Document Number:

UM-P(V1.0)

TBF-PROFIBUS DP SLAVE USER MANUAL

CONTENTS

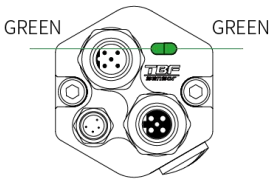
1. INTRODUCTION

Linear encoder type magnetostrictive sensor with Profibus DPV0 communication Interface ,IEC 61158 standard.

For more information on the communication standard, see the documentation downloadable from www.profibus.com, managed by the P.N.O. (Profibus Network Organization).

2. ELECTRICAL CONNECTIONS AND CONFIGURATION OF LEDS

The built-in LED indicator light provides basic fault feedback and fault alarm of the sensor.

<table>
<tr><td rowspan="4"> 
</td><td>Green light</td><td>Green light</td><td>Function</td></tr>
<tr><td>ON</td><td>OFF</td><td>Power on normally</td></tr>
<tr><td>ON</td><td>ON</td><td>Communication normal</td></tr>
<tr><td>OFF</td><td>OFF</td><td>No power</td></tr>
</table>

With this type of cable, the maximum lengths for a bus segment (depending on speed) are:											
Transfer Rate	kbit/s	9.6	31.25	45.45	93.75	187.5	500	1500	3000	6000	12000
Cable length	m	1200	1200	1200	1000	1000	400	200	100	60	20

3. PROFIBUS STRUCTURE

3.1 CONNECTION

A Profibus network lets you connect peripheral Slave devices (transducers or actuators) to Class 1 Master central control units (typically PLCs).

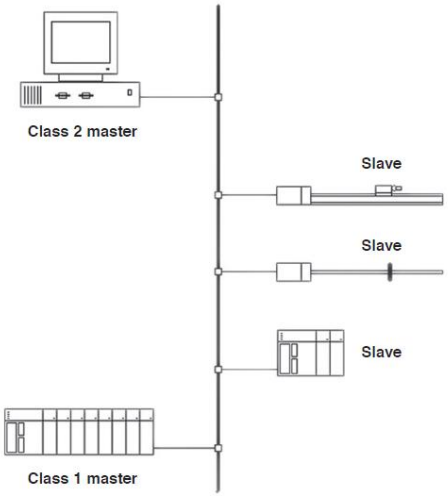
The network software is installed with a Class 2 Master containing a database with the GSD files of all connected devices.

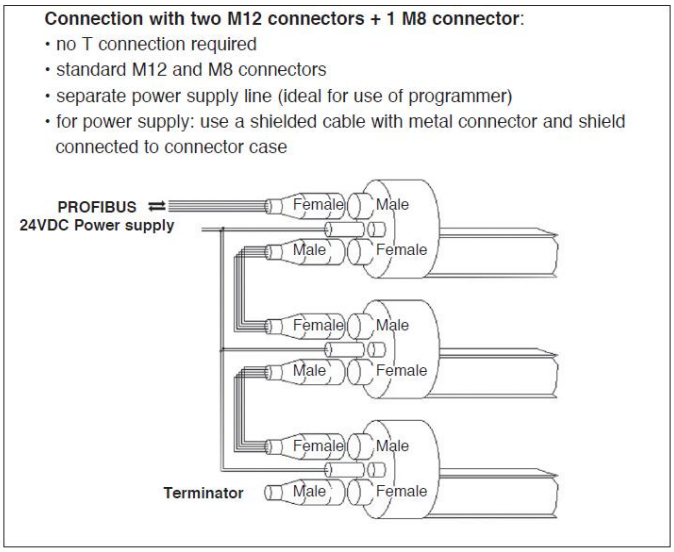
The network is designed and parameterized with a graphics tool, then the configuration is downloaded to the Class 1 Masters in the network.

The Class 1 Master(s) start(s) the communication process with the peripheral devices according to the configuration received from the Class 2 Master.

This process includes an initial Data-Exchange regarding Slave identification, parameterization, and configuration. When this phase is done, application management begins with exchange of process data on the network.

The GSD file contains all information on device identification, supported functions, and length/format of data packets.





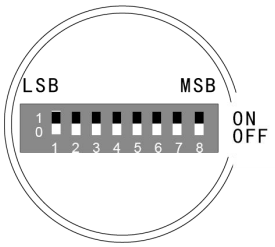
3.2 SETTING THE PROFIBUS NODE ADDRESS

The transducer’ s default address is 125. A different address may be requested in the order. The range of Profibus

addresses is 0 to 127, but to be parameterized (and be operative) the Slave must have a node address from 0 to 125. Address 127 is reserved.

If the slave address is 126, you have to assign the address a value from 0 to 125 to make it operative because no Class 1 Master can use address 126.

At most, a single Slave with address 126 can be connected to the Profibus bus, but this address still cannot be used for Data-Exchange.



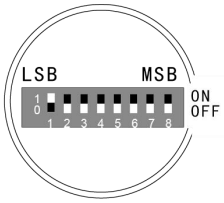


chart 1

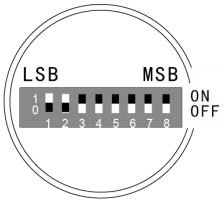


chart 2

1. When the needle at position "1" is dialed from "0" to"1", the address is "00000001" (decimal 1), see chart1.
2. When the needles at position "1" and "2" are dialed from"0" to "1", the address is "00000011" (decimal 3), see chart2.
3. By parity of reasoning, when the needle at position "3" is dialed from "0" to "1", the address is" 00000111 "(decimal 7).
4. When the needle at position "4" is dialed from "0" to "1", the address is "00001111" (decimal 15).
5. When the needle at position "5" is dialed from "0" to "1", the address is "00011111" (decimal 31).
6. When the needle at position "6" is dialed from "0" to "1", the address is "00111111"(decimal 63).
7. When the needle at position "7" is dialed from "0" to "1", the address is "01111111"(decimal 127).

4. PROFIBUS TELEGRAMS

4.1 PARAMETERIZATION TELEGRAM (SAP 61)

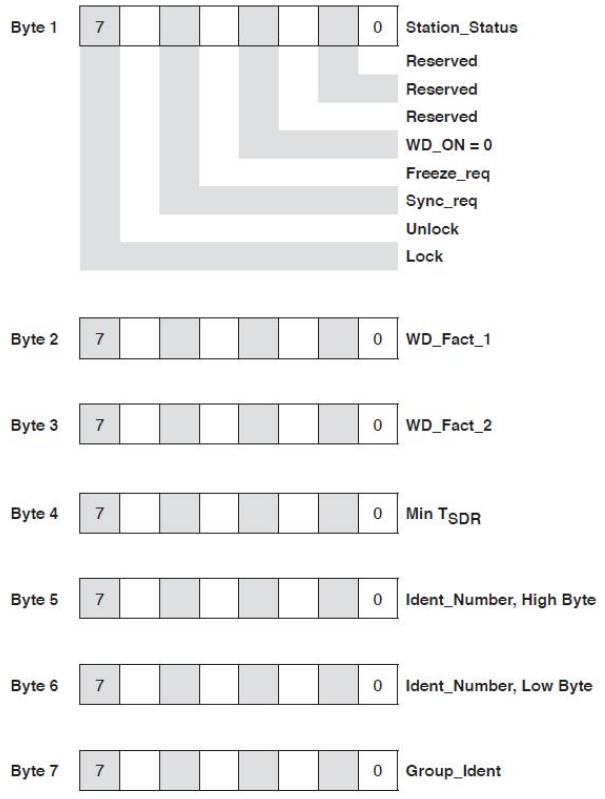
The Profibus Master uses the parameterization telegram after receiving diagnostics confirmation from the Slave. It is used to set and configure the basic parameters used by the communication protocol and the device’s various function modes, some of which are user-configurable.

A transducer can accept the parameterization via all or only part of the modules in the GSD file (in all cases, not more than one module per device).

