Interface Description

COM/TTX300/PB-EN

Temperature Transmitter TTX300

PROFIBUS PA 3.01

Temperature Transmitter
TTX300

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1 Introduction

This manual describes the communication-specific properties of the TTX300-PA transmitter.

General information on operation, sensor configuration, connection, or explosion protection can be found in the operating instructions and commissioning instructions.

The TTX300 transmitter meets the criteria of PA profile 3.01 incl. Condensed Status (Classic Status optional).

A device driver in the form of an EDD (Electronic Device Description) or DTM (Device Type Manager), as well as a GSD file, are required for commissioning purposes.

The EDD, DTM, and GSD file can be downloaded from www.abb.com.

2 ID number

Each PROFIBUS device has been assigned a unique identification number by the PROFIBUS umbrella organization PI (PROFIBUS International).

For the TTX300 transmitter, this is 0x3470.

Applying this device-specific ID number enables the entire scope of functions offered by the device to be used. The transmitter supports additional, profile-specific ID numbers (in accordance with the PA profile).

It is recommended that profile-specific ID numbers and device drivers are used if it is important for devices to be interchangeable in the sense of the PA profile.

Various ID numbers can be selected using the device driver or HMI:

- Profile
- Device-specific [0x3470]

The profile ID number is determined by the number and type of function blocks in the device. The TTH300 transmitter supports the following profile ID numbers:

0x9700	1 AI	(PV = primary value = value calculated from sensor 1 and sensor 2)
0x9701	2 AI	(PV & SV1 = calculated value and sensor 1)
0x9702	3 AI	(PV & SV1 & SV2 = calculated value and sensor 1 and sensor 2)
0x9703	4 AI	(PV & SV1 & SV2 & SV3 = calculated value and sensor 1 and sensor 2 and electronic unit temperature)

As indicated above, the selection is made in two stages:

1. Profile-specific or device-specific option selected
2. When the profile is selected, the profile ID number is selected as well.

The profile GSD files can be obtained via the Internet (www.profibus.com). The current device-specific GSD file and the device driver (DTM, EDD) can be found at www.abb.com.

The ID number used in the system is communicated to the field device during startup. The field device checks the requested ID number with its own and signals a parameter fault (PrmFault) if these do not match.

If the field device has been incorrectly addressed in this way, it cannot participate in cyclic data exchange.

In this case, either a GSD file that is compatible with the ID number of the field device must be used, or the ID number in the field device must be adjusted appropriately.

Important

The parameter fault (PrmFault) message may also refer to a device address that has been set incorrectly, if the configuration / parameterization data has been assigned the ID number of a different field device. In this case it is necessary to check the ID number and device address.

3 Configuration

In a PROFIBUS context, configuration refers to the process of defining the scope and structure of cyclic input and output data. The configuration settings are made offline in the cyclic master (PROFIBUS master within the control system or PLC) and communicated to the field device once during startup. The configuration settings can only be changed by interrupting cyclic data exchange.

Important

- Output data refers to data or variables that are sent cyclically from the master to the field device (for example, a setpoint sent to an actuator or positioner).
- Input data refers to data / variables that are sent cyclically from the field device to the master (such as temperature measurements).

PA field devices are modular slaves, meaning that the scope and structure of the cyclic input and output data can be selected offline during the configuration phase. The configuration settings determine the number and type of the function blocks that are active in the device. A function block such as an analog input (AI) has input and / or output data that has been defined in accordance with the block type. The more function blocks in the field device are activated by means of configuration, the more input and output data is communicated cyclically with this device.

The PROFIBUS PA profile defines the following function blocks (that are relevant for the TTH300):

Analog input (AI)	For transferring an analog measured value as a 32-bit floating point + status byte from the slave to the master (field device to control system / PLC)
Analog output (AO)	For transferring an analog setpoint as a 32-bit floating point + status byte from the master to the slave (control system / PLC to field device)
Discrete input (DI)	For transferring a discrete (digital) value as a byte + status byte from the slave to the master (field device to control system / PLC)

