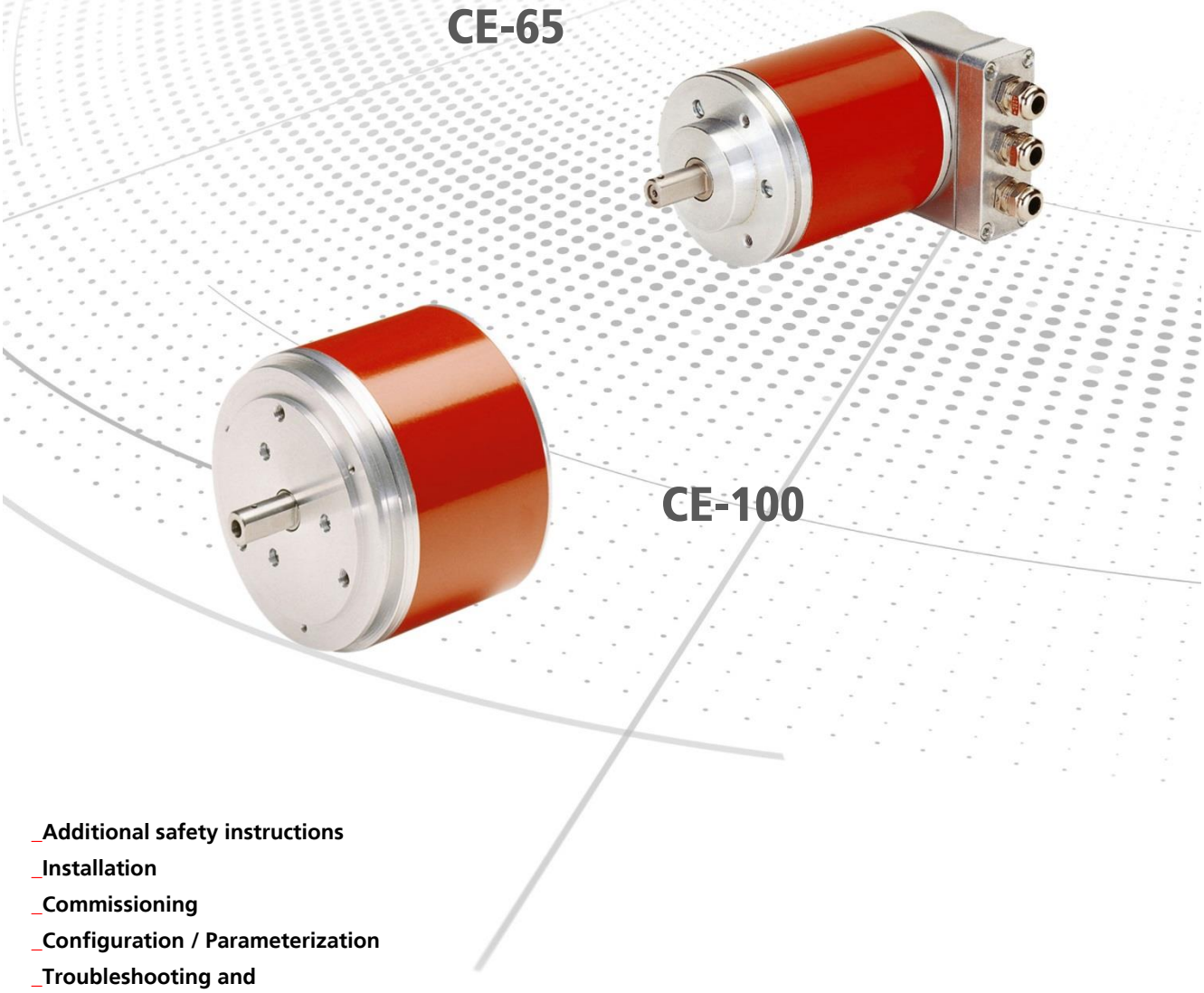
TR electronic

PROFIBUS®

+SSI

Absolute-Encoder



_Additional safety instructions
_Installation
_Commissioning
_Configuration / Parameterization
_Troubleshooting and
Diagnostic options

User Manual

4.00+ / WIU00001

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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>).

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1 General information

This User Manual includes the following topics:

- Basic safety instructions
- Technical data
- Assembly
- Installation
- Commissioning
- Configuration / parameterization
- Troubleshooting and Diagnostic options

As the documentation is arranged in a modular structure, this User Manual is supplementary to other documentation, such as product datasheets, dimensional drawings and 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 model with ***PROFIBUS-DP*** interface:

- CE-65
- CE-100

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 EC Declaration of conformity

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

A corresponding declaration of conformity 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 used / Terminology

CE	Absolute Encoder with optical scanning unit
DP	***D***ecentralized ***P***eriphery
EC	***E***uropean ***C***ommunity
EMC	***E***lectro ***M***agnetic ***C***ompatibility
ESD	***E***lectro ***S***tatic ***D***ischarge
GSD	Device Master File
IEC	***I***nternational ***E***lectrotechnical ***C***ommission
PNO	PROFIBUS User Organization (PROFIBUS Nutzerorganisation)
PROFIBUS	Manufacturer independent, open field bus standard
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.

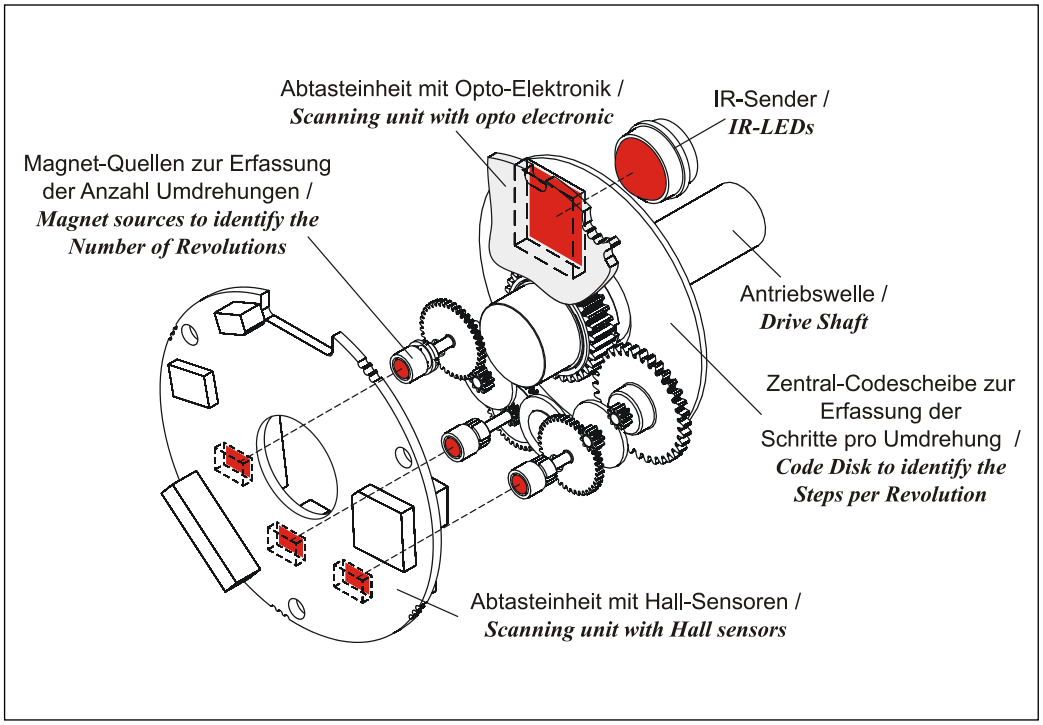
Single-Turn

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 balanced 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 balanced and output via different interface modules depending on the type of interface used.

