



# Absolute Encoder ZE-115-M (Art.No.: 173-00001)

- \_ Safety informations**
- \_ Assembly**
- \_ Commissioning**
- \_ Parameterization**
- \_ Cause of faults and remedies**

**User Manual**

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| Dimension drawing .....  | <a href="http://www.tr-electronic.com/f/04-503-001">www.tr-electronic.com/f/04-503-001</a>               |
| Declaration of conformity .....  | <a href="http://www.tr-electronic.com/f/TR-ECE-KE-GB-0189">www.tr-electronic.com/f/TR-ECE-KE-GB-0189</a> |

## Revision index

| Revision  | Date     | Index |
|---|----------|-------|
| First release                                     | 05/19/90 | 00    |
| Description of the firmware extension 3.x to 4.x. | 06/26/01 | 01    |
| General modifications                             | 04/07/16 | 02    |

# 1 Safety

## 1.1 General Potential for Danger

The ZE-115 rotary encoder cannot function as a stand-alone unit, i.e. it is a component part that is intended to be installed in a complete system consisting of several such components working together. This means that the rotary encoder does not have a direct protection device of its own.

The encoder provides no diagnostics for errors that may occur, such as speed too high, track errors, transfer errors, etc. This means that you must check the received data yourself for validity.

All the persons who are involved in the assembly, commissioning and operation of the device

- must be appropriately qualified
- must follow exactly the instructions in this manual.

This is for your own safety and the safety of your equipment!

## 1.2 Safety Information

This operating manual contains information that you must comply with to ensure your personal safety and to avoid damage to property. The information is emphasized by warning triangles, which have different appearances to match the level of danger:



### **Warning**

Means that if the appropriate safety measures are ignored, death, severe injury or considerable damage to property can occur.



### **Caution**

Means that if the appropriate safety measures are ignored, slight injury or damage to property can occur.



### **Note**

Emphasizes important information about the product, its properties or helpful hints for using it.

## 1.2.1 Installation information

Due to the fact that the rotary encoder is normally used as a component part of a larger system, this information is intended to provide a guideline for safe installation of the rotary encoder in its environment.



### **Warning**

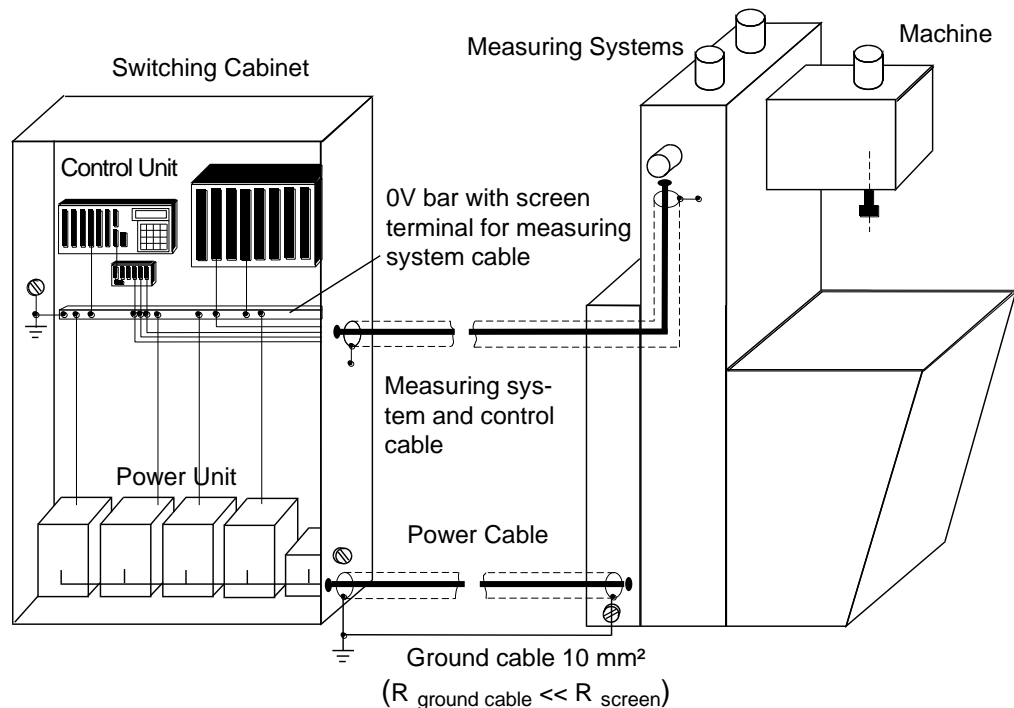
- Observe the safety and accident prevention regulations that apply to the specific application.
- In the case of equipment with a fixed connection (stationary installations/systems) without all-pole mains switches and/or fuses, you must install a mains switch or a fuse in the system and connect the equipment to a protective earth.
- Before commissioning devices that are run with mains voltage, check whether the set rated voltage range matches the local mains voltage.
- With a 24-V supply, ensure safe electrical isolation of the extra-low voltage. Use only mains units that comply with IEC 364-4-41 or HD 384.04.41 (VDE 0100 Part 410) standards.
- Fluctuations in or deviations from the rated mains voltage may not exceed the tolerances stated in the technical data. If they do, functional failures of the electrical components and hazardous conditions cannot be ruled out.
- You must take precautions to ensure that, following voltage dips and failures, it is possible to restart an interrupted program in an orderly manner. In this context, no dangerous operating status conditions may occur even for a brief period of time. If necessary, you must force an **EMERGENCY STOP**.
- EMERGENCY STOP devices that comply with EN 60204/IEC 204 (VDE 0113) must remain effective in all the operating modes of the automation equipment. Unlocking the EMERGENCY STOP devices must not result in an uncontrolled or undefined restart.
- Install the connecting and signal lines such that inductive and capacitive interference does not adversely affect the automation functions.
- Install automation technology equipment and its operator input elements such that they are sufficiently protected against being operated by mistake.
- Take appropriate hardware and software measures in the I/O link to prevent possible cable or wire breakages on the signal side leading to undefined status conditions in the automation equipment.