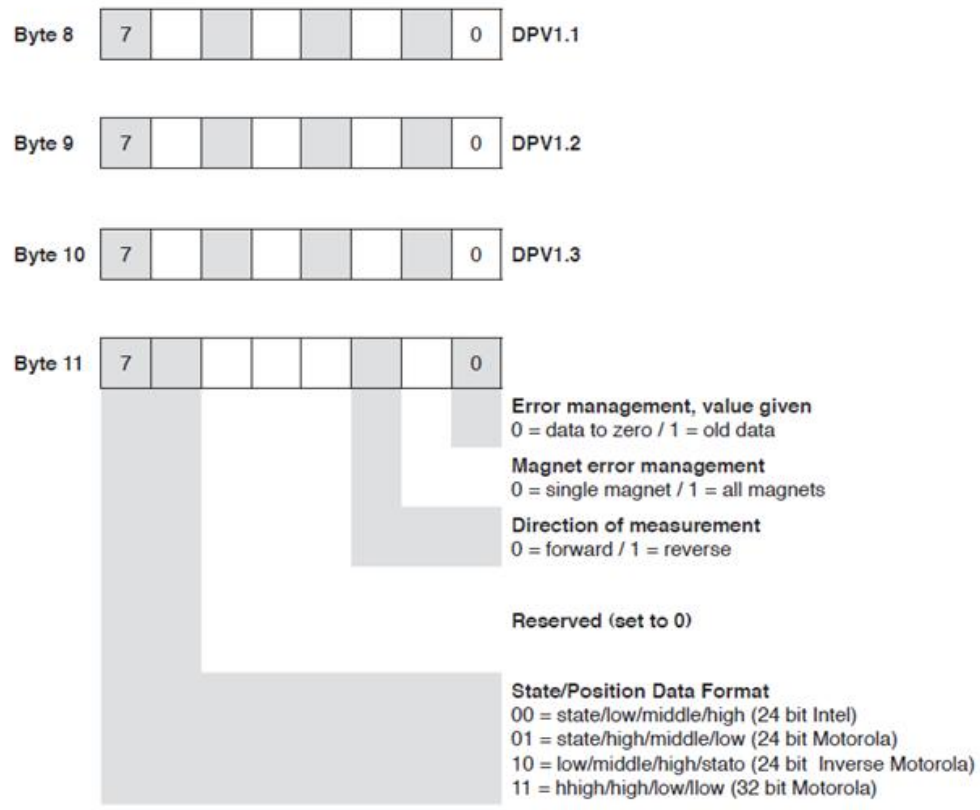
If a module unsuitable for the transducer is used, the transducer sends a “Parameterization Error” to the Master.

The first part of the parameterization telegram (bytes 1..7) conforms to standard EN 50170, while the second part (bytes 8..15) includes the specific bytes of the manufacturer (user parameterization).

Standard Parameterization (Bytes 1..7)



Standard Parameterization (Bytes 8..17)



Error management methods and the format of data sent to the Slave are selected via byte 11:

• Bit 0: In case of error, defines if the position data has to show 0 or the last value used in input.

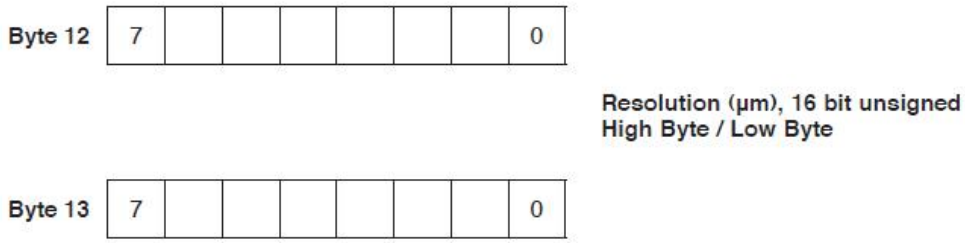
• Bit 1: Defines if the error message is to be applied to the single magnet in error or to all installed magnets without distinction

• Bit 2: Defines if the measurement has to show increasing values from electronics to the opposite end of the device or vice versa

• Bit 6-7: Define the format of the state/position data in the Data Input telegram (from slave to master) to adapt the device to different controllers

This parameterization DOES NOT affect the order of the preset data in the Data Output telegram (data from master to slave) or the offset data in the diagnostics telegram.

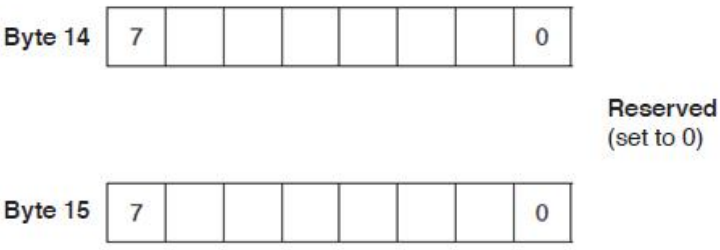
NOTE: the choice for parameterization of the State/Position data format automatically determines.

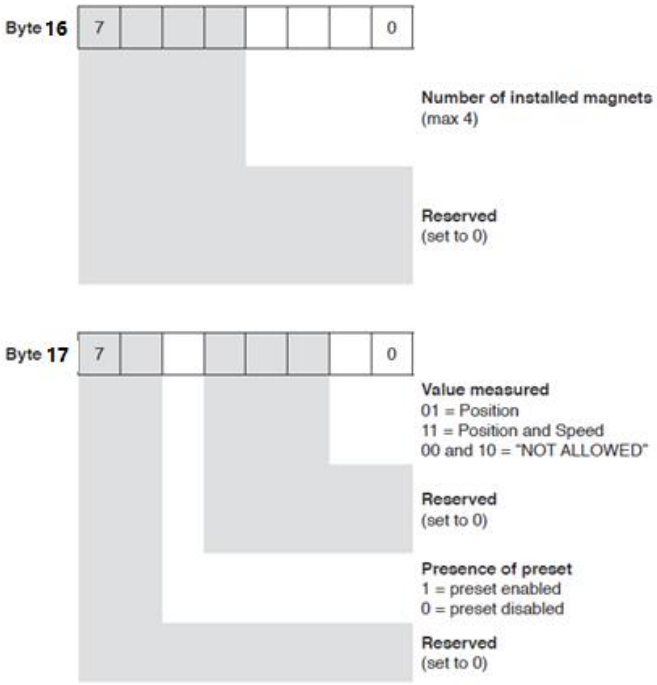


The required resolution is transferred as a 16-bit integer with unit of measurement [µm].

The device defines and supports the following possibilities:

- 1 µm
- 2 µm
- 5 µm
- 10 µm
- 20 µm
- 50 µm
- 100 µm
- 200 µm
- 500 µm
- 1000 µm





The type of Measurement requested and function with Preset mode are specified via byte 17:

• Bit 0 and 1: Define if the transducer has to supply only the Position data or Position and Speed (the latter only for enabled models)

• Bit 5: Defines if the transducer has to return the Position data as factory calibration or correct the measurement via the saved preset.

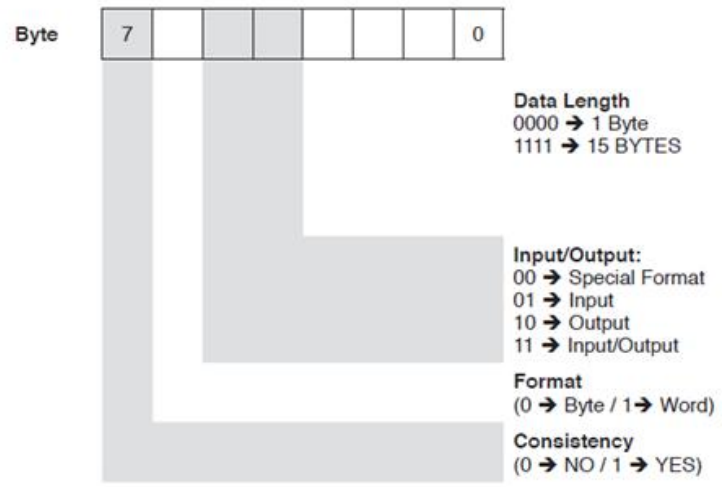
If the Preset is requested, you can, if necessary, communicate a new preset value in the Output Data message (from master to slave).

In the state bytes of the Input Data message, the slave signals if the preset is saved and therefore used to correct the Position data .

CONFIGURATION TELEGRAM (SAP 62)

The configuration telegram is sent by the master after correct parameterization. This telegram is used to set the number of the input/output bytes exchanged during Data-Exchange based on the type of module used in the previous parameterization phase.

The telegram configuration bytes are structured as follows:



The configuration telegram is formed and sent according to the installed module and is specified in the GSD file. The number of bytes of the configuration telegram varies according to the installed module.

Using a module with N magnets, its length is N +1 for modules with Position measurement.