Principle



2 Basic safety instructions

2.1 Definition of symbols and instructions

⚠ WARNING	means that death or serious injury can occur if the required precautions are not met.
⚠ CAUTION	means that minor injuries can occur if the required precautions are not met.
NOTICE	means that damage to property can occur if the required precautions are not met.
	indicates important information or features and application tips for the product used.
	means that appropriate ESD-protective measures are to be considered according to DIN EN 61340-5-1 supplementary sheet 1.

2.2 Obligation of the operator before start-up

As an electronic device the measuring system is subject to the regulations 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 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, non-intended 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 intended 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 Intended use

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

Intended 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.

2.5 Non-intended use

Danger of death, physical injury and damage to property in case of non-intended use of the measuring system!

⚠ WARNING

- As the measuring system ***does not constitute a safety component*** according to the EC machinery directive, a plausibility check of the measuring system values must be performed through the subsequent control system.

NOTICE

- It is mandatory for the operator to integrate the measuring system into his own safety concept.
- The following areas of use are especially forbidden:
  - in environments where there is an explosive atmosphere
  - for medical purposes

2.6 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-intended 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.

2.7 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.

2.8 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 !

2.9 Safety information's

⚠ WARNING

NOTICE

- ***Destruction, damage or malfunctions of the measuring system and risk of physical injury!***
  - ➢ 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.

NOTICE

- ➢ 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!

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 ratings

Operating voltage: ..... 11-27 V DC (+/- 5% residual ripple)

Max. current consumption: ..... < 350 mA at 11 V DC, < 150 mA at 27 V DC

Output capacity: ..... Max. 25 bits

Resolution: ..... Max. 8192 increments per revolution (13 bits)

Measuring range: ..... 4096 revolutions (12 bits)

Output code: ..... Binary

Baud rate: ..... 12 Mbps

Encoder interface: ..... PROFIBUS-DP acc. to DIN 19245 Part 1-3

Special features: ..... Programming is performed via the parameterization message at the start-up of the encoder or PROFIBUS-DP master

SSI-OUT data interface

Clock input:	Optocoupler
Data output:	RS422 (2-wire)
Clock rate:	80 kHz - 1MHz
Code:	Programmable, left-justified

Operating temperature range: ..... 0 to +60 °C

4.2 Mechanical ratings

Mechanically permissible speed: ..... 6000 rpm

Permissible shaft load: ..... 40 N axial, 60 N radial (at end of shaft)

Minimum bearing lifetime: ..... 3.9×10^{10} revolutions at:

Operating speed:	3000 rpm
Shaft loading:	20 N axial, 30 N radial (at end of shaft)
Operating temperature:	60 °C

Max. angular acceleration: ..... $\leq 10^4$ rad/s^2

Moment of inertia: ..... 2.5×10^{-6} kg m^2

Starting torque at 20 °C: ..... 2 Ncm

Vibration loading (50-2000Hz): ..... ≤ 100 m/s^2

Shock loading (11 ms): ..... ≤ 1000 m/s^2

5 Assembly

Encoder shaft drive

Encoders of the CE series are connected to the drive shaft by an elastic coupling which compensates for any deviations in the axial and radial direction between the encoder and drive shaft. This avoids excessive strain on the bearings. Couplings can be ordered on request.

Flange mounting

The centering collar with fit f7 centers the encoder in relation to the shaft. It is fixed to the machine by means of three screws in the flange (Fig. 1).

Clamping bracket mounting

The centering collar with fit f7 centers the encoder in relation to the shaft. The encoder is fixed by means of two clamping brackets (Fig. 2).

Fig. 1

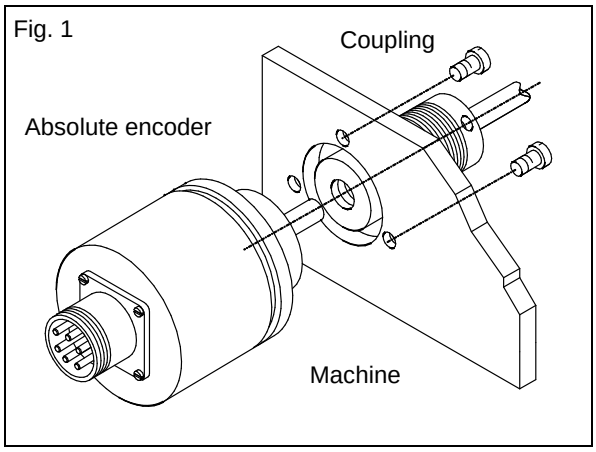
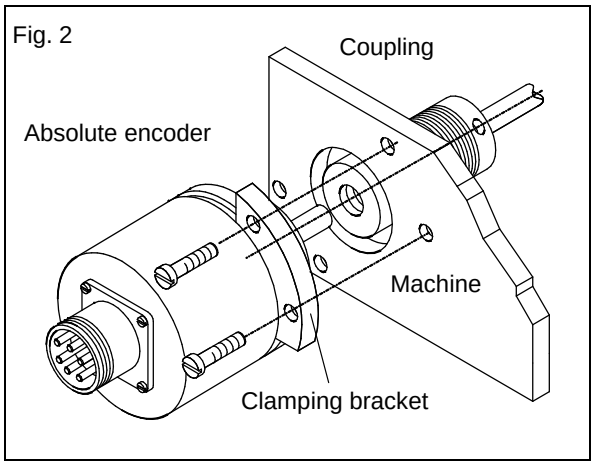


Fig. 2

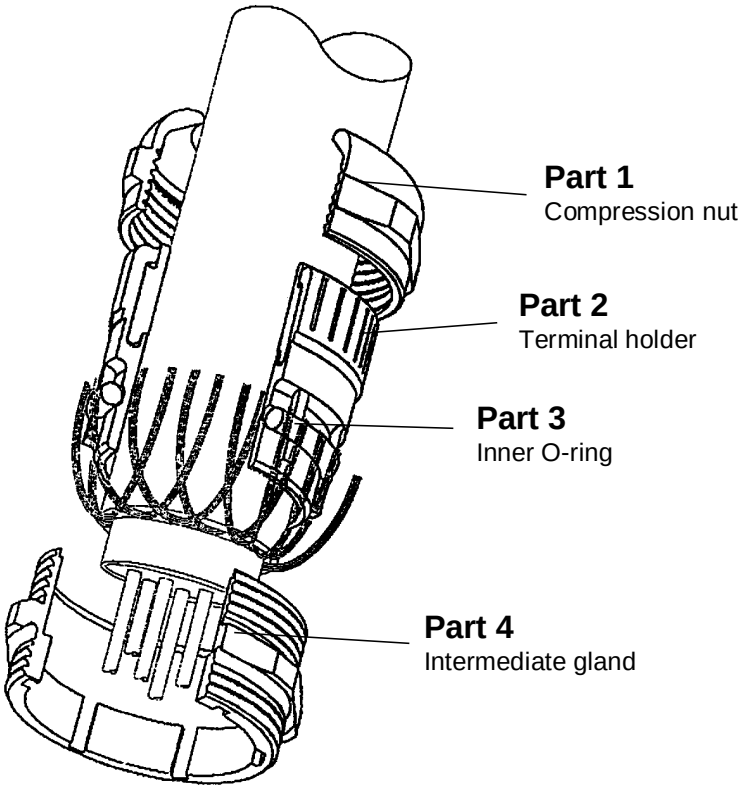


5.1 Connecting the Cable Screening to the Bus-Cap

To prevent disturbance signals entering the encoder housing, we used cable screw glands with which it is possible to connect the screen on the inside. For this reason, **no** connection point for the screen is provided inside the cup-cap.

