Series 442 Installation and Operating Instructions

1 SAFETY NOTES

Safe and secure operation of the head transmitter can only be guaranteed if the operating instructions and all safety notes contained are, understood, and followed.

1.1 Correct Use

The unit is a universal, presettable temperature transmitter for resistance thermometer (RTD), thermocouple (TC) as well as resistance and voltage sensors. The unit is constructed for mounting in a connection head (form B) and field housing. The manufacturer cannot be held responsible for damage caused by misuse of the unit.

Separate Ex (hazardous area) documentation is attached with this operating manual as drawing M006601, for measurement systems in hazardous areas. The installation conditions and connection values indicated in these instructions must be followed!

1.2 Installation and operation

The unit is constructed using the most up-to-date production equipment and complies with the safety requirements of the EU guidelines. If it is installed incorrectly or is misused then certain application dangers can occur. Trained personnel must do installation, wiring and maintenance of the unit. These personnel must have read and understood these instructions and must follow them to the letter.

1.3 Operational safety - Hazardous areas

When installing the unit in a hazardous area the national safety requirements must be met. Make sure that all personnel are trained in these areas. The measurement and safety rules must be followed in all these installations.

2 FUNCTION AND SYSTEM CONSTRUCTION

2.1 Function

Electronic monitoring and transformation of various input signals into an analog output signal in industrial temperature measurement. The head transmitter is mounted in a connection head (form B) or separated from the sensor in a field housing. Setting up of the head transmitter is done using a "HART® Communicator DXR 275" or PC and configuration software.

2.2 Measurement system

Transforming the following input signals:

- Resistance thermometers (RTD) and resistance sensors (in 2, 3 or 4 wire connection systems)
- Thermocouples (TC)
- Voltage sensors into a scalable analog output signal (4…20 or 20…4) mA

Fault monitoring of:

- Measurement range override or undercut
- Sensor breakage and short circuit - not for thermocouples (TC)

3 INSTALLATION

3.1 Installation conditions

Ambient temperature:	(-40 to 85) °C [-40 to 185] °F (For hazardous areas, see drawing M006601)
Installation area:	Field housing; connection head Form B according to DIN 43 729
Installation angle:	No limit

Safety notes: The unit must only be powered by a power supply that operates using an IEC 61010-1 compliant energy limited circuit.

3.2 Installation

- Feed the sensor leadwires through the central hole in the head transmitter
- Position the head transmitter in the connection head in such way so that the current output terminals (terminals 1 and 2) are towards the cable entry gland.
- Feed the mounting screws (M4 x 20 mm long for form B heads) through the holes in the head transmitter.
- Screw the head transmitter into the field housing using a screwdriver while not over tightening.