Example 1

1 Magnet, Position measurement, without Preset

Configuration string: 0x93, 0xA0

where:

- 0x93: 4 input data bytes (state/position magnet 1)

- 0xA0: 1 output data byte (Control)

Example 2

2 Magnets, Position, with Preset

Configuration string: 0x93, 0x93, 0xA3

where:

- 0x93: 4 input data bytes (state/position magnet 1)

- 0x93: 4 input data bytes (state/position magnet 2)

- 0xA3: 4 output data byte (Control and Preset)

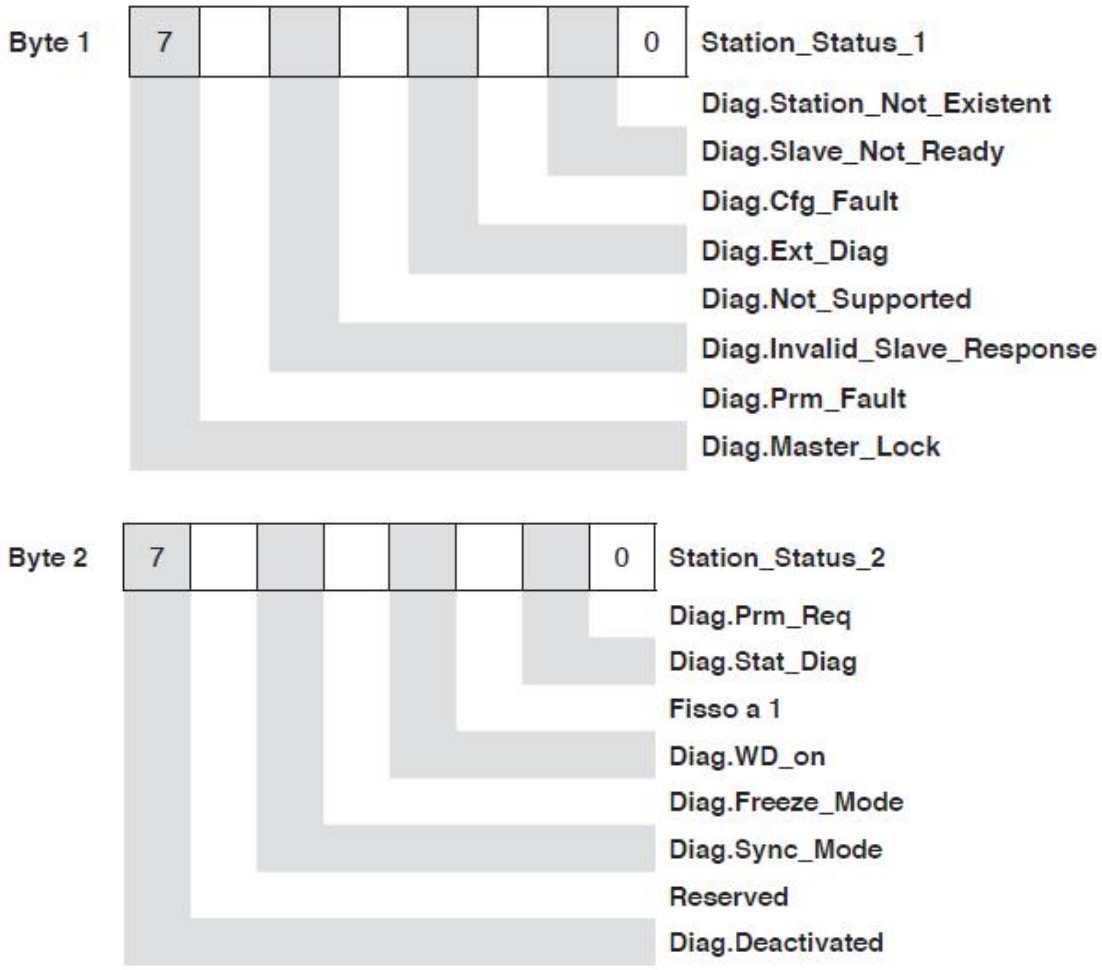
DIAGNOSTICS TELEGRAM (SAP 60)

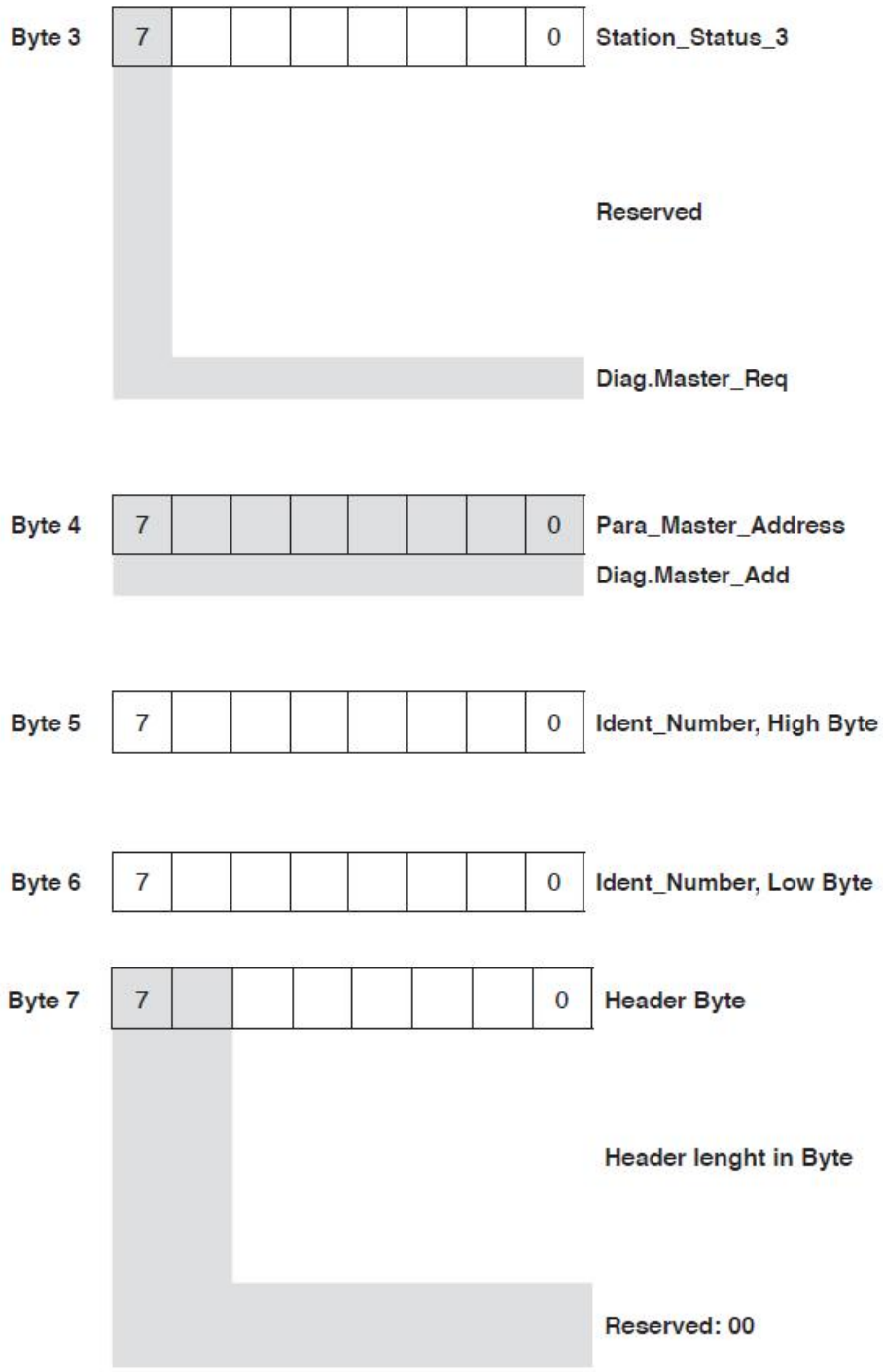
If necessary, the master can interrogate the slave on its current conditions. The device’ s response is contained in the diagnostics reply telegram.

There is a part linked to DP standard (bytes 1..6) and a specific manufacturer’ s section.

