User Manual 111-00016

CE-65-S

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Document information

Release date/Rev. date:	01/10/2007
Document rev. no.:	TR - ECE - BA - DGB - 0059 - 00
File name:	TR-ECE-BA-DGB-0059-00.DOC
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Font styles

Italic or **bold** font styles are used for the title of a document or are used for highlighting.

`Courier` font displays text, which is visible on the display or screen and software menu selections.

″ < > ″ indicates keys on your computer keyboard (such as <RETURN>).

Contents

Revision index

Revision	Date	Index
First release	01/10/07	00

1 General information

The User Manual includes the following topics:

- Basic safety instructions
- Technical data
- Mounting
- Installation
- Interface / Features
- Cause of faults and remedies

As the documentation is arranged in a modular structure, this User Manual is supplementary to other documentation, such as product datasheets, dimensional drawings, leaflets etc.

The User Manual may be included in the customer's specific delivery package or it may be requested separately.

1.1 Applicability

This User Manual applies exclusively to the following measuring system series with ***ASI*** interface:

- CE-65-S, Art.-No.: 111-00016

The products are labelled with affixed nameplates and are components of a system.

The following documentation therefore also applies:

- the operator's operating instructions specific to the system,
- this User Manual

1.2 Declaration of manufacturer

The series CE-65-S measuring systems have been developed, designed and manufactured under observation of the applicable international and European standards and directives.

A corresponding manufacturer’s declaration can be requested from TR-Electronic GmbH.

The manufacturer of the product, TR-Electronic GmbH in D-78647 Trossingen, operates a certified quality assurance system in accordance with ISO 9001.

1.3 Abbreviations and definitions

ASI	***A***synchronous ***S***erial ***I***nterface
CE	Absolute Encoder with optical scanning unit, Solid Shaft
EC	***E***uropean ***C***ommunity
EMC	***E***lectro ***M***agnetic ***C***ompatibility
ESD	***E***lectro ***S***tatic ***D***ischarge
IEC	***I***nternational ***E***lectrotechnical ***C***ommission
LSB	***L***east ***S***ignificant ***B***yte
MSB	***M***ost ***S***ignificant ***B***yte
VDE	German Electrotechnicians Association

1.4 General functional description

In contrast to incremental measuring systems, the absolute measuring system provides the current position value instantaneously. If this measuring system is moved mechanically in the deactivated state, the current position can be read out directly as soon as the voltage supply is switched on again.

The TR absolute measuring systems can be supplied in ***Single-Turn*** or ***Multi-Turn*** versions depending on the type required.

Single-Turn

This measuring system resolves **a single revolution** or turn of the drive shaft into measuring increments (e.g. 8192). The number of measuring increments per revolution is recorded and calculated via a code disk. This measured value is output via different interface modules depending on the type of interface used, and is repeated after each revolution.

Multi-Turn

Besides the angular positions per revolution, multi-turn measuring systems also record **multiple rotations or turns**. The drive shaft is connected to an internal reduction gear via which the number of revolutions is recorded.

In the case of the multi-turn measuring system, the measured value is thus composed of the **angular position** and the **Number of Revolutions**. The measured value is also calculated and output via different interface modules depending on the type of interface used.