4 Block overview

4.1 Block structure

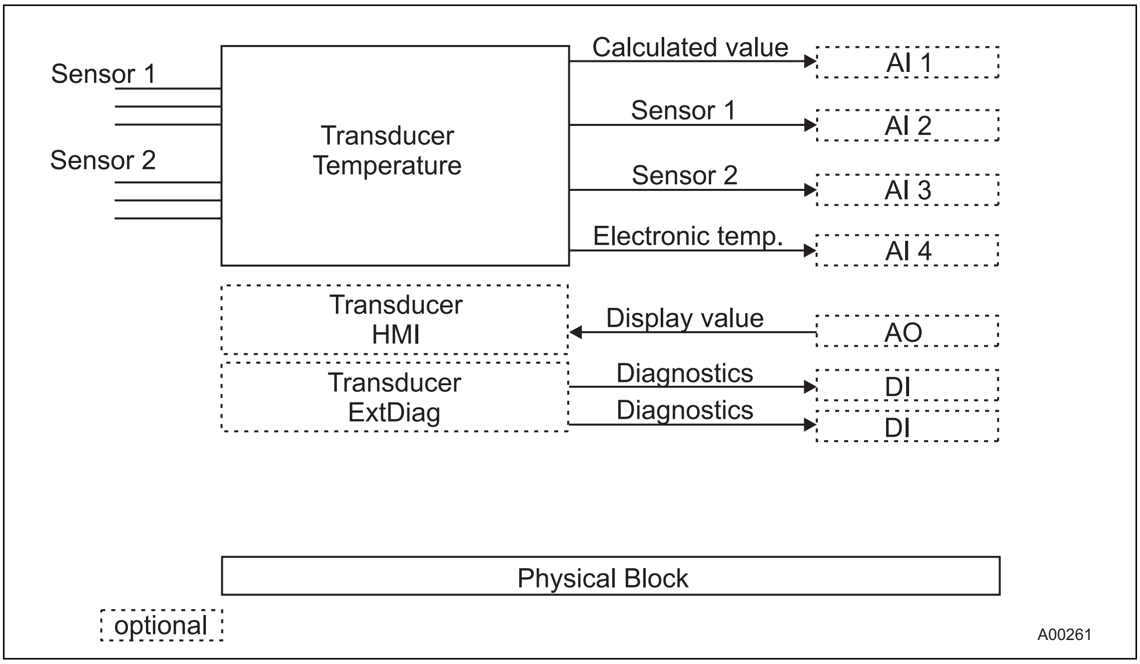

Fig. 1

4.2 Slot assignment

	0x3470 TTH300	0x9700 PA profile 1*AI	0x9701 PA profile 2*AI	0x9702 PA profile 3*AI	0x9703 PA profile 4*AI	Transported value
Physical Block	Slot 0	Slot 0	Slot 0	Slot 0	Slot 0	-
Analog input block 1	Slot 1	Slot 1	Slot 1	Slot 1	Slot 1	PV = Calculated value
Analog input block 2	Slot 2	-	Slot 2	Slot 2	Slot 2	SV 1 = Sensor 1
Analog input block 3	Slot 3	-	-	Slot 3	Slot 3	SV 2 = Sensor 2
Analog input block 4	Slot 4	-	-	-	Slot 4	SV 3 = Electronic unit temp.
Analog output	Slot 5	-	-	-	-	Value to local HMI
Discrete input 1	Slot 6	-	-	-	-	Extended diagnostics 1
Discrete input 2	Slot 7	-	-	-	-	Extended diagnostics 2
Transducer – temperature	Slot 8	Slot 8	Slot 8	Slot 8	Slot 8	-
Transducer – HMI	Slot 9	-	-	-	-	-
Transducer – extended diagnostics	Slot 10	-	-	-	-	-

4.3 Physical Block

The "Physical Block" contains general data about the field device, such as the manufacturer, device type, version number, and so on. The following key "Physical Block" parameters are displayed under the heading "Identification" in the device driver (EDD / DTM):

Parameter	Description
Software Version	Field device firmware version
Hardware Version	Field device hardware version
Vendor	Field device manufacturer
Device Type	Type or name of the field device
Serial Number	Field device serial number
Certifications	Certificates (e.g., explosion protection)
Descriptor	Text that can be entered by the user and which is saved in the field device's non-volatile memory
Message	Text that can be entered by the user and which is saved in the field device's non-volatile memory
Install Date	Date on which the device was installed in the system, or date of first commissioning. Can be entered by the user; saved in the field device's non-volatile memory.
ID number	ID number selection (between device / manufacturer-specific and profile)
Assembly Date	Field device assembly date
Static Revision Counter	Revision counter for the parameter set of each block

4.4 Analog input

The "analog input block" meets the criteria of PA profile 3.01 (incl. "Condensed" Status). An AI block performs various tasks, such as rescaling, alarm handling, simulation, and so on.