4 WIRING

4.1 Overview

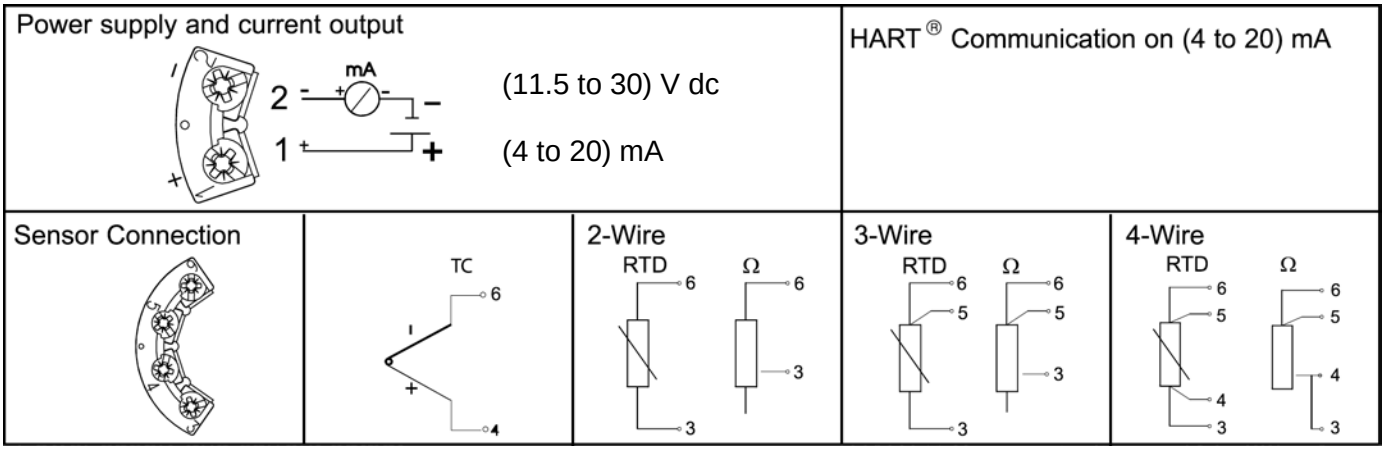

Figure 4-1 Head transmitter wiring

Pos. A

4.2 Measurement unit connection

Attention: Switch off power supply before opening the housing cover. Do not install or connect the unit to power. If this is not followed parts of the electronic circuit will be damaged.

- Sensors:
  Connect the sensor leads to the respective head transmitter terminals (Terminals 3 to 6) by following the wiring diagram (see figure 4-1).

- Output signal and power supply:
  Connect dc power cables to terminals 1 and 2 according to the wiring diagram (see figure 4-1).

Hint: The screws on the terminals must be screwed tightly. Head transmitter configuration during measurement operation is possible. There is no need to disconnect cables!

4.3 HART® connection

Connection is made directly using the (4 to 20) mA signal cables. **Note:** The measurement circuit must have a load of at least 250 Ω. See Figure 4-2 and 4-3.

Connection of a HART® hand operating module DXR 275

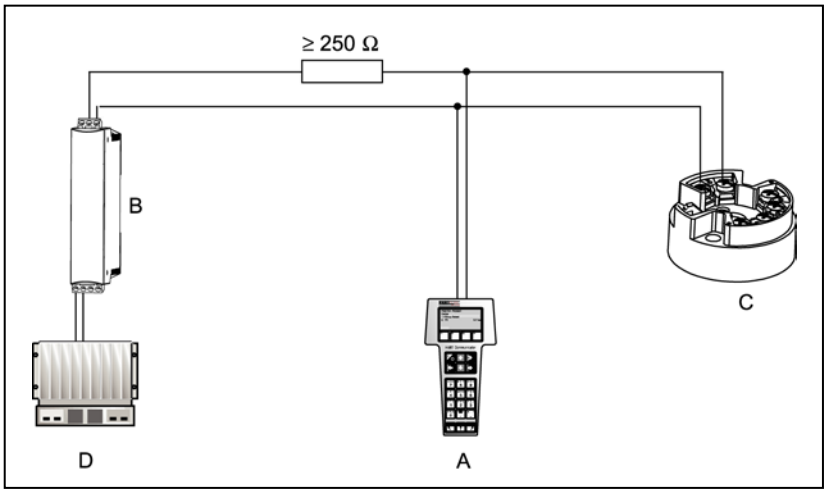

Figure 4-2 Electrical connection of the HART® operating module
A = HART® module
B = Loop power supply
C = HART® transmitter
D = PLC with passive input