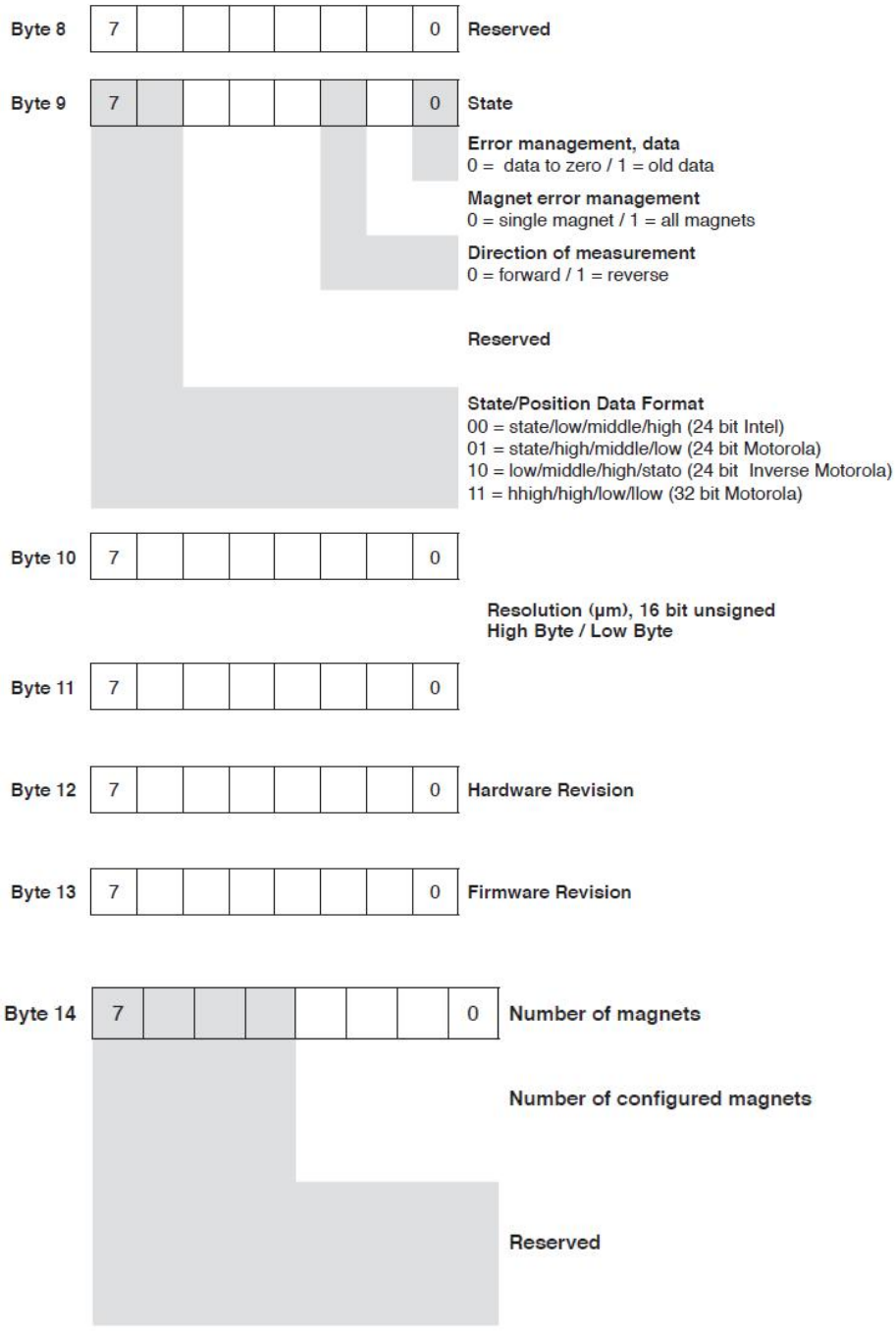
Octet number	Description	Data type
1-6	Standard diagnostics	Unsigned 8
7	Extended diagnostics header	Unsigned 8
8	Reserved	Unsigned 8
9	Status	Unsigned 8
10-11	Resolution(μm)	Unsigned 16(Motorola)
12	Hardware Revision	Unsigned 8
13	Firmware Revision	Unsigned 8
14	Number of Magnets	Unsigned 8
15	Measurement type and Presence of Preset	Unsigned 8
16-17	Measurement Range (mm)	Unsigned 16(Motorola)
18-21	Production Number	Unsigned 32(Motorola)
22-24	Pulse Speed(m/s)	Unsigned 24(Intel)
25-27	Magnet 1 Position Offset	Unsigned 24(Intel)
28-30	Magnet 2 Position Offset	Unsigned 24(Intel)
31-33	Magnet 3 Position Offset	Unsigned 24(Intel)
34-36	Magnet 4 Position Offset	Unsigned 24(Intel)
….		
67-69	Magnet 15 Position Offset	Unsigned 24(Intel)

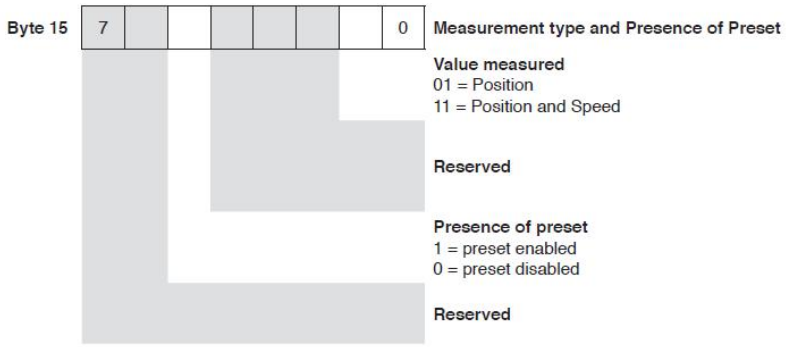
Standard Diagnostics (Bytes 1..6)

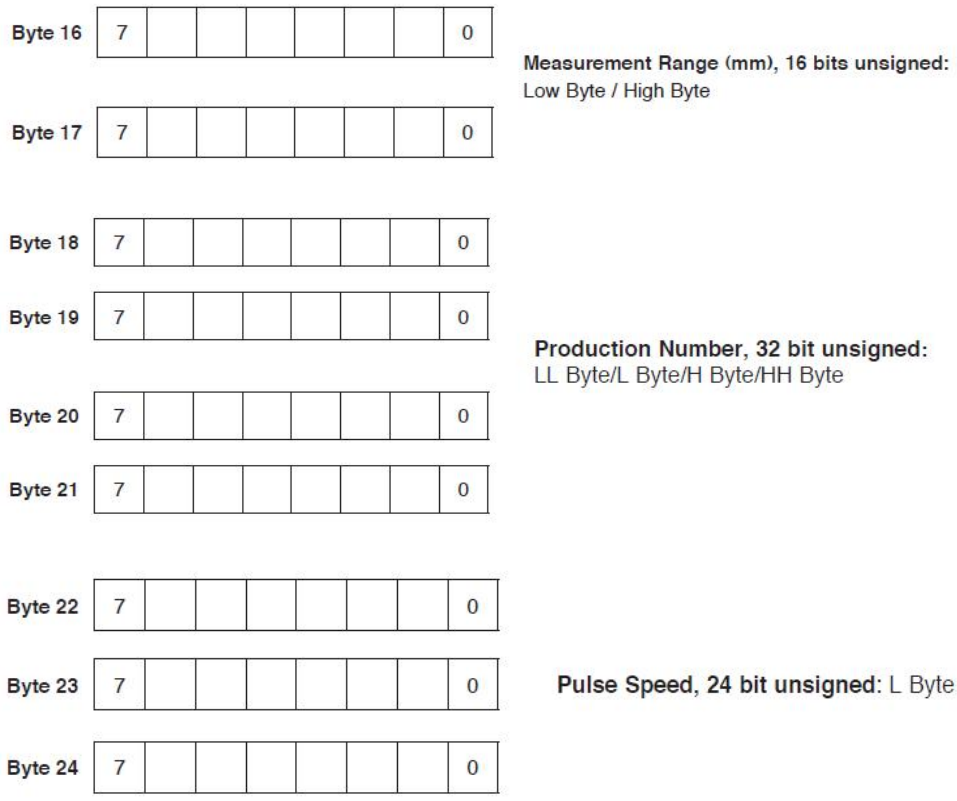




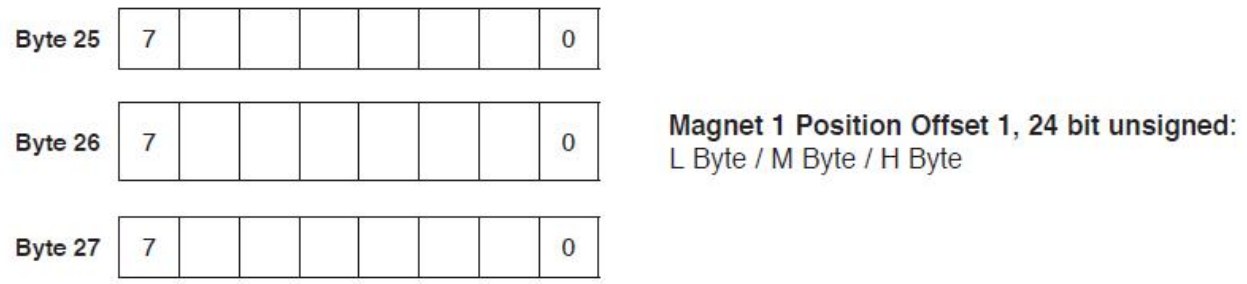
Extended Diagnostics (from Byte 8)

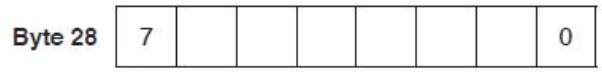

Byte 8
7
0
Reserved
Byte 9
7
0
State
Error management, data
0 = data to zero / 1 = old data
Magnet error management
0 = single magnet / 1 = all magnets
Direction of measurement
0 = forward / 1 = reverse
Reserved
State/Position Data Format
00 = state/low/middle/high (24 bit Intel)
01 = state/high/middle/low (24 bit Motorola)
10 = low/middle/high/stato (24 bit Inverse Motorola)
11 = hhigh/high/low/llow (32 bit Motorola)
Byte 10
7
0
Resolution (µm), 16 bit unsigned
High Byte / Low Byte
Byte 11
7
0
Byte 12
7
0
Hardware Revision
Byte 13
7
0
Firmware Revision
Byte 14
7
0
Number of magnets
Number of configured magnets
Reserved

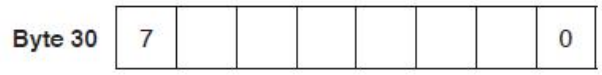




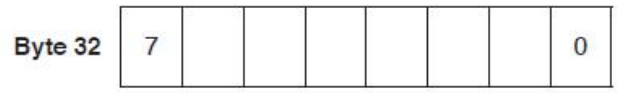
For modules with preset, depending on the number of magnets installed, the diagnostics telegram shows the value of the position measurement offset factor (expressed in [µm] with the same resolution of the Position data used for the current parameterization).