Principle

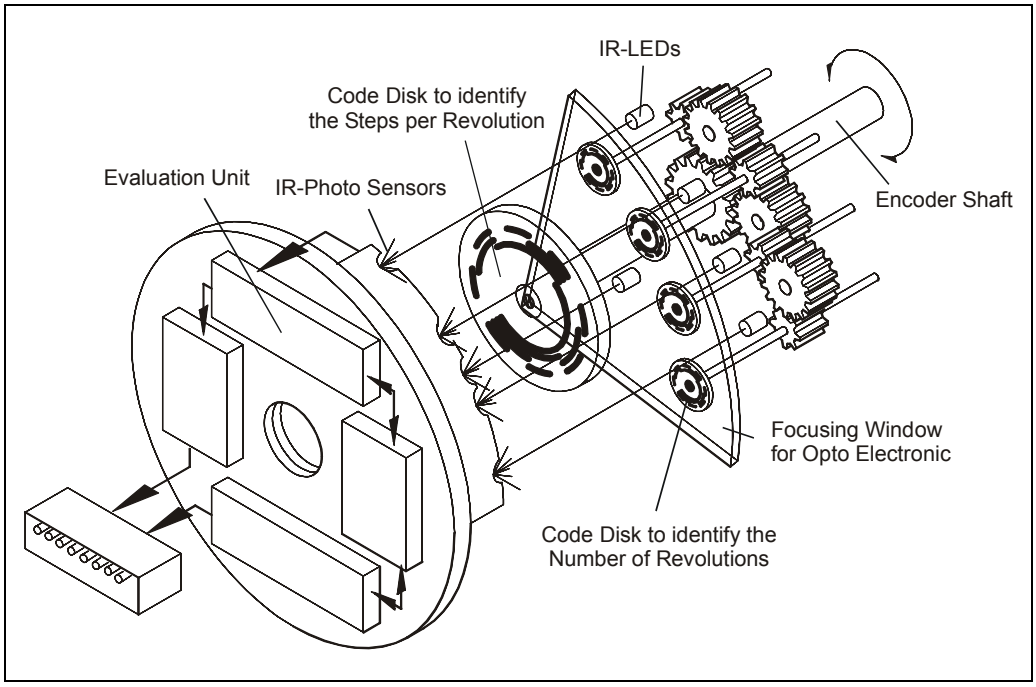


Figure 1: Measuring system operating principle

2 Basic safety instructions

2.1 Definition of symbols and instructions

 ***WARNING !***	means that death, serious injury or major damage to property could occur if the stated precautions are not met.
 ***CAUTION !***	means that minor injuries or damage to property can occur if the stated precautions are not met.
	indicates important information's or features and application tips for the product used.
	means that appropriate ESD-protective measures are to be considered according to DIN EN 100 015-1. (Cause of a potential equalization between body and device-mass as well as the housing-mass about a high-impedance resistance (approx. 1 MΩ) e.g. with a commercial ESD wrist strap).

2.2 Obligation of the operator before start-up

In accordance with the EC Machinery Directive, the measuring system is considered to be a machine part for fitting into a system/machine. Moreover, the conformity of the measuring system was investigated in respect of the EMC Directive.

It is therefore only permitted to start up the measuring system if it has been established that the system/machine into which the measuring system is to be fitted satisfies the provisions of the EC Machinery Directive, the EC EMC Directive, the harmonized standards, European standards or the corresponding national standards.

2.3 General risks when using the product

The product, hereinafter referred to as **"the measuring system"**, is manufactured according to state-of-the-art technology and accepted safety rules. **Nevertheless, improper use can pose a danger to life and limb of the user or third parties, or lead to impairment of the measuring system or other property!**

Only use the measuring system in a technically faultless state, and only for its designated use, taking safety and hazard aspects into consideration, and observing this **User Manual**! Faults which could threaten safety should be eliminated without delay!

2.4 Proper use

The measuring system is used to measure angular motion and to condition the measurement data for the subsequent control of industrial control processes.

Proper use also includes:

- observing all instructions in this User Manual,
- observing the nameplate and any prohibition or instruction symbols on the measuring system,
- observing the enclosed documentation, e.g. product insert, connector configurations etc.,
- observing the operating instructions from the machine or system manufacturer,
- operating the measuring system within the limit values specified in the technical data.

The following areas of use are especially forbidden:

- in environments where there is an explosive atmosphere
- for medical purposes

Examples of typical fields of application at industrial process and control processes:

- Transfer machines
- Machine tools
- Gantry robots
- Assembly installations
- etc. ...
- Everywhere, where rotation or angular movements must be detected for evaluation

WARNING !

Where there is a danger of physical injury and damage to property arising from jumps in the position of the measuring system!

- As the measuring system **does not constitute a safety component**, a plausibility check of the measuring system values must be performed through the subsequent control system.
- It is mandatory for the operator to integrate the measuring system into his own safety concept.

2.5 Warranty and liability

The General Terms and Conditions ("Allgemeine Geschäftsbedingungen") of TR-Electronic GmbH always apply. These are available to the operator with the Order Confirmation or when the contract is concluded at the latest. Warranty and liability claims in the case of personal injury or damage to property are excluded if they result from one or more of the following causes:

- Non-designated use of the measuring system.
- Improper assembly, installation, start-up and programming of the measuring system.
- Incorrectly undertaken work on the measuring system by unqualified personnel.
- Operation of the measuring system with technical defects.
- Mechanical or electrical modifications to the measuring systems undertaken autonomously.
- Repairs carried out autonomously.
- Third party interference and Acts of God.