Connection of HART® modem using TransComm Software

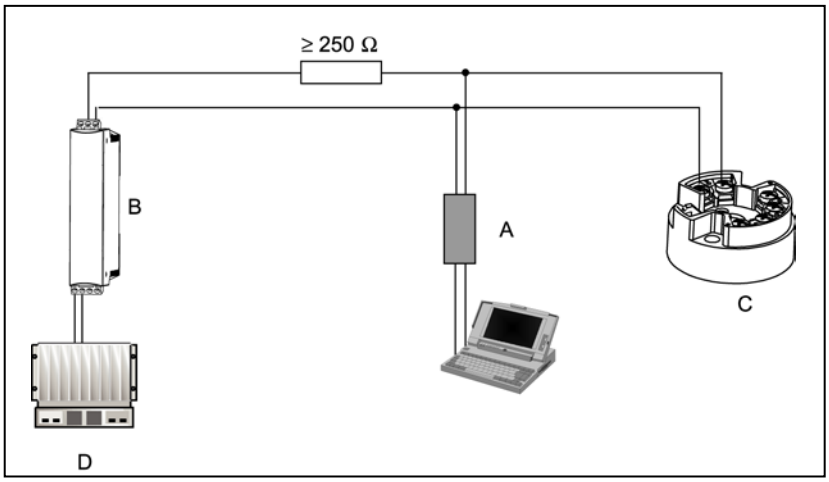

Figure 4-3 Electrical connection of the HART® modem
A = HART® modem
B = Loop power supply
C = HART® transmitter
D = PLC with a passive input

4.4 Shield grounding

Please take note when installing the head transmitter remotely in a field housing. The shield on the (4 to 20) mA signal output must have the same potential as the shield at the sensor connections! When using grounded thermocouples, shielding of the output (4 to 20) mA cable is recommended. In plants with strong electromagnetic fields, shielding of all cables with a low ohm connection to the transmitter housing is recommended.

5 OPERATION

5.1 Communication

The temperature transmitter is setup using the HART® protocol. The values measured can also be read using the HART® protocol using a universal hand operating module "HART® Communicator DXR 275/375.

5.2 HART® Communicator DXR 275

Selection of the unit functions using the "HART® Communicator" is done using various menu levels as well as with the help of a special HART® function matrix (see figure 6-2).

Hint: When using the HART® hand unit all parameters can be read out, however, the programming is blocked. It is possible to release the HART® function matrix by entering 281 in the LOCK function. The condition remains even after a power failure. The HART® function matrix can be locked again by releasing the personal code number. More detailed information to the HART® hand operation module can be found in its respective operating manual.

6 INSTALLING

6.1 Installation check

Monitor all connections making sure they are tight. In order to guarantee fault free operation the terminal screws must be tight onto the connection leads. The unit is now ready for operation.

6.2 Function check

Measuring the analog (4 to 20) mA output signal or following failure signals:

Underranging	Linear drop from 4.0 to 3.8 mA
Overranging	Linear increase from 20.0 to 20.5 mA
Failure, e.g. sensor breakage; sensor short circuit	≤ 3.6 mA ("low") or ≥ 21 mA ("high"), can be selected The "high" alarm setting can be set between 21.6 mA and 23 mA, thus providing the flexibility needed to meet the requirements of various control systems.

6.3 Installation

Once the power supply has been connected the head transmitter is operational.

6.4 Quick Setup

The head transmitter left the factory with a default parameter configuration. If no customer specific configuration was mentioned on the order then the default parameter configuration is constructed as follows:

Sensor	Pt100 (RTD)
Connection mode	3-wire
Measurement range and units	(0 to 100) °C

Using the Quick Setup the operator is led through all the most important unit functions that must be setup for standard measurement operation of the unit. Using the HART® hand module a quick set-up of the black highlighted fields of the HART® function matrix (see figure 6-2) is possible.

- Type of sensor (V2H0)
- Unit meas. Value (V2H2)
- Value of 4 mA (V2H4)
- Value of 20 mA (V2H5)
- Connection (V2H6)

6.5 Configuration with HART® protocol

Selection of all head transmitter functions using the HART® hand module is done with various menu levels with the help of the Pyromation function matrix (see figure 6-2). All head transmitter functions are described in 6.6, Description of unit functions.

What needs to be done:

1. Switch on the hand module:
   - Measurement unit is not yet connected. The HART® main menu appears. This menu level appears for all HART® programming independent of the type of instrumentation. Information to offline programming can be found in the "Communicator DXR 275/375 operating manual.
   - Measuring unit is connected. The menu level "Online" appears. In this "Online" menu level the actual measured data such as measured value (PV) and output current (AO) are continuously displayed. Entry into the Series 442 operating matrix is done using the line "Matrix parameters". This matrix systematically contains all HART® accessible functions.
2. Using "Matrix parameters" the function group can be selected (e.g. basic calibration) and then followed by the required function, e.g. "Sensor input".
3. Enter numeric values or change settings. Then acknowledge using the F4 "Entry" function key.
4. "SEND" appears when operating the F2 function key. Once the F2 key has been operated all values entered in the hand module are transmitted to the Series 442 measurement system.
5. A return to the "Online" menu level is made using the F3 "HOME" function key. Here, the actual transmitter values measured with the new settings can be read.

