Instruction

MI 020-583
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I/A Series® Temperature Transmitter Model RTT80-F with FOUNDATION Fieldbus™ Protocol

invensys

Foxboro®

Contents

Figures 7

Tables 9

1. Introduction **11**
General Description 11
Reference Documents 11
Transmitter Identification 11
Standard Specifications 14
Output 15
Power Supply Voltage 16
Performance Specifications 16
Environmental Specifications 19
Mechanical Construction 20
Electrical Certification Rating 21
Electrical Safety Specifications 22
ATEX Compliance Documents 22
PTB 12ATEX2006 22
FM 13ATEX0068X 23
IECEx Compliance Documents 23
IECEx PTB 12.0046 23
IECEx FMG 14.0005X 23
Warnings 23

2. Installation **25**
Mounting 25
Requirements 26
Basic Module Mounting Options 26
Universal Housing Mounting Options 27
Dual Compartment Housing Mounting Options 28
Thermowell Mounting 29
Cover Locks 30
Universal Housing Cover Locks 30
Dual Compartment Housing Cover Locks 30
Wiring 31
Input Connections 31

Terminal Assignment ... 31
Connecting the Sensor Cables ... 32

3. Configuration and Operation ... 35
RTT80-F Block Model ... 35
Resource Block ... 36
Operating Mode ... 37
Block Status ... 37
RESTART Parameter ... 37
Nonvolatile Parameters ... 37
Timeout for Remote Cascade Modes ... 38
Alert Notification ... 38
FEATURES and FEATURE_SEL Parameters ... 38
Fault State for Whole Resource ... 38
Write Lock ... 38
Other Implemented Features ... 39
Block Error ... 39
Transducer Blocks ... 39
Sensor 1 and Sensor 2 Transducer Blocks ... 40
Advanced Diagnostic Transducer Block ... 44
Display Transducer Block ... 45
Analog Input (AI) Function Block ... 46
Supported Modes ... 47
Alarm Types ... 47
Mode Handling ... 47
Status Handling ... 47
Initialization ... 47
PID Function Block ... 48
Supported Modes ... 49
Alarm Types ... 49
Mode Handling ... 49
Status Handling ... 49
Initialization ... 50
Input Selector Function Block ... 50
Configuration ... 50
Hardware Settings ... 50
Function Check ... 51
Switching on the Measuring Device ... 51
Commissioning ... 52
Device Description ... 52
Device ID ... 52
Configuration Wizards ... 52

Initial Commissioning 53
FOUNDATION Fieldbus Parameters 60
Resource Block Parameters 60
Sensor 1 and Sensor 2 Transducer Block Parameters 69
Display Transducer Block Parameters 76
Advanced Diagnostic Transducer Block Parameters 76
Analog Input (AI) Block Parameters 77
PID Block Configurable Parameters 79
Operation 82
Data Transfer 82
Optional Local Display 82

4. Maintenance and Troubleshooting.. 85
Calibration 85
Post-Connection Check and Troubleshooting 86
Replacing the Transmitter 87
DIN Rail Mounted Units 87
Universal Housing Mounted Units 87
Dual Compartment Housing Mounted Units 88
Diagnostics 88
Configuration of Event Behavior according to FOUNDATION Fieldbus Field Diagnostics 89
Event Groups 90
Assignment Parameters 91
Transmission of Event Messages to the Bus 95
Event Priority 95
Suppression of Certain Events 95
FOUNDATION Fieldbus Diagnostic Parameters 95
Diagnostic Parameters in the Resource Block 95
Diagnostic Parameters in the Advanced Diagnostic Transducer Block 97
Display 102
Device Interface 102
Troubleshooting Guidelines 104
General Troubleshooting Checklist 104
Reduction to Known Working State 106
Addressing 106
Works on Bench But Not in Network 106
Open Trunk 106
Hand-held Master Works at One End of Trunk But Not Other End 107
Working Network Suddenly Stops 107
Test Equipment 107
Switch Mode Checklist 108

Schedule Download Checklist 108
Status Messages 108
WARNING Error Category 108
ALARM Error Category 108
Block Errors 112
Block Configuration Errors 113
Corrosion Monitoring 114
Application Errors Without Messages 115
Restart 116