To make it easier to configure the transmitter, the channel parameter (CHANNEL) is already preset to the relevant channel for the "Transducer Temperature" block:

AI 1: PRIMARY_VALUE_1 = Value calculated from sensor 1 and sensor 2 (differential, average, etc.)

AI 2: PRIMARY_VALUE_2 = Measured value for sensor 1

AI 3: PRIMARY_VALUE_3 = Measured value for sensor 2

AI 4: SECONDARY_VALUE = Temperature of the reference junction or device temperature with internal reference junction

4.5 Discrete input

The "discrete input block" meets the criteria of PA profile 3.01 (incl. "Condensed" Status) and is used by the TTX300 for cyclic reading out of extended diagnostics information. Both DI blocks are used in conjunction with the "Transducer ExtDiag" block.

See the section titled "Transducer - extended diagnostics".

4.6 Analog output

The "analog output block" meets the criteria of PA profile 3.01 (incl. "Condensed" Status) and can be used as an option for outputting any cyclic analog value from the network. The value may come from a different field device or even from the host (i.e., from the control system). The TTX300 can be used as a display device for this purpose.

4.7 Transducer – temperature

The "transducer block" contains all the parameters and functions required for measuring and calculating temperature. The values that are measured and calculated are available as "transducer block output values", and are called by the function blocks as "channels".

It is only possible to read out measured values cyclically from function blocks.