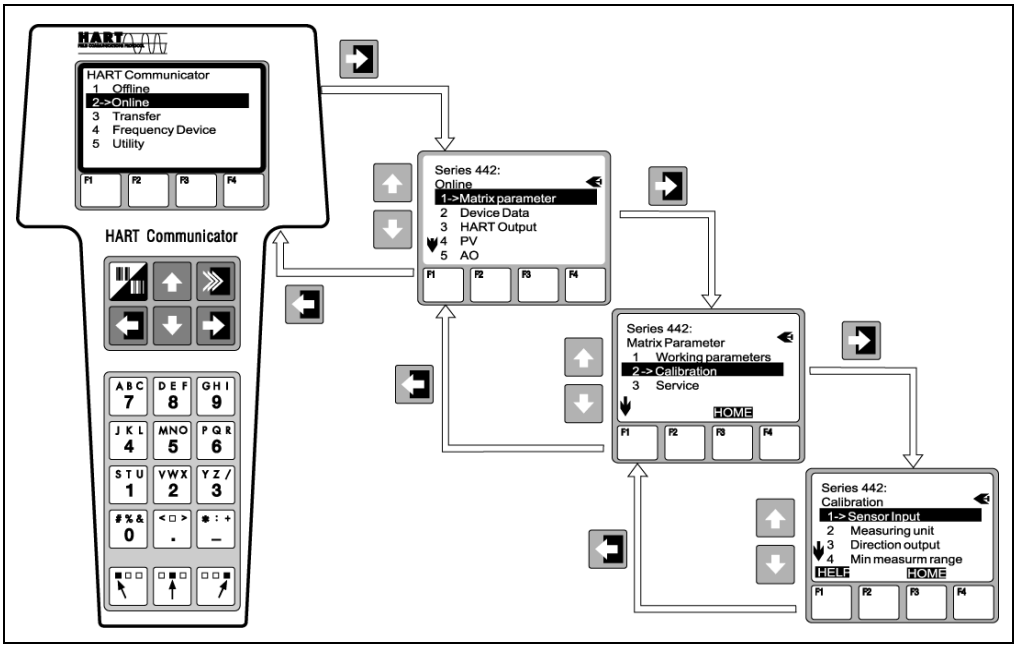

Figure 6-1 Configuration at the hand module example "Sensor input"