5. RTT80 Configuration with a Device Type Manager 117
Main Screen 117
Block Mode Screen 117
Setup Screen 118
Advanced Setup Screen 119
Expert Screen 119
System Screen 120
Display Screen 121
Sensor 1 and Sensor 2 Screens 122
Diagnostics Screen 123
Measured Values Screen 124
Min./Max. Values Screen 125
Function Block Screen 126

Figures

1 Typical Identification Label for Housing and Sensor Mounting Code BB 12
2 Typical Identification Labels for Universal Housing 13
3 Typical Identification Labels for Dual Compartment Housing 13
4 Basic Module Mounting Options (Housing and Sensor Mounting Code BB) 26
5 Universal Housing Mounting Options
(Housing and Sensor Mounting Codes SS, TT, LL, MM, WW, and YY) 27
6 Dual Compartment Housing Mounting Options: Remote Sensor
(Housing and Sensor Mounting Codes GG, HH, QQ, and RR) 28
7 Dual Compartment Housing Mounting Options: Integral Sensor
(Housing and Sensor Mounting Codes CC, DD, EE, FF, JJ, KK, NN, and PP) 29
8 Thermowell Mounting (Dual Compartment Housing Shown) 29
9 Universal Housing Cover Lock 30
10 Dual Compartment Housing Cover Locks 31
11 Input Connections on the Basic Module and Universal Housing 32
12 Dual Compartment Housing Wiring from the Terminal Block to the Module 32
13 RTT80-F Block Model 36
14 Linear Scaling of Temperature-Linear Curve 42
15 Drift Detection 45
16 Analog Input Block Schematic 46
17 PID Block Parameter Summary 48
18 PID Block Schematic 48
19 **Display DIP Switches 51**
20 NI-FBUS Configurator Screen Display after Establishing a Connection 54
21 Connecting Function Blocks with NI-FBUS Configuration Software 59
22 Optional Local Display Information 83
23 Input Connections 87
24 Main DTM Screen 117
25 Block Mode Screen 117
26 Setup Screen 118
27 Advanced Setup Screen 119
28 Expert Screen 119
29 System Screen 120
30 Display Screen 121
31 Sensor 1 Screen 122
32 Diagnostics Screen 123
33 Measured Values Screen 124
34 Min./Max. Values Screen 125
35 Function Block Screen with Analog Input 1 Selected 126
36 Continuation of Function Block Screen with Analog Input 1 Selected 127

Tables

1 Reference Documents 11
2 Resistance Thermometers (RTD) Inputs 14
3 Thermocouple Inputs 15
4 Measurement Accuracy 16
5 Housing Specifications 20
6 Electrical Safety Specifications 22
7 Input Types 33
8 Display DIP Switches 51
9 Resource Block FOUNDATION Fieldbus Parameters 61
10 Sensor 1 and Sensor 2 Transducer Block User Configurable Fieldbus Parameters 69
11 Display Transducer Block User Configurable Parameters 76
12 Analog Input (AI) Block User Configurable Fieldbus Parameters 77
13 PID Block User Configurable Fieldbus Parameters 79
14 Optional Local Display Information 83
15 Diagnostic Errors 89
16 Diagnostic Severity 89
17 Event Groups 90
18 Default Setting of Assignment Parameters 91
19 Field Diagnostic Parameters in the RTT80 Resource Block 95
20 Advanced Diagnostic Transducer Block Parameters 97
21 Diagnostic Codes 102
22 Status Messages 109
23 Application Errors for RTD Connections 115
24 Application Errors for Thermocouple Connections 115

1. Introduction

General Description

The RTT80-F Temperature Transmitter is a microprocessor-based temperature transmitter that receives input signals from thermocouples, RTDs, resistance (ohms), or millivolt sources. It is offered in a basic configuration or with universal or dual compartment housing options. It is available with HART or FOUNDATION fieldbus communications protocol. This document (MI 020-583) describes the transmitter with FOUNDATION fieldbus communication.
(For instructions on the HART version, see MI 020-582.)