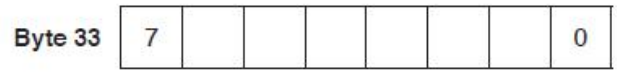




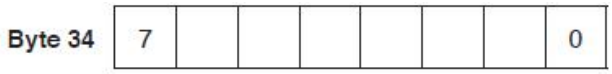


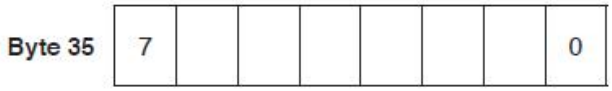
Magnet 2 Position Offset 2, 24 bit unsigned:
L Byte / M Byte / H Byte



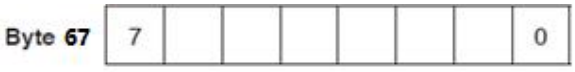


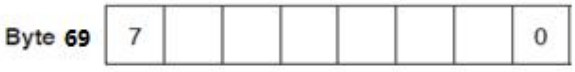
Magnet 3 Position Offset, 24 bit unsigned:
L Byte / M Byte / H Byte





Magnet 4 Position Offset, 24 bit unsigned:
L Byte / M Byte / H Byte





Magnet 15 Position Offset, 24 bit unsigned:
L Byte / M Byte / H Byte

The offset factor transmitted in the diagnostics telegram is expressed with the same resolution used for the current
Slave parameterization.

The offset factor varies with the parameterization used, and depends on:

- Resolution of position data
- Direction of measurement

Data-Exchange TELEGRAM (SAP 0)

After Parameterization and Configuration are correctly done, the Master and Slave can start Data-Exchange, during which the master cyclically interrogates the Slave to request data and give commands (if necessary), while the Slave replies to the Master by transmitting Position (and possibly Speed) data.

The Data-Exchange Input and Output telegrams differ in length and content according to the module installed during configuration and to the specific parameterization adopted.

A complete Data-Exchange cycle includes a request telegram, sent from master to slave (OUTPUT DATA), followed by a reply telegram from slave to master (INPUT DATA).

OUTPUT DATA (Master Slave)

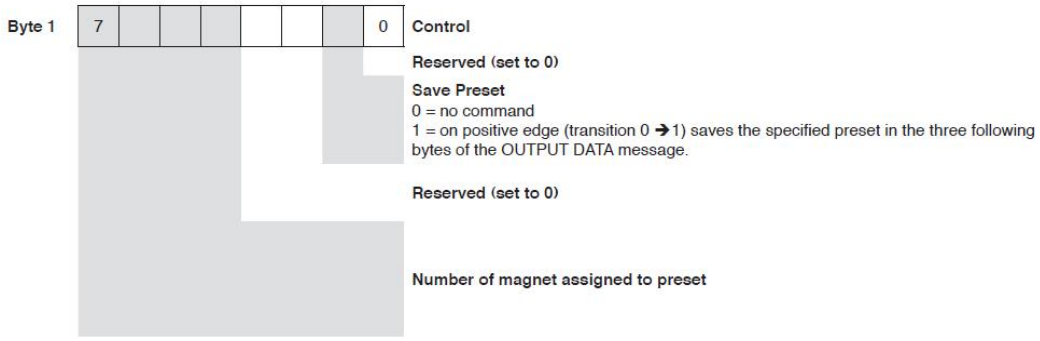
OUTPUT DATA means the Data-Exchange telegram sent from Master to Slave.

The number of OUTPUT bytes (from Master to Slave) in the Data-Exchange message is:

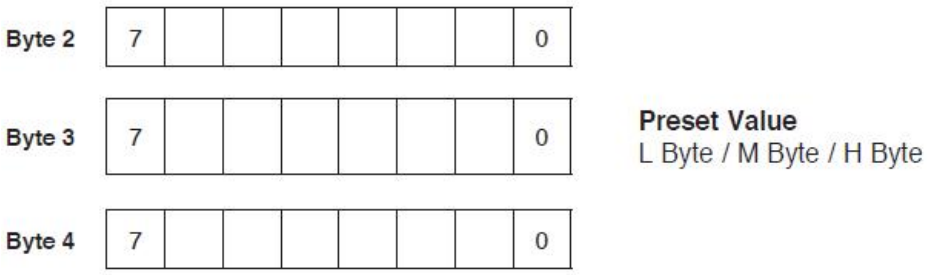
• 1 for modules without preset

• 4 for modules with preset

The first byte is the Control Byte.



If the Slave is parameterized with a “measurement with preset” module, three additional bytes are transmitted, in which you can specify the preset value that you want to save:



Example

Module without Preset

The OUTPUT DATA message is composed of the following bytes:

Byte 1: Control Byte

Module with Preset

The OUTPUT DATA message is composed of the following bytes:

Byte 1: Control

Byte 2: Preset (L Byte)

Byte 3: Preset (M Byte)

Byte 4: Preset (H Byte)

INPUT DATA (Slave Master)

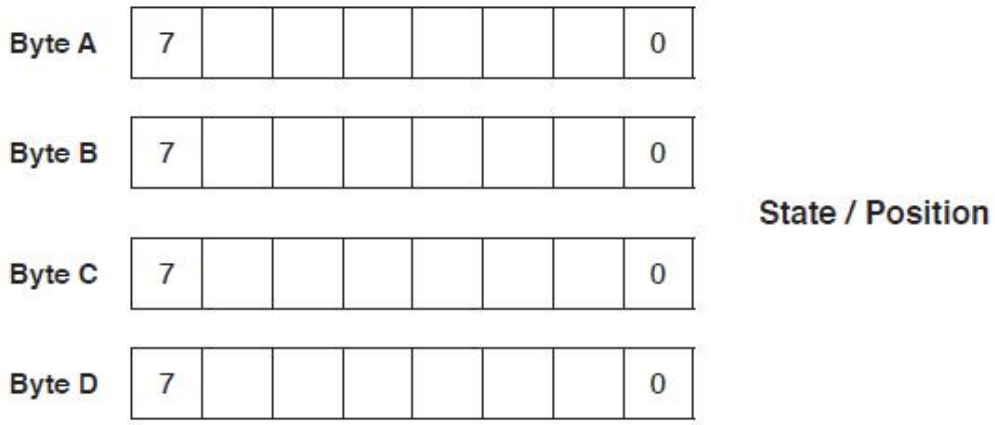
INPUT DATA means the Data-Exchange telegram containing the measurement data sent from Slave to Master.

Depending on the chosen parameterization, for each magnet the number of INPUT bytes (from Slave to Master) in the

Data-Exchange message is:

• 10 for modules with position measurement

Depending on the chosen parameterization, one of the four bytes for position measurement can be replaced by a state byte; in this case, the actual position data is 24-bit.



INPUT DATA for position data can be transmitted to the Master in four different ways, depending on the type of "Data

Format" selected for parameterization of the Slave (byte 11 parameterization telegram, see paragraph Parameterization).

This lets you adapt the output data to the type of PLC used.

Parameterization	State/Position			
	A	B	C	D
Intel Format with State (Standard)	State	L	M	H
Motorola Format with State (Siemens)	State	H	M	L
Inverse Motorola Format with State (Allen-Bradley)	L	M	H	State
Motorola 32-bit without state (Siemens S7)	HH	H	L	LL

You can therefore request transmission of the position data in 24-bit format with State byte, or in 32-bit format without State. With a parameterization that requests Position and Speed measurement, the following convention is used: all of the State/Position bytes for all magnets present are transmitted first, and then all of the Speed bytes.

Example

Using a 4-magnet configuration with Position measurement, the INPUT DATA message is composed of the following bytes:

Byte 1...4 : (State)/Position Magnet 1

Byte 5...8 : (State)/Position Magnet 2

Byte 9..12 : (State)/Position Magnet 3

Byte 13..16 : (State)/Position Magnet 4

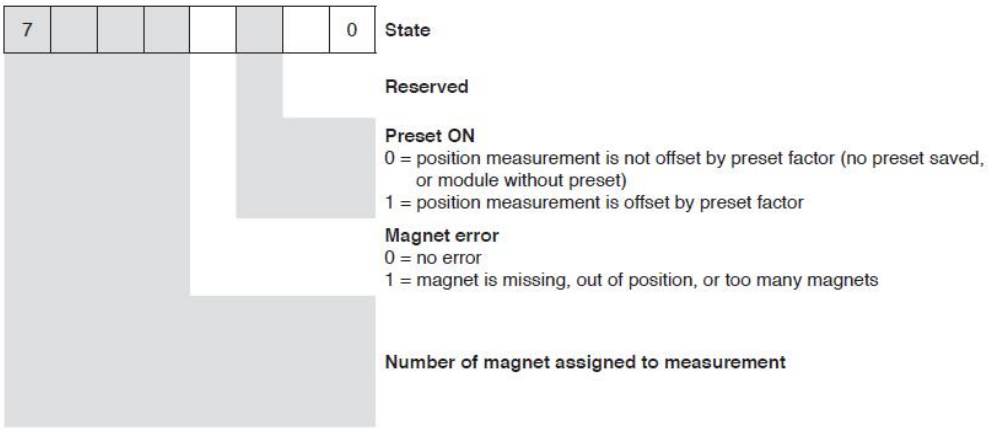
INPUT DATA (Slave Master)

State/Position 1				State/Position 2				State/Position 3				State/Position 4			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Transmission of the state byte lets you detect any error conditions, such as a number of magnets differing from the number specified in parameterization.