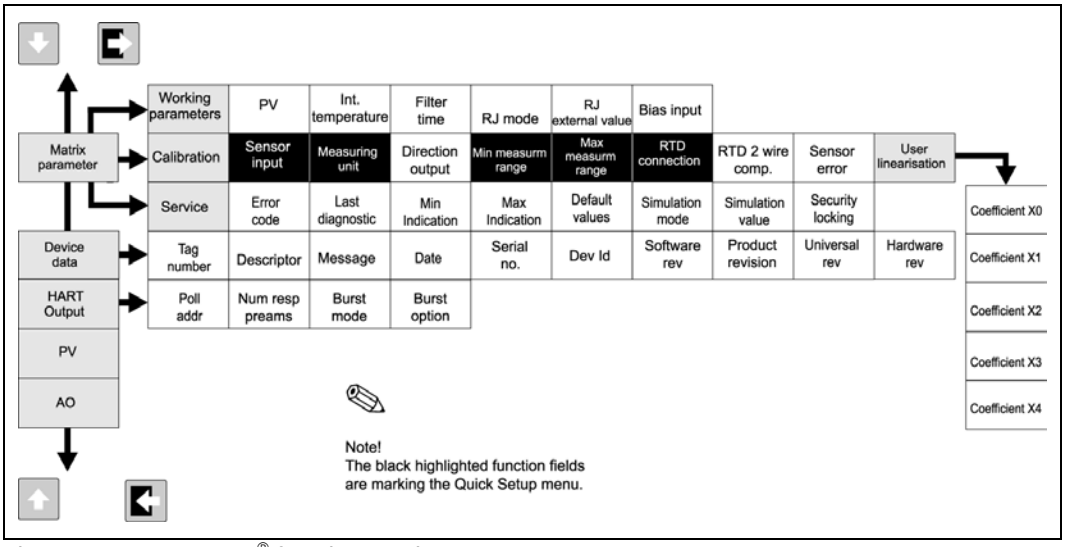

Figure 6-2 HART® function matrix

6.6 Description of unit functions

The following table contains a listing and description of all functions of the HART® protocol that can be used for setting up the temperature transmitter. **Note:** Factory default values are shown in bold text. The HART® operating module (DXR275) display is indicated by the following symbol.

Function group: WORKING PARAMETERS	
Primary value • V0H0 • (PV)	Display of actual measured temperature Display: 7-digit number with floating decimal point and engineering unit. (e.g. 199.98 Ohm; -62.36 deg. C)
Int. temperature • V0H1	Display of the actual measured temperature of the internal comparison measurement point.
Filter time • V0H2	Digital filter selection 1st grade. Input: (0 to 100) seconds **0 s**
RJ Mode • V0H3	Selection of internal (Pt100) or external (0 to 80) °C cold junction compensation. Entry: Internal; External **Internal**
RJ External Value • V0H4	Entry of external cold junction value. Entry: (-40.00 to 85.00) °C (°C, °F, K) **0.00 °C** Hint! Entry only possible on selection of an external cold junction compensation in unit function RJ MODE.
Bias Input (Offset) • V0H5	Entry of zero point correction (Offset). Entry: (-10.00 to 10.00) °C (°C, °F, K) **0.00 °C** Hint! Entry returns to factory default values when changing sensor type!

Function group: BASIC CALIBRATION	
Type of sensor • V2H0	Entry of sensor used: **Sensor type — Range start — Range end value** (-10 to 75) mV -10 mV 75 mV (10 to 400) Ω 10 Ω 400 Ω (10 to 2000) Ω 10 Ω 2000 Ω Pt100 DIN -200 °C [-328 °F] 850 °C [1562 °F] Pt100 JIS -200 °C [-328 °F] 649 °C [482 °F] Pt500 -200 °C [-328 °F] 250 °C [482 °F] Pt1000 -200 °C [-328 °F] 250 °C [482 °F] Ni100 -60 °C [-76 °F] 180 °C [356 °F] Ni500 -60 °C [-76 °F] 150 °C [302 °F] Ni1000 -60 °C [-76 °F] 150 °C [302 °F] Polynom RTD -270 °C [-454 °F] 2500 °C [4532 °F] Type B 0 °C [32 °F] 1820 °C [3308 °F] Type C 0 °C [32 °F] 2320 °C [4208 °F] Type D 0 °C [32 °F] 2495 °C [4523 °F] Type E -270 °C [-454 °F] 1000 °C [1832 °F] Type J -210 °C [-346 °F] 1200 °C [2192 °F] Type K -270 °C [-454 °F] 1372 °C [2501 °F] Type L -200 °C [-328 °F] 900 °C [1652 °F] Type N -270 °C [-454 °F] 1300 °C [2372 °F] Type R -50 °C [-58 °F] 1768 °C [3214 °F] Type S -50 °C [-58 °F] 1768 °C [3214 °F] Type T -270 °C [-454 °F] 400 °C [752 °F] Type U -200 °C [-328 °F] 600 °C [1112 °F] Polynom TC -270 °C [-454 °F] 2500 °C [4532 °F] **Pt100 DIN**
Temp. Compensation • V2H1	Selection of temperature compensation of the cold junction when using customer specific linearization of the TC polynomial Input: None, Type B, Type C, Type D, Type E, Type J, Type K, Type L, Type N, Type R, Type S, Type T, Type U **None**
Measuring Unit • V2H2	Enter engineering units. Entry: °C, °F, K **°C**
Current output • V2H3	Enter standard (4 to 20) mA or inverse (20 to 4) mA current output signal. Entry: 4-20 mA 20-4 mA **4-20 mA**
Value of 4 mA • V2H4	Entry: For limits see unit function SENSOR TYPE **0.00 °C**
Value of 20 mA • V2H5	Entry: For limits see unit function SENSOR TYPE. **100.00 °C**
Connection • V2H6 • RTD connection 	Entry of RTD Connection mode Entry: 2 wire 3 wire 4 wire **3 wire**