2.6 Organizational measures

- The User Manual must always be kept accessible at the place of use of the measuring system.
- In addition to the User Manual, generally applicable legal and other binding accident prevention and environmental protection regulations are to be observed and must be mediated.
- The respective applicable national, local and system-specific provisions and requirements must be observed and mediated.
- The operator is obliged to inform personnel on special operating features and requirements.
- The personnel instructed to work with the measuring system must have read and understood the User Manual, especially the chapter “Basic safety instructions” prior to commencing work.
- The nameplate and any prohibition or instruction symbols applied on the measuring system must always be maintained in a legible state.
- Do not undertake any mechanical or electrical modifications on the measuring system, apart from those explicitly described in this User Manual.
- Repairs may only be undertaken by the manufacturer or a facility or person authorized by the manufacturer.

2.7 Personnel qualification; obligations

- All work on the measuring system must only be carried out by qualified personnel.

  Qualified personnel includes persons, who, through their training, experience and instruction, as well as their knowledge of the relevant standards, provisions, accident prevention regulations and operating conditions, have been authorized by the persons responsible for the system to carry out the required work and are able to recognize and avoid potential hazards.
- The definition of “Qualified Personnel” also includes an understanding of the standards VDE 0105-100 and IEC 364 (source: e.g. Beuth Verlag GmbH, VDE-Verlag GmbH).
- Define clear rules of responsibilities for the assembly, installation, start-up and operation. The obligation exists to provide supervision for trainee personnel !

2.8 Safety information's

WARNING !

- ***Destruction, damage or malfunctions of the measuring system !***
  - De-energize the system before carrying out wiring work or opening and closing electrical connections.
  - Do not carry out welding if the measuring system has already been wired up or is switched on.

CAUTION !

- Ensure that the area around the assembly site is protected from corrosive media (acid, etc.).
- Avoid any shocks (e.g. hammer-blow) on the shaft while mounting.
- Do not open the measuring system.

- ***The measuring system contains electrostatically endangered circuit elements and units which can be destroyed by an improper use.***
  - Contacts of the measuring system connection contacts with the fingers are to be avoided, or the appropriate ESD protective measures are to be applied.

- ***Disposal***

  If disposal has to be undertaken after the life span of the device, the respective applicable country-specific regulations are to be observed.

3 Transportation / Storage

Notes on transportation

Do not drop the device or expose it to strong strokes!
Device contains an optical system.

Only use the original packaging!
The wrong packaging material can cause damage to the device during transportation.

Storage

Storage temperature: -30 to +80°C
Store in a dry place

4 Technical data

4.1 Electrical characteristics

Supply voltage: ..... 11-35 V DC
Overvoltage protection
Reverse polarity protection
Overcurrent protection

Current consumption without load: ..... < 150 mA

Total resolution: ..... 12 bit

Number of steps / revolution: ..... 4096 (12 bit)

Number of revolutions: 1

Transmission: ..... twisted and shielded copper cable

ASI Interface
Data transmission: RS422 (2-wire)
Format: ..... 1 Start bit, 8 Data bits, no parity, 1 Stop bit
Data record: ..... 8 signs
Baud rate: 4800
Cycle time: ..... 26 ms ±500µs
Output code: ..... ASCII
Overvoltage protection
Overcurrent protection
Emission protection

Optoelectronics
Infrared light source: ..... median life 10^6 hours
Infrared receiver: ..... Photo transistor

Inputs
Preset: ..... electronic adjustment
Logic level: ..... „0“ < + 2 VDC, „1“ = Supply voltage
Impedance: ..... 2.3 kOhm, against 0 V

4.2 Environmental data

Vibration, DIN EN 60068-2-6: 1996 ..... ≤ 100 m/s^2, sine 100 Hz

Shock, DIN EN 60068-2-27: 1995 ..... ≤ 250 m/s^2, half-sine 11ms

EMC

- Discharge of static electricity, DIN EN 61000-4-2: 2001
- Burst, DIN EN 61000-4-4: 2004
- Immunity to disturbance, DIN EN 61000-6-2: 2001

