Operating Instructions

42/11-50 EN

Temperature Transmitter TF12/TF12-Ex (head mounted) and TF212/TF212-Ex (field mounted)

PROFIBUS PA

Pt 100 (RTD), thermocouples

1 or 2 independent channels

Industrial IT enabled

PROFIBUS PROCESS FIELD BUS

ABB

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Pt 100 (RTD), thermocouples
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Important information

Symbols

In order that you can make the best use of this document and to ensure safety during commissioning, operation and maintenance of the equipment, please note the following explanation of the symbols used.

Explanation of the symbols used.

Symbol	Signal Word	Definitions
	DANGER	DANGER indicates an **imminently hazardous** situation which, if not avoided, **will result** in death or serious injury. (High level of risk.)
	WARNING	WARNING indicates a **potentially hazardous** situation which, if not avoided, **could result** in death or serious injury. (Medium level of risk.)
	CAUTION	CAUTION indicates a **potentially hazardous** situation which, if not avoided, **could result** in minor or moderate injury. (Low level of risk.)
	NOTICE	NOTICE indicates a **potentially harmful** situation which, if not avoided, **may result** in damage of the product itself or of adjacent objects. (Damage to property)
	IMPORTANT	IMPORTANT indicates useful hints or other special information which, if not observed, could lead to a decline in operating convenience or affect the functionality. (Does not indicate a dangerous or harmful situation.)

As well as the instructions in this document, you must also follow the generally applicable accident prevention and safety regulations.

If the information in this document is insufficient in any situation, please contact our service department, who will be happy to help you.

Please read this document carefully before installation and commissioning.

CE marking

The product complies with the specifications in the EMC Directive 89/336/EEC and the Low-Voltage Directive 73/23/EEC.

Affiliated reference documents

Version information	34/11-51 EN
Linking device LD800P manual	3BDD011704R101
Profile definition for PROFIBUS PA	
Temperature transmitter TF12/TF212	40/11-50 EN
TF12/TF212 version matrix	3KDE115000R3001
DTM TF12/TF212 parameter setting instructions	45/11-50 EN
Driver TF12/TF212 supplementary information	3KDE115004R3901

TF12/TF12-Ex

Data sheet	10/11-8.26 EN
EC type examination certificate	ZELM 99 ATEX 0021 (intrinsically safe)

TF212/TF212-Ex

Data sheet	10/11-8.70 EN
TF212-Ex “flameproof enclosure“, suppl. operating instructions	42/11-53 XA
TF212-Ex type examination certificates:	ZELM 99 ATEX 0021 (intrinsically safe) PTB 99 ATEX 1144X (flameproof enclosure) DMT 02 ATEX E248 (intrinsically safe)

1 Safety instructions

1.1 General safety instructions

The devices were designed, produced and tested in accordance with IEC 1010-1 (corresp. to EN 61010-1 and DIN VDE 0411 Part 1 "Safety requirements for electrical measurement, control and laboratory equipment"), CE-certified, and delivered in a safe condition.

DANGER
When handling these devices (during transport, storage, installation, commissioning, operation, maintenance, and de-commissioning) observe these operating instructions and the information on all type plates, labels and safety instructions attached to the devices.

The regulations, standards and directives referred to in these operating instructions are applicable in Germany. When using the devices in other countries, the relevant national regulations, standards and directives must be observed.

1.2 Safety instructions applicable to all device variants

– Safe separation from current circuits with electrical shock hazard is only guaranteed if the connected devices comply with VDE 0106 T.101 (basic requirements for safe separation).
– In order to ensure safe separation lay feed lines separately from current circuits with shock hazard or provide them with an additional insulation.
– Prior to switching the devices on, make sure that the ambient requirements specified in the data sheets (see also chapter 6 “Technical data” on page 26) are met and the supply voltage is in accordance with the transmitters' power specifications.
– The devices must be shut down and secured reliably against unintentional restart if it must be assumed that safe operation is no longer ensured.
– Always observe the technical data in the data sheets 10/11-8.26 (TF12/TF12-Ex) and 10/11-8.70 (TF212/TF212-Ex) or the specifications in chapter 6 “Technical data” on page 26, respectively.

1.3 Special safety instructions for TF12-Ex and TF212-Ex

DANGER
When working on TF12-Ex or TF212-Ex transmitters, always observe the information in the type examination certificates. For explosion protection type "flameproof enclosure" additionally observe the supplementary operating instructions 42/11-53 XA (see chapter “Affiliated reference documents” on page 4).

– TF12-Ex and TF212-Ex transmitters may be installed directly in zone 1.
– Both the measuring current circuit and the fieldbus connector comply with EEx ia.
– The segment coupler required for powering the transmitter (IEC 1158) must be selected in accordance with the Ex classification.
– Mount the TF12-Ex transmitter in such a way that a degree of housing protection of at least IP 20 acc. to IEC Publication 529 (144) is achieved, also for all connected parts.
– When grounding the bus line (especially the shield), strictly adhere to the specifications in IEC 60079-14 or EN 60 079-14, respectively.
– If a device with an intrinsically safe current circuit is connected to the transmitters, a proof for the intrinsic safety of this interconnection in accordance with DIN VDE 0165 / 08.98 (= EN 60079-14/1997 and IEC 60 079-14/1996) must be delivered.
– Only persons who are familiar with the installation, commissioning, operation and maintenance of similar devices and have the required qualification are authorized to work on the devices. Prior to starting work with the devices make sure that all safety instructions pertaining to explosion protection are observed.

1.4 Declaration of conformity

The requirements of the European directive 94/9/EC are met.
The product conforms with the European Directive 89/336/EEC and its amendments as it meets the requirements of the following standards:
– Interference emission: EN 50 081-1:1992
– Interference immunity: EN 50 082-2:1995
– Test: EN 61 000-4 Parts 2, 3, 4, 5 and 6.

2 Device features

Series TF12 (head mounted) or TF212 (field mounted) temperature transmitters feature a temperature linear output signal, an excellent long-term stability, and enhanced self-diagnostics. Additionally, they have the following properties:

- Input
  - Resistance thermometers (2, 3, 4-wire circuit)
  - Thermocouples/voltages, mV sources (-15...+115 mV)
  - Resistance remote signalling units (0...400 Ω, 0...4000 Ω)
- Output
  - PROFIBUS PA profile V3.0, types A and B
  - Bus design acc. to IEC 1158-2, 31.25 kbit/s
- Electrical isolation between input and output
- Digital, long-term stable processing of measuring values
- Customer-specific linearization
- Continuous sensor and self-monitoring
- Approvals for explosion protection
  TF12-Ex
  - intrinsically safe Ex II 2 (1) G EEx ia IIC T6: ZELM 99 ATEX 0021

  TF212-Ex
  - intrinsically safe Ex II 2 (1) G EEx ia IIC T6: ZELM 99 ATEX 0021
  - flameproof enclosure Ex II 1/2 G EEx d IIC T6: PTB 99 ATEX 1144X
  - dust explosion proof Ex II 1 D IP 65 T 135 °C: DMT 02 ATEX E248
- Input functionality
  - 1 or 2 channels
  - Redundancy/average value/differential value
- EMC to EN 50082-2 and NE 21
- Polarity reversal protection and fixed bus current limitation
- Parameterization
  - DTM for FDT 0.98-1 and FDT 1.2 interface and DSV401 (SMART VISION)
  - Siemens Simatic PDM driver for TF12, TF212

Overview of the properties relevant for PROFIBUS

Physical layer	MBP (Manchester-encoded bus-powered) 1) MBP-IS (intrinsic safety)
Communication technology	PROFIBUS DP (DPV0 and DPV1)
Application profiles I	No
Application profiles II	PA 3.0
Integration technologies	GSD, EDD, DTM

2.1 PROFIBUS master requirements

Series TF12/TF212 transmitters can be connected to all systems provided with a PROFIBUS DP master.

The following functions can be realized via the PROFIBUS DP (V0) services:
- Transmitter configuration
- Device and channel related transmitter diagnosis messages
- Cyclic reading of input values with status information

In order to be able to use the full range of functions provided by the series TF12/TF212 transmitters, the master has to support additional functions. An important feature of modern master systems is the support of PROFIBUS DPV1 services.

PROFIBUS DPV1 services allow for:
- Input and output data monitoring
- Transmitter input and output simulation (forcing)
- Transmitter parameterization

3 Mounting and connection

3.1 Mounting

TF12/TF12-Ex

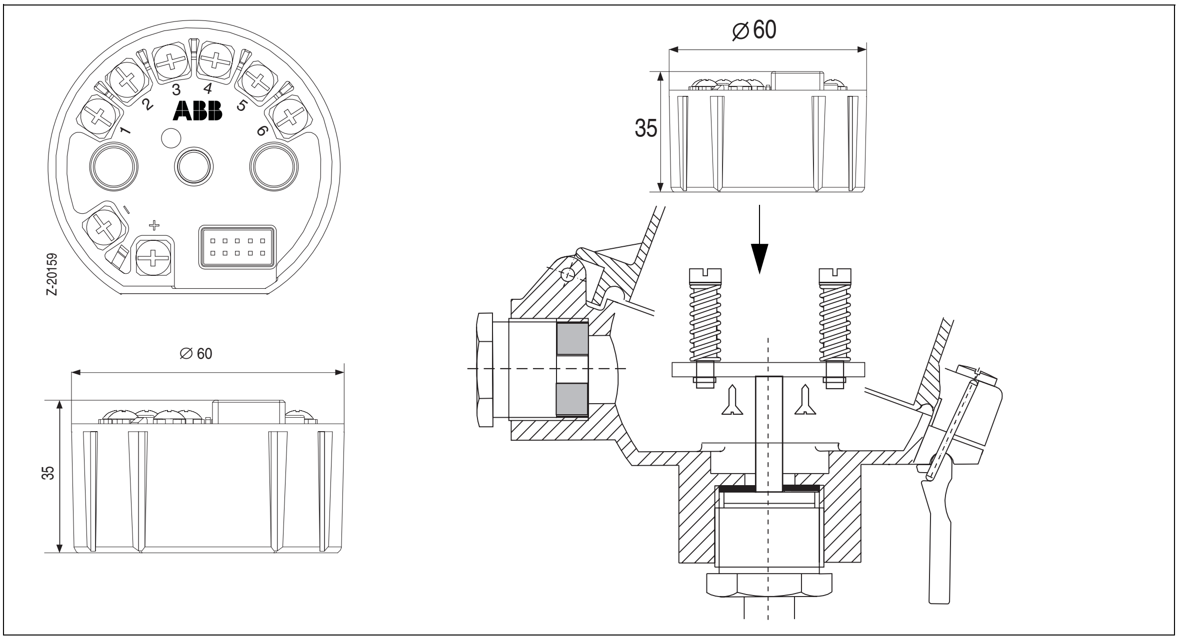


Fig. 3-1 Mounting the transmitter in the sensor head (all dimensions in mm)
Mounting on a measuring inset with riveted bushes and springs (e.g. BUSH connection head)
The measuring inset and transmitter are seen in the illustration rotated by 90°.