Reference Documents

For additional and related information, refer to the documents listed in Table 1.

Table 1. Reference Documents

Document	Description
PSS 2A-1F8 A	Model RTT80 I/A Series® Temperature Transmitter with HART Communication Protocol
PSS 2A-1F8 B	Model RTT80 I/A Series® Temperature Transmitter with FOUNDATION Fieldbus Communication Protocol
MI 020-580	Model RTT80 I/A Series Temperature Transmitter Intrinsic Safety (CSA/FM) Connection Diagrams
MI 020-581	Model RTT80I/A Series Temperature Transmitter Intrinsic Safety (ATEX/IECEx) Connection Diagrams
MI 020-582	Model RTT80 I/A Series Temperature Transmitter with HART Communication Protocol
MI 020-583	Model RTT80 I/A Series Temperature Transmitter with FOUNDATION fieldbus Communication Protocol
DP 020-580	Model RTT80 I/A Series® Temperature Transmitter Dimensional Print
PL 008-680	Model RTT80 I/A Series® Temperature Transmitter Parts List

Transmitter Identification

See Figures 1, 2, and 3 for typical agency and data labels. For transmitters enclosed in a housing, the basic unit agency label is located on the basic unit and the applicable agency and data labels are externally mounted on the transmitter housing.

— NOTE

Figures 1, 2, and 3 show typical data plates. For a recapitulation of the specific information that applies to each agency certification, see “Electrical Certification Rating” on page 21.