Working temperature ..... -20 °C…+70 °C

Storage temperature ..... -30 °C…+80 °C, dry

Relative humidity, DIN EN 60068-3-4: 2002 ..... 98 %, non condensing

Protection class, DIN EN 60529: 1991 ..... IP 54

4.3 Mechanical data

Mechanically permissible speed ..... ≤ 6.000 min^{-1}

Shaft load, at the shaft end ..... ≤ 50 N axial, ≤ 20 N radial

Bearing life time ..... ≤ 4 x 10^8 revolutions at

- **Speed** ..... ≤ 3.000 min^{-1}
- **Operating temperature** ..... ≤ 60°C
- **Shaft load, at the shaft end** ..... ≤ 25 N axial, ≤ 10 N radial

Angular acceleration ..... ≤ 10^5 rad/s^2

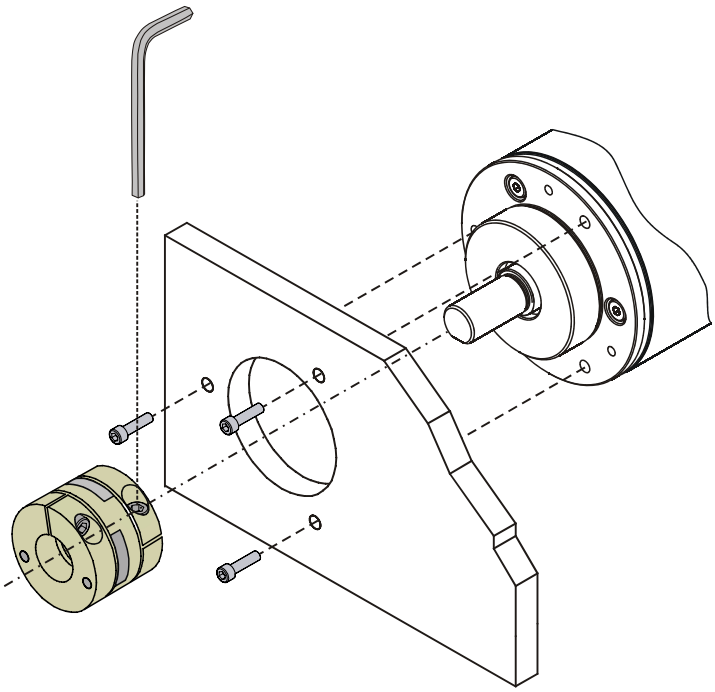
Momentum of inertia ..... typically 5 x 10^{-6} Nm/sec^2