## 1.2.1.1 Screening

The use of electronic sensor active systems in modern machines makes it crucial to enforce a consistent and correctly executed interference suppression and wiring concept.

These conditions are the only guarantee that systems containing electronic measuring systems will function properly.

### Recommended Screened Cable Wiring



## 1.2.1.2 General Measures for Interference Suppression

- Route (screened) lines connecting to the encoder either a long way from or completely physically separated from energy lines that carry disturbances.
- Use only completely screened lines for data transfer and ensure they are well earthed. In the case of differential data transfer, (RS422, RS485 etc.), you must additionally use twisted-pair lines.
- Use cables with a minimum cross-section of 0.22 mm<sup>2</sup> for data transfer.
- Use a ground cable with a minimum cross-section of 10 mm<sup>2</sup> to avoid equipotential bonding via the screen. In this context, you should ensure that the ground cable's resistance must be much lower than the screen's resistance.
- Wire the screen continuously keeping a large area in contact with special screen connecting terminals.
- Avoid crossing cables. If this is not possible, the cables should only cross at right-angles.



### 1.2.1.3 Wiring the converter housing

#### **i** **Note**

In addition to the connection terminals, the converter housing contains all the electronics for converting SSI signals that come from the encoder into appropriate Profibus data. To protect the electronics from environmental influences, we chose a housing that complies with type of protection IP 67 according to DIN 40 050.

Please be sure that during cabling you use the proper cable screw glands and their seals (o-rings). The lid of the housing must be tightened correctly (see "**Appropriate Use**" on page 11). Screw glands and lid must be sealed properly. If dirt or oil will penetrate inside the converter housing the electronic will be damaged.

#### **Connection**

You should use the Siemens-specified twisted-pair cables for the positive and negative signals of the SSI clock, SSI data and RS485 signals.

For the Profibus, you only need to connect the DataA and DataB terminals. On the connection board, there are two sets for the lines to the previous station and to the next one. Terminals P5V2 and M5V2 must be kept open.

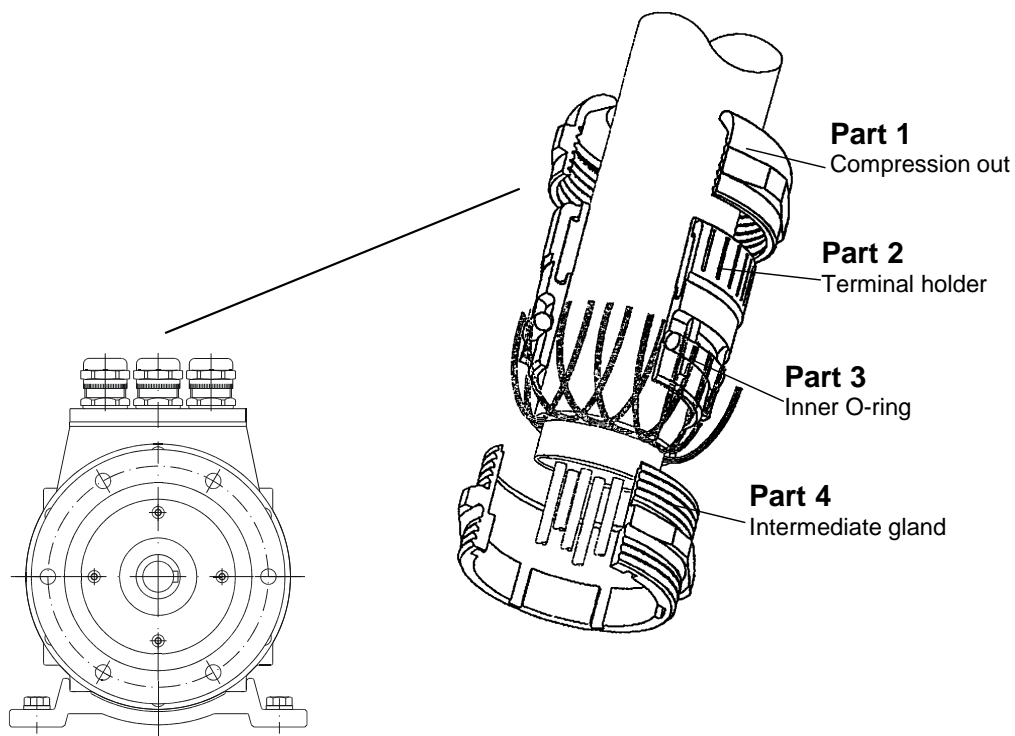
Chapters 4 and 5 of the manual entitled Distributed Peripheral System ET200 contain supplementary information about additional line lengths and installation of the Profibus. You can obtain this manual from Siemens quoting order number EWA 4NEB 780 6000-01