Procedure:

1. Screw the cable screw gland into the housing.
2. Dismount the compression nut (1) and the terminal holder (2).
3. Push the compression nut (1) and the terminal holder (2) over the cable.
4. Strip the cable; push back the braiding around the terminal holder (2) such that the braiding goes over the inner O-ring (3) and does not lie over the cylindrical section or the torsional bars.
5. Insert the terminal holder (2) into the intermediate gland (4) such that the torsional bars fit into the intended lengthwise grooves in the intermediate gland (4).
6. Screw the compression nut (1) to the intermediate gland (4).



6 Device description / start-up

6.1 PNO identification number

The encoder has the PNO ID number AAAB (hex). This number is reserved and filed with the PNO.

6.2 PNO certificate

The encoder has passed a certification test by an independent test laboratory of the Profibus User Organization and is certified under the number Z00319. The relevant documents are held by TR Electronic and the PNO.

6.3 PNO encoder profile

The Profibus User Organization has issued an encoder profile defining the structure of an encoder on the Profibus. A copy of this profile can be obtained for a fee from the PNO office. Details of prices are available exclusively by the Profibus User Organization.

6.4 Operating requirements

Theoretically, the encoder can be connected to any Profibus-DP network, provided the PROFIBUS-DP master is capable of transmitting a parameter message. Similarly, the configuration software should be able to display the parameter structure specified in the device master file in order to allow the parameters to be entered. If this is not the case, the encoder cannot be programmed and runs on the bus with the maximum resolution, and without the possibility of scaling or adjustment as Class-1 encoder.

TR Electronic supplies a Software/Support CD containing the device master file (.GSD) and a type file (.200) for users with SIEMENS masters. If the CD is not enclosed with this documentation, it can be purchased by order number: 490-01001, Soft-No.: 490-00406.

For details of how to integrate the encoder into the interface of the DP master configuration software, please refer to the relevant documentation.

6.5 Setting the station address

The station address of the encoder is set exclusively via the rotary switch in the cover containing the connecting terminals. When the terminals are viewed from above (outgoing cable facing downwards), the left-hand switch sets the tens and the right-hand switch the units of the station address.
The addressing of the encoder is limited within the Profibus address area. Valid station addresses are 3 - 99.
If an invalid station address is set, the device will not start up and the LEDs will not be illuminated.

6.6 PROFIBUS – interface

All devices are connected in a bus structure (line). Up to 32 subscribers (master or slaves) can be connected together in a segment.
The bus is terminated with an active bus termination at the beginning and end of each segment. For stable operation, it must be ensured that both bus terminations are always supplied with voltage. The bus termination can be switched in the measuring system connector hood. As a general rule, both switches must always be switched on (if encoder is the last station) or switched off (if the encoder is not the last station).

Repeaters (signal amplifiers) have to be used with more than 32 subscribers or to expand the network scope in order to connect the various bus segments.

All cables used must conform with the PROFIBUS specification for the following copper data wire parameters:

Parameter	**Cable type A**
Wave impedance in Ω	135...165 at a frequency of 3...20 MHz
Operating capacitance (pF/m)	30
Loop resistance (Ω/km)	≤ 110
Wire diameter (mm)	> 0.64
Wire cross-section (mm²)	> 0.34

The PROFIBUS transmission speed may be set between 9.6 kBit/s and 12 Mbit/s and is automatically recognized by the measuring system. It is selected for all devices on the bus at the time of commissioning the system.

The range is dependent on the transmission speed for cable type A:

Baud rate (kbits/s)	9.6	19.2	93.75	187.5	500	1500	12000
Range / Segment	1200 m	1200 m	1200 m	1000 m	400 m	200 m	100 m

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. It is also important that the data line is routed separate from power current carrying cables if at all possible. At data speed ≥ 1.5 Mbit, drop lines should be avoided under all circumstances.

The measuring system connector hood offers the possibility of connecting the inward and outward data cables directly to the removable connector hood. This avoids drop lines and the bus connector can be connected to and disconnected from the bus at any time without interruption of data traffic.

The PROFIBUS guidelines and other 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!

6.7 Device master file

For encoders with version 3.x, the device master file of the encoder has the filename TR03AAAB.GSD. Because of the extended performance range, for devices with version 4 and up the file ***TR05AAAB.GSD was created.
For users of older Siemens masters, there is also a so-called type file called TRAAAB3X.200 which fulfils the same function as the device master file TR03AAAB.GSD, but has a special data format.
To find out how to integrate these files into the system configuration, please refer to the documentation of the configuration program for the Profibus master.
The encoder also has two bitmap files named TRAAAB3N.BMP and TRAAAB3S.BMP or TRAAAB5N.DIP and TRAAAB5S.DIP which represent the encoder in the normal and faulty states respectively. These images also have to be integrated into the system configuration according to the instructions of the relevant documentation.

* Usable as of COMPROFIBUS version 5.0 (S5) or STEP7 as of version 5.0 service pack 3 (S7).

The file TR05AAAB.GSD causes:

- 4 byte parameter (see also notes on page 30)
  (no partitioning into high and low word at decimal input)

- Extended performance range
  - Teach In
  - Limit switches
  - switchable diagnostic length
  - switchable units for rev. per min

see also chapter "New in firmware versions 4.x opposite 3.x", page 48.

Downloads:

- TR03AAAB.GSD: www.tr-electronic.de/f/TR-ECE-ID-MUL-0005
- TR05AAAB.GSD: www.tr-electronic.de/f/TR-ECE-ID-MUL-0006
- TRAAAB3X.200: www.tr-electronic.de/f/TR-ECE-ID-MUL-0005

6.8 Configuration and parameterization

6.8.1 Configuration

Configuration means specifying the length and type of process data and the manner in which they are to be handled. For this purpose, the configuration program usually provides an input list in which the user has to enter the appropriate identifiers.

Since the encoder supports several possible configurations, the identifier to be entered is preset depending on the required nominal configuration, so that all you have to do is enter the I/O addresses. The identifiers are deposited in the device master file.

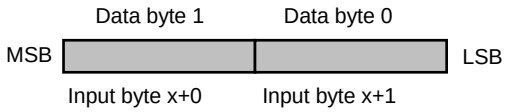
Depending on the required **nominal configuration**, the encoder will assign a different number of input and output words on the PROFIBUS.

In the following, the individual nominal configurations and the position of the communication bytes for the data transfer with the PROFIBUS-DP master are described.

6.8.1.1 Class 1 16-bit resolution, identifier D0 (HEX):

The encoder uses one input word only, which is consistently transferred via the bus.

Input word IW x



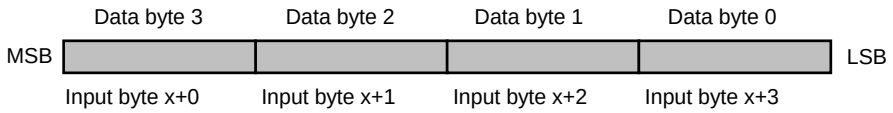
Relevant parameter data:

- Count direction

6.8.1.2 Class 1 32-bit resolution, identifier D1 (HEX):

The encoder uses two input words only, which are consistently transferred via the bus.

Double input word ID x



Relevant parameter data:

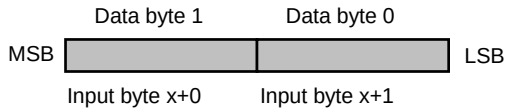
- Count direction

In the case of configurations for CLASS 1, preset adjustment is not possible via the PROFIBUS, and only the code sequence can be changed. The encoder operates with the standard resolution specified on the rating plate. The diagnostic data are limited to 16 bytes.

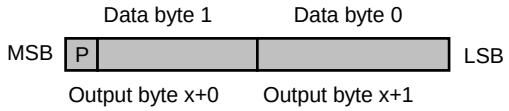
6.8.1.3 Class 2 16-bit resolution, identifier F0 (HEX):

The encoder uses one input word and one output word which are consistently transferred via the bus.