Start-up torque at 20°C ..... typically 1 Ncm

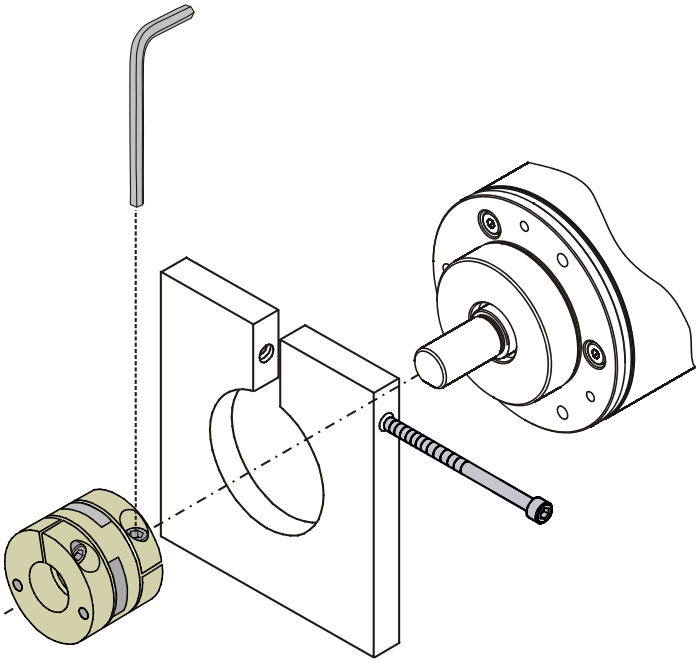
Mass ..... typically 0.8 kg

5 Mounting

5.1 Flange mounting



5.2 Clamping flange

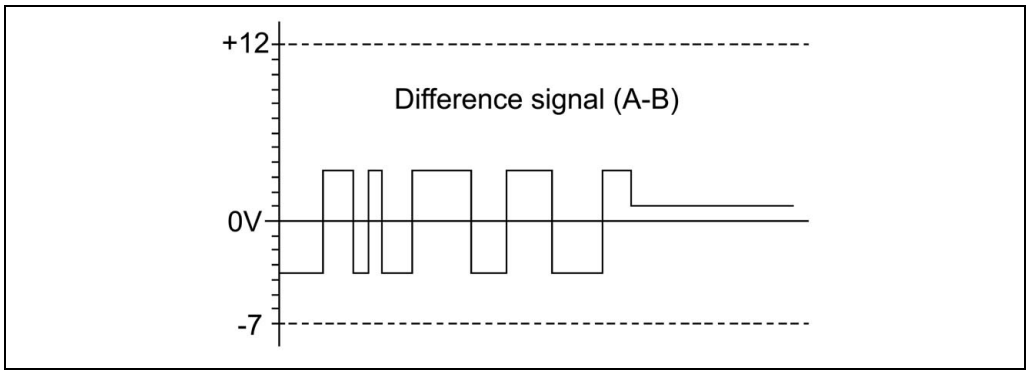


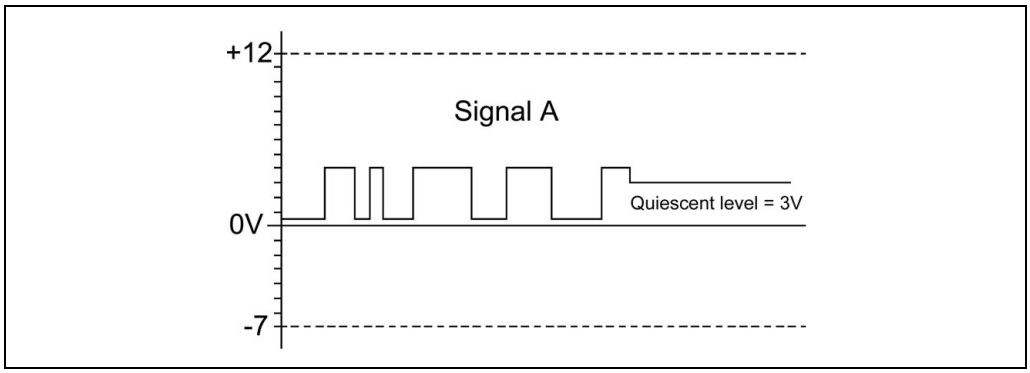
6 Installation / Preparation for commissioning

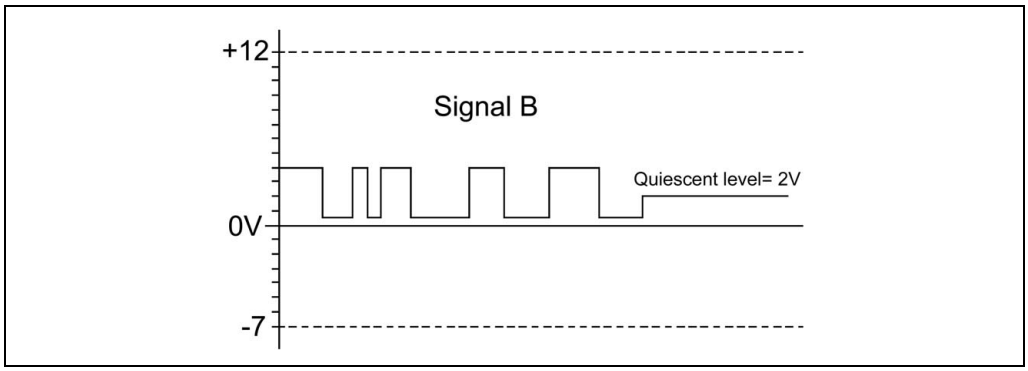
6.1 RS422 Data transmission technology

With the RS422 transmission one line-pair is used for the signals Data+ and Data–.

The serial data are transmitted without mass reference as a voltage difference between two corresponding lines.
The receiver evaluates only the difference between the two lines. Therefore common-mode interferences on the transmission line do not lead to a corruption of the useful signal.
Under load RS422 transmitters provide output levels of ±2V between the two outputs. RS422 receivers still recognize levels of ±200mV as valid signal.