For example, a magnet that is missing or positioned beyond the maximum stroke, or too many magnets, will generate an error message. Two magnets positioned too closely together may also generate an error condition.

The state byte also tells you whether or not the current measurement data is influenced by correction of the set preset (only on modules with preset).



NOTE: if data ordering in Motorola 32 bit format is used, and parameterization without preset was set, you can still detect a possible error condition on the magnet by configuring error management (data value) as “data at zero”. Normally, the measurement is never zero: if there is an error, the measurement data is forced to zero, from which you deduce that the measurement is in error.

On the other hand, if parameterization with preset was set, data ordering in Motorola 32 bit format could generate false magnet error signals.

In this case, to eliminate all doubt, you have to check that the red LED is off (not a very practical method).

Lastly, Motorola 32 bit format provides no way to check if the preset is ON.

SETTING THE POSITION PRESET (for modules with preset)

The Preset lets you specify a Position data value for each magnet independently, so that you can set a new zero point or any other preset value for each cursor.

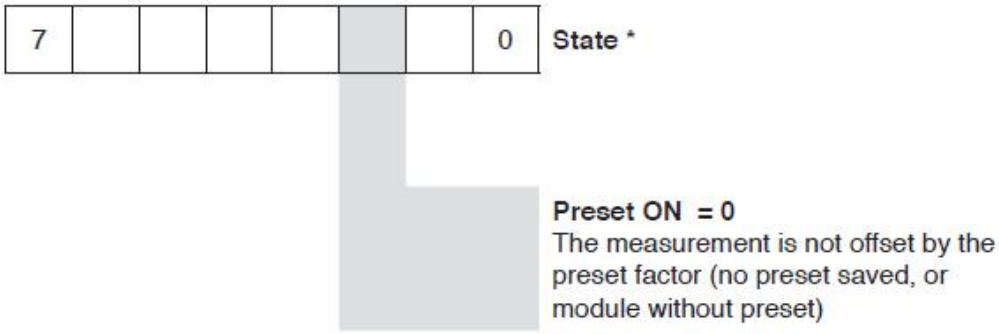
To use the Preset function on the transducer, you have to parameterize it by selecting the relative module during parameterization. Once the preset is saved, it can be used later (even after the transducer has been switched off and back on) without having to repeat the procedure.

A new transducer, fresh from the factory, has no saved preset. When a new transducer is parameterized for the first time with a Preset module, the position measurement returned is not influenced by the preset correction. This can be seen by observing bit 2 on the State byte of the Input Data for the magnets present.

Example: preset not saved

If no preset has been saved yet for a certain magnet, bit 2 (Preset ON) is zero.

INPUT DATA



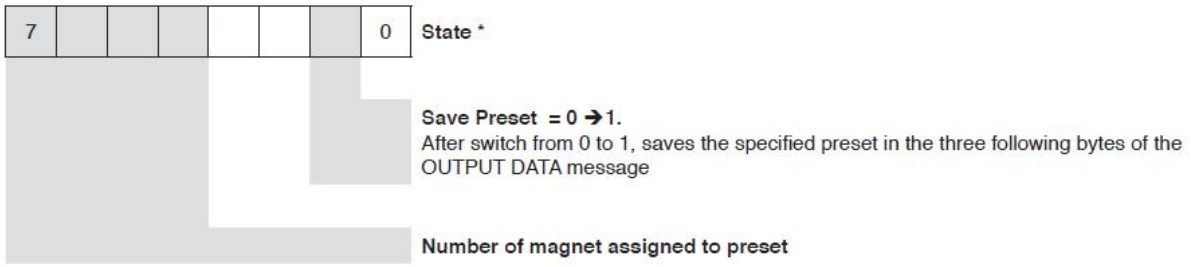
The measurement therefore matches a “measurement without preset.” Until a preset value is assigned to a magnet, that magnet will continue to return the position data without the preset correction.

The preset value is acquired, saved, and used by the transducer to correct the position data value only when the “Save Preset” command is launched.

The “Save Preset” command is launched by the Output Data control byte.

Example: launch “Save Preset” command

OUTPUT DATA



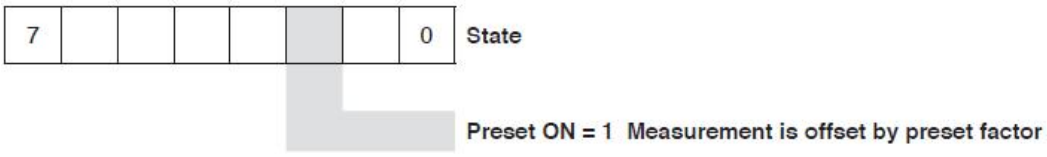
The magnet assigned to the corresponding preset value is defined by bits 4-7 of the Control Byte. A positive edge on bit 2 of the Control Byte lets you launch the "Save Preset" command to the slave.

The new preset value, contained in the 3 following bytes of the OUTPUT DATA message, is then acquired and saved by the Slave.

The transducer immediately redefines the position data of the relative cursor. Note that bit 2 on the State byte of the Input Data for the relative magnet equals 1.

Example: preset saved for current magnet

INPUT DATA



Before launching a new "Save Preset" command, you have to reset bit 1 of the Control Byte. The preset value is saved internally and the offset (difference between absolute measurement and preset value) is presented in the diagnostics packet.

Therefore,

Offset = Absolute Measurement - Preset

If you use a module with preset, you can calculate the value of the "absolute" measurement of the sensor, i.e., not affected by the preset, as follows:

Absolute Measurement = Measurement with Preset + Offset

The offset data in the diagnostics message is expressed with the same resolution as the current position data.

IMPORTANT: The preset value must be specified in [µm] with the same resolution used for the current parameterization of the Slave.

Example 1

You want to set the preset value of magnet number 1 to 50mm, and the transducer is currently parameterized with resolution of data at 20µm.

Calculation:

1. Convert position to µm: 50mm = 50000µm

2. Divide by the resolution of the data: 50000µm/20 = 2500

The preset value to be specified in bytes 2, 3 and 4 is 2500 = 0x0009C4.

To set the preset on magnet 1, the control byte must be

00010010b = 0x12

The OUTPUT DATA message to be sent by the Master is:

0x12 0xC4 0x09 0x00

The Master, after a few cycles, has to send the following message to reset the command bit:

0x10 0xC4 0x09 0x00

or

0x00 0xC4 0x09 0x00

Example 2

You want to set the preset value of magnet number 2 to -40cm, and the transducer is currently parameterized with resolution of data at 100µm.

Calculation:

1. Convert position to µm: -40cm = -400000 µm

2. Divide by the resolution of the data: -400000/100 = -4000

The preset value to be specified in bytes 2, 3 and 4 is -4000 = 0xFFF060 (negative numbers with representation in two’ s complement).

To set the preset on magnet 2, the control byte must be

00100010b = 0x22

The OUTPUT DATA message to be sent by the Master is:

0x22 0x60 0xF0 0xFF

The Master, after a few cycles, has to send the following message to reset the command bit:

0x20 0x60 0xF0 0xFF

or

0x00 0x60 0xF0 0xFF

Example 3

You want to set the preset value of magnet number 3 to zero.

Calculation:

Not needed

The preset value to be specified in bytes 2, 3 and 4 is 0x000000.

The OUTPUT DATA message to be sent by the Master is:

0x32 0x00 0x00 0x00

The Master, after a few cycles, has to send the following message to reset the command bit:

0x30 0x00 0x00 0x00

or

0x00 0x00 0x00 0x00

See the table specifying the Control Byte value to be sent in the OUTPUT DATA message to launch the "Save Preset" command.

Magnet Number	Control Byte Value (Hex)
1	12
2	22
3	32
4	42
..	F2

NOTE: when a preset is set, and depending on its value, the position data may assume negative values (representation in two's complement).

NOTE: when the measurement for a certain magnet is in error state (condition shown by the State byte), you cannot run the “Save Preset” command for that magnet.

In this case, the command is ignored.