### 1.2.1.4 Connecting the Cable Screening to the Field-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 Field-Bus-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).



**Repeat orders**

|                    | Article            | Article number |
|--------------------|--------------------|----------------|
| Filler plug:       | PG11 (with O-ring) | 49-010-006     |
| Cable screw gland: | PG11 (with O-ring) | 49-010-003     |
| O-ring:            | Field – Bus - Cap  | 26-000-001     |

## 1.3 Appropriate Use

The rotary encoder is used for registering angular movement and for pre-processing measuring data for a downstream controller.

The ZE-115 encoder can be parameterized via the PROFIBUS according to the PNO profile and is designed to be run on PROFIBUS-DP networks according to DIN 19245 Part 1-3 up to a maximum of 12 Mbauds. The parameterization and equipment diagnostics are performed by the PROFIBUS master according to Version 1.1 of the PNO encoder profile.

The PNO technical guidelines for setting up the PROFIBUS-DP network must be observed in all cases in order to ensure trouble-free operation.

Parallel to the Profibus data the angular data can also output at the same time synchronous-serial.

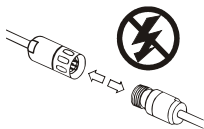


### Note

In order to avoid harm at the field-bus-cap and to guarantee the density of the encoder the three screws must be tightened uniformly. Onto a close O-ring seat, it is to be respected.



### Warning

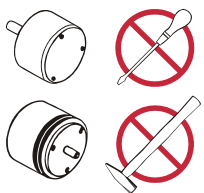


**Deenergize the system before carrying out wiring or opening and closing electrical connections!**

Short-circuits, voltage peaks etc. can lead to malfunctions and uncontrolled conditions in the system or to serious personal injury or damage to property.

**Before switching on the system, check all the electrical connections!**

Connections that are made incorrectly can lead to system malfunctions; wrong connections may result in serious personal injury or damage to property.



**For safety reasons, mechanical or electrical changes to the measuring systems are prohibited!**



### **Caution**

- **Avoid radial and axial deviations between the encoder and the drive shaft!**  
At assembly, you should use couplings that can take up these forces.
- **Always keep to the operating temperature range of -20° to +70 °C!**
- **Keep to the sealing of the Field-Bus-Cap (see note on page 11), principal when industrial liquids to run over the housing!**



### **Note**

Always keep to the commissioning, operating and programming instructions specified in this manual.

## 1.4 Danger Due to Accessories



### **Caution**

**Clamps that are not connected correctly in the converter housing can lead to an encoder malfunction!**

- Tightly screw the mating connector to its intended connector.

## 1.5 Authorized Operators

This/a device may only be commissioned by qualified personnel. In the context of the safety-specific information in this document, qualified personnel are considered to be persons who are authorized to commission, ground and mark circuits, equipment and systems in accordance with recognized safety standards.

## 1.6 Safety Measures at the Place of Assembly



### **Warning**

***Do not carry out welding if the encoder has already been wired-up or is switched-on!***

Potential fluctuations can destroy the encoder or adversely affect its function.

***Do not touch connector contacts with your hands!***

Static charges could destroy the electronic components in the encoder.

***Inputs that are not being used may not be connected*** (refer to the pin assignments)!

***Keep to the supply voltage range:*** 11-27 V DC ( $\pm 5\%$  residual ripple)



### **Note**

Ensure that the area around the place of assembly is protected from aggressive media (acid, etc.).