2 wire comp. • V2H7	Entry of leadwire compensation on RTD 2 wire connection Entry: (0.00 to 30.00) Ohm **0.00 Ohm**
Failsafe mode • V2H8	Entry of failure signal on sensor fracture or short circuit. Entry: Max (≥ 21.0 mA) Min (≤ 3.6 mA) **Min**

Function group: USER LINERIZATION The following function fields are only active in the unit function SENSORTYPE (V2H0) on selection of customer-specific linearization (Polynomial TC or RTD)	
Coefficient X0 • V3H0	Input of first coefficient for customer-specific linearization (4th order polynomial with five coefficients), see 6.8, Interactive setting up of the temperature transmitter
Coefficient X1 • V3H1	Input COEFFICIENT X1, see 6.8, Interactive setting up of the temperature transmitter
Coefficient X2 • V3H2	Input COEFFICIENT X2, see 6.8, Interactive setting up of the temperature transmitter
Coefficient X3 • V3H3	Input COEFFICIENT X3, see 6.8, Interactive setting up of the temperature transmitter
Coefficient X4 • V3H4	Input COEFFICIENT X4, see 6.8, Interactive setting up of the temperature transmitter

Function group: SERVICE	
Error code • V9H0	Display of actual error code. Display: See “8.1, Application fault messages” **0**
Last diagnostic • V9H1	Display of previous error code. Display: See “8.1, Application fault messages” **0**
Config. changed • V9H2	Parameter changes are done. Display: Yes/no **No**
Min Indication • V9H3	Display the minimum process value. The process value is accepted at the beginning of the measurement. Hint! Min. process value will be changed to the actual process value on write. On reset to factory default, the default value is entered. **+10 000**
Max Indication • V9H4	Display the maximum process value. The process value is accepted at the beginning of the measurement. Hint! Max. process value will be changed to the actual process value on write. On reset to factory default, the default value is entered. **-10 000**

Default values • V9H5	Entry: 182 (Reset to factory default settings) **0**
Output current • V9H6	Display of the actual output current signal.
Simulation mode • V9H7	Entry of simulation mode. Entry: Off On **Off**
Simulation value • V9H8	Entry of simulation value (current). Entry: (3.58 to 21.7) mA **0.00 mA**
Security locking • V9H9	Release code for setting up. Entry: Lock = 0 Release = 281 **281**

Function group: USER INFORMATION	
Tag number • VAH0	Entry and display of measure point description (TAG). Entry: 8 characters
Descriptor • VAH1	Entry and display of plant description. Entry: 16 characters
Hardware version • VAH2	Display of unit version. e.g.: 1.0000 indicates version 1.00.00
Software version • VAH3 • Software Rev. 	Display of software version. e.g.: 8010 indicates version 1.0
Serial Number • VAH4	8-digit display of Pyromation device serial numbers

6.7 Configuration using HART® protocol and TransComm

The configuration of the head transmitter can be done using both the HART® protocol and the TransComm software. The following table shows the structure of the interactive menu led operation of TransComm.

Configurable parameters	
Standard settings	• Sensor type • Connection mode (2, 3 or 4 wire connection) • Units (°C or °F) • Measurement range start (depends on sensor) • Measurement range end (depends on sensor) • Coefficient X0 to X4 (on sensor type Polynom RTD/TC) • Temperature-compensation (on sensor type Polynom TC)
Expanded settings	• Cold junction compensation (internal/external on TC connection) • Temperature external (on TC with cold junction compensation external) • Compensation resistance (0 to 20) Ω on 2 wire connection • Fault condition reaction (≤ 3.6 mA or ≥ 21.0 mA) • Output (analog standard/inverse) • Damping (0 to 8) s • Offset (-9.9 to +9.9) °C [-17.8 to +17.8] °F • TAG (Measurement point identification) • Identifier (Descriptor)
Service functions	• Simulation (on/off)

For detailed TransComm operating instructions please read the online documentation contained in the software.