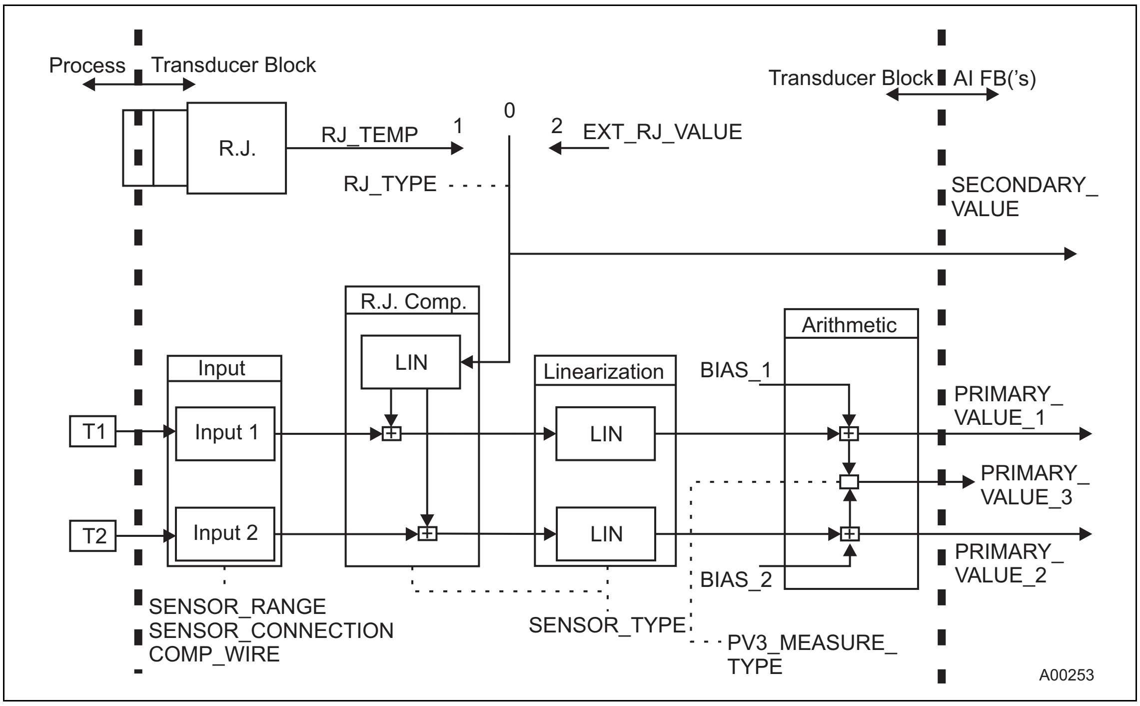

Fig. 2

Parameter	Description
Measurement Mode	PV measurement mode. Selection depends on selections for sensor types 1 / 2: PV1 (sensor 1) PV2 (sensor 2) PV1 (sensor 1) - PV2 (sensor 2) difference PV2 (sensor 2) - PV1 (sensor 1) difference Mean Redundancy
Type Sensor 1 / 2	Sensor type setting for sensor 1 / 2. All sensors specified in the datasheet or manual are supported.
Range Sensor 1 / 2	Physical measurement range of sensor 1 / 2, depending on sensor type selected
Bias (Offset) Sensor 1 / 2	For sensor 1 / 2, an offset (also negative) can be added to the measured value.
Connection Sensor 1 / 2	Type of sensor connection (two-wire, three-wire, or four-wire circuit). Only used for resistance sensors.
Cold Junction Compensation 1 / 2	Reference junction type: No reference (not used) – No compensation Internal – Internal (measured in transmitter) External – Externally stabilized via thermostat Sensor 1 – Measured via resistance thermometer at channel 1 (can only be set at channel 2)
Temperature fixed CJ 1 / 2	If an externally stabilized reference junction is being used, its temperature is entered here in °C.
Line Resistance 1 / 2	Line resistance for sensor 1 / 2 if an RTD or linear resistor has been selected as a sensor and a two-wire circuit connection has been selected

Parameter	Description
CvD Data Set 1 / 2	Callendar-Van Dusen dataset 1 / 2. Coefficients R0, A, B, C.
Fixpoint 1 / 2	User-specific characteristic with 32 pairs of reference points each (X1..32, Y1..32), strictly monotonically increasing or decreasing
Drift Limit	Detection level for drift monitoring between sensor 1 / 2
Drift Time	Detection time for drift monitoring between sensor 1 / 2
Drift Detection active	Switch sensor drift monitoring on / off
Noise Filter	The transmitter has a characteristic representing noise / interference suppression for the sensor measuring signals. This characteristic can be changed during runtime. The "slow" setting improves the quality of the measurement for noisy measuring signals. The "fast" setting reduces the response time of the transmitter, but requires higher-quality measuring signals. The quality of the measuring signals can be improved by using shielded measuring lines that are as short as possible.

4.8 Transducer – HMI

The "Transducer HMI" block contains all the parameters and functions that are required for configuring the local LCD display. As an option, the display value can be specified using an AO block, via the fieldbus network.

Parameter	Description
Language	Language used for HMI (LCD display). Language of device driver in host system / configuration tool is not influenced by this setting.
Contrast	Contrast adjustment
Local Operation	Option of blocking local operation
View 1	Selects signal to show in 1-line view
View 2 line 2	Selects signal to show at line 1 in 2-line view
View 2 line 2	Selects signal to show at line 2 in 2-line view
Autoscroll	Activates or deactivates automatic changeover between view 1 (1-line) and 2 (2-line)

4.9 Transducer – extended diagnostics

PA devices supply diagnostic information via their "Physical Block". This information can be read out by the device driver (EDD, DTM). Normally, it is not possible to access this data in the host from its application, meaning that there is also no way of responding to individual diagnostics events in an application-controlled manner. For example, a particular function could be started in the control system if a display indicating that maintenance is required appears as a result of redundancy switching in the sensor. The transmitter offers two DI (discrete input) blocks for this purpose.