6.2 Cable definition

Signal	Line
Data+ / Data– (RS422+ / RS422–)	min. 0,25mm^2, twisted in pairs and shielded
Supply voltage	min. 0,5mm^2, twisted in pairs and shielded

A shielded data cable must be used to achieve high electromagnetic interference stability. The shielding should be connected with low resistance to protective ground using large shield clips ***at both ends***. Only if the machine ground is heavily contaminated with interference towards the control cabinet ground the shield should be grounded **in the control cabinet only.**
It is also important that the data-lines are routed separate from power current carrying cables if at all possible.

The applicable standards and guidelines are to be observed to insure safe and stable operation!

In particular, the applicable EMC directive and the shielding and grounding guidelines must be observed!

6.3 Connection

The pin assignment depends on the device type and is therefore noted at each measuring system on the nameplate as pin assignment number. At the delivery of the measuring system one device specific pin assignment in printed form is enclosed.

Pin assignment number: 693

CAUTION !

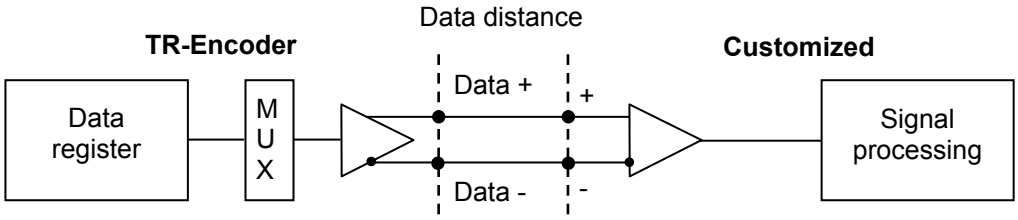
- ***Destruction, damage or malfunctions of the measuring system by overvoltage!***
  - The voltage difference between case and ground must be in the range from ±48 V DC.
  - The continuous voltage difference between any connection and ground must be in the range from ±32 V DC.
  - All connections are protected against repetitive pulses and must not exceed the following values:
    Energy = 3 mJ, Voltage peak = 1000 V, Rise time = 5 ns

6.4 Switching on the supply voltage

After the connection have been carried out, the supply voltage can be switched on.

The initialization procedure is terminated after 600 ms ±10% and the measuring system sends automatically its data.

7 ASI Interface



The **ASI** data communication is an **A**synchronous-**S**erial transmission. The electric data correspond to the RS422 interface with two lines for the inverted and the not inverted signal.

The baud rate used at the ASI data transmission amounts 4800 baud. In each case 8 data bits are transferred together with 1 start bit and 1 stop bit. At a report, altogether 8 characters, each with 8 bits are transferred. The transmission of a complete position-/speed-message report with pause takes 26 ms ±500µs. Thus, the data are transferred in 38.5 Hz rhythm.
To guarantee an error-free data transmission, twisted-pair lines must be used.

7.1 Message format

Transfer rate:	4800 baud
Start bit:	1
Data bits:	8
Parity:	no
Stop bit:	1
Idle time between two transmissions:	approx. 9.5ms

A transmission consists of 8 signs:

Position:	3 signs, hexadecimal as ASCII sign
Speed:	2 signs, hexadecimal as ASCII sign
CRC:	1 sign, EXOR, hexadecimal as ASCII sign
Sync 1:	1 sign, 0x0D „Carriage return“, fixed value
Sync 2:	1 sign, 0x0A „Line feed“, fixed value

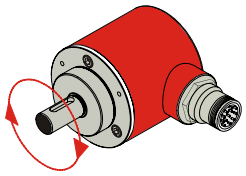
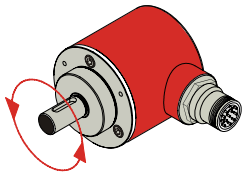
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
1. Sign	2. Sign	3. Sign	4. Sign	5. Sign	6. Sign	7. Sign	8. Sign
MSB		LSB	MSB	LSB		0x0D	0x0A
2^0 - 2^7	2^0 - 2^7	2^0 - 2^7	2^0 - 2^7	2^0 - 2^7	2^0 - 2^7	2^0 - 2^7	2^0 - 2^7
Position Binary format			Speed Binary format		CRC	CR	LF