## 2 Transportation / Assembly

### 2.1 Transportation / Storage

#### Transportation Information

***Do not drop encoders or subject them to excessive jolting!***

The device contains an optical system with glass elements.

***Use only the original packaging material!***

Incorrect packaging material can cause damage to the device in transit.

#### Storage

Storage temperature: -30 to +80 °C

Store in a dry place.

## 2.2 Assembly

### Drive of the Encoder Shaft

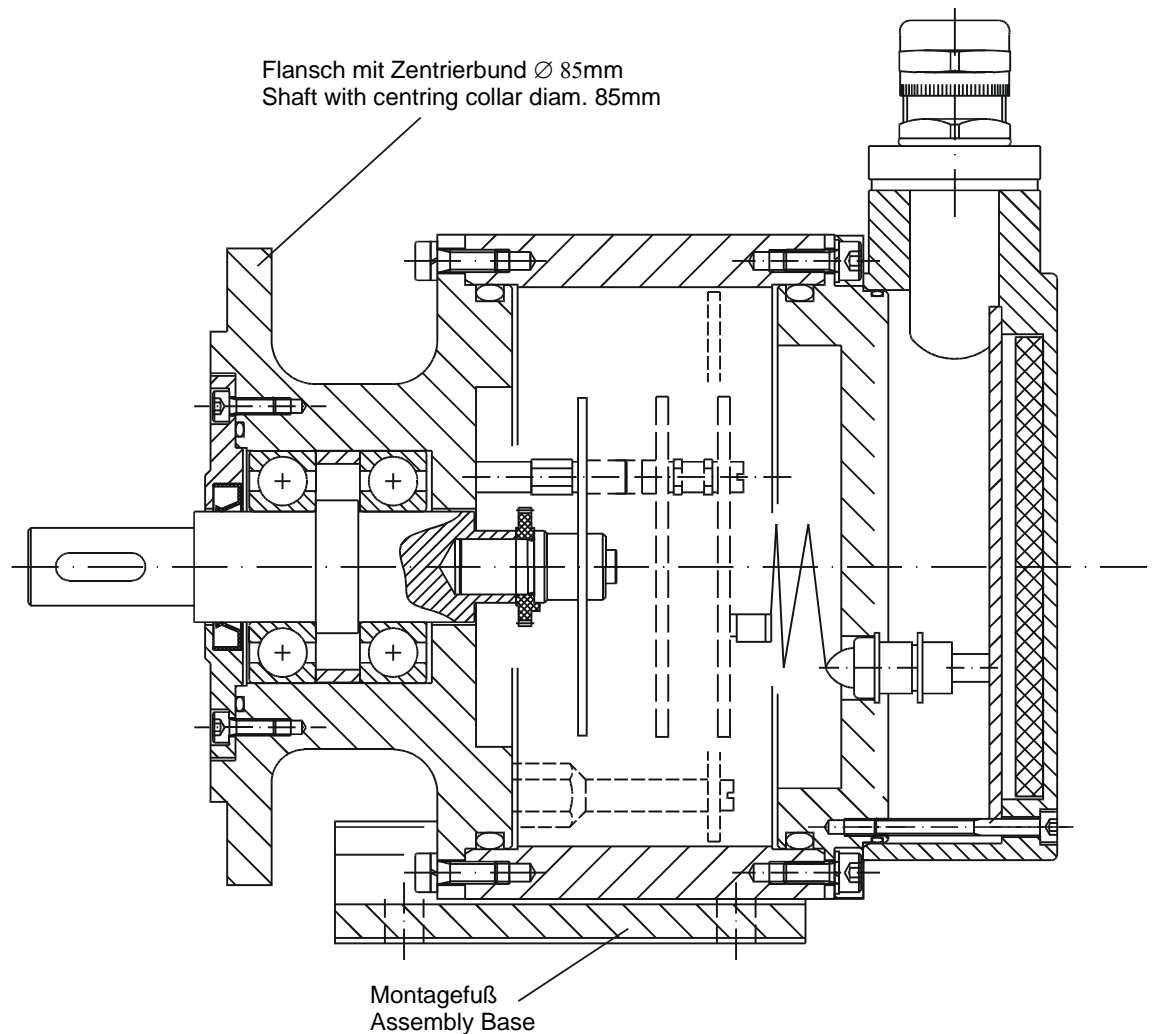
The ZE-115 encoder is connected to the drive shaft by an elastic coupling which takes up deviations in the axial and radial directions between the encoder and the drive shaft. This prevents excessive bearing loading. You can order couplings on request.

### Flange Fastening

The 85-mm-diameter centring collar with fit j6 centres the encoder to the shaft. The collar is fastened to the machine by means of six screws in the flange (Figure 1).