DANGER
Exclusively use the threading M3 × 6 mm screws delivered with the device. When using other, longer screws the transmitter may be damaged. In case of explosion-protected transmitters this may void the explosion protection.

TF212/TF212-Ex

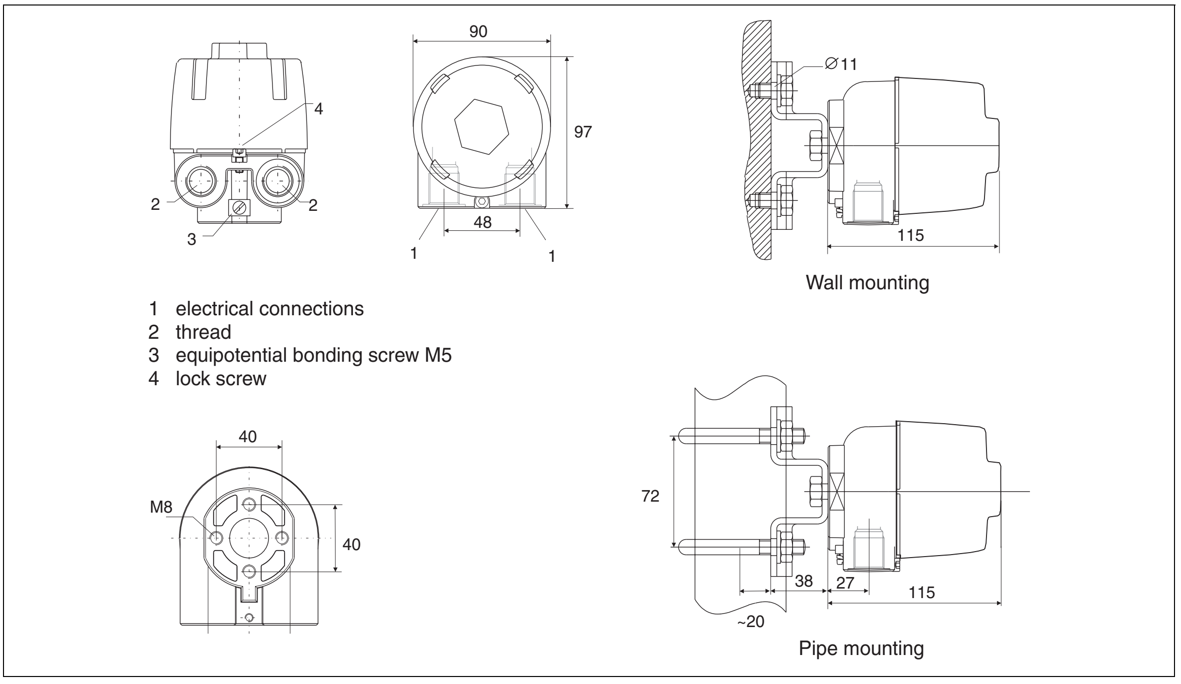
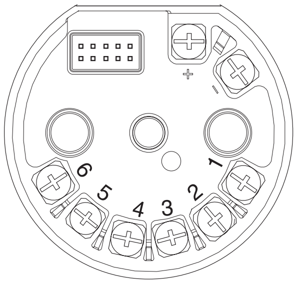


Fig. 3-2 Dimensional drawings of TF12/TF212 (all dimensions in mm)

3.2 Connection on the field side

One or two sensors can be connected to series TF12/TF212 transmitters, as required. Various resistance thermometers, thermocouples or combinations thereof are supported. Linear voltage and resistance measurement are possible as well.



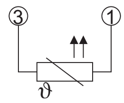
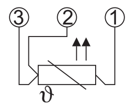
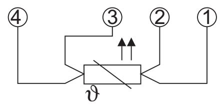
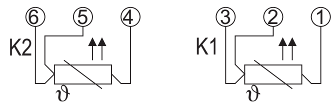
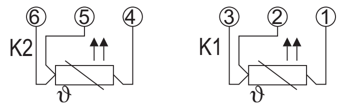
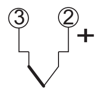
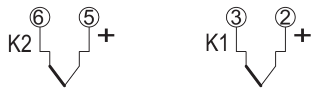
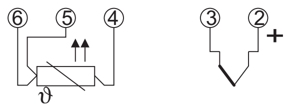
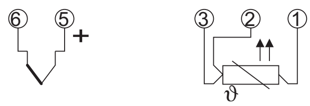
Sensor	Connection
a) Resistance thermometer, 2-wire circuit	
b) Resistance thermometer, 3-wire circuit	
c) Resistance thermometer, 4-wire circuit	
d) Double resistance thermometer, 2-wire circuit	
e) Double resistance thermometer, 3-wire circuit	
f) Thermocouple	
g) Double thermocouple	
h) Combination of resistance thermometer and thermocouple	
i) Combination of thermocouple and resistance thermometer	
Resistance measurement	A measuring resistor is connected in the same way as the resistance thermometer, i.e. in a 2-wire, 3-wire or 4-wire circuit.
Voltage measurement	A voltage source is connected in the same way as the thermocouple.

Fig. 3-3 Connection diagrams

Each of the two channels can be parameterized according to the respective sensor type, independent of the other channel. The above-seen table also allows for combinations not listed (e.g. channel 1 with 2- wire resistance thermometer and channel 2 with 3-wire resistance thermometer). The possible combinations also include linear voltage and resistance measurement.

3.3 Connection on the bus side

General

The following standards, which can be downloaded from the Internet under www.profibus.com, are valid for the PROFIBUS network:

Documentation	Reference
PROFIBUS PA User and Installation Guideline	2.092
PROFIBUS Standard DP - Specification	IEC61158-3
PA-Brochure	PA-Brochure_English.pdf
Profile for Process Control Devices (PA Profile)	3.042
GSD Specification	2.122

All fieldbus cables in a PROFIBUS network must be shielded. The cable type is defined by the PROFIBUS standard. The document "PROFIBUS PA User and Installation Guideline" listed in the table above informs you about the required shielding and grounding measures.

CAUTION

The specifications in this manual and in the data sheets are only valid with the cable types, shielding and grounding measures, max. cable lengths etc. stipulated in the PROFIBUS standard.

Connecting the transmitter to the bus

Series TF12/TF212 transmitters can be connected to a fieldbus in accordance with IEC 1158-2 ('PROFIBUS PA'). When connecting the transmitters, take care for correct polarity.

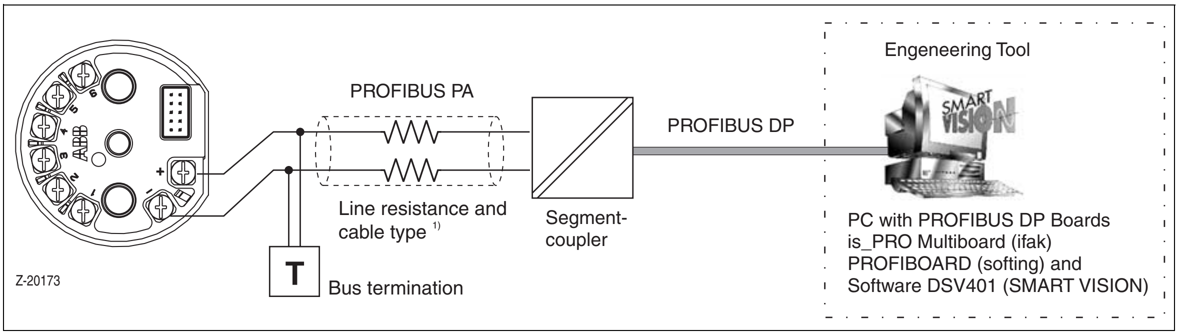


Fig. 3-4 Bus connection for communication and parameterization
1) The PROFIBUS standard EN 61158-2 requires the use of shielded bus cables.
Please refer to the "General" section in this chapter for references regarding the shielding measures to be taken.