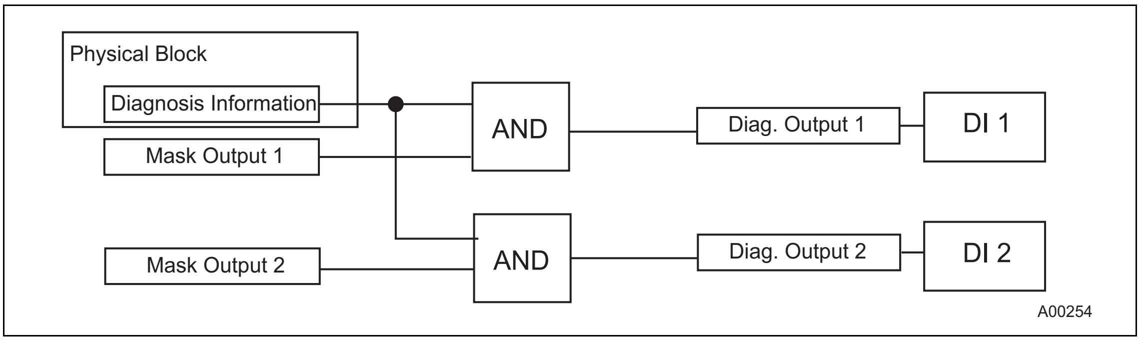

Fig. 3:

The behavior of the binary signals can be parameterized in the transducer's extended diagnostics using parameters "Mask Output 1" and "Mask Output 2". ANDing is performed bit by bit. The result is TRUE (not equal to 0) if at least one bit operation produces 1 logically; otherwise, it is FALSE (equal to 0). The result is sent on to the connected DI block. Both masks can be set independently of one another. The operation with the second mask provides the value for DI block 2.

Activating the check box sets a 1 in the mask. The behavior of the transducer block and the connected DI blocks can be checked by simulating diagnostics (an online connection must be available).

Parameter	Description
Output 1 / 2	Displays output channel 1 / 2 (communicated via DI 1 / 2)
Mask Output 1 / 2	Masking of diagnostic conditions that will lead to a logic 1 signal at the block's output. The output is 1 (true) if at least one of the masked conditions is true. The setting does not influence diagnostics processing itself.

5 Diagnostics

A PROFIBUS PA device supplies three different types of diagnostics information:

- Event-controlled, to the cyclic master via "DDLM_SLAVE_DIAG Service"
- Via diagnostics data query from the physical block
- As a measured value status

5.1 DDLM_SLAVE_DIAG

During cyclic communication, the master regularly requests input data from the slave via "Request Data Exchange". The slave's response contains a bit (diagnostic flag) which states whether new diagnostics information is available in the slave.

If something changes in Diagnosis or Diagnosis Extension in the slave (one or more bits set / deleted), then the slave sets the "Diagnostic Flag" to "true" once in "Response Data Exchange". Following this, the master requests diagnostics data from the slave using "Request Get Diag". The slave responds with "Response Get Diag". Therefore, the "Get Diag" facility only takes place when the diagnostics data in the slave changes.

The way in which diagnostic information can be evaluated / displayed is mainly determined by the options offered by the control system / PLC. Differences may arise in the language, format, and representation of the messages, as well as additional information such as the slave address, TAG, or message time stamp. In profile mode (ID number: 0x97xx), the diagnostic information is restricted to the messages described in the profile.

In accordance with NAMUR recommendation NE 107 and PA profile 3.01, the diagnostic messages are grouped according to sensor, operating conditions, electronics, and installation / configuration, and classified according to whether there is a fault, whether maintenance is required, whether the device is being operated outside of specifications, and whether a functional check is to be carried out.

5.2 Diagnostics data in the physical block

The information read out via the physical block or the "Diagnostics" driver function is the same as the information sent via "DDLM_SLAVE_DIAG". However, the field device simply sends it following a request from a class 2 master (EDD or DTM host), rather than on an event-controlled basis.

Additionally, the following extended diagnostics or asset management information is available:

Parameter	Description
Fieldbus Supply	Transmitter supply voltage
Device Temperature	Device / electronic unit temperature
Min Device Temperature	Drag indicator: Minimum device / electronic unit temperature
Max Device Temperature	Drag indicator: Maximum device / electronic unit temperature
Min Value Sensor 1 / 2	Drag indicator: Minimum measured value, sensor 1 / 2
Max Value Sensor 1 / 2	Drag indicator: Maximum measured value, sensor 1 / 2
Running Hours	Operating hours counter
At ...range...	Operating hours, grouped according to device temperature

5.3 Measured value status

The status of each measured value is described with a byte, which is always communicated together with the measured value. The coding of the status byte is described in PA profile 3.01. The TTX300 supports both the conventional coding in accordance with PA profile 3.0 and the new Condensed Status (optional in PA 3.01). The selection is made via the GSD file: If the profile GSD file is used, the status is conventional (expanded or classic). If the device-specific GSD file is used, the status byte coding is specified by the control system / PLC.