### Assembly Base Fastening

Since this type of fastening does not allow direct centring of the shaft, you must be particularly careful to line up the encoder shaft with the drive shaft. Fastening to the machine is by means of four screws on the assembly base. Do not mount the link element while the machine is switched on.



## 3 Device description / start-up

### 3.1 PNO identification number

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

### 3.2 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.

### 3.3 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.

### 3.4 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 disk containing the device master file (.GSD) and a type file (.200) for users with SIEMENS masters. If the disk is not enclosed with this documentation, it can be ordered quoting reference number 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.

### 3.5 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.



### 3.6 Bus termination

All PROFIBUS networks must be terminated by a resistor at the ends of the bus segments. The matching resistor and resistors for connecting to the data reference potential are located in the cover with the terminals, and can be connected via DIL switches if necessary, provided the encoder is the last station of a bus segment. 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).

### 3.7 Baud rate

The Baud rate at which the PROFIBUS is operated may lie within the range of 9.6 kBaud to 12 Mbaud, and is detected automatically by the encoder.

### 3.8 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).

#### Download:

- TR03AAAB.GSD and TRAAAB3X.200 for encoders with version 3.x  
[www.tr-electronic.com/f/TR-ECE-ID-MUL-0005](http://www.tr-electronic.com/f/TR-ECE-ID-MUL-0005)
- TR05AAAB.GSD for encoders with version 4.x  
[www.tr-electronic.com/f/TR-ECE-ID-MUL-0006](http://www.tr-electronic.com/f/TR-ECE-ID-MUL-0006)

#### The file TR05AAAB.GSD causes:

- 4 byte parameter (see also notes on page 26)  
(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 46.

## 3.9 Configuration and parameterization

### 3.9.1 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.

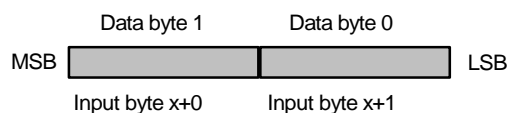
Depending on the required **nominal configuration**, the encoder will assign a different number of input and output words on the PROFIBUS.

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.

#### 3.9.1.1 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

#### 3.9.1.2 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

**i**

**Note:**

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.

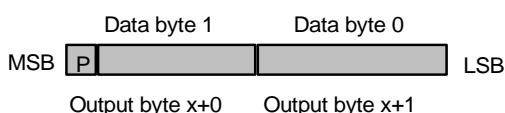
### 3.9.1.3 Class 2 16-bit resolution, identifier F0 (HEX):

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*



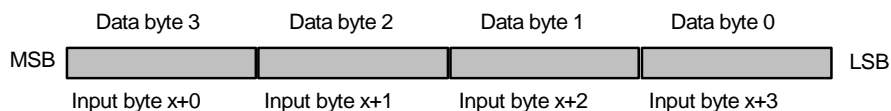
Relevant parameter data:

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

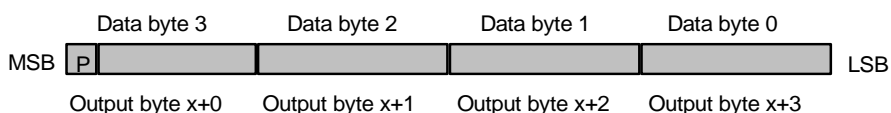
### 3.9.1.4 Class 2 32-bit resolution, identifier F1 (HEX):

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*



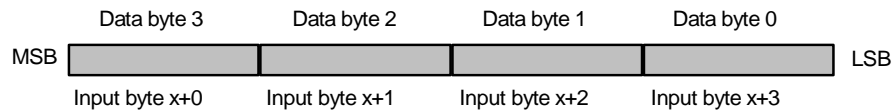
Relevant parameter data:

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

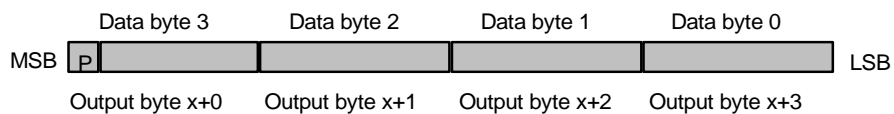
### 3.9.1.5 TR-mode position, identifier F1 (HEX):

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<sup>1</sup>
- 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

---

<sup>1</sup> SSI on request, not standard

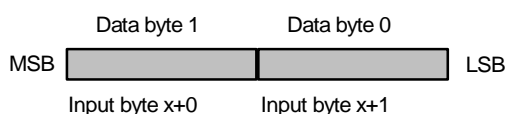
### 3.9.1.6 TR-mode position+velocity, identifier F1 (HEX):

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.