Connection via M12 connector

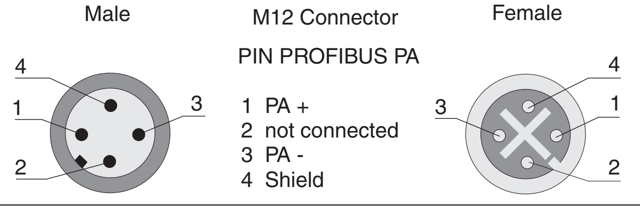


Fig. 3-5 M12 connector

Connection to a PROFIBUS DP network

Usually, modern PROFIBUS masters have an RS 485 type PROFIBUS DP interface. To be able to address a slave of the TF12/TF212 series with this master, the RS 485 signal (9600 bit/s...12 Mbit/s) must be converted to an MBP signal (31,25 kbit/s) by a segment coupler. Series TF12/TF212 transmitters are designed to be used with the following segment couplers:

– ABB LD800P (segment coupler with freely selectable DP baud rate)
– Pepperl & Fuchs SK2
– Pepperl & Fuchs SK1

For segment couplers allowing for a freely definable baud rate on the PROFIBUS DP side (e.g. ABB LD800P), the GSD file delivered with the slave usually has to be converted. Both the original file and an already converted version for use with LD800P are available for series TF12/TF212 transmitters under catalog number 3KDE115200S0004.

Other options

So-called multi-barriers can be used to improve the PROFIBUS PA performance (e.g. to increase the possible number of devices on the bus). PA slaves like series TF12/TF212 transmitters are then connected under the multi-barrier. The multi-barrier does not act as a segment coupler (s.a.), i.e. the physical layer is not converted. TF12/TF212 transmitters can be used e.g. with multi-barriers of type MB204 or MB204-Ex from ABB.

4 PROFIBUS PA communication

4.1 Slave address

Conventions

Up to 127 bus stations can be addressed via the PROFIBUS. A maximum of 32 stations may be run on a bus segment without using repeaters. As there must be at least one master on the bus, the maximum slave address range amounts to 126. Note that temporarily connected diagnostic or configuration units (Class_2 Masters) must be considered as stations, too. Address 0 should not be used for slaves. Address 126 is used for commissioning slaves that allow for address setting via the PROFIBUS and, therefore, should not be used permanently, either.

CAUTION

Do not assign the same station address twice within one bus system. Otherwise, both stations with the same address will stop cyclic data exchange.

Address setting

The address is exclusively set using the "Set_Slave_Address" PROFIBUS service. The type of address setting depends on the process control system or PROFIBUS master used. The "Commissioning" chapter of this manual details the address setting procedure for ABB systems.

Factory setting

In factory, all transmitters of the TF12/TF212 series are set to PROFIBUS address 126. Customized parameterization is possible.

4.2 GSD file

Besides physically connecting all stations to a PROFIBUS segment you also have to configure the entire DP system in the PROFIBUS master. Some vendors of distributed industrial control systems (DCS) or process control systems (PCS) that can be used as PROFIBUS masters offer quite convenient, PC-based configuration tools for this purpose. Electronic data sheets for PROFIBUS applications called the General Station Description (GSD) are the basis for this configuration. The GSD file describes all slave properties relevant for operation on the PROFIBUS. In order to ensure vendor-independent slave configuration, the file format has been standardized.

GSD file structure

The GSD's basic structure is defined in EN50170. More detailed information is available from the PROFIBUS user association (PNO) under http://www.profibus.com/. The GSD files are usually directly delivered by the vendor and, in some cases, can also be downloaded from the Internet. GSDs for different languages may be provided in separate files with the corresponding file extensions:

– Default: ?=d
– English: ?=e
– French: ?=f
– German: ?=g
– Italian: ?=i
– Portuguese: ?=p
– Spanish: ?=s

An English GSD file called ABB_04C4.GSD is available for TF12/TF212 transmitters. As the GSD file of PA devices typically does not contain parameters, this English version can be used for all languages.
Every vendor delivers a GSD file with his PROFIBUS slaves. This allows the user or configuration tool to eliminate potential errors resulting from invalid parameters already in the configuration phase. At that time the slave does not yet communicate with the master.

The GSD file is an electronically readable ASCII text file and can be viewed with any text editor.

CAUTION

Only the original GSD file from the device vendor ensures correct functioning of a slave. Any manipulation of the GSD file may cause serious errors and is at the user's own risk.

The GSD file defines communication-specific parameters like the supported baud rate. Additionally, it may contain possible slave parameters. Series TF12/TF212 transmitters are modular slaves. In contrast to a compact slave a modular slave has a variable structure, i.e. it is made up of several individual modules or configurations. The GSD file describes the individual configurations with the corresponding properties. Among them are:
– the range of input data,
– settable parameters,
– diagnostic data.

Additionally, system limitations like the number of possible configurations, the maximum sum of input and output data etc. are specified

4.3 Block model of the PROFIBUS PA profile

4.3.1 Overview

The PROFIBUS standard only describes the individual services and telegrams and is, therefore, extended with profiles defining additional properties and consideration aspects of the data. The PA profile 3.0 harmonizes various device properties and simplifies the use of different PA devices in the same PROFIBUS system. An essential feature of the PA profile 3.0 is the way to look at a field device in the form of defined function blocks. In this profile, series TF12/TF212 transmitters consist of a Physical Block (PB), a Transducer Block (TB), and several Analog Input Blocks (AI Blocks). To be able to access the parameters or objects of a block, a DPV1 communication must be established with the device.

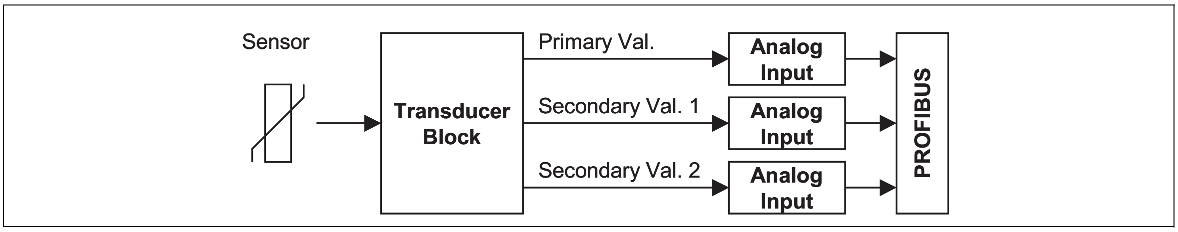


Fig. 4-1 Block model of the PROFIBUS PA profile, overview

4.3.2 Transducer block

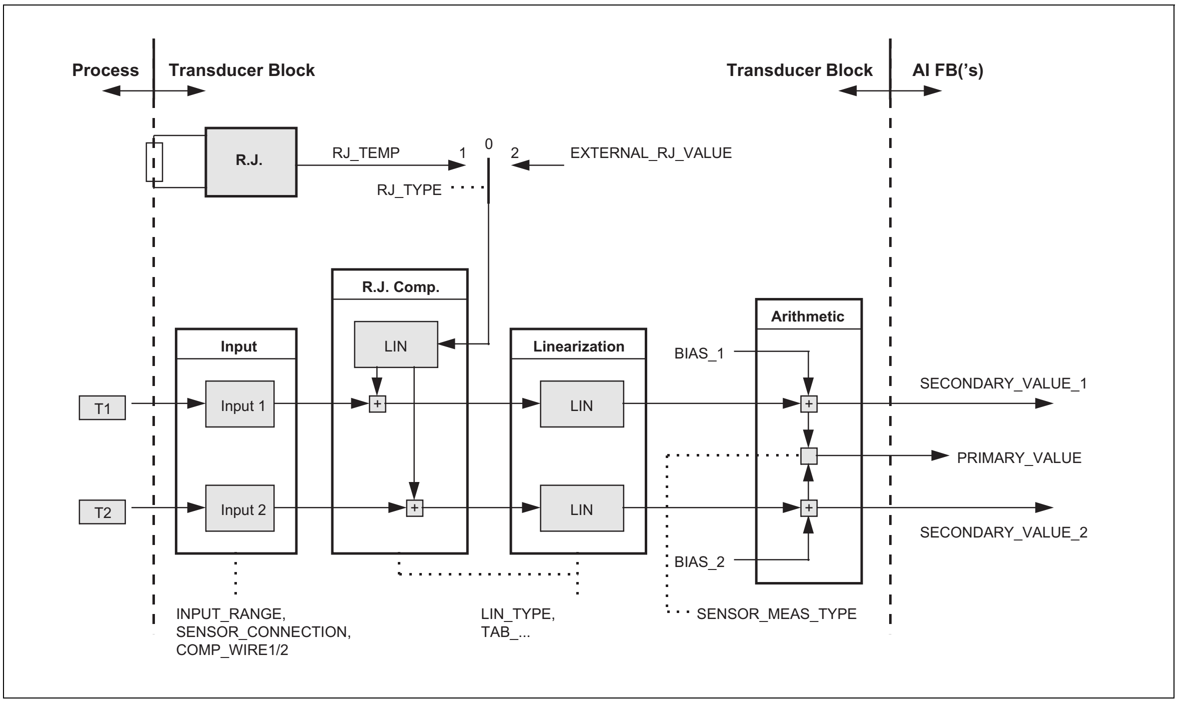


Fig. 4-2 Transducer block

In the transducer block, the raw data coming from the sensors are pre-processed, i.e. linearized, subject to a plausibility check and provided with correction values. Series TF12/TF212 transmitters have a transducer block.

IMPORTANT
The output data of the transducer block (primary value, secondary values 1 and 2) can only be viewed via the subsequent analog input blocks.