Figure 1. Typical Identification Label for Housing and Sensor Mounting Code BB

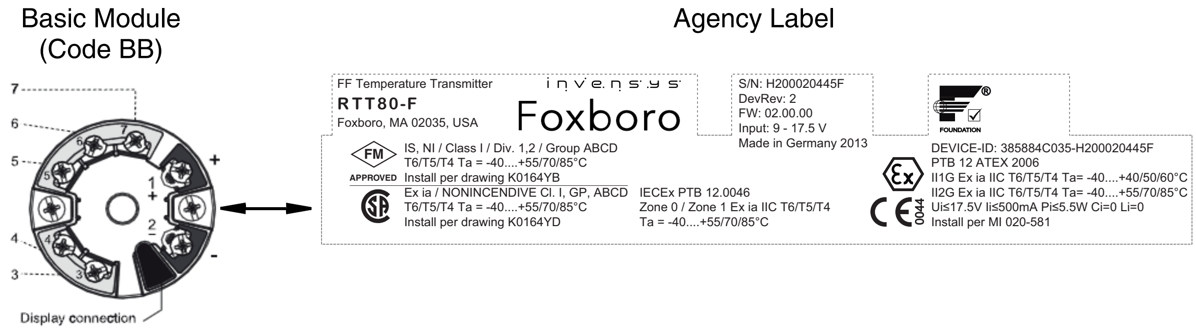


Figure 2. Typical Identification Labels for Universal Housing

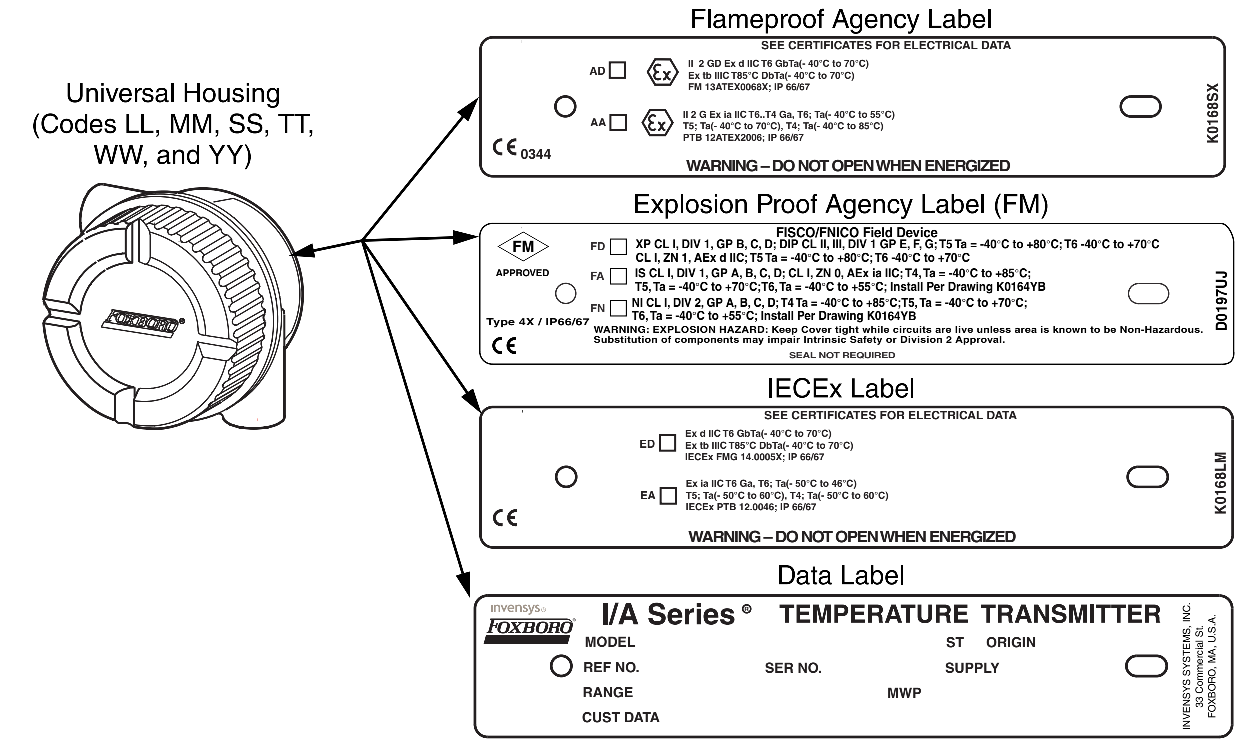
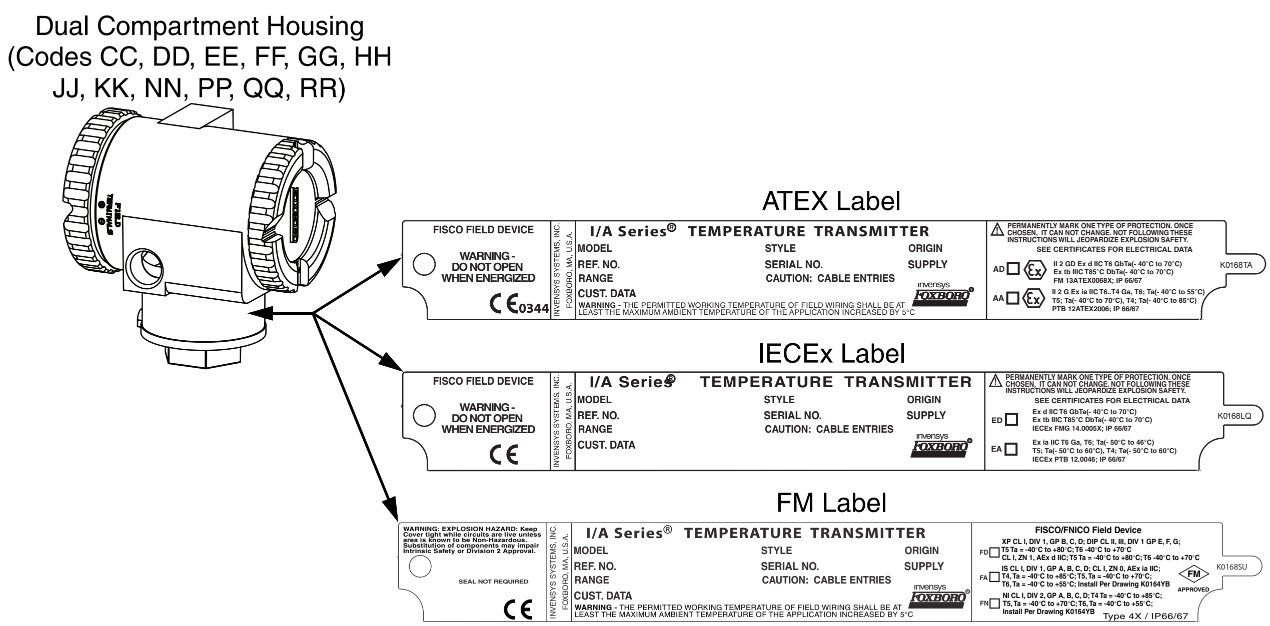


Figure 3. Typical Identification Labels for Dual Compartment Housing



Standard Specifications

Input:

Measured Variable: Temperature (temperature linear transmission behavior), resistance and voltage.