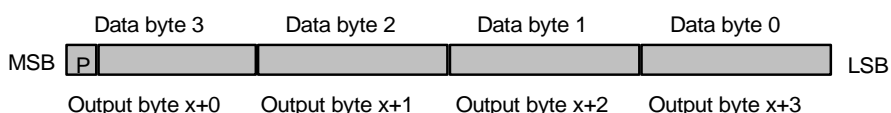
#### Double input word ID x



#### 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<sup>2</sup>
- 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
- Speed [1/n rpm]

## i

#### Important note:

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.

<sup>2</sup> SSI on request, not standard

### 3.9.2 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.

#### 3.9.2.1 Code sequence:

Defines the count direction of the encoder.

##### Selection

- Increasing clockwise \*
- Increasing counter-clockwise

#### 3.9.2.2 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)

#### 3.9.2.3 Commissioning diagnostic control:

Defines whether the encoder outputs an extended diagnostic message.

##### Selection

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

#### 3.9.2.4 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)

#### 3.9.2.5 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

### 3.9.2.6 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

### 3.9.2.7 Revolutions numerator hi and revolutions numerator lo

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

### 3.9.2.8 Revolutions denominator

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

### 3.9.2.9 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)

### 3.9.2.10 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

### 3.9.2.11 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)

### 3.9.2.12 Preset 1 value [units] hi and preset 1 value [units] lo

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



### 3.9.2.13 Preset 2 value [units] hi and preset 2 value [units] lo

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

### 3.9.2.14 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

### 3.9.2.15 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

### 3.9.2.16 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

### 3.9.2.17 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

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### 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) !)   |

### 3.9.3 Scaling function

#### 3.9.3.1 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:

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

## i

### Important Notes

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.

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\* Operator input

### 3.9.3.2 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                       |



#### Important Notes

**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.**

### 3.10 Preset adjustment

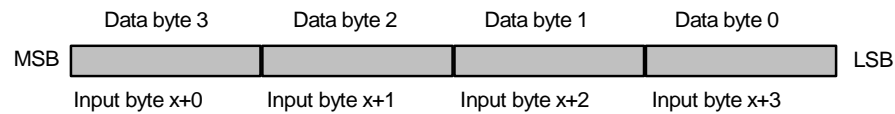
In 'Class 2' mode and in the 'TR - operation modes', the PROFIBUS can be used to adjust the encoder to any position value within a range of 0 to (measuring length in increments - 1).

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.

### 3.11 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  $\frac{1}{4}$  of a revolution)
- For rotating applications the commissioning function is not suitable and not valid

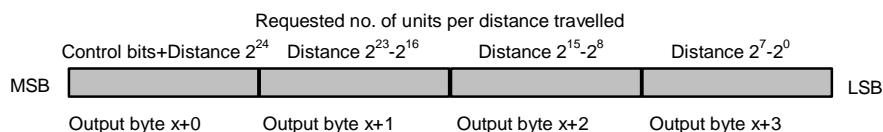
When the teach-in function is activated, the green LED flashes at a frequency of approx. 1 Hz.

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

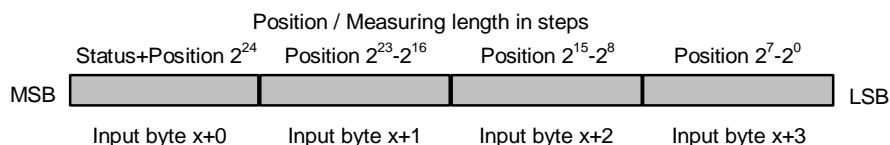
- OFF, no status:  
This setting is compatible with version 3.x, that means the bits  $2^{25}$  to  $2^{31}$  are always "0".
- OFF, with status:  
In this setting the status bits are visible, but the function is not activated
- ON, with status  
The commissioning function is active

### 3.11.1 Input/output configuration for teach-in

#### Outputs



#### Inputs



#### 3.11.1.1 Assignment of the status byte

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

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

#### 3.11.1.2 Assignment of the control byte

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

### 3.11.2 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  | Er | 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  | 01 | 01 | 0  | 1  | The encoder now acknowledges the newly selected direction of ro. in bit 0 and bit 28  |           |    |    |    |    |    |    |    |    |    |    |    |    |    |   | 01 |   |   |   |   |   |   |   |   |
| M→S        |    | 0                    | 0  | 0  | 0  | 0  | 0  | 0  | Changeover is completed by setting bit 28 to 0  |           |    |    |    |    |    |    |    |    |    |    |    |    |    |   |    |   |   |   |   |   |   |   |   |
| S→M        |    | 0                    | 0  | 0  | 01 | 01 | 0  | 1  | The process actual value is now output again  |           |    |    |    |    |    |    |    |    |    |    |    |    |    |   |    |   |   |   |   |   |   |   |   |