4.3.3 Analog input block (AI block)

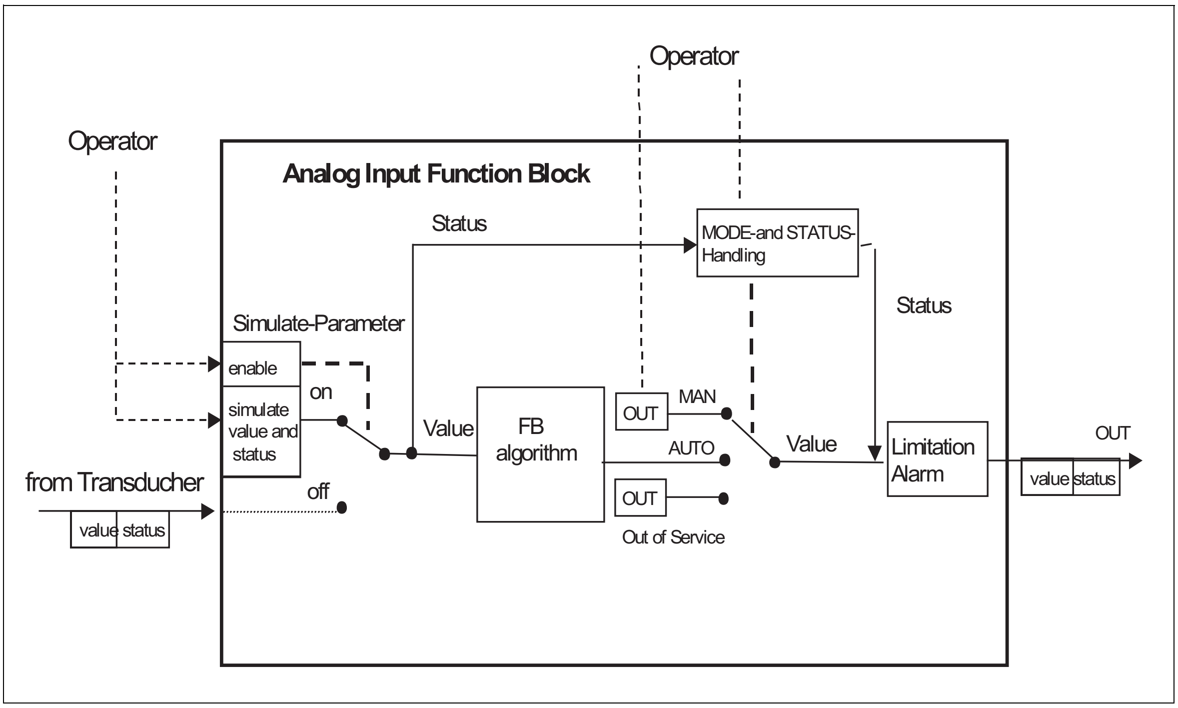


Fig. 4-3 Analog input block (AI block)

The analog input block cyclically makes the calculation results from the transducer block available on the PROFIBUS. The tasks of the AI block are basically the generation of alarms when parameterizable limit values are exceeded or fallen below and the - optional - post-scaling of measured values, e.g. to a percentage of the defined measuring range. Series TF12/TF212 transmitters have 1 to 3 AI blocks. The number of AI blocks is defined by the configuration (see the next section in this manual).

4.4 Configuration

IMPORTANT

Definition

In the context of PROFIBUS DP the configuration is the arrangement of the individual I/O modules (configurations) of a modular slave and, thus, the changes affecting the structure of the I/O datagrams.

Configuration changes usually imply that cyclic data exchange on the PROFIBUS is stopped and normally require a new I/O assignment in the PROFIBUS master.

The following table describes possible configurations for series TF12/TF212 transmitters.

Configuration	Description
Calculated Temperature	The transmitter delivers only one input value. The source and the characteristic of this input value are defined by the parameters of the transducer block.
Temperature 1	The transmitter delivers only one input value. This value comes from sensor input 1 (terminals 1...4). Its characteristic is defined by the parameters of the transducer block.
Temperature 2	The transmitter delivers only one input value. This value comes from sensor input 2 (terminals 4...6). Its characteristic is defined by the parameters of the transducer block.
Calculated Temp. & Temperature 1	The transmitter delivers 2 input values: 1) Calculated value (see above) 2) Value of channel 1 (see above)
Temperature 1 & Temperature 2	The transmitter delivers 2 input values: 1) Value of channel 1 (see above) 2) Value of channel 2 (see above)
Calculated Temp. & Temperature 2	The transmitter delivers 2 inputs values: 1) Calculated value (see above) 2) Value of channel 2 (see above)
Calculated Temp. & Temp. 1&2	The transmitter delivers 3 input values: 1) Calculated value (see above) 2) Value of channel 1 (see above) 3) Value of channel 2 (see above)
Calc. Temp. & Difference-Temp. 2-1	The transmitter delivers 2 input values: 1) Calculated value (see above) 2) Difference channel 2 - channel 1

The configuration is defined when creating the slave in the PROFIBUS master. In case of a GSD-based project configuration the corresponding modules are selected (see Commissioning).

4.5 Parameterization

IMPORTANT

Definition

In the context of PROFIBUS DP parameterization means the definition of properties of already configured modules.

Since parameter changes have no effect on the I/O data structure, they do not necessarily require a re-compilation in the master. Series TF12/TF212 transmitters can be parameterized in online-mode, i.e. parameterization in parallel with cyclic data exchange is possible.

CAUTION

Parameterization changes affect the characteristic of measured value processing. As a result, the measured values may leap.

For a detailed description of all data and parameters accessible through acyclic data exchange via DPV1 please refer to the TF12/TF212 profile definition for PROFIBUS PA (see chapter “Affiliated reference documents” on page 4).

4.5.1 Transducer block

The following table provides a short description of the frequently used parameters. A description of all parameters is available in the TF12/TF212 profile definition for PROFIBUS PA (see chapter “Affiliated reference documents” on page 4“).

Parameter	Description
Sensor type	Selection of different sensors or linearizations. The setting is independent of sensor input 1 and 2.
Base resistance1)	For resistance thermometers the base resistance in Ω is specified for an ambient temperature of 0 °C, e.g. 100.0 Ω for a Pt 100 resistance thermometer.
Type of connection1)	The type of connection (2-wire, 3-wire or 4-wire) is specified for resistance thermometers or resistors. When selecting "4-wire" channel 2 cannot be used.
Reference temperature source2)	The type of reference junction is indicated for thermocouples (except type B). When selecting "internal" the transmitter measures the terminal temperature and uses this value as a reference. When selecting "external", the reference is already predefined (see reference temperature).
Reference temperature 2) 5)	When using an external reference junction the value in °C is specified here.
Description3)	Designation of the user-defined characteristic. Up to 4 characteristics can be stored in the transmitter.
Offset (Ch. 1) / Offset (Ch. 2)	An offset can optionally be added to (or - in case of a negative value - subtracted from) the calculated value after linearization.
Primary Value 1	Selection of a characteristic or calculation of the primary value. The primary value can be set to different values, similar to a multiplexer (difference SV1 - SV2). SV1 and SV2 are the secondary variables 1 and 2, i.e. the values from sensor inputs 1 and 2.
TB unit 4)	For resistance thermometers and thermocouples a unit can be defined for all processing.

1) For resistance thermometers only
2) For thermocouples only
3) With user-defined characteristics only
4) For thermocouples or resistance thermometers only
5) With external reference junction only

4.5.2 Analog input block (AI block)

The following table provides a short description of the frequently used parameters. A description of all parameters is available in the TF12/TF212 profile definition for PROFIBUS PA (see chapter “Affiliated reference documents” on page 4).

Parameter	Description
LO_LO_LIM	If the measured value falls below this value, the transmitter reports an alarm and indicates a limit value violation in the measured value status.
LO_LIM	If the measured value falls below this value, the transmitter reports an alarm (warning) and indicates a limit value violation in the measured value status.
HI_LIM	If the measured value exceeds this value, the transmitter reports an alarm and indicates a limit value violation in the measured value status.
HI_HI_LIM	If the measured value exceeds this value, the transmitter reports an alarm (warning) and indicates a limit value violation in the measured value status.
Hysteresis	Has an effect on all alarm limits
Damping	Filter time constant of a filter with PT1 characteristic. Indicated in seconds.
Simulation	Online available in online-mode.

The following illustration shows the effect of the alarm limits:

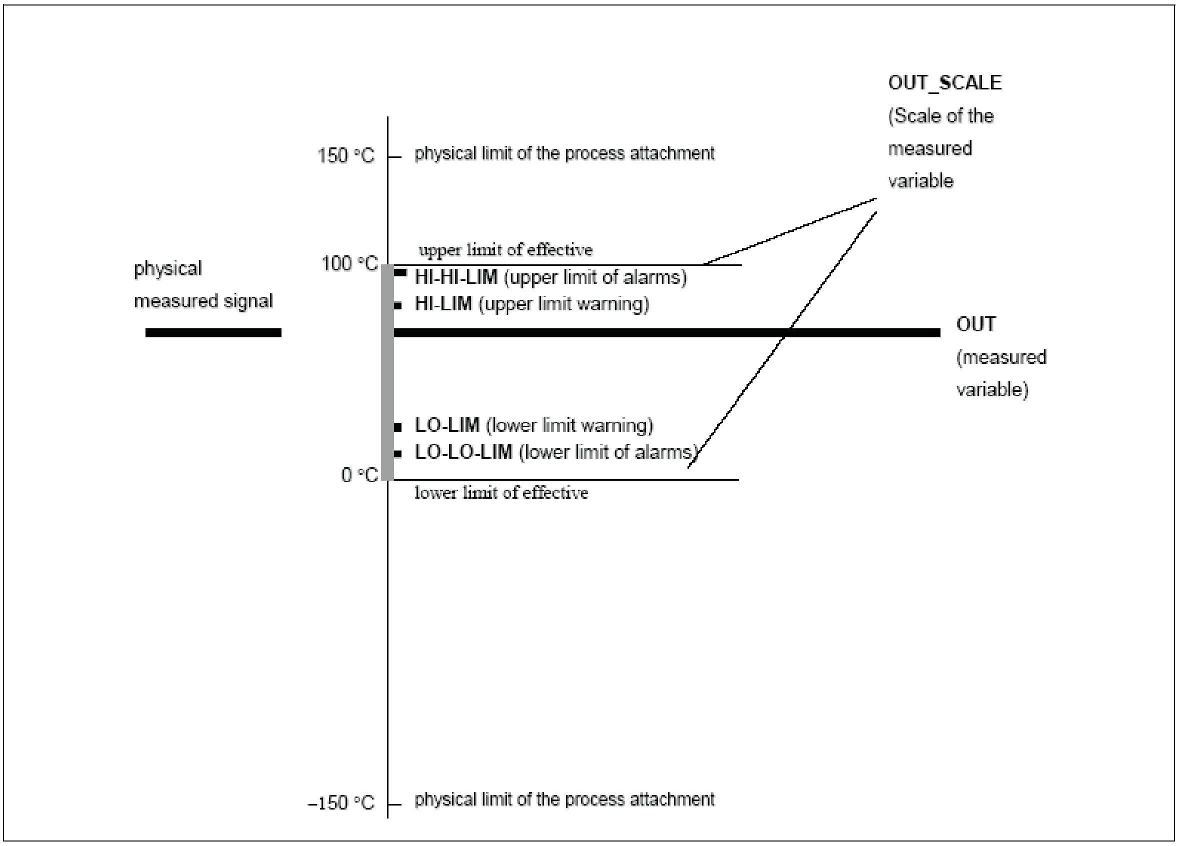


Fig. 4-4 Effect of alarm limits

4.6 Cyclic data exchange

4.6.1 Data format

All cyclic input data have the typical PROFIBUS format with 4 bytes FloatingPoint (Real) + 1 byte status information. In the PROFIBUS world this data type is called DS_33. Cyclic transmission of the measured value status, however, does not substitute an event-based diagnosis. The measured value status is mainly used for marking the measured value itself as good, uncertain or bad. All modern systems with available function block or channel function block support measured value reading as Real value. The evaluation of the measured value status is system-specific. For this reason only the fundamentals of status byte processing and coding are described here. The measured value status is made up of the 6-bit status and the 2-bit limit value status (limits).

4.6.2 Measured value status (bit-coded)

Structure

Bit	7	6	5	4	3	2	1	0
Meaning	Quality		Quality Substatus				Limits	

Quality

Bits 1...0	**Description**
00	bad: Measured value cannot be used.
01	uncertain: Measured value is out of parameterized limits. Sensor is working out of the specified range.
10	good, Non-Cascade: Measured value can be used.
11	good, Cascade: Measured value can be used.

Quality Substatus

The evaluation of the substatus depends on the status of the *Quality* bit. The following table describes only the values delivered by series TF12/TF212 transmitters.

Bits 5...2	Designation	Description
Quality = bad		
0111	out of service	AI block is not operating cyclically.
Quality = uncertain		
0000	non-specific	
0001	last usable value	No measured value available, e.g. due to sensor break.
0101	engineering unit violation	The measured value is out of the parameterized measuring range (see limits).
Quality = good (Non-Cascade)		
0000		Measured value can be used without any limitations.
0010	active advisory alarm	Measured value has exceeded or fallen below HI_LIM / LOW_LIM (see limits).
0011	active critical alarm	Measured value has exceeded or fallen below HI_HI_LIM / LO_LO_LIM (see limits).

Limits

Bits 1...0	Description
00	OK, measured value is within parameterized limits.
01	Measured value has fallen below the low range limit (LO_LO_LIM).
10	Measured value has exceeded the high range limit (HI_HI_LIM).
11	Measured value has a constant value (constant output).

4.6.3 Measured value status (as byte)

Status	Description / typical situation
0x80	OK, measured value is within parameterized limits.
0x44	Sensor break of resistance thermometer (e.g. Pt 100).
0x54	Short circuit of resistance thermometer (e.g. Pt 100).
0x55	Measured value has fallen below the sensor's physical measuring range.
0x56	Measured value has exceeded the sensor's physical measuring range.
0x89	LO_LO_LIM < measured value < Lo_LIM
0x8A	HI_LIM < measured value < HI_HI_LIM
0x8D	Measured value < LO_LO_LIM
0x8E	Measured value > HI_HI_LIM

4.7 Diagnosis

4.7.1 Principle

When the slave is in the DataExchange state, it acknowledges the output datagrams from the master with input datagrams. In the header of this datagram the slave can inform the master that a diagnosis is available. The TF12/TF212 communicates to the master messages about incoming or outgoing errors. The master then fetches the information from the diagnosis buffer with the next datagram. The TF12/TF212 ensures that a new buffer (with modified data) is transferred to the PROFIBUS only when the master has read the "old" buffer. Between two diagnosis telegrams (or notifications) there is a pause of 25 ms. With this the TF12/TF212 avoids that the PROFIBUS is overloaded with diagnosis telegrams due to quickly incoming and outgoing diagnoses (example: wire break in case of loose connection).

4.7.2 Structure

The structure of the diagnosis telegram is in accordance with the PROFIBUS DP standard.

1...6	7...12
DP standard	Device-specific diagnosis

4.7.3 DP standard diagnosis (octets 1...6)

Octet 1: Station_status_1

The following is an excerpt from EN 50170, Part 2

Bit 7 **Diag.Master_Lock**
The DP-Slave has been parameterized from another master. This bit is set by the DP-Master (class 1), if the address in octet 4 is different from 255 and different from the own address. The DP-Slave sets this bit to zero.

Bit 6 **Diag.Prm_Fault**
This bit is set by the DP-Slave if the last parameter frame was faulty, e. g. wrong length, wrong Ident_Number, invalid parameters.

Bit 5 **Diag.Invalid_Slave_Response**
This bit is set by the DP-Master as soon as receiving a not plausible response from an addressed DP-Slave. The DP-Slave sets this bit to zero.

Bit 4 **Diag.Not_Supported**
This bit is set by the DP-Slave as soon as a function was requested which is not supported from this DP-Slave.

Bit 3 **Diag.Ext_Diag**
This bit is set by the DP-Slave. It indicates that a diagnostic entry exists in the slave specific diagnostic area (Ext_Diag_Data) if the bit is set to one. If the bit is set to zero a status message can exist in the slave specific diagnostic area (Ext_Diag_Data). The meaning of this status message depends on the application and will not be fixed in this specification.

Bit 2 **Diag.Cfg_Fault**
This bit is set by the DP-Slave as soon as the last received configuration data from the DP-master are different from these which the DP-Slave has determined.

Bit 1 **Diag.Station_Not_Ready**
This bit is set by the DP-Slave if the DP-Slave is not yet ready for data transfer.

Bit 0 **Diag.Station_Non_Existent**
This bit is set by the DP-Master if the respective DP-Slave can not be reached over the line. If this bit is set the diagnostic bits contains the state of the last diagnostic message or the initial value. The DP-Slave sets this bit to zero.

Octet 2: Station_status_2

The individual bits have the following meaning:

Bit 7 **Diag.Deactivated**
This bit is set by the DP-Master as soon as the DP-Slave has been marked inactive within the DP-Slave parameter set and has been removed from cyclic processing. The DP-Slave sets this bit always to zero.

Bit 6 reserved

Bit 5 **Diag.Sync_Mode**
This bit is set by the DP-Slave as soon as the respective DP-Slave has received the Sync control command.

Bit 4 **Diag.Freeze_Mode**
This bit is set by the DP-Slave as soon as the respective DP-Slave has received the Freeze control command.

Bit 3 **Diag.WD_On (Watchdog on)**
This bit is set by the DP-Slave as soon as his watchdog control has been activated.

Bit 2 **This bit is set to 1 by the DP-Slave.**

Bit 1 **Diag.Stat_Diag (static diagnostics)**
1: Diag.Stat_Diag (static diagnostics) If the DP-Slave sets this bit the DP-Master shall fetch diagnostic information as long as this bit is reset again. For Example, the DP-Slave sets this bit if it is not able to provide valid user data.

Bit 0 **Diag.Prm_Req**
If the DP-Slave sets this bit the respective DP-Slave shall be reparameterized and reconfigured. The bit remains set until parameterization is finished. This bit is set by the DP-Slave.

If bit 1 and bit 0 are set, bit 0 has the higher priority.

Octet 3: Station_status_3
The individual bits have the following meaning:

Bit 7 **Diag.Ext_Diag_Overflow**
If this bit is set there exists more diagnostic information than specified in Ext_Diag_Data. For Example, the DP-Slave sets this bit if there are more channel diagnostics than the DP-Slave can enter in its send buffer; or the DP-Master sets this bit if the DP-Slave sends more diagnostic information than the DP-Master can enter in its diagnostic buffer.

Bit 0 to 6: reserved

Octet 4: Diag.Master_Add
In this octet the address of the DP-Master is entered which has parameterized this DP-Slave. If none of the DP-Masters has parameterized the DP-Slave then the DP-Slave inserts the address 255 in this octet.

Octet 5 to 6 (unsigned16): Ident_Number
The manufacturer identifier is given for a DP-Device. This identifier can be used on the one hand for verification purpose and on the other hand for exact identification.

4.7.4 Device-specific diagnosis

Series TF12 /TF212 transmitters deliver the following device-specific diagnoses.
The message texts are specified in the GSD file. The assignment is bit-wise.

Bits →	7...6	5...0	
Octet 7	**Header**	**Length**	
	00	000110 = 6	
Byte	**Bit**	**Meaning**	**Possible reason**
Octet 8	0	Hardware error	Temperature of internal reference junction is implausible.
	4	Memory error	Checksum error of the ROM, EEPROM
	5	Measuring error	Wire break, short-circuit of the sensor wires
	6	Initialization error	No parameter set available, due to EEPROM error.
Octet 9	2	Configuration error	Different units selected for Sensor 1 and Sensor 2.
	3	Warm start	With Reset command via the bus ('Factory Reset').
	4	Cold start	With Reset command via the bus ('Factory Reset').
	7	Wrong Ident_Number	Different PNO-IDs in DPV1 and DPV0 parameterization.
Octet 10		not used	
Octet 11		not used	
Octet 12	0	AD converter calibration error	Device not calibrated. The input values may be inaccurate.