Type of Input: It is possible to connect two sensor inputs which are independent of each other. These are not galvanically isolated from each other.

Table 2. Resistance Thermometers (RTD) Inputs

Type of Input	Designation	Measuring Range Limits	Min Span
Per IEC 60751 (α = 0.00385)	Pt100	-200 and +850°C	10 K
	Pt200	-200 and +850°C	10 K
	Pt500	-200 and +250°C	10 K
	Pt1000	-200 and +250°C	10 K
Per JIS C1604-81 (α = 0.003916)	Pt100	-200 and +649°C	10 K
Per DIN 43760 (α = 0.006180)	Ni100	-60 and +250°C	10 K
	Ni1000	-60 and +150°C	10 K
Per Edison Copper Winding No.15 (α = 0.004274)	Cu10	-100 and +260°C	10 K
Per Edison Curve (α = 0.006720)	Ni120	-70 and +270°C	10 K
Per GOST (α = 0.003911)	Pt50	-200 and +1100°C	10 K
	Pt100	-200 and +850°C	
Per GOST (α = 0.004280)	Cu50	-200 and +200°C	10 K
	Cu100		
–	Pt100 (Callendar-van Dusen)	10 and 400 Ω (a)	10 Ω
		10 and 2000 Ω	100 Ω
–	Nickel Polynomial	10 and 400 Ω	10 Ω
		10 and 2000 Ω	100 Ω
–	Copper Polynomial	10 and 400 Ω	10 Ω
		10 and 2000 Ω	100 Ω
Resistance Transmitter			
–	Resistance Ohms	10 and 400 Ω	10 Ω
		10 and 2000 Ω	100 Ω

a. The measuring range limits are specified by entering the limit values that depend on the coefficients A to C and R0.

Table 3. Thermocouple Inputs

Type of Input	Designation	Measuring Range Limits	Recommended Temp. Range	Min Span
Per IEC 584 Part 1	Type A (W5Re-W20Re)	0 and +2500°C	0 to 2000°C	50 K
	Type B (PtRh30-PtRh6) (a)(b)	40 and +1820°C	100 to 1500°C	50 K
	Type E (NiCr-CuNi)	-270 and +1000°C	0 to 750°C	50 K
	Type J (Fe-CuNi)	-210 and +1200°C	20 to 700°C	50 K
	Type K (NiCr-Ni)	-270 and +1372°C	0 to 1100°C	50 K
	Type N (NiCrSi-NiSi)	-270 and +1300°C	0 to 1100°C	50 K
	Type R (PtRh13-Pt)	-50 and +1768°C	0 to 1400°C	50 K
	Type S (PtRh10-Pt)	-50 and +1768°C	0 to 1400°C	50 K
	Type T (Cu-CuNi)	-260 and +400°C	-185 to +350°C	50 K
Per ASTM E988	Type C (W5Re-W26Re)	0 and 2315°C	0 to 2000°C	50 K
	Type D (W3Re-W25Re)	0 and 2315°C	0 to 2000°C	50 K
Per DIN 43710	Type L (Fe-CuNi)	-200 and +900°C	0 to 750°C	50 K
	Type U (Cu-CuNi)	-200 and +600°C	-185 to +400°C	50 K
Voltage Transmitter				
–	Millivolt (mV)	-20 and +100 mV	–	–

a. The measuring error will increase for temperatures lower than 300°C (572°F). See Table 4.

b. When operation conditions are based on a large temperature range, the RTT80 offers the ability to split the range. For example, a Type S or R thermocouple can be used for the low range, while a Type B can be used for the upper range.