Input word IW x



Output word for preset adjustment OW x



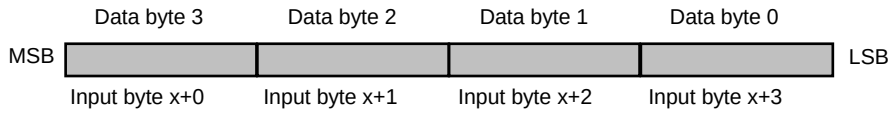
Relevant parameter data:

- Count direction
- Class 2 functionality (on/off)
- Scaling function (on/off)
- Commissioning diagnostic control (on/off)
- Measuring units per revolution
- Total measuring range

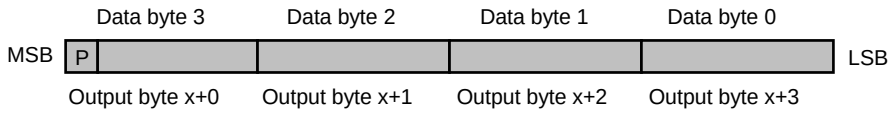
6.8.1.4 Class 2 32-bit resolution, identifier F1 (HEX):

The encoder uses two input words and two output words which are consistently transferred via the bus.

Double input word ID x



Double output word for preset adjustment OD x



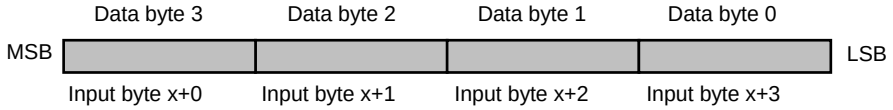
Relevant parameter data:

- Count direction
- Class 2 functionality (on/off)
- Scaling function (on/off)
- Commissioning diagnostic control (on/off)
- Measuring units per revolution
- Total measuring range

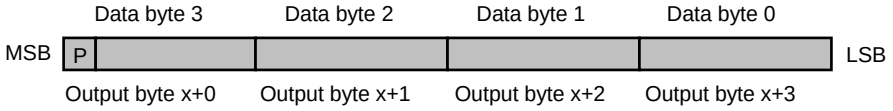
6.8.1.5 TR-mode position, identifier F1 (HEX):

The encoder uses two input words and two output words which are consistently transferred via the bus.

Double input word ID x



Double output word for preset adjustment OD x



Relevant parameter data:

- Count direction
- Commissioning diagnostic control (on/off)
- Total measuring range
- Revolutions numerator
- Revolutions denominator
- Code SSI interface[1]
- Code PROFIBUS interface
- Preset 1 value (24V inputs)
- Preset 2 value (24V inputs)

New in version 4.x

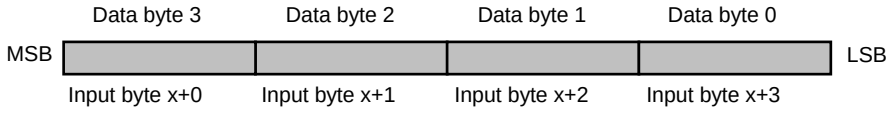
- Teach-In function (commissioning function)
- Short diagnostic
- Limit switch lower limit
- Limit switch upper limit

[1] SSI on request, not standard

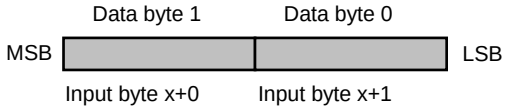
6.8.1.6 TR-mode position+velocity, identifier F1 (HEX):

The encoder uses two input words for the position plus a separate input word for the velocity, and two output words which are consistently transferred via the bus. The velocity is output with a sign in revolutions per minute and has an accuracy of +/- 1 rpm.

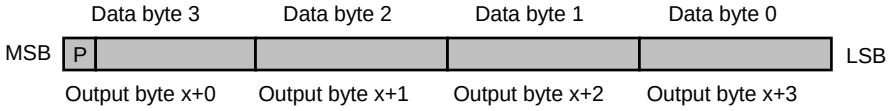
Double input word ID x



Input word IW x



Double output word for preset adjustment OD x



Relevant parameter data:

- Count direction
- Commissioning diagnostic control (on/off)
- Total measuring range
- Revolutions numerator
- Revolutions denominator
- Code SSI interface[2]
- Code PROFIBUS interface
- Preset 1 value (24V inputs)
- Preset 2 value (24V inputs)

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- Teach-In function (commissioning function)
- Short diagnostic
- Limit switch lower limit
- Limit switch upper limit
- Speed [1/n rpm]

The configurations designated "TR mode" are not compatible with the PNO encoder profile in terms of the parameter record. The scaling function prescribed by the PNO profile is a simple special case of a general gear. Due to the extended 'gear' scaling function, additional parameters are therefore necessary in order to describe the gear fully.

In other words, the TR-specific modes represent an extension of the encoder function which is not restricted by its compatibility with the PROFIBUS-DP and certification.

[2] SSI on request, not standard

6.8.2 Parameterization

Parameterization means providing a PROFIBUS-DP slave with certain information required for operating purposes before it begins the cyclical exchange of process data. For example, the encoder requires data concerning the resolution, count direction, preset values, etc.
The configuration program for the PROFIBUS-DP master usually provides an input mask via which the user can enter the parameter data or select from lists. The structure of the input mask is stored in the device master file. The number and type of the parameters to be entered by the user depend on the chosen nominal configuration.

6.8.2.1 Code sequence:

Defines the count direction of the encoder.

Selection

- Increasing clockwise *
- Increasing counter-clockwise

6.8.2.2 Class 2 functionality:

Defines the encoder's range of functions.
"Class 2 deactivated" means that the encoder only performs Class 1 functions, does not scale the position value and is not adjustable.

Selection

- No (Class 2 functions deactivated)*
- Yes (Class 2 activated)

6.8.2.3 Commissioning diagnostic control:

Defines whether the encoder outputs an extended diagnostic message.

Selection

- Disabled (Commissioning diagnostic control deactivated)*
- Enabled (Commissioning diagnostic control activated)

6.8.2.4 Scaling function control:

Defines whether the encoder scales the position on the basis of the subsequent parameter. If Class 2 is deactivated, it does not scale the position value and is not adjustable.

Selection

- Disabled (scaling deactivated)*
- Enabled (scaling activated)

6.8.2.5 Measuring units per revolution:

Defines the number of increments displayed by the encoder for each revolution of the encoder shaft.

Input

- Lower limit: 1 increment / revolution
- Upper limit: 8192 increments per revolution (depending on capacity - marked on rating plate)
- Default value: 4096

6.8.2.6 Total measuring range [units] hi and total measuring range [units] lo

Together, these parameters define the total number of increments displayed by the encoder before it starts again from zero.

Inputs for HI word

- Lower limit 0
- Upper limit 512 (depending on the total capacity, which is calculated by multiplying the max. number of increments per revolution by the maximum number of revolutions. This data is marked on the rating plate.)
- Default value: 256

Inputs for LO word

- Lower limit 0
- Upper limit 65535 (depending on the total capacity, which is calculated by multiplying the max. number of increments per revolution by the maximum number of revolutions. This data is marked on the rating plate.)
- Default value: 0

6.8.2.7 Revolutions numerator hi and revolutions numerator lo

⚠ WARNING

NOTICE

Danger of personal injury and damage to property exists if the measuring system is restarted after positioning in the de-energized state by shifting of the zero point!

If the number of revolutions is not an exponent of 2 or is >4096, it can occur, if more than 512 revolutions are made in the de-energized state, that the zero point of the multi-turn measuring system is lost!

- Ensure that the quotient of ***Revolutions Numerator / Revolutions Denominator*** for a multi-turn measuring system is an exponent of 2 of the group
  2^0, 2^1, 2^2…2^{12} (1, 2, 4…4096).

  or

- Ensure that every positioning in the de-energized state for a multi-turn measuring system is within 512 revolutions.