4.8 Behavior in case of fault

In case of fault the measured value status is set in addition to the diagnosis status. In contrast to the diagnosis the measured value status is always available in real-time and consistently and is – therefore – best suited for use in a control loop.

If the transmitter is not capable of determining a correct measuring value, due to an internal or external fault, the last valid measuring value is maintained. A substitute value strategy in the PROFIBUS master or process control system is based on the measured value status or diagnosis information of the system in case of a slave or bus failure. Parameterizing the substitute value strategy in the transmitter itself would not cover all cases (→ e.g. bus failure) and is, therefore, not implemented in the transmitter.

5 Commissioning

5.1 Standard PROFIBUS master (DPV0, GSD file)

This chapter only aims at giving a rough overview, since the procedure considerably depends on the master system used. Please refer to the corresponding manuals for a detailed description.

IMPORTANT
TF12/TF212 transmitters are normally parameterized via acyclic services (DPV1). If the existing PROFIBUS master or its configuration tool does not support DPV1 parameterization, you can use either already pre-parameterized transmitters or a special parameterization tool (e.g. DSV401 (SMART VISION) from ABB).

First of all you have to copy the GSD file to the subdirectory of the configuration tool or programming software where all GSD files reside (usually ...\GSD\...). In order to allow for graphical representation, three bitmap files come with the GSD file.

In some cases the addition of new slaves/GSD files to the database or hardware catalog must be enabled explicitly in the programming software (Read GSD...). The procedure for creating a new system incl. the master is detailed in the corresponding manuals and cannot be described here in a general way.

Usually, new slaves or modules are added to a modular slave by using the ’Drag and drop’ or ’Paste’ function. In the first step the slave must be logically connected to the bus. To achieve this, select the slave from the respective menu. In order to allow for quick navigation to the wanted slave, the multitude of slaves are grouped in families. Series TF12/TF212 transmitters belong to the PA Device family. When the slave is logically connected, a free bus address is assigned to it. Then the desired configuration has to be selected for the new slave (see description earlier in this document).

When the configuration is selected, the master is informed about the transmitter's data throughput. The properties or the behavior of the configured transmitter is defined by parameterizing the device.

IMPORTANT
A pre-parameterized transmitter can be commissioned with any of the available configurations.

When the project has been released and loaded, the transmitter is capable of communicating with the master and can be commissioned. The application program in the master can access the individual I/O data. The data are processed in the master application. This is entered graphically by using a function block diagram.

CAUTION
When the transmitter is parameterized with a separate tool in parallel with the cyclic master (e.g. PDM), the cyclic input data may abruptly change without a diagnosis being reported to the process control system. When using a separate parameterization tool, the user must ensure data consistency between the individual masters.

5.2 FDT process control system (DPV1, DTM)

IMPORTANT
When configuring and commissioning the transmitter with an FDT compatible process control system, data consistency is automatically ensured, since all parameter changes or a parameter download are always initiated by the configuration program of the process control system.

5.2.1 AC800F (Freelance)

Parameter verification (database - device)
When commissioning a pre-parameterized or calibrated device note that the parameter settings saved in the CBF project are verified when the 'Upload' or 'Load from Device' function is selected. Parameterizing the database in offline mode is also possible. In this case the transmitter can be fully parameterized in the commissioning phase by selecting the 'Download' or 'Save to Device' option.

IMPORTANT
Both procedures described above (upload / download) copy all parameters from the source to the target, i.e. all parameter settings already residing in the target area will be overwritten.

5.2.2 DPV1 communication

In order to allow for acyclic communication with the transmitter, the DPV1_Timeout parameter in the PROFIBUS master must be set to a value of at least 3000 (3000 x 10 ms = 30 s). You can find the parameter on the 'Info' parameter tag of the PROFIBUS master module.

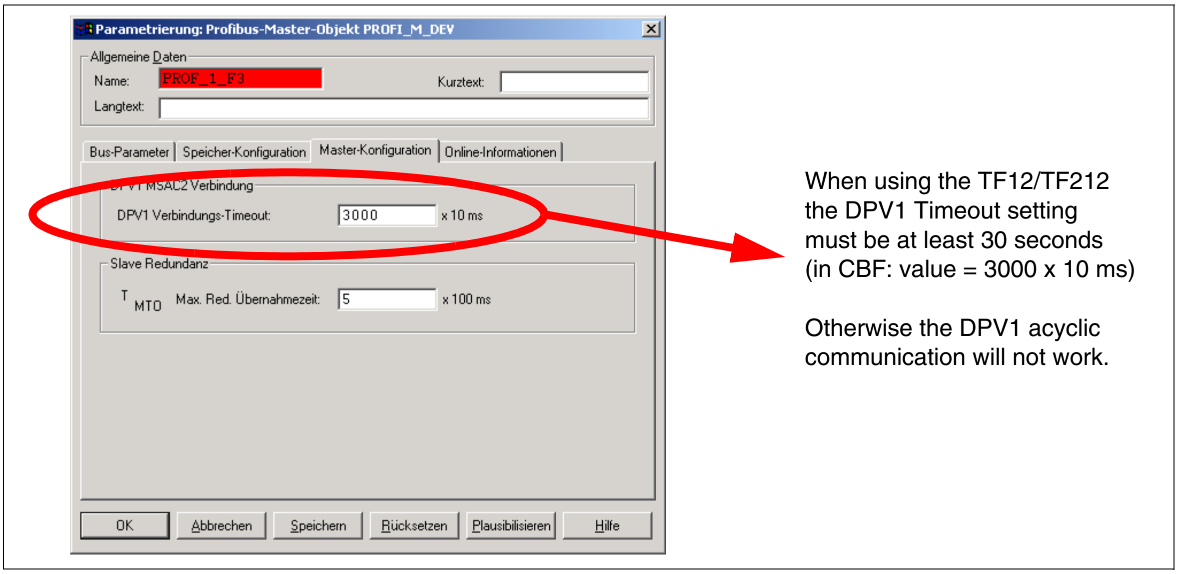


Fig. 5-1

5.2.3 Setting the slave address

Changes to the PROFIBUS address are based on the SetSlaveAddress principle. When commissioning the transmitter, first determine the existing slave address of the transmitter and then set a new address via the CBF.

(1) Searching for a station

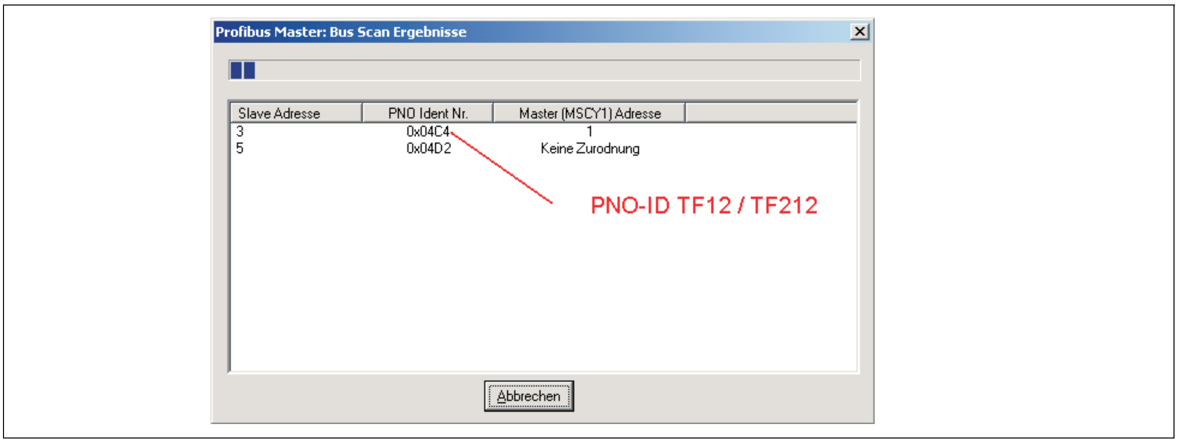


Fig. 5-2

The stations are identified by their PNO IDs. Series TF12/TF212 transmitters have the PNO ID No. 0x04C4.

(2) Setting / Changing the device address (in the transmitter)

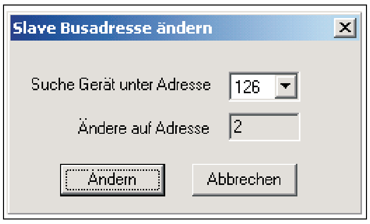


Fig. 5-3

IMPORTANT
The target address of the setting (bottom field) always corresponds to the configured value of the node. Address settings always have an impact on the device address. The configured node address can be changed in the offline phase (see description below).

In the top field you can set the address of the transmitter on the bus. The new address setting is activated by selecting the 'Change' option.