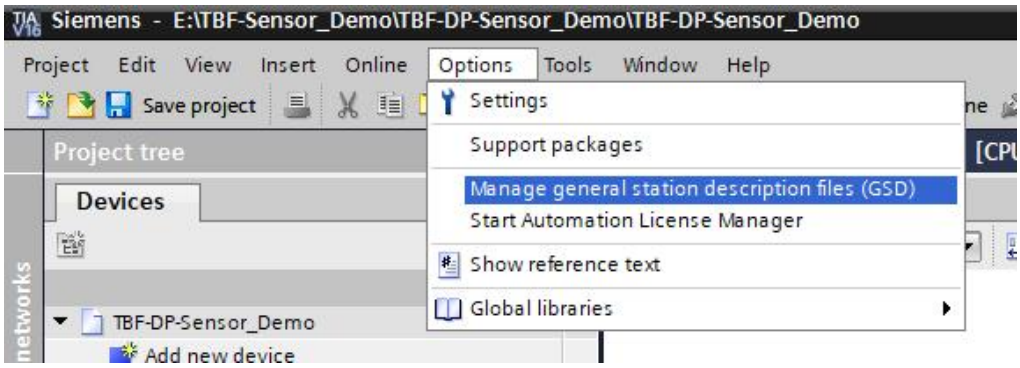
IMPORTANT:

The saved preset value, as well as the offset factor in the diagnostics message , remain valid even when changing the resolution of the position data or the direction of measurement after subsequent and different parameterizations.

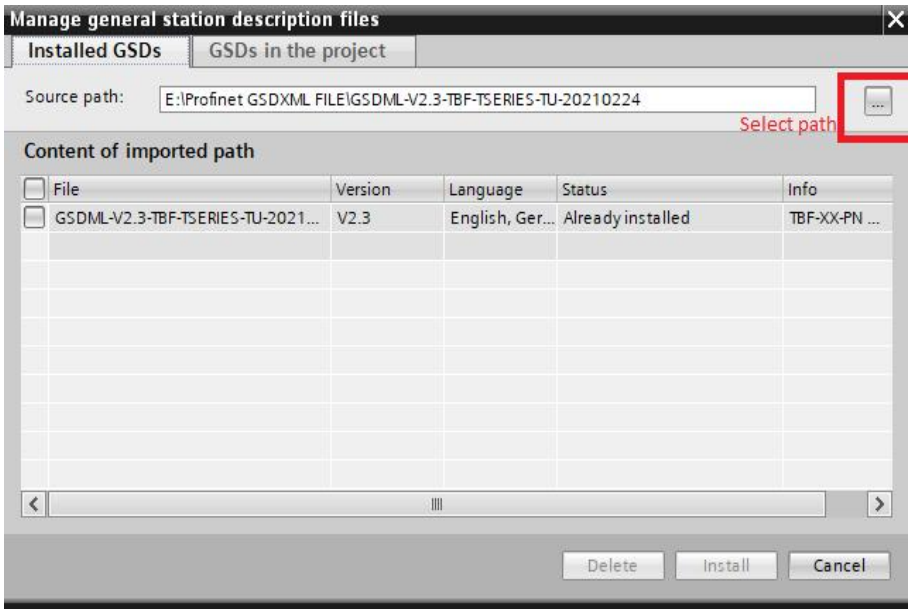
Therefore, it is not necessary to repeat the preset saving procedures. If you plan to use different resolutions, it is advisable to run the preset saving procedure using the highest resolution (low µm value) possible for the application

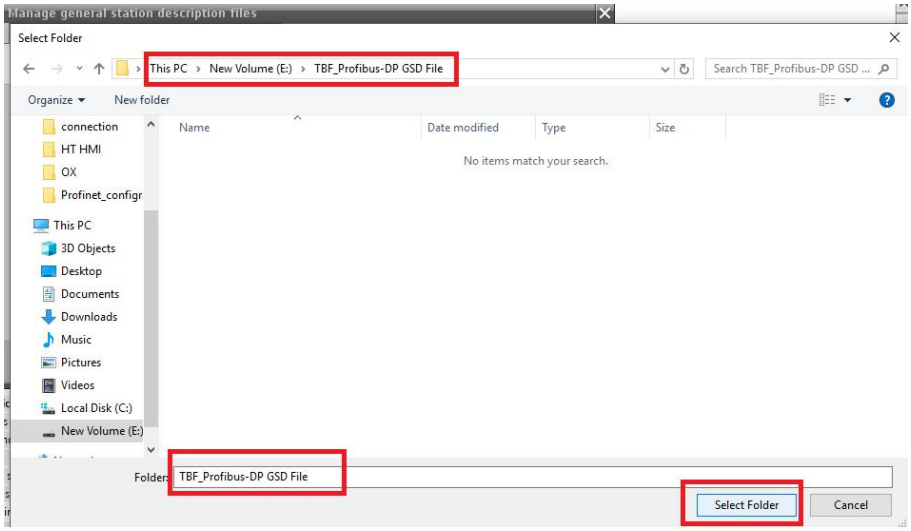
8. GSD file and Commissioning

8.1 Open TIA POTAL software, Options->Manager general station description files (GSD).

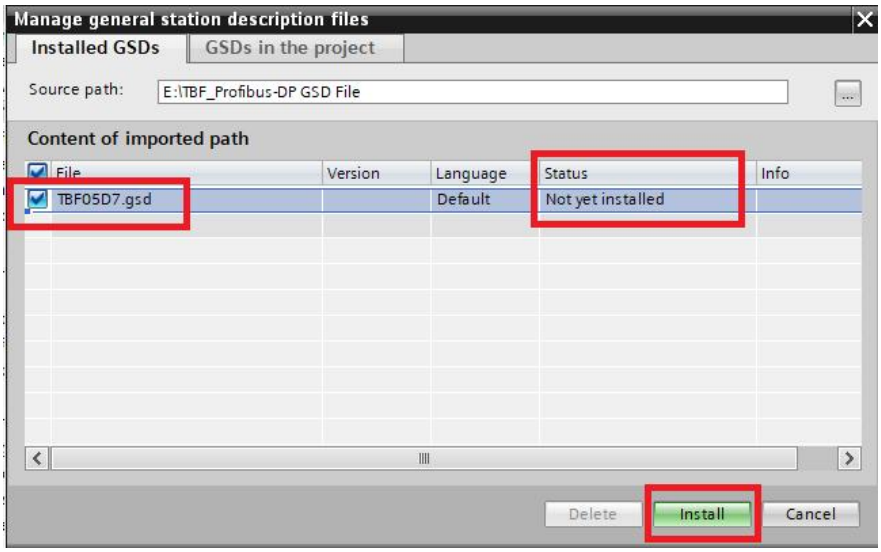


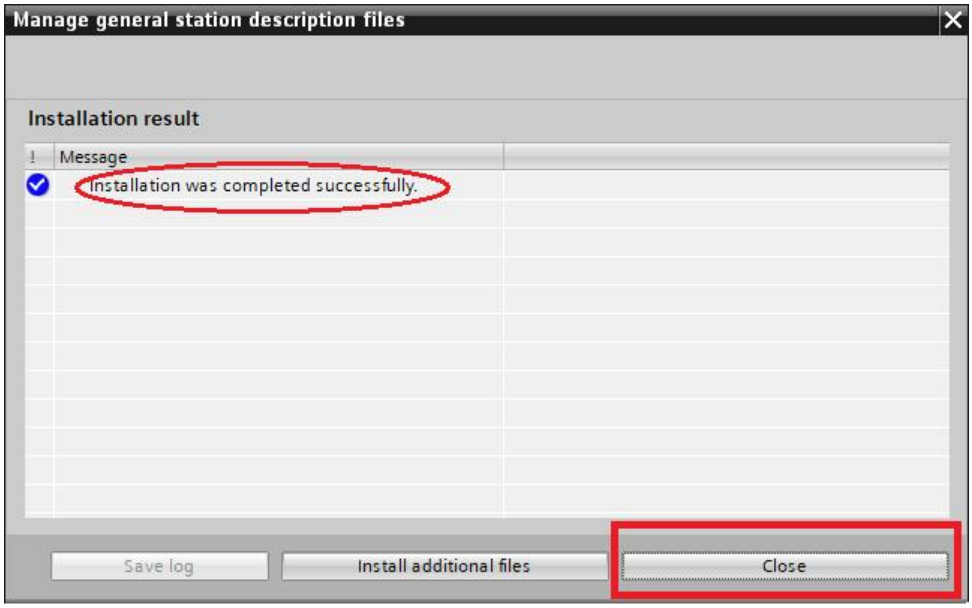
8.2 Open the path where the GSD file is located, select this folder