Together, these parameters define the total number of revolutions displayed by the encoder before it starts again from zero.

Inputs for HI word

- Lower limit 0
- Upper limit 3
- Default value: 0

Inputs for LO word

- Lower limit 1
- Upper limit 65535
- Default value: 4096

6.8.2.8 Revolutions denominator

⚠ WARNING

NOTICE

Danger of personal injury and damage to property exists if the measuring system is restarted after positioning in the de-energized state by shifting of the zero point!

If the number of revolutions is not an exponent of 2 or is >4096, it can occur, if more than 512 revolutions are made in the de-energized state, that the zero point of the multi-turn measuring system is lost!

- Ensure that the quotient of ***Revolutions Numerator / Revolutions Denominator*** for a multi-turn measuring system is an exponent of 2 of the group
  2^0, 2^1, 2^2…2^{12} (1, 2, 4…4096).

  or

- Ensure that every positioning in the de-energized state for a multi-turn measuring system is within 512 revolutions.

Together, these parameters define the total number of revolutions displayed by the encoder before it starts again from zero.

- Lower limit 1
- Upper limit 99
- Default value: 1

6.8.2.9 Code SSI interface:

Defines the output code for the (optional) SSI interface. The transfer to the PROFIBUS takes place in binary form according to the PNO profile.

Selection

- Gray (encoder supplies 24-bit Gray code)
- Binary (encoder supplies 24-bit binary code)*
- Shifted Gray (encoder supplies clipped Gray code)

6.8.2.10 Data bits SSI interface:

Defines the number of data bits on the SSI interface.
Output format: MSB left-justified

- Lower limit 8
- Upper limit 32
- Default value 24

6.8.2.11 Code PROFIBUS interface:

Defines the output code for the PROFIBUS interface.

Selection

- Binary (encoder supplies 24-bit binary code)
- Gray (encoder supplies 24-bit Gray code)*
- Shifted Gray (encoder supplies clipped Gray code)

6.8.2.12 Preset 1 value [units] hi and preset 1 value [units] lo

⚠ WARNING

NOTICE

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!

Together, these parameters define the position value to which the encoder is adjusted with the leading edge of the 1st preset input. To suppress interference, however, the preset is only carried out if the preset signal is present without interruption during the entire response time of 30 ms. A re-execution of the preset is not possible until the input signal has been reset again and a filter time of 30 ms has been waited.

The inputs depend on the total measuring length in increments

- Lower limit 0
- Upper limit total measuring length in increments - 1
- Default value 1

6.8.2.13 Preset 2 value [units] hi and preset 2 value [units] lo

⚠ WARNING

NOTICE

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!

Together, these parameters define the position value to which the encoder is adjusted with the leading edge of the 2nd preset input. To suppress interference, however, the preset is only carried out if the preset signal is present without interruption during the entire response time of 30 ms. A re-execution of the preset is not possible until the input signal has been reset again and a filter time of 30 ms has been waited.

The inputs depend on the total measuring length in increments

- Lower limit 0
- Upper limit total measuring length in increments - 1
- Default value 2

6.8.2.14 Commissioning function

This parameter defines the setting of the commissioning function. In the standard setting "Off, no status" the encoder is compatible to encoders with version 3.x (further details see Teach-In function).

Selection
- Off, no status (V3.x), default
- Off, with status
- On, with status

6.8.2.15 Short diagnostic (16 byte)

With this parameter in the TR operation modes the number of diagnostic bytes can be limited from 6+51 bytes to 6+10 bytes. Therefore the encoder can be operated also to Profibus masters with older issue numbers in these modes.

Selection
- No, default
- Yes

6.8.2.16 Limit switch lower and upper limit

Is the status switched on (see commissioning function) the encoder can inform the master via a bit whether the actual value is within the limits.
It is valid:

Limit switch bit = 0 if lower limit < actual value < upper limit
Limit switch bit = 1 if actual value < lower limit or actual value > upper limit

The inputs depend on the total measuring length in increments.

- Lower limit 0
- Upper limit total measuring length in increments - 1
- Default value 0

6.8.2.17 Speed [1/n rpm]

With this parameter the information of the rotation speed can be scaled in arbitrary increments between 1/1 and 1/100 rpm.

- Lower limit 1
- Upper limit 100
- Default value 1

Notes for the input of parameters with data format 32 bits
(only in connection with the device master file "TR03AAAB.GSD")

The Profibus standard DIN 19245 provides the data format "UNSIGNED32" for the definition of 32 bits of parameter data in the device master file. This data format isn't supported by all configuration programs for profibus master. These programs clip the more significant word of the parameter. In order to allow inputs despite this, these parameters are split up into single words.
Illogically enough, the input in the input masks also has to be made in decimal form.
This affects the following parameters:

- Total measuring range [units]
- Revolutions numerator
- Preset 1 value
- Preset 2 value

In the meantime, we recommend the following procedure for entering measuring lengths in increments larger than 16 bits:

1. Convert the desired measuring length in increments to a hexadecimal figure using a calculator and store this figure.
2. Convert only the four less significant tetrads (figures) back to decimal format separately. This gives you the input 'Total measuring range [units] lo'
3. Convert only the remaining more significant tetrads (figures) back to decimal format separately. This gives you the input 'Total measuring range [units] hi'

Example:

Total measuring length in increments:	10 500 000 (D)
converted to hexadecimals:	A0 37A0 (H)
results in four less significant tetrads:	37A0 (H)
and remaining more significant tetrads:	A0 (H)
Total measuring range [units] lo:	14240(D) (=37A0 (H) !)
Total measuring range [units] hi:	160 (D) (=A0 (H) !)

6.8.3 Scaling function

6.8.3.1 Nominal configurations PNO Class 1+2

The encoder does not support a gear function. The position value is decoded in binary form and balanced against a zero offset and the code sequence.
The position is calculated according to the following formula:

$$\text{Number of increments per revolution}^{*} = \frac{\text{Measuring length in increments}^{*}}{\text{Number of revolutions}}$$

When entering the parameterization data, make sure the parameters 'Measuring length in increments' and 'Number of increments per revolution' are chosen so that the quotient of the two parameters is a second power.
If this is not the case, the encoder will correct the measuring length in increments to the next smallest second power in revolutions. The number of increments per revolution remains constant.
The re-calculated measuring length in increments can be read out via the extended diagnostic information for Class 2 and is always smaller than the predefined measuring length. Therefore it can be that the actually needed total increment number is exceeded and the encoder generates a zero-point changeover before reaching the maximum mechanical displacement distance.

Since the internal absolute position (before the encoder was scaled and a zero-point adjustment was executed) recurs periodically after 4096 revolutions, at rotating applications (endless driving to the same direction, the number of revolutions is not a power of two) it comes inevitably to offsets.
For such applications, one of the TR - nominal configurations has to be used.

* Operator input

6.8.3.2 Nominal configuration TR-mode position and TR-mode position+velocity

The encoder supports the gear function for rotating applications. The position value is balanced against a zero offset, the code sequence and the entered gear parameters. The number of increments per revolution is calculated according to the following formula:

$$\text{Number of increments per revolution} = \frac{\text{Measuring length in increments}^*}{\frac{\text{Number of revolutions numerator}^*}{\text{Number of revolutions denominator}^*}}$$

Gear limits:

Maximum no. of revolutions	256000
Minimum no. of revolutions	1
Maximum no. of increments per revolution	see encoder rating plate
Minimum denominator	1
Maximum denominator	99

For rotating applications (endless driving to the same direction, the number of revolutions must not to be a power of two), one of the TR - nominal configurations must to be used.

