure there is sufficient installation space before starting work.
- Ensure the assembly site is clean and tidy: loose components and tools lying around or on top of each other are sources of accidents.

If components need to be replaced:

- Ensure that the spare parts are fitted correctly.
- Reinstall all fastening elements correctly.
- Before switching on again, make sure that all covers and protective devices are correctly installed and working properly.

9 Maintenance

This device is maintenance-free.

WARNING
Danger due to incorrect maintenance.

Incorrect maintenance can lead to serious personal injury or property damage.

Therefore:
Maintenance work may only be carried out by qualified personnel authorised and instructed by the operator.

10 Cleaning

WARNING
The unit may only be cleaned with a damp cloth; do not use aggressive cleaning agents.

11 Type code

11.1 Encoder type code

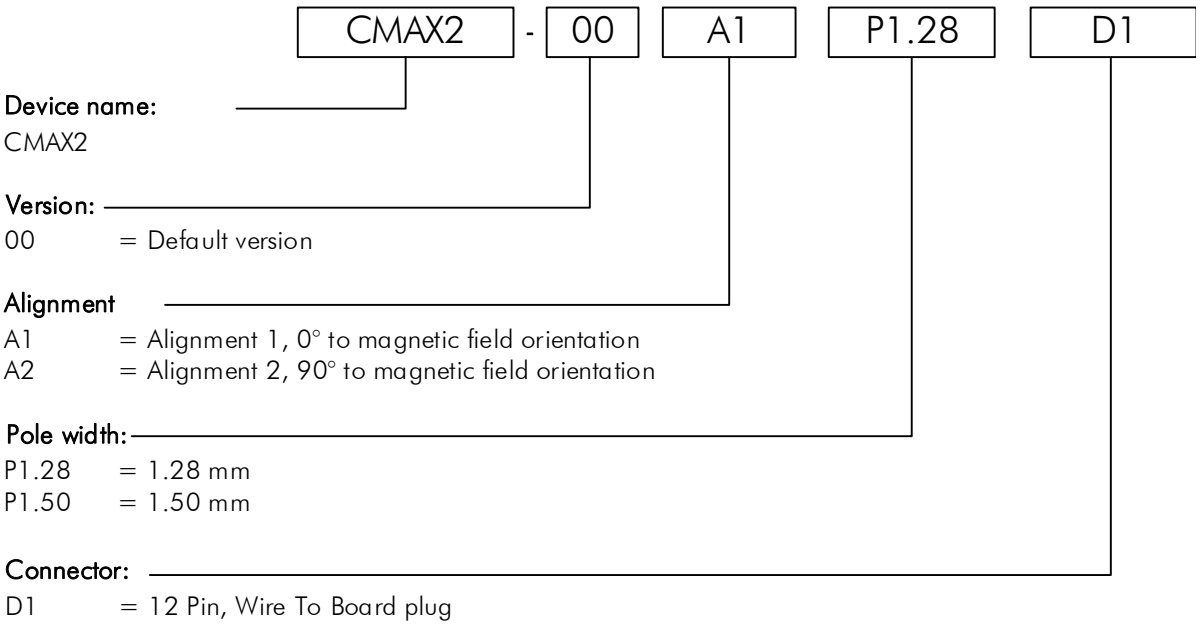


Figure 22: Encoder type code

11.2 Accessories

11.2.1 CMAX2 Accessories

Table 11: CMAX2 Accessories

Type code	Description
PROGRAMMIERGERÄT CMAX2	Programming unit including cable (KABEL BG CMAX2-DSUB-PROG, USB cable)
KABEL BG CMAX2-00-01.0	Connection cable 1 m, absolute + incremental (twisted pair, one end open wire ends, 6 x 2 x 0.08 mm², PVC-jacket)

11.2.2 CMAX2 Magnetic Tape

Table12: CMAX2 Magnetic Tape

Type code*	Description
AB30-01280-10-2-R-EPS20 M:16-N:15 or M:32-N:31 or M:64-N:63	Vernier magnetic tape (pole pitch 1.28 mm) on backing material 1.4310, tape width 10 mm; length: 40,96 mm 81,92 mm 163,84 mm
AB30-01500-10-2-R-EPS20 M:16-N:15 or M:32-N:31 or M:64-N:63	Vernier magnetic tape (pole pitch 1.50 mm) on backing material 1.4310, tape width 10 mm; length: 48 mm 96 mm 192 mm

*Examples. Others on request, please contact sales

11.2.3 Magnetic rings for CMAX2

Table13: CMAX2 magnetic rings

Type code	Description
MRR-BB-CCC-DDD-EE-FFFF	Magnetic rings radial standard (Others on request, please contact sales)
MRR-00-024-015-08-0064 MRR-00-028-022-10-0064 MRR-00-050-022-10-0128 MRR-00-050-028-08-0128 MRR-00-059-022-10-0128	BB version CCC outer diameter [mm] DDD inner diameter [mm] EE width/height [mm] FFFF number of magnetic poles
MRA-BB-CCC-DDD-EE-FFFF MRA-00-056-022-02-0128 MRA-00-065-022-02-0128	Magnetic rings axial radial standard (Others on request, please contact sales) BB version CCC outer diameter [mm] DDD inner diameter [mm] EE width/height [mm] FFFF number of magnetic poles

11.3 Available versions

Table14: CMAX2 versions

Type code	Description
CMAX2-00A1P1.28D1	CMAX2 in alignment 1 with a pole width of 1.28 mm and a Molex connector
CMAX2-00A1P1.50D1	CMAX2 in alignment 1 with a pole width of 1.50 mm and a Molex connector
CMAX2-00A2P1.28D1	CMAX2 in alignment 2 with a pole width of 1.28 mm and a Molex connector
CMAX2-00A2P1.50D1	CMAX2 in alignment 2 with a pole width of 1.50 mm and a Molex connector

Notes:

Notes:

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