6 Address conflict detection

All PROFIBUS devices in a logical network require a unique address (0 ... 126). The user is responsible for managing and assigning device addresses. If two devices have the same address, communication with these two devices is no longer possible.

This is particularly important when it comes to replacing devices in cases where the devices are already participating in cyclic data exchange with the PROFIBUS master (control system, PLC).

If a faulty device needs to be replaced, the new device may already have been assigned an address from when it was used previously. If this address is already allocated in the network, the result will be an address conflict.

This means that it will no longer be possible to access the measuring point!

The TTX300 detects address conflicts within the same logical bus segment and automatically assigns the address 125. If 125 has also been assigned, address 124 is used instead (the highest possible free address that is ≤ 125). For the most part, this prevents address conflicts when replacing devices and, therefore, stops unrelated measuring points from experiencing the type of failure associated with this problem.

The extent to which this can be done is limited by the behavior of those PA segment couplers which do not communicate telegrams from nodes in the faster DP network ("north side of the coupler") to the PA bus.

Depending on the number of nodes, network transmission quality (telegram repetitions), and bus cycle time, the TTX300 may have a slightly longer startup time.

7 Commissioning without an acyclic master

A temperature transmitter that conforms to the PA profile, such as the TTX300, is described in full with more than 300 parameters, which can be set using the DTM and EDD device drivers. The use of both technologies assumes that a powerful control system is in place, or relies on a PC-linked parameterization tool being used in conjunction with the control system. Older or more basic control systems / PLCs do not usually offer an FDT or EDD-compatible interface.

In cases where separate parameterization tools are used, the user must ensure data consistency between the control system application and device parameters. Once a device has been replaced, the parameter set must be explicitly reloaded (downloaded) to the field device (this is generally carried out manually).

A common source of faults is, for example, a incorrect unit setting:

The control system application is set to unit x, but the field device supplies unit y.

Since the unit is not transferred along with the measured value, this fault can easily go undetected, especially if the units are similar (e.g., °C and °F).

If separate parameterization tools are being used, it is a good idea to have a mechanism in place that automatically loads the appropriate parameters for the measuring point when the device is started up. This ensures parameter set consistency between the device and control system, regardless of how the field device has been used in the past. In most applications (straightforward temperature measurement using standard sensors), only a fraction of the more than 300 parameters is required.

With GSD file-based parameterization, what the TTX300 is really offering is Plug & Play functionality. In this case, parameterization takes place directly from the configuration tool of the control system or PROFIBUS master. The DTM and EDD are not required for this.

Depending on the capabilities of the PROFIBUS master, the parameters can be changed and loaded seamlessly during cyclic operation. The parameters are loaded automatically when the master or field device is restarted.

Unlike FDT and EDD technology, a GSD file imposes some restrictions in terms of the range of languages that are supported. This means that, for example, decimal numbers cannot be entered and the plausibility of parameters cannot be verified against one another. Therefore, only the most important parameters can be accessed in a simplified form.

The way in which parameters are displayed and entered may vary from system to system. The following parameters can be set in this way:

Global parameters

Parameter	Description
Status format	Classic: Status byte coded acc. to PA profile 3.0 Condensed: Status byte coded acc. to PA profile 3.01, Amendment 2
Parameterization	Defines whether parameters are set via DPV0 (GSD) and DPV1 (acylical, EDD or DTM), or via DPV1 (EDD, DTM)

Transducer Temperature

Parameter	Description
Measurement Mode	PV measurement mode. Selection depends on selections for sensor types 1 / 2: PV1 (sensor 1) PV2 (sensor 2) PV1 (sensor 1) - PV2 (sensor 2) difference PV2 (sensor 2) - PV1 (sensor 1) difference Mean Redundancy
PV unit	Unit of PV (calculated value)
Noise filter	The transmitter has a characteristic representing noise / interference suppression for the sensor measuring signals. This characteristic can be changed during runtime. The "slow" setting improves the quality of the measurement for noisy measuring signals. The "fast" setting reduces the response time of the transmitter, but requires higher-quality measuring signals. The quality of the measuring signals can be improved by using shielded measuring lines that are as short as possible.
Sensor 1 (LIN_TYPE)	Sensor type setting for sensor 1 / 2
Sensor Connect. 1 / 2 / RJ Type 1 / 2	Resistance sensors: Type of sensor connection (two-wire, three-wire, or four-wire circuit). Thermo-couples: Reference junction type: No reference (not used): No compensation Internal: Internal (measured in transmitter) External: Externally stabilized via thermostat Sensor 1: Measured via resistance thermometer at channel 1 (can only be set at channel 2)