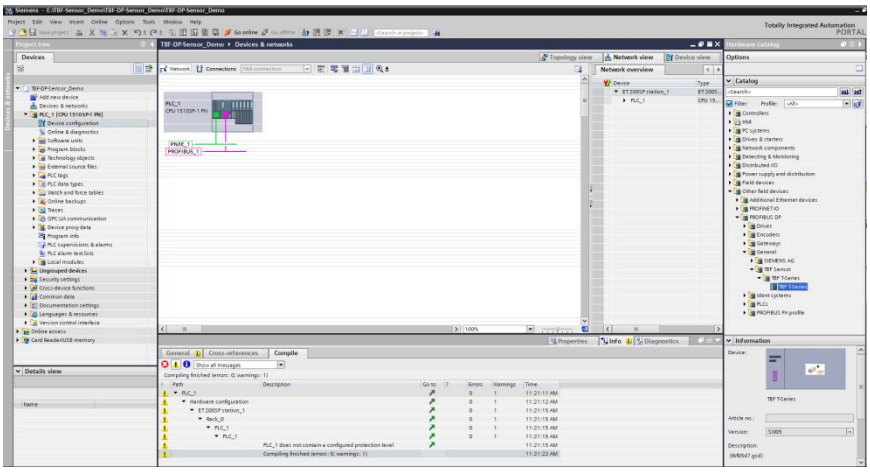


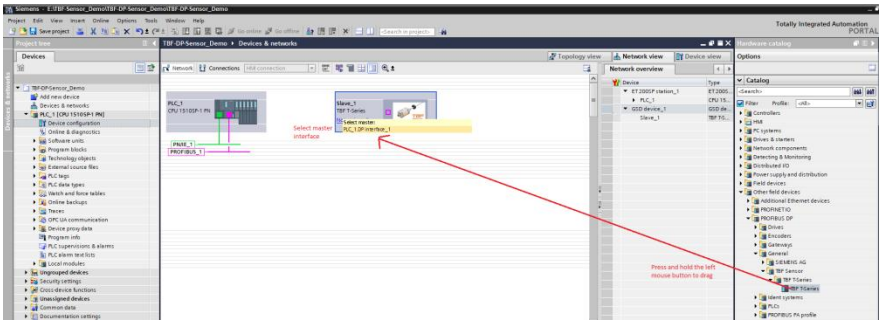
8.3 Select Install ,wait for Install finished and Close.



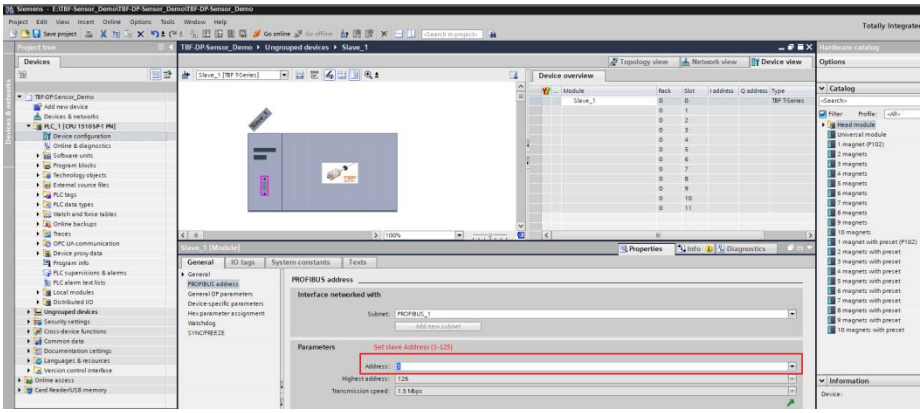


8.4 After creating a new project, open the network view, Hardware catalog->Other field devices->PROFIBUS DP ->General->TBF-Sensors->TBF T-Series, Double-click the left mouse button or drag .

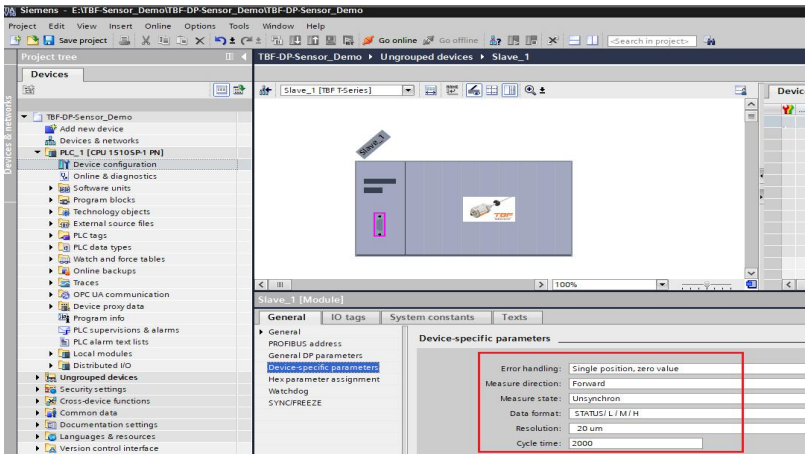




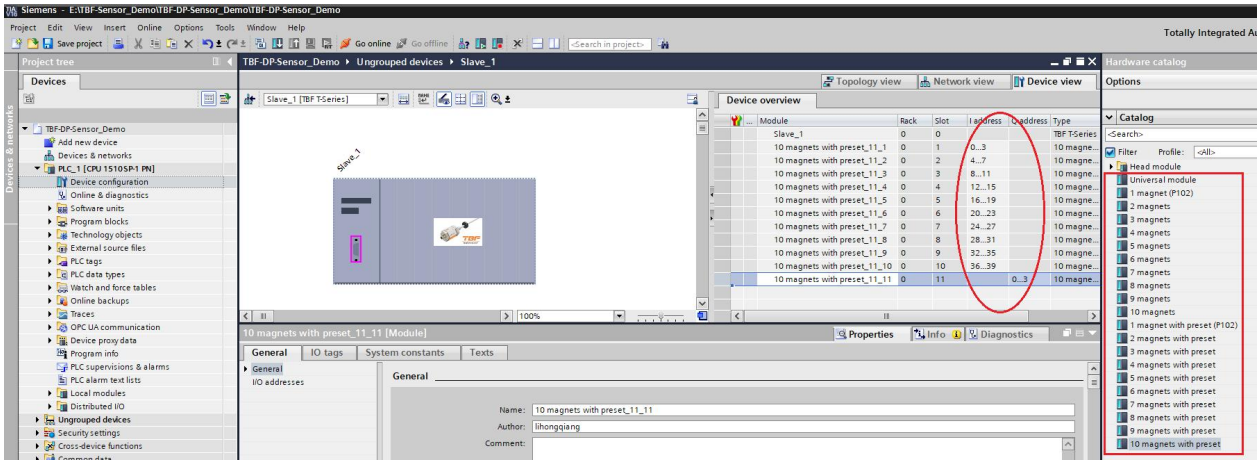
8.5 Set slave address and Baud rate according to the customer configuration .



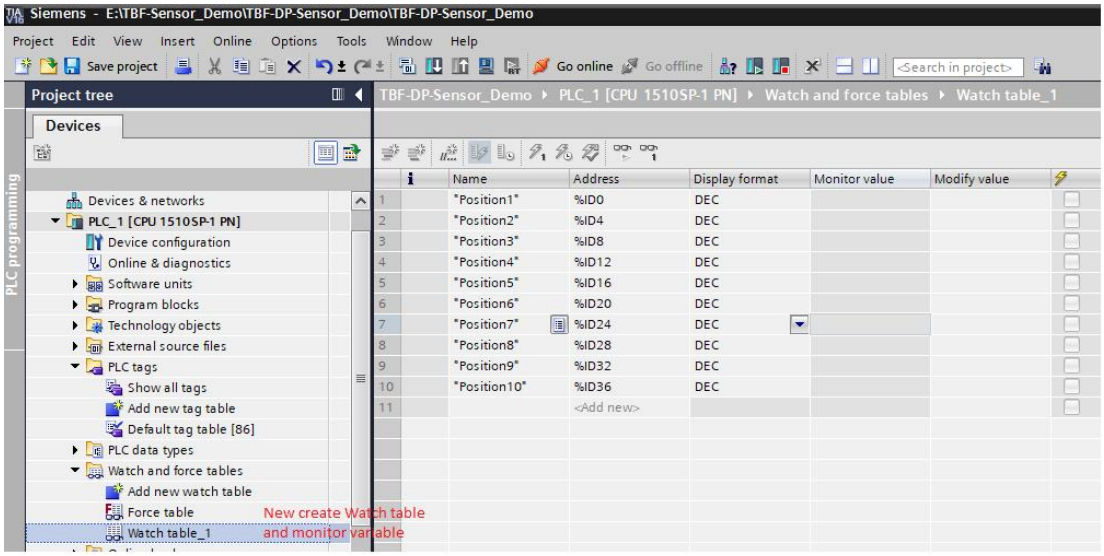
8.6 Select Device-specific parameters, Configure parameter settings.



8.7 Select the Sunmodules , for example 10 magnets with preset, mapped Hardware IO Address follows: bytes 40 INPUT and bytes 4 OUTPUT



8.8 Create a new Watch table_1 table to monitor variables.



TBF Electronic Technology GmbH(German branch)

Felix-Wankel-Str.1 1.OG 85221 Dachau, Germany

Tel: +49(0)8131 337578-0

E-mail: info@tbfsensor.com

Beijing Tebeifu Electronic Technology Co., Ltd.

Building 6, Dazu Enterprise Bay,

8th yard of Liangshuihe 2nd street, BDA P.R.China

Tel: 010-67948976/67948916

Fax:010-67948979

Mailbox: sale@tbfsensor.com

Web: www.tbfsensor.com