### Teach-In Start

| M = Master |    | Status-/Control bits |    |    |    |    |    |    |  | Data bits |    |    |    |    |    |    |    |    |    |    |    |    |    |   |    |   |   |   |   |   |   |   |   |
|------------|----|----------------------|----|----|----|----|----|----|--|-----------|----|----|----|----|----|----|----|----|----|----|----|----|----|---|----|---|---|---|---|---|---|---|---|
| S = Slave  | Er | 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  | 01 | 01 | 0  | 1  | Acknowledging by setting bit 30 to 1                                   |           |    |    |    |    |    |    |    |    |    |    |    |    |    |   | 01 |   |   |   |   |   |   |   |   |
| M→S        |    | 0                    | 0  | 0  | 0  | 0  | 0  | 0  | Resetting  |           |    |    |    |    |    |    |    |    |    |    |    |    |    |   |    |   |   |   |   |   |   |   |   |
| S→M        |    | 0                    | 1  | 0  | 01 | 01 | 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  | Er | 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  | 01 | 01 | 0  | 1  | Transfer of the total measuring range for the new gear factor (this should be noted!) |           |    |    |    |    |    |    |    |    |    |    |    |    |    |   | 01 |   |   |   |   |   |   |   |   |
| M→S        |    | 0                    | 0  | 0  | 0  | 0  | 0  | 0  | Resetting   |           |    |    |    |    |    |    |    |    |    |    |    |    |    |   |    |   |   |   |   |   |   |   |   |
| S→M        |    | 0                    | 0  | 0  | 01 | 01 | 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  | Er | 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                      |           |    |    |    |    |    |    |    |    |    |    |    |    |    |   |   |   |   |   |   |   |   |   |   |

### 3.12 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.

#### 3.12.1 Limitation of SSI interface

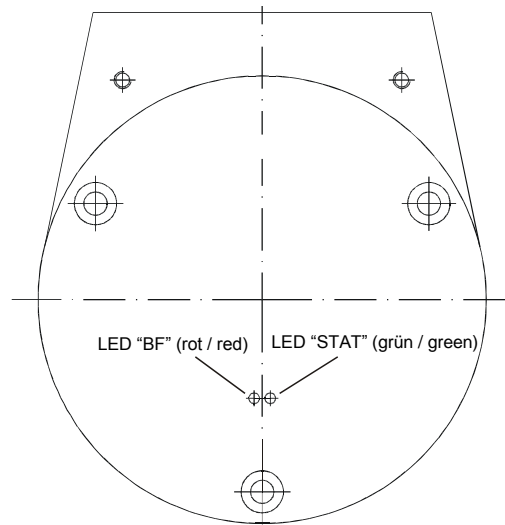
The encoder position is re-loaded after each read process, and remains unchanged until the next time it is accessed. If the SSI master (e.g. drive controller or WF assembly) reads the position at prolonged or irregular intervals, this may lead to contouring error messages.

To avoid this, the position should be read at short, regular intervals.

The monoflop time of the SSI interface is around 35 - 55  $\mu\text{s}$  (typ. 41  $\mu\text{s}$ ) as opposed to 20 - 40  $\mu\text{s}$  in the standard interface.

## 4 Trouble-shooting and diagnostic facilities

### 4.1 Visual indicators



The encoder is equipped with two LEDs. 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.

#### 4.1.1 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<br>See section 3.9 on page 18                      |
| Flashing at a frequency of 1 Hz  | Parameterization or configuration error in PNO-compatible nominal configuration<br>Data have been corrected<br>or<br>Teach-in mode active | Check configuring and operational status of PROFIBUS master<br><br>Deactivate teach-in mode |
| On                               | Encoder ready for operation   |   |

#### 4.1.2 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<br>Check configuring and operational status of PROFIBUS master |
| On                              | Irreparable encoder fault           | Check parameter data   |

## 4.2 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.

### 4.2.1 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                      | Other device-specific diagnoses         |                            |
| to<br><br>Byte 241<br>(max) |   |                            |

#### 4.2.1.1 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                       |

#### 4.2.1.2 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. |

#### 4.2.1.3 Station status 3

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

### 4.2.1.4 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.

### 4.2.1.5 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).

### 4.2.1.6 Length (in byte) of extended diagnosis

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

## 4.2.2 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)<br>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 |

### 4.2.2.1 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               |     |       |

### 4.2.2.2 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          |                      |                              |

### 4.2.2.3 Encoder type

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

See encoder profile for other codes

### 4.2.2.4 Single-turn resolution

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

### 4.2.2.5 Number of resolvable revolutions

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

### 4.2.2.6 Additional alarms

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

| Bit     | Meaning  | = 0 | = 1 |
|---------|----------|-----|-----|
| Bit 0-7 | Reserved |     |     |



#### 4.2.2.7 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                 |               |           |

#### 4.2.2.8 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         |
|          |                            |             |                 |

#### 4.2.2.9 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                   |               |           |

#### 4.2.2.10 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  |

### 4.2.2.11 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  |

### 4.2.2.12 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).

### 4.2.2.13 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.

### 4.2.2.14 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.

### 4.2.2.15 Number of increments per revolution

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

### 4.2.2.16 Measuring length in increments

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

### 4.2.2.17 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.

### 4.2.2.18 Manufacturer-specific diagnostics

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

# i

## Important note

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.