6.8 Interactive setting up of the temperature transmitter

Customer specific linearization and sensor matching is done using the TransComm configuration software. The program calculates the linearization coefficients X0 to X4 that need to be entered into the PC configuration software.

7 MAINTENANCE

The head transmitter is maintenance free.

8 TROUBLESHOOTING

Always start troubleshooting with the checklists below if faults occur after start up or during operation. This takes you directly (via various queries) to the cause of the problem and the appropriate remedial measures. **Note:** Due to its design, the device cannot be repaired. However, it is possible to send the device in for examination.

8.1 Application fault message

Application fault messages are shown in the display of the HART® hand operating module “DXR275/375” once the menu point “ERROR CODE” has been selected.

Fault code	Cause	Action/cure
0	No fault, Warning	None
10	Hardware fault (unit defective)	Replace head transmitter
11	Sensor short circuit	Check sensor
12	Sensor cable open circuit	Check sensor
13	Reference measurement point defective	None
14	Unit not calibrated	Return head transmitter to manufacturer
106	Up/Download active	None (will be automatically acknowledged)
201	Warning: Measured value too small	Enter other values for measured value range start
202	Warning: Measured value too large	Enter other values for measured range end
203	Unit is reset (to factory default settings)	None

8.2 Application faults without messages

General errors

Problem	Possible cause	Remedy
Device not reacting	Supply voltage does not match that specified on the nameplate.	Apply the correct voltage.
	No contact between connecting cables and terminals.	Check the contacting of the cables and correct if necessary.
Output current < 3.6 mA	Signal cable is wired incorrectly.	Check wiring.
	Electronics are defective.	Replace the device.
HART communication not working.	Missing or incorrectly installed communication resistor.	Install the communication resistor (250 Ω) correctly.
	HART-Modem is connected incorrectly.	Connect HART-Modem correctly.

Application errors for RTD sensor connection

Problem	Possible cause	Remedy
Measured value is incorrect/inaccurate.	Incorrect sensor orientation.	Install the sensor correctly.
	Heat conducted by sensor.	Observe the face-to-face length of the sensor.
	Device programming is incorrect (number of wires).	Change the **Connection type** device function.
	Device programming is incorrect (scaling).	Change scaling.
	Incorrect RTD configured.	Change the **Sensor type** device function.
	Sensor connection.	Check that the sensor is connected correctly.
	The cable resistance of the sensor (2-wire) was not compensated.	Compensate the cable resistance.
	Offset incorrectly set.	Check offset.
Failure current (≤ 3.6 mA or ≥ 21 mA)	Faulty sensor.	Check the sensor.
	RTD connected incorrectly.	Connect the connecting cables correctly (terminal diagram).
	Incorrect device programming (e.g. number of wires).	Change the **Connection type** device function.
	Incorrect programming.	Incorrect sensor type set in the **Sensor type** device function. Set the correct sensor type.

Application errors for TC sensor connection

Problem	Possible Cause	Remedy
Measured value is incorrect/inaccurate	Incorrect sensor orientation.	Install the sensor correctly.
	Heat conducted by sensor.	Observe face-to-face length of the sensor.
	Device programming is incorrect (scaling).	Change scaling.
	Incorrect thermocouple type (TC) configured.	Change the **Sensor type** device function.
	Incorrect comparison measuring point set.	Set the correct reference junction.
	Interference via the thermocouple wire welded in the thermowell (interference voltage coupling).	Use a sensor where the thermocouple wire is not welded.
	Offset incorrectly set.	Check offset.
Failure current (≤ 3.6 mA or ≥ 21 mA)	Faulty sensor.	Check the sensor.
	Sensor is connected incorrectly.	Connect the connecting cables correctly (terminal diagram).
	Incorrect programming	Incorrect sensor type set in the **Sensor type** device function. Set the correct sensor type.