7.1.1 Translation table for ASCII-signs / Data bits

ASCII sign		Bits 2^3-2^0
"0" = 30H	-->	0 0 0 0
"1" = 31H	-->	0 0 0 1
"2" = 32H	-->	0 0 1 0
"3" = 33H	-->	0 0 1 1
"4" = 34H	-->	0 1 0 0
"5" = 35H	-->	0 1 0 1
"6" = 36H	-->	0 1 1 0
"7" = 37H	-->	0 1 1 1
"8" = 38H	-->	1 0 0 0
"9" = 39H	-->	1 0 0 1
"A" = 41H	-->	1 0 1 0
"B" = 42H	-->	1 0 1 1
"C" = 43H	-->	1 1 0 0
"D" = 44H	-->	1 1 0 1
"E" = 45H	-->	1 1 1 0
"F" = 46H	-->	1 1 1 1

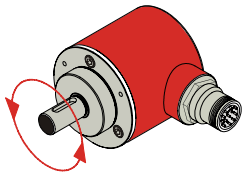
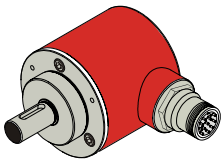
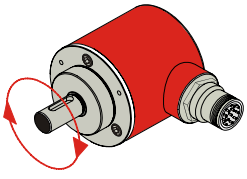
8 Measuring system functions

8.1 Count direction

	Count direction decreasing
	Count direction increasing

8.2 Speed output

±127 Steps/sec:

	0x01: 127 Steps/sec … 0x7F: 1 Step/sec
	„Rest“ 0x80: 0 Steps/sec
	0x81: 1 Step/sec … 0xFF: 127 Steps/sec

Speeds which are larger than the limit values are limited to the positive or negative limit value when the speed is output.

8.3 Calculation of the CRC bits

The CRC character is calculated as a XOR operation (EXCLUSIVE-OR) about the hex values of the characters 1 -5:

CRC bit 2^0 =	Bit 2^8 of the position XOR Bit 2^4 of the position XOR Bit 2^0 of the position XOR Bit 2^4 of the speed XOR Bit 2^0 of the speed

CRC bit 2^1 =	Bit 2^5 of the position XOR Bit 2^1 of the position XOR Bit 2^5 of the speed XOR Bit 2^1 of the speed

CRC bit 2^2 =	Bit 2^6 of the position XOR Bit 2^2 of the position XOR Bit 2^6 of the speed XOR Bit 2^2 of the speed

CRC bit 2^3 =	Bit 2^7 of the position XOR Bit 2^3 of the position XOR Bit 2^7 of the speed XOR Bit 2^3 of the speed

8.4 Preset, external input

WARNING !

Risk of injury and damage to property by an actual value jump when the Preset adjustment function is performed!

- The preset adjustment function should only be performed when the measuring system is at rest, otherwise the resulting actual value jump must be permitted in the program and application!

With the rising edge of the external Preset input the measuring system is adjusted to the position value “0”. To suppress interference, however, the preset is only carried out if the preset signal is present without interruption during the entire response time of 50 ms. A re-execution of the preset is not possible until the input signal has been reset again and a filter time of 50 ms has been waited.

If the Preset input is not used, he should be connected to 0V to suppress interference.

8.5 Opto electronic – Failure detection / Failure reset

The failure detection of the opto electronic is based on the speed measurement.

If during the speed measurement an irregularity (value skip) is determined, the measuring system assumes a failure and inverts the bits 2^0 to 2^3 of the CRC sign.

The error message is cleared if the supply voltage of the measuring system is switched off and then switched on again.

8.6 Behavior at voltage drops

Voltage drops ≤ 50 ms are ignored by the measuring system and send further correct position and speed data.

In case of longer voltage drops, e.g. > 10 sec, the measuring system answers at the least after 600ms ±10% with correct position and speed data when the voltage is present again.

9 Causes of faults and remedies

See also chapter “Opto electronic – Failure detection / Failure reset“ page 25.

Fault	*Cause*	*Remedy*
Position skips of the measuring system	Strong vibrations	Vibrations, impacts and shocks, e.g. on presses, are dampened with "shock modules". If the error recurs despite these measures, the measuring system must be replaced.
	Electrical faults EMC	Perhaps isolated flanges and couplings made of plastic help against electrical faults, as well as cables with twisted pair wires for data and supply, see chapter Cable definition page 45.
	Extreme axial and radial load on the shaft may result in a scanning defect.	Couplings prevent mechanical stress on the shaft. If the error still occurs despite these measures, the measuring system must be replaced.