## 4.3 Other faults

| Fault   | Cause   | Remedy  |
|---|---|---|
| Encoder step changes  | Strong vibrations   | Vibrations, shocks and jolts, e.g. on presses, are cushioned by so-called "shock modules". If the error persists despite these precautions, the encoder must be replaced.   |
|   | Electrical faults<br>EMC  | Electrical faults can be countered by means of insulating plastic flanges and couplings, and by data and power supply cables with twisted-pair conductors. The screening and wiring arrangement must conform to the assembly guidelines for PROFIBUS. |
|   | Excessive axial and radial loading of shaft or scanning defect. | Couplings prevent mechanical strain on the shaft. If the error persists despite this precaution, the encoder must be replaced..   |
| Profibus operates when the encoder is not connected, but indicates a fault when the bus cover is mounted on the encoder | PROFIBUS Data-A and Data-B reversed                             | Inspect all connections and conductors relating to the wiring of the encoder.   |

## 5 Appendix

### 5.1 Technical Data

#### 5.1.1 Electrical Characteristic Data

|   |  |
|---|--|
| <b>Operating voltage:</b> .....                   | 11-27 V DC ( $\pm$ 5% residual ripple)   |
| <b>Max. current consumption:</b> .....            | < 350 mA at 11 V DC, < 150 mA at 27 V DC   |
| <b>Output capacity:</b> .....                     | 24 bit   |
| <b>Resolution:</b> .....                          | 4096 steps/rev (12 bit)  |
| <b>Measuring range:</b> .....                     | 4096 revolutions (12 bit)  |
| <b>SSI data interface:</b>                        |  |
| Structure:.....                                   | Data: 2-wire acc. to EIA RS422<br>Pulses: Opto-coupler input   |
| Cable type: .....                                 | Twisted-pair, well screened with wave impedance of 100 $\Omega$ to 130 $\Omega$ . Min. cross section 0.25mm <sup>2</sup> with a capacity of approx. 60 pF/m. |
| Screen: .....                                     | Refer to chapter entitled "Installation information" on page 7 to 10   |
| Length of cable:.....                             | up to 250 m at 125 kHz, up to 50 m at 1 MHz  |
| Transmission rate:.....                           | 80 kHz - 1MHz  |
| Transmission procedure:.....                      | synchronous-serial, 24 bit left-justified  |
| Output code:.....                                 | programmable (binary, Gray)  |
| <b>PROFIBUS-DP data interface:</b> .....          |  |
| Baud rate:.....                                   | RS485, PROFIBUS-DP acc. DIN 19245 part 1-3<br>max. 12 Mbps   |
| Station address: .....                            | 3 - 99   |
| Special features:.....                            | Parameter programming according to PNO Profile Class 2   |
| <b>Inputs:</b>                                    |  |
| Preset1 + 2: .....                                | Electronic adjustment  |
| Switching level:.....                             | 1-level > +8 V, 0-level > +2 V, up to $\pm$ 35 V, 5 k $\Omega$   |
| <b>Operating temperature range:</b> .....         | -20 to +70 °C  |
| <b>Type of protection (double housing):</b> ..... | IP 67 (DIN 40 050)   |

## 5.1.2 Mechanical Characteristic Data

|  |   |
|--|---|
| <b>Mechanically permissible speed:</b> ..... | 3600 RPM                                    |
| <b>Permissible shaft loading:</b> .....      | 100 N axial, 150 N radial (at end of shaft) |
| <b>Minimum bearing lifetime:</b> .....       | 2,8 x 10 <sup>10</sup> revolutions at:      |
| Operating speed: .....                       | 3000 RPM                                    |
| Shaft loading:.....                          | 60 N axial, 90 N radial (at end of shaft)   |
| Operating temperature: .....                 | 60 °C                                       |
| <b>Max. angular acceleration:</b> .....      | ≤ 10 <sup>4</sup> rad/s <sup>2</sup>        |
| <b>Vibration</b> .....                       | According to DIN 40 046, Part 8             |
| Form of vibration.....                       | sine  |
| Frequency range .....                        | 50 Hz to 2000 Hz                            |
| Acceleration.....                            | ≤ 245 m/s <sup>2</sup> (25 g) peak          |
| Axes.....                                    | X-, Y- and Z-axis                           |
| Duration .....                               | 2 h/axis                                    |

### 5.2 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.