6.9 Preset adjustment

⚠ WARNING

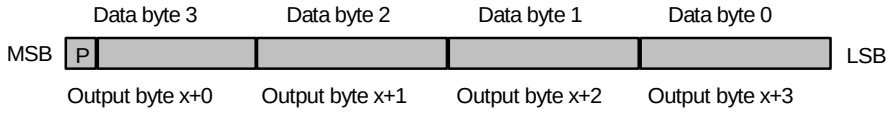
NOTICE

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

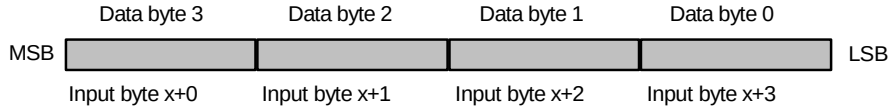
- The preset adjustment function should only be performed when the measuring system is at rest, otherwise the resulting actual value jump must be permitted in the program and application!

In 'Class 2' mode and in the 'TR - operation modes', the PROFIBUS can be used to adjust the encoder to any position value within a range of 0 to (measuring length in increments - 1).
This is done by setting the most significant bits of the output data (2^{31} for configuration Class 2 - 32 bits or 2^{15} for configuration Class 2 - 16 bits).

Outputs



Inputs



The preset adjustment value transferred in data bytes 0 - 3 is accepted as the position value with the leading edge of bit 32 (=bit 7 of data byte 3).
To suppress interference, however, the new position value is only carried out if the control bit 32 is present without interruption during the entire response time of 30 ms. A re-adjustment is not possible until the control bit has been reset again and a filter time of 30 ms has been waited.
In the Class 2 mode this process is not acknowledged via the inputs.
In the TR - operations modes at status switched-on (see adjustments of the Commissioning function) this process is acknowledged via the most significant bit.

6.10 Commissioning function (Teach-in function for linear axes)

This function is activatable in the parameterization.
When the commissioning function is activated, the relevant distance can be traversed with the machine. On the basis of the input "requested number of units per distance traveled", the encoder automatically calculates its measuring length in increments from the position difference and the selected measuring units. This value can then be entered in the parameterization file, so that the teach-in process does not need to be repeated should the encoder be exchanged.

For the Teach-In procedure following reductions are valid:

- The number of the revolutions must be programmed fixed to 4096 and may not be changed in the parameterization!
- The maximum displacement distance mustn't exceed 2048 revolutions
- During the Teach-In process the maximum number of increments per revolution of the encoder mustn't be exceeded (e.g. specification of a measuring length of 3000 increments and indication of a displacement distance of ¼ of a revolution)
- For rotating applications the commissioning function is not suitable and not valid

When the teach-in function is activated, the green LED flashes at a frequency of approx. 1 Hz.

To remain downward compatible to the version of 3.x, in the parameter setting there are three different settings:

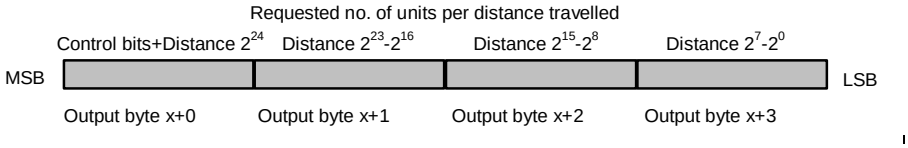
- OFF, no status:
  This setting is compatible with version 3.x, that means the bits 2^{25} to 2^{31} are always "0".

- OFF, with status:
  In this setting the status bits are visible, but the function is not activated

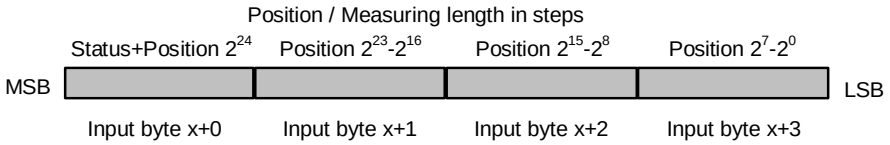
- ON, with status
  The commissioning function is active

6.10.1 Input/output configuration for teach-in

Outputs



Inputs



6.10.1.1 Assignment of the status byte

At activated status the status bits 2^{25} to 2^{31} have the following meaning:

Bit 25	Ready status 0 = Encoder not ready-to-operate 1 = Encoder ready-to-operate
Bit 26	Operating mode 0 = Commissioning mode 1 = Normal mode
Bit 27	Software limit switches 0 = lower limit switch < process-actual value < upper limit switch 1 = process-actual value < lower limit switch or process-actual value > upper limit switch
Bit 28	Counting direction (at the moment) Bit 28 = 0: Counting direction cw (with look on the shaft) Bit 28 = 1: Counting direction ccw (with look on the shaft)
Bit 29	Teach-In, takeover drive distance 0 = Drive distance not taken 1 = Drive distance taken
Bit 30	Start Teach-In 0 = No start 1 = Teach-In function started
Bit 31	Adjustment acknowledgement 0 = No adjustment requested 1= Requested adjustment was executed

6.10.1.2 Assignment of the control byte

Bit 25	No meaning
Bit 26	No meaning
Bit 27	No meaning
Bit 28	Change counting direction 0 = Keep counting direction 1 = Invert present counting direction
Bit 29	Takeover Teach-In 0 = No takeover of the drive distance 1 = Takeover of the drive distance
Bit 30	Start Teach-In 0 = No start 1 = Start
Bit 31	Adjustment request 0 = No adjustment requested 1 = Adjust encoder to the preset value

6.10.2 Teach-in procedure

The teach-in procedure takes place in several stages which are described below. It is assumed that the PROFIBUS is in operation, that the PLC is in its cycle, and that its process image is continuously updated. The inputs and outputs assigned by the encoder in the PLC must be able to be controlled via a programming device (e.g. "Control variables" function in SIMATIC-S5 system), or alternatively by a PLC handling facility.

1. After selecting manual or set-up mode, move the machine by hand to the starting position of the distance to be measured.
2. Find out whether the present adjusted counting direction is correct for the application. If not, first the counting direction must be inverted with setting the "*Change counting direction*" bit in the control byte. The encoder displays the present counting direction in the status byte.
3. Set the "*Start Teach-In*" bit in the control byte
   The encoder then re-programs its measuring length in increments to the maximum resolution, memorizes its current position and acknowledges this process by setting the "*Teach In Function Started*" bit in the status byte.
4. Reset the "*Start Teach-In*" bit in the control byte
   The "*Teach-In Started*" bit remains set furthermore!
5. In manual or set-up mode, move the machine by hand to the ending position of the distance to be measured. Measure the distance between initial and ending position with a measuring tape of arbitrary measurement unit.
6. Enter the real distance in measured units according to the tape measure in data bytes D0 and D1 of the outputs.
7. Set the "*Takeover of the drive distance*" bit in the control byte
   The encoder then calculates the measuring length in increments from the requested travelling distance in measured units, enters the calculated measuring length in increments in data bytes D0 .. D2 of the inputs and acknowledges this process by setting the "*Teach-In, drive distance taken*" bit of the status byte.
8. Make a note of the measuring length in increments!
9. Reset the "*Takeover of the drive distance*" bit in the control byte
   The encoder then accordingly resets the "*Teach-In started*" and "*Teach-In, drive distance taken*" bits in the status byte. Thus the Teach-In process is completed.
10. Carry out presetting or adjustment.

If one of the steps was omitted or incompletely executed, the entire procedure must be repeated.
During the teach-in process, the encoder must not be adjusted and no presettings may be performed.

Once all axes have been set up with the teach-in function, the noted measuring lengths in increments must be entered in the parameterization file of the encoder using the configuration program for the PROFIBUS master (e.g. COM-ET-200 or COM PROFIBUS), and the teach-in mode must be deactivated. This ensures that the teach-in process does not have to be repeated should the encoder be exchanged.