Parameter	Description	
Line R 1 / 2 / Fix. RJ Val. 1 / 2 (x100)	Resistance sensors	Line resistance for sensor 1 / 2 if an RTD or linear resistor has been selected as a sensor and a two-wire circuit connection has been selected
	Thermo-couples	If an externally stabilized reference junction is being used, its temperature is entered here in °C.

Transducer - HMI

Parameter	Description
HMI Language	Language used for HMI (LCD display). Language of device driver in host system / configuration tool is not influenced by this setting.
HMI Local operation	Option of blocking local operation
HMI Autoscroll	Activates or deactivates automatic changeover between view 1 (1-line) and 2 (2-line)
HMI Contrast	Contrast adjustment
HMI Select View 1	Selects signal to show in 1-line view
HMI Select View 2 Line 1	Selects signal to show at line 1 in 2-line view
HMI Select View 2 Line 2	Selects signal to show at line 2 in 2-line view

Analog input block 1 ... 4 (AI 1 ... 4)

Parameter	Description
Scale START input (PVEu0 x10)	Input scaling (start) in unit of measured value, multiplied by 10
Scale END input (PVEu100 x10)	Input scaling (end) in unit of measured value, multiplied by 10
Scale START output (OUTEu0 x10)	Output scaling (start) in target unit, multiplied by 10
Scale END output (OUTEu100 x10)	Output scaling (end) in target unit, multiplied by 10
Damping (PVTIME)	Damping time constant in s
Failure strategy (FSAFE_TYPE)	Determines the output value of the block if the input value is faulty (BAD status)
Failsafe value (FSAFE_VALUE x10)	Specifies the substitute value (multiplied by 10) when the "Substitute value + UNCERTAIN" substitute value strategy is selected. This value is transferred cyclically to the PROFIBUS master instead of the measured value or the most recently valid value.

Parameter	Description
Upper lim. alarm (HI_HI_LIM x10)	Upper alarm limit value, multiplied by 10
Upper lim. warning (HI_LIM x10)	Upper warning limit value, multiplied by 10
Lower lim. warning (LO_LIM x10)	Lower warning limit value, multiplied by 10
Lower lim. alarm (LO_LO_LIM x10)	Upper alarm limit value, multiplied by 10
Unit	Block output unit

Analog output block (AO)

Parameter	Description
Scale START input (PVEu0 x10)	Input scaling (start) in unit of measured value, multiplied by 10
Scale END input (PVEu100 x10)	Input scaling (end) in unit of measured value, multiplied by 10
Scale START output (OUTEu0 x10)	Output scaling (start) in target unit, multiplied by 10
Scale END output (OUTEu100 x10)	Output scaling (end) in target unit, multiplied by 10
Failsafe Time (FSAFE_TIME)	Time in s after which the output of the block follows the selected substitute value strategy
Failure strategy (FSAFE_TYPE)	Determines the output value of the block if the input value is faulty (BAD status)
Unit	Setpoint unit (SP)
Failsafe value (FSAFE_VALUE x10)	Specifies the substitute value (multiplied by 10) when the "Substitute value + UNCERTAIN" substitute value strategy is selected. This value is transferred cyclically to the PROFIBUS master instead of the measured value or the most recently valid value.
Increase Close	Not relevant for TTX300

Discrete input block 1 ... 2 (DI 1 ... 2)

Parameter	Description
Failure strategy (FSAFE_TYPE)	Determines the output value of the block if the input value is faulty (BAD status)
Signal is	Inverted or not inverted
Failsafe value	Specifies the substitute value when the "Substitute value + UNCERTAIN" substitute value strategy is selected. This value is transferred cyclically to the PROFIBUS master instead of the measured value or the most recently valid value.

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