(3) Setting / Changing the node address (in a project)

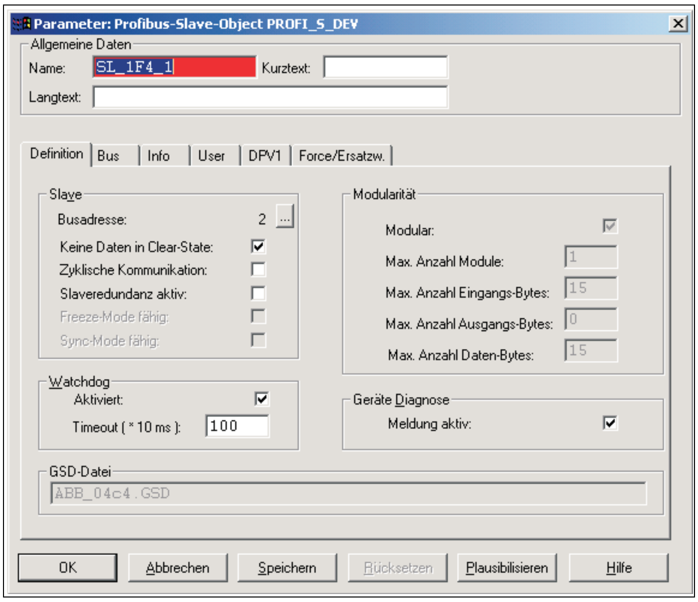


Fig. 5-4

The 'Bus address' parameter can be used to change the node address in such a way that it corresponds to the found or pre-parameterized transmitter. After this change the project must be subject to a plausibility check and then transmitted to the controller.

IMPORTANT
Preferably adapt the device address (2) rather than the node address (3).

Prerequisites:
– No data exchange must be in progress between the transmitter of which the address is to be changed and the own or another master.
– A communication link with the device must already exist or it must be possible to establish this communication.

Changing the address of a device already in use in the project
To be able to change the address of such a device first terminate cyclic data exchange between the master and the transmitter. This is possible in CBF (online mode) in the parameter mask by unselecting the 'Cyclic communication' option (then select 'Correct').

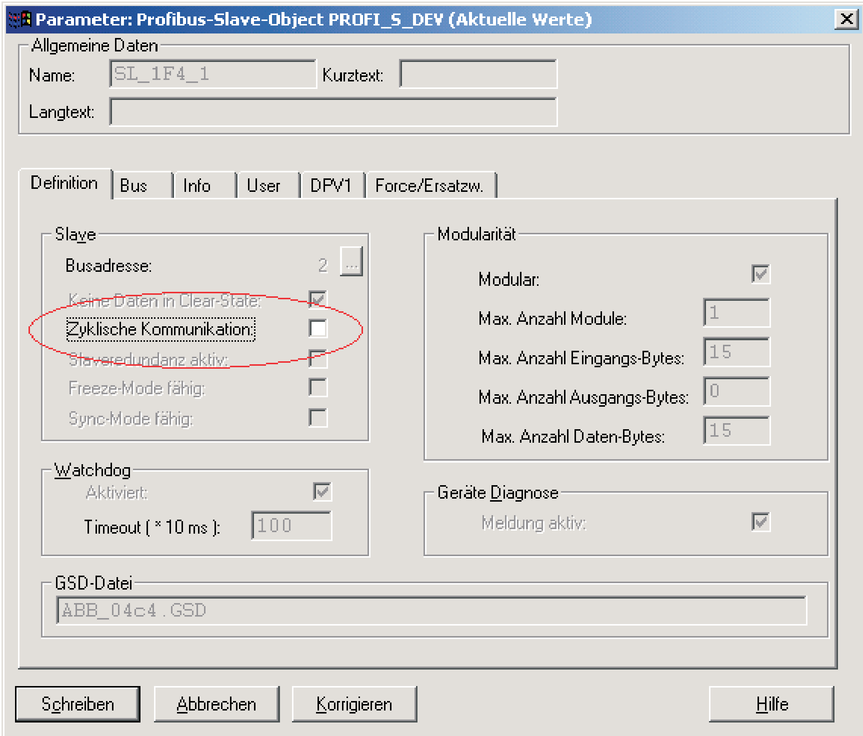


Fig. 5-5

The transmitter is then ready for assigning a new address.

5.2.4 AC800M

All description files needed to operate the series TF12/TF212 transmitters are provided in the Device Integration Package PROFIBUS available for the System 800xA. All drivers and files included in this package have been cross-checked with each other. For details please refer to the ABB Device Integration Center or e-mail to dic@de.abb.com.

CAUTION
When using Hardware Definition Files (HWD) that have not been distributed with the Device Integration Package for configuring the transmitter in the Control Builder M, note that ABB does not accept any liabilities for possible malfunctions that may arise from invalid or corrupted HWD files.

The TF12 input data are available as REAL (analog value) and DWORD (measured value status). The measured value status (one byte) occupies the LowByte or bits 0...7 of the respective DWORD variable.

5.2.5 Symphony / Melody

Initializing the Watchdog and the Min_TSRD parameter

Once the TF12/TF212 transmitter has been added to the project (in the planning phase) and the bus (FB0/FB1) and slave address have been assigned, the slave watchdog and the Min_TSDR parameter have to be initialized by using the 'View DP configuration' command. Make the settings as seen in the example below:

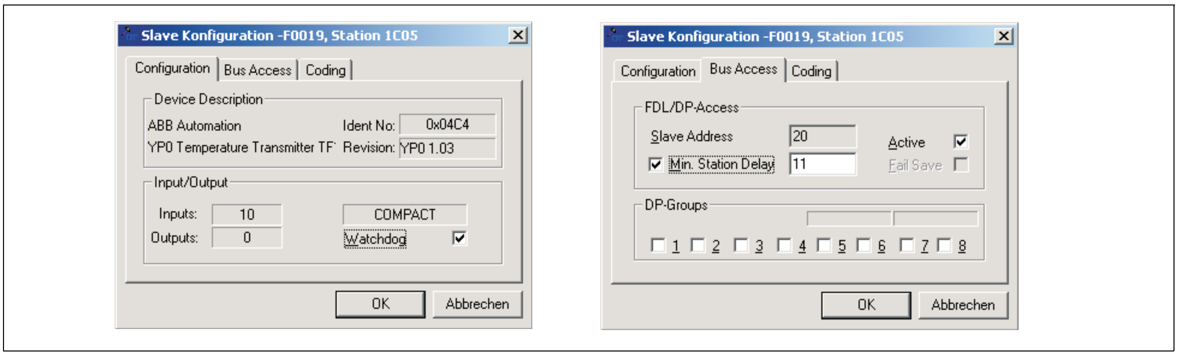


Fig. 5-6

Configuration and channel assignment

To be able to make the channel assignment, first select the transmitter configuration. With this the DTM provides all channels or signals in accordance with the configuration, if the parameterization is to be performed in offline mode.

If no pre-parameterized transmitters are used, preferably make all parameter settings in the transmitter in the planning phase. With that you select the Composer database as the leading instance for the parameter data.

If you intend to use pre-parameterized transmitters, we recommend to file no parameters in the DTM, as the parameter settings will be uploaded from the transmitter at a later time using the 'Parameter verification" function (see next section).

CAUTION

Once you have exited the DTM, check again that the bus parameter settings (Watchdog, Min_TSDR) are as described in the previous section.

Parameter verification (database - device)

The device parameters must be consistent with the Composer database in any case. If necessary, this must be forced. For pre-parameterized transmitters this is achieved by uploading all transmitter parameter settings in the database. If the database has been the leading instance in the planning phase, however, all parameters settings must be downloaded from the database into the transmitter. In all cases the Composer will recognize upon selection of the 'Enable and commission' function that the planning phase data set in the new bus node is different from the operating data set. The 'Load configuration' window is activated for all new or modified nodes. In case of an offline-parameterization (database → transmitter) please accept the suggested changes and start loading.

CAUTION

For pre-parameterized or calibrated transmitters it is absolutely necessary to unselect the respective checkbox (see illustration below). Otherwise, the parameter settings in the device will be overwritten during the data download.

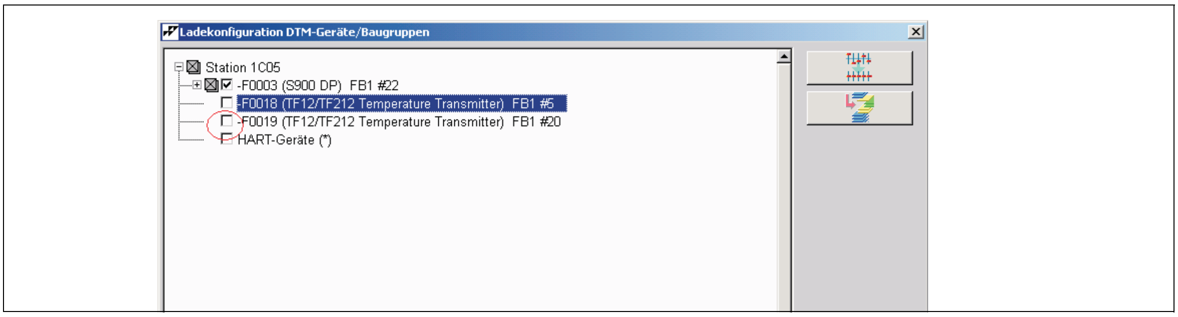


Fig. 5-7

When all other data have been loaded, a parameter verification must be performed in the operating phase. During this verification all device parameters are uploaded from the transmitter and the planning, release or operating phase is copied:

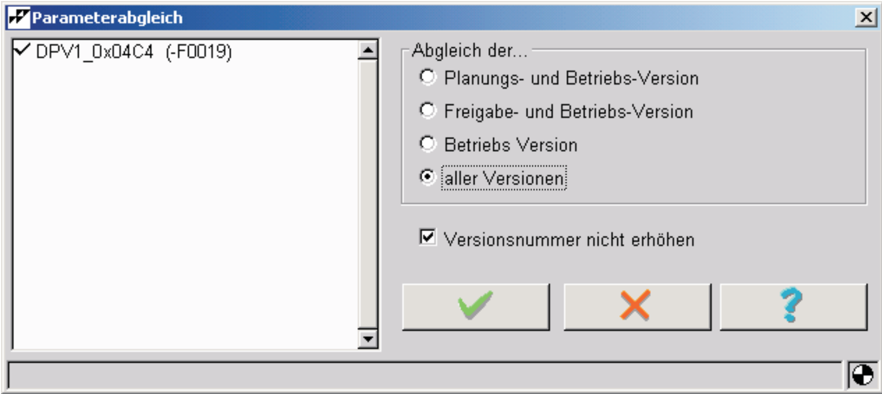


Fig. 5-8

A successfully executed parameter verification is indicated by the following message:

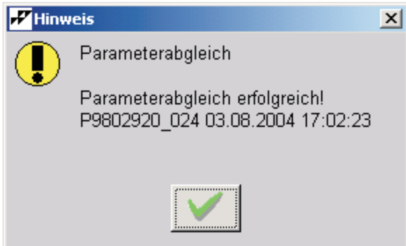


Fig. 5-9

Consequences of inconsistent parameter settings

If the device data have never been loaded, error messages will be output in the operating phase when the DTM is accessed:

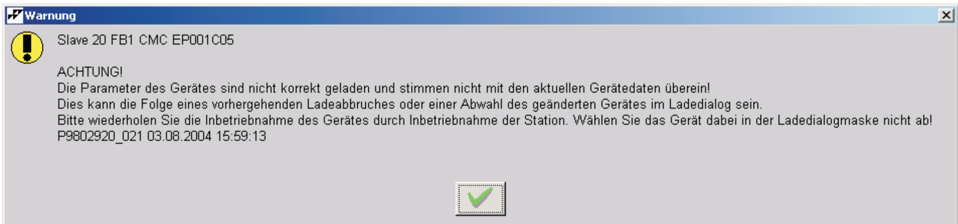


Fig. 5-10

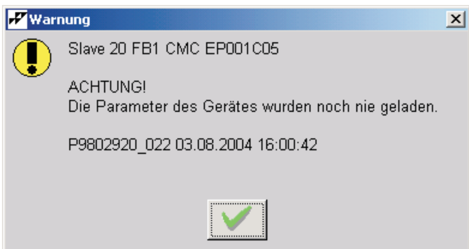


Fig. 5-11 Warning

In this case immediately perform a parameter verification.

6 Technical data

Output

Digital output signal
PROFIBUS PA profile V3.0, types A and B

Transmission rate
31.25 kbit/s

Nominal current consumption
11.8 mA

Max. current in case of device error
15 mA

Damping (programmable)
t_{63} = 0...60 s

Input

Resistance (temperature linear)

Resistance thermometer
Pt 50...Pt 100...Pt 1000

Resistance
0...400 Ω/0...4000 Ω

Maximum line resistance (R_W) per wire
< 5 Ω

Measuring current
200 µA

Sensor short-circuit
< 5 Ω (for RTD)

Sensor break
> 5 MΩ

Thermocouples

Types
B, C, D, E, J, K, L, N, R, S, T, U

Voltages
-15 mV...+ 115 mV

Sensor monitoring current
200 µA

Input resistance
5 MΩ

Input filter
50/60 Hz

Internal reference junction
Pt 100, programmable

Power supply (on transmitter terminals)

Supply voltage (protected against polarity reversal)
Non-Ex application U_s = 9...32 V DC
For ex-applications, max. U_i = 9...17.5 V DC

General characteristics

Rise time
< 0.1...1.25 s

Vibration resistance
Vibration in operation 2g to DIN IEC 68T.2-6

Electrical isolation (I/O)
1.5 kV

Environmental capabilities

Ambient temperature range
-40...+85 °C

Transport and storage temperature
-40...+100 °C

Relative humidity
< 100 % (100 % humidity with isolated terminals, only)

Condensation
permitted

Influences

Influence of ambient temperature (related to 25 °C)
Pt 100 ± 20 ppm/K related to 1050 °C
Thermocouple ± 40 ppm/K related to the defined thermocouple measuring range (IEC 584)

Input element		Measuring range	Basis
Standard	Sensor		Measuring error
IEC 584-1	Thermocouple type B Thermocouple type E Thermocouple type J Thermocouple type K Thermocouple type R Thermocouple type S Thermocouple type T Thermocouple type N	400...+1820 °C (+752...+3308 °F) –100...+1000 °C (–148...+1832 °F) –100...+1200 °C (–148...+2192 °F) –180...+1370 °C (–292...+2498 °F) – 50...+1760 °C (– 58...+3200 °F) – 50...+1760 °C (– 58...+3200 °F) –200...+ 400 °C (–328...+ 752 °F) –180...+1300 °C (–292...+2372 °F)	0.8 K 0.2 K 0.2 K 0.2 K 0.8 K 0.8 K 0.2 K 0.2 K
W3. ASTME 998	Thermocouple type C Thermocouple type D	0...+2300 °C (+ 32...+4172 °F) 0...+2300 °C (+ 32...+4172 °F)	0.8 K 0.8 K
DIN 43710	Thermocouple type L Thermocouple type U	–100...+ 900 °C (–148...+1652 °F) –200...+ 600 °C (–328...+1112 °F)	0.2 K 0.2 K
IEC 751[1)]	Resistance thermometer Pt 100 Resistance thermometer Pt 1000 Resistance thermometer Pt 100/PT1000	–200...+ 850 °C (–328...+1562 °F) –200...+ 850 °C (–328...+1562 °F) –100...+ 250 °C (–148...+ 482 °F)	0.4 K 0.4 K 0.2 K
DIN 43760[2)]	Resistance thermometer Ni 100	– 60...+ 250 °C (– 76...+ 482 °F)	0.2 K
Resistance	2-, 3-, 4-wire	0...400 Ω/0...4000 Ω	0.05 Ω/0.4 Ω
Voltage		–15 mV...+115 mV	20 µV

1) a = 0.00385
2) a = 0.00618

Characteristics at rated conditions

acc. to IEC 770 (related to 25 °C)

Measuring error incl. characteristic deviation

Pt 100 (within range -100...+250 °C)		± 0.2 K
Resistance measurement	0...400 Ω	± 0.05 Ω
	0...4000 Ω	± 0.4 Ω
Thermocouple, e.g. type K		± 0.2 K
Voltage measurement	-15...+115 mV	± 20 µV

Additional influence of the internal reference junction

Pt 100 DIN IEC 751 Cl. B

Mechanical construction

TF12

Housing material

polycarbonate

Color

black (non-Ex type)
blue (Ex-type)

Weight

250 g (without accessories)

Terminals

Screw terminals 2.5 mm^2

TF212

Housing material	aluminum / stainless steel
Degree of protection	IP 66 and IP 67
Color (EPOXY)	light gray (RAL 9002)
Weight	1.25 kg (without accessories)

Electrical connections

Thread	M20 x 1.5 1/2“ NPT, 3/4“ NPT, 1/2“ GK

Screw connections (cable ∅ 3.5...8.7 mm) s. ordering information

Intern./extern. grounding screw	6 mm^2 M5 / 2.5 mm^2 M4
Terminals	screw terminals 2.5 mm^2

Explosion protection

TF12-Ex/TF212-Ex

Intrinsically safe (ATEX) — **Ex II 2 (1) G EEx ia IIC T6**

EC type examination certificate	ZELM 99 ATEX 0021
Temperature class T6/T4	< 60 °C/85 °C

Suitable for connection to fieldbus systems in acc. with
– FISCO Model

Supply circuit	Output [ia]	Input [ia]
Max. voltage	U_i = 17.5 V	U_o = 5.9 V
Short-circuit current	I_i = 360 mA	I_o = 17 mA
Max. power	P_i < 2.52 W	P_o < 26 mW
Internal inductance	L_i < 10 µH	negligible
Internal capacitance	C_i = 1nF	negligible

Flameproof enclosure (ATEX) — **Ex II 1/2 G EEx d IIC T6**

EC type examination certificate	PTB 99 ATEX 1144 X

Dust explosion protection

Zone 20: intrinsically safe model	
Marking	Ex II 2 (1) G EEx ia IIC T6 + II 1 D IP65 T 135 °C
EC type examination certificate	ZELM 99 ATEX 0021 and DMT 02 ATEX E248
Zone 20: not intrinsically safe model	
Marking	Ex II 1 D IP65 T 135 °C
EC type examination certificate	DMT 02 ATEX E248

Electromagnetic compatibility (EMC)

Meets the requirements of NAMUR NE 21 recommendation.

With Pt 100 sensor

Type of test	Degree	Standard
Burst to signal/ data lines	1 kV	EN 61000-4-4 EN 50082-2
Static discharge contact discharge to: contact plate supply terminals	 8 kV 6 kV	EN 61000-4-2
Radiated field 80 MHz...1 GHz	10 V/m	EN 61000-4-3
Coupling 150 kHz - 80 MHz	10 V	EN 61000-4-6

Parameterization / structure

Type of inputs (2 independent channels), measuring range, input filter, damping, alarm function, limit values, compensation for aging, saving of all data in the non-volatile memory

Standard parameters (factory setting)

Channel 1

Pt 100, 3-wire circuit
L-L/L/H/H-H-Lim = -200 °C/-200 °C/850 °C/850 °C
Damping 0 s, unit °C

Channel 2

Pt 100, 3-wire circuit
L-L/L/H/H-H-Lim = -200 °C/-200 °C/850 °C/850 °C
Damping 0 s, unit °C

Default address

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Process Control System (PCS)

Cyclic communication can be established with all PROFIBUS compatible process control systems. Acyclic communication requires a Class 2 Master. The communication can be established on the basis of the generic slave (conforming with Profile 3.0; only standard parameters) or a TF12-specific driver.

Drivers are available for the following process control systems:

- Freelance 2000/Control Builder F (DTM or template)
- Symphony (Composer via DTM)
- Siemens (via PDM)

Configuration tools

- DTM for FDT 0.98-1 and 1.2 interface and DSV401 (SMART VISION)

Siemens Simatic PDM driver for TF12/TF212

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