The following tables display the processes schematically again:

Setting of the counting direction

M = Master		Status-/Control bits							Data bits																							
S = Slave	Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
M→S		0	0	0	**1**	0	0	0	The selected direction of rotation is changed over from 0 to 1 or 1 to 0 using bit 28																									
S→M		0	0	0	**0/1**	0/1	0	1	The encoder now acknowledges the newly selected direction of ro. in bit 0 and bit 28																								0/1
M→S		0	0	0	**0**	0	0	0	Changeover is completed by setting bit 28 to 0																								
S→M		0	0	0	**0/1**	0/1	0	1	The process actual value is now output again																								

Teach-In Start

M = Master		Status-/Control bits							Data bits																							
S = Slave	Bit	31	**30**	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
M→S		0	**1**	0	0	0	0	0	The Teach-In mode is activated by setting bit 30																								
S→M		0	**1**	0	0/1	0/1	0	1	Acknowledging by setting bit 30 to 1																								0/1
M→S		0	**0**	0	0	0	0	0	Resetting																								
S→M		0	**1**	0	0/1	0/1	0	1	Non-calculated process actual values (gear factor=1, no preset active)																								

Teach-In, takeover drive distance

M = Master		Status-/Control bits							Data bits																							
S = Slave	Bit	31	**30**	**29**	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
M→S		0	**0**	**1**	0	0	0	0	Number of increments which the encoder should output is now sent to the encoder																								
S→M		0	**1**	**1**	0/1	0/1	0	1	Transfer of the total measuring range for the new gear factor (this should be noted!)																								0/1
M→S		0	**0**	**0**	0	0	0	0	Resetting																								
S→M		0	**0**	**0**	0/1	0/1	0	1	The process actual value, calculated with the new gear factor, is output																								

Preset-Adjustment

M = Master		Status-/Control bits							Data bits																							
S = Slave	Bit	31	30	29	**28**	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
M→S		1	0	0	**0**	0	0	0	Here the preset value is transferred as desired new actual value																								
S→M		0	0	0	**0**	0	0	0	The encoder acknowledges the takeover in bit 7 of the status byte																								
M→S		0	0	0	**0**	0	0	0	By setting the bit 31 to 0, the adjustment is finished																								
S→M		0	0	0	**0**	0	0	0	The process actual value is now output again																								

6.11 Optional SSI interface

The encoder has a separate Synchronous Serial Interface via which its position value can be made available to a further evaluation unit (e.g. drive controller). The position value output at this interface is identical to the value output on the PROFIBUS in terms of conversion and code sequence. In order to use this interface, a special cover with terminals for the SSI interface is necessary.

6.11.1 Limitation of SSI interface

The encoder position is re-loaded after each read process, and remains unchanged until the next time it is accessed. If the SSI master (e.g. drive controller or WF assembly) reads the position at prolonged or irregular intervals, this may lead to contouring error messages.
To avoid this, the position should be read at short, regular intervals.
The monoflop time of the SSI interface is around 35 - 55 µs (typ. 41 µs) as opposed to 20 - 40 µs in the standard interface.

7 Troubleshooting and Diagnostic options

7.1 Visual indicators

The encoder is equipped with two LEDs in the bus cover: one red LED (BF) for indicating errors and one green LED (STAT) for indicating status information.
When the encoder is started up, both LEDs flicker briefly. Thereafter, the indications depend on the operational status of the encoder.

7.1.1 Indicator states, green LED (STAT)

Green LED	Cause	Remedy
Off	Absence of voltage supply	Check voltage supply wiring
	Station address incorrectly set	Set station address (valid values 3-99 !)
	Bus cover not mounted and screwed on correctly	Check bus cover for correct seating
	Bus cover defective	Replace bus cover
	Hardware error, encoder defective	Replace encoder
Flashing at a frequency of 10 Hz	Irreparable parameterization or configuration error.	Check parameterization and configuration See section 6.8 on page 21
Flashing at a frequency of 1 Hz	Parameterization or configuration error in PNO-compatible nominal configuration Data have been corrected or Teach-in mode active	Check configuring and operational status of PROFIBUS master Deactivate teach-in mode
On	Encoder ready for operation	

7.1.2 Indicator states, red LED (BF)

Red LED	Cause	Remedy
Off	No error, bus in cycle	
Flashing at a frequency of 1 Hz	Encoder not yet addressed by master	Check set station address Check configuring and operational status of PROFIBUS master
On	Irreparable encoder fault	Check parameter data

7.2 How to use the PROFIBUS diagnostics

In a Profibus system, the Profibus masters supply the process data to a so-called host system, e.g. a PLC-CPU. If a slave is not accessible, or no longer accessible, on the bus, or if the slave itself reports a fault, the master must communicate this fault to the host system in some form or other. There are several possible ways of doing this, the evaluation of which depends entirely on the application in the host system.
As a general rule, a host system cannot be stopped following the failure of only one component on the bus, but must respond appropriately to the failure as prescribed by the safety regulations. The master normally provides the host system initially with a summary diagnosis, which the host system reads cyclically from the master, and which serves to report the states of the individual bus stations to the application. If a station is reported to be faulty in the summary diagnosis, the host can request further data from the master (slave diagnostics), which then allow a more detailed evaluation of the causes. The indications thus obtained may either have been generated by the master, if the relevant slave does not respond (or no longer responds) to the master's requests, or they may come directly from the slave, if the slave itself reports a fault. The generation or reading of the diagnostic message between the master and slave takes place automatically, and does not have to be programmed by the user.
In addition to the standard diagnostic information, the encoder provides an extended diagnostic message according to Class 1 or Class 2 of the PNO encoder profile, depending on the nominal configuration.

7.2.1 Standard diagnosis

The standard DP diagnosis is structured as follows (always from the point of view of the master in relation to the slave).

Byte no.	Meaning	
Byte 1	Station status 1	General part
Byte 2	Station status 2	
Byte 3	Station status 3	
Byte 4	Master address	
Byte 5	Manufacturer's identifier HI byte	
Byte 6	Manufacturer's identifier LO byte	
Byte 7	Length (in bytes) of extended diagnosis	Device-specific extensions
Byte 8 to Byte 241 (max)	Other device-specific diagnoses	

7.2.1.1 Station status 1

Bit 7	Master_Lock	Slave has been parameterized by another master (bit is set by master)
Bit 6	Parameter_Fault	The last parameterization message to have been sent was rejected by the slave
Bit 5	Invalid_Slave_Response	Set by the master if the slave does not respond
Bit 4	Not_Supported	Slave does not support the requested functions
Bit 3	Ext_Diag	Bit = 1 means that there is an extended diagnostic message from the slave
Bit 2	Slave_Cfg_Chk_Fault	The configuration identifier(s) sent by the master was/were rejected by the slave
Bit 1	Station_Not_Ready	Slave is not ready to exchange cyclical data
Bit 0	Station_Non_Existent	The slave has been configured but is not present on the bus

7.2.1.2 Station status 2

Bit 7	Deactivated	Slave has been deleted from the poll list by the master
Bit 6	Reserved	
Bit 5	Sync_Mode	Set by slave on receipt of SYNC command
Bit 4	Freeze_Mode	Set by slave on receipt of FREEZE command
Bit 3	WD_On	Slave watchdog is activated
Bit 2	Slave_Status	Always set for slaves
Bit 1	Stat_Diag	Static diagnosis
Bit 0	Prm_Req	The slave sets this bit if it has to be re-parameterized and re-configured.

7.2.1.3 Station status 3

Bit 7	Ext_Diag_Overflow	Overflow in extended diagnosis
Bit 6 - 0	Reserved	

7.2.1.4 Master address

In this byte, the slave enters the station address of the first master to have sent a valid parameterization message. If several masters access the bus simultaneously, their configuration and parameterization information must coincide exactly in order to ensure correct operation of the Profibus.

7.2.1.5 Manufacturer's identifier

In bytes 5+6, the slave enters the manufacturer-specific identification number, an unambiguous number for each device type which is reserved and filed with the PNO. The identifier number of the encoder is AAAB(h).

7.2.1.6 Length (in byte) of extended diagnosis

If additional diagnostic information is available, the slave enters the number of bytes following the standard diagnosis here.

7.2.2 Extended diagnosis

In addition to the standard DP diagnostic message, the encoder also provides an extended diagnostic message according to the PNO encoder profile. This message varies in length depending on the chosen nominal configuration. In the configurations designated "TR mode", the diagnostic message corresponds to PNO Class 2.
The following pages provide a general overview of the available diagnostic information. Which individual options your encoder actually supports can be read out from the device itself.

Byte no.	Meaning	Class
Byte 7	Length (in bytes) of extended diagnosis	1
Byte 8	Alarms	1
Byte 9	Operating status	1
Byte 10	Encoder type	1
Byte 11-14	Encoder resolution in increments per revolution (rotary) Encoder resolution in measuring increments (linear)	1
Byte 15-16	Number of resolvable revolutions	1
Byte 17	Additional alarms	2
Byte 18-19	Supported alarms	2
Byte 20-21	Warnings	2
Byte 22-23	Supported warnings	2
Byte 24-25	Profile version	2
Byte 26-27	Software version (firmware)	2
Byte 28-31	Operating hour counter	2
Byte 32-35	Offset value	2
Byte 36-39	Manufacturer's offset value	2
Byte 40-43	Number of increments per revolution	2
Byte 44-47	Measuring length in increments	2
Byte 48-57	Serial number	2
Byte 58-59	Reserved	2
Byte 60-63	Manufacturer-specific diagnostics	Optional

7.2.2.1 Alarms

Bit	Meaning	= 0	= 1
Bit 0	Position error	No	Yes
Bit 1	Supply voltage faulty	No	Yes
Bit 2	Current consumption too high	No	Yes
Bit 3	Diagnosis	OK	Error
Bit 4	Memory error	No	Yes
Bit 5	Not applicable		
Bit 6	Not applicable		
Bit 7	Not applicable		

7.2.2.2 Operating status

Bit	Meaning	= 0	= 1
Bit 0	Code sequence	Increasing clockwise	Increasing counter-clockwise
Bit 1	Class-2 functions	No, not supported	Yes
Bit 2	Diagnosis	No, not supported	Yes
Bit 3	Status scaling function	No, not supported	Yes
Bit 4	Not applicable		
Bit 5	Not applicable		
Bit 6	Not applicable		
Bit 7	Not applicable		

7.2.2.3 Encoder type

Code	Meaning
00	Single-turn absolute encoder (rotary)
01	Multi-turn absolute encoder (rotary)

See encoder profile for other codes

7.2.2.4 Single-turn resolution

The hardware single-turn resolution of the encoder can be read out via bytes 11-14.

7.2.2.5 Number of resolvable revolutions

The maximum number of encoder revolutions can be read out via diagnostic bytes 15-16.

7.2.2.6 Additional alarms

Byte 17 is reserved for additional alarms, although no other alarms are implemented.

Bit	Meaning	= 0	= 1
Bit 0-7	Reserved		

7.2.2.7 Supported alarms

Bit	Meaning	= 0	= 1
Bit 0	Position error	Not supported	Supported
Bit 1	Supply voltage monitoring	Not supported	Supported
Bit 2	Current consumption monitoring	Not supported	Supported
Bit 3	Diagnostic routine	Not supported	Supported
Bit 4	Memory error	Not supported	Supported
Bit 5-15	Not applicable		

7.2.2.8 Warnings

Bit	Meaning	= 0	= 1
Bit 0	Frequency exceeded	No	Yes
Bit 1	Permissible temp. exceeded	No	Yes
Bit 2	Control reserve light	Not reached	Reached
Bit 3	CPU watchdog status	OK	Reset performed
Bit 4	Operating time warning	No	Yes
Bit 5-15	Battery charge	OK	Too low

7.2.2.9 Supported warnings

Bit	Meaning	= 0	= 1
Bit 0	Frequency exceeded	Not supported	Supported
Bit 1	Permissible temp. exceeded	Not supported	Supported
Bit 2	Control reserve light	Not supported	Supported
Bit 3	CPU watchdog status	Not supported	Supported
Bit 4	Operating time warning	Not supported	Supported
Bit 5-15	Reserved		

7.2.2.10 Profile version

Diagnostic bytes 24-25 indicate the version of the PNO encoder profile supported by the encoder. They consist of the revision number and revision index (e.g. 1.40 corresponds to 0000 0001 0100 0000 or 0140 (hexadecimal code))

Byte 24	Revision number
Byte 25	Revision index

7.2.2.11 Software version

Diagnostic bytes 26-27 indicate the internal software version of the encoder. They consist of the revision number and revision index (e.g. 1.40 corresponds to 0000 0001 0100 0000 or 0140 (hexadecimal code))

Byte 26	Revision number
Byte 27	Revision index

7.2.2.12 Operating hour counter

Diagnostic bytes 28-31 represent an operating hour counter which is incremented by one digit every 6 minutes. The measuring unit for operating hours is thus 0.1 hours.
If this function is not supported, the operating hour counter is set to the maximum value FFFFFFFF (hexadecimal code).

7.2.2.13 Offset value

Diagnostic bytes 32-35 indicate the offset in relation to the absolute scanning position which is calculated during the execution of the preset function.

7.2.2.14 Manufacturer-specific offset value

Diagnostic bytes 36-39 indicate an additional manufacturer-specific offset in relation to the absolute scanning position which is calculated during the execution of the preset function.

7.2.2.15 Number of increments per revolution

Diagnostic bytes 40-43 indicate the configured increments per revolution of the encoder.

7.2.2.16 Measuring length in increments

Diagnostic bytes 44-47 indicate the configured measuring lengths in increments of the encoder.

7.2.2.17 Serial number

Diagnostic bytes 48-57 indicate the serial number of the encoder. If this function is not supported, asterisks are used (hexadecimal code 0x2A) ********** to indicate the configured measuring length in increments of the encoder.

7.2.2.18 Manufacturer-specific diagnostics

The encoder does not support any other manufacturer-specific diagnostics.

According to the PNO encoder profile, an encoder must set the bits 'Ext.diag' (extended diagnostic information available) and 'Stat.diag' (static error) in the event of an internal error being detected in the station status. This means that, in case of error, the encoder stops providing position data and is removed from the process image by the PROFIBUS master until the error bits are reset. It is not possible for the user to acknowledge the error via the PROFIBUS in this way.

This function is only guaranteed provided the Commissioning Diagnostic function is activated.

7.3 Other faults

Fault	*Cause*	*Remedy*
Position skips of the measuring system	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. Shielding and wire routing must be performed according to the PROFIBUS construction guidelines.
	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.
The PROFIBUS runs if the measuring system is not connected, but leads to faults if the bus hood is plugged onto the measuring system.	PROFIBUS Data A and Data B switched	Check all connections and lines associated with the wiring of the measuring system.

8 Appendix

8.1 New in firmware versions 4.x opposite 3.x

- The till now optionally available commissioning function is activatable in version 4.x at full downward compatibility any time.
- The reduction is cancelled, that the scaling function can be activated only in connection with the Class 2 functions. The device then works as Class 1 device with short diagnostic length and is nevertheless scalable.
- In the TR operation modes the diagnostic length can be limited on the length of the Class 1 diagnosis.
- If the status byte is activated a limit switch bit with two limit values is available to supervise the displacement range.
- The information of the rotational speed is scalable in arbitrary steps between 1/1 and 1/100 revolutions per minute.