When assigning both sensor inputs, the following connection combinations are possible:

		Sensor 1			
		2-wire RTD	3-wire RTD	4-wire RTD	**Thermocouple**
Sensor 2	**2-wire RTD**	Ok	Ok	N/A	Ok
	3-wire RTD	Ok	Ok	N/A	Ok
	Thermocouple	Ok	Ok	Ok	Ok

Output

Output Signal:

- FOUNDATION fieldbus™ H1, IEC 61158-2
- FDE (Fault Disconnection Electronic) = 0 mA
- Data transmission rate: supported baud rate = 31.25 kBit/s
- Communication distance: 1900 m (6235 ft) maximum
- Signal coding = Manchester II
- Compliance with ITK 6.1.0
- Output data: values via AI blocks: temperature (PV), temp sensor 1 + 2, terminal temperature
- LAS (link active scheduler), LM (link master) function is supported:
  Thus, the RTT80 transmitter can assume the function of a link active scheduler

(LAS) if the current link master (LM) is no longer available. The device is supplied as a BASIC device. To use the device as an LAS, this must be defined in the distributed control system and activated by downloading the configuration to the device.

- In accordance with IEC 60079-27, FISCO/FNICO

Mains Voltage Filter: 50/60 Hz

Galvanic Isolation: U = 2 kV ac (sensor input to the output)

Current Consumption: ≤ 11 mA

Switch-on Delay: 8 s

Power Supply Voltage

U = 9 to 32 V dc, reverse polarity protection (maximum voltage U_b = 35 V)
When certified as intrinsically safe.

Concept	FISCO	Entity
V_{max}	17.5 V	24 V
I_{max}	500 mA	250 mA
P_{max}	5.5 W	1.2 W

NOTE
Although the RTT80 offers reverse polarity protection, be sure that the transmitter is connected to the proper voltage polarities as marked on the device.

Performance Specifications

Response Time: 1 s per channel

Reference Operating Conditions:

- Calibration temperature: +25°C ± 5K (77°F ± 9°F)
- Supply voltage: 24 V dc
- 4-wire circuit for resistance adjustment

Resolution A/D converter: 18 bit

Maximum Measured Error: The accuracy data are typical values and correspond to a standard deviation of ±3s (normal distribution), that is, 99.8% of all the measured values achieve the given values or better values.

Table 4. Measurement Accuracy

	Designation	Performance Characteristics
Resistance thermometers (RTD)	Cu100, Pt100, Ni100, Ni120 Pt500 Cu50, Pt50, Pt1000, Ni1000 Cu10, Pt200	0.1°C (0.18°F) 0.3°C (0.54°F) 0.2°C (0.36°F) 1°C (1.8°F)
Thermocouples (TC)	Type: K, J, T, E, L, U Type: N, C, D Type: S, B, R	Typical, 0.25°C (0.45°F) Typical, 0.5°C (0.9°F) Typical, 1.0°C (1.8°F)

	Measuring Range	Performance Characteristics
Resistance transmitters (Ω)	10 to 400 Ω 10 to 2000 Ω	± 0.04 Ω ± 0.8 Ω
Voltage transmitters (mV)	-20 to 100 mV	± 10 μV

Sensor Transmitter Matching: RTD sensors are one of the most linear temperature measuring elements. Nevertheless, the output must be linearized. To improve temperature measurement accuracy significantly, the device enables the use of two methods:

1. Callendar-Van Dusen coefficients (Pt100 resistance thermometer)

   The Callendar-Van Dusen equation is described as:

   $$R_T = R_0[1+AT-BT^2+C(T-100)T^3]$$

   The coefficients A, B and C are used to match the sensor (platinum) and transmitter in order to improve the accuracy of the measuring system. The coefficients for a standard sensor are specified in IEC 751. If no standard sensor is available or if greater accuracy is required, the coefficients for each sensor can be determined specifically by means of sensor calibration.

2. Linearization for copper/nickel resistance thermometers (RTD)

   The polynomial equations for nickel are described as:

   $$R_T = R_0[1+AT-BT^2+C(T-100)T^3]$$

   The equations for copper, subject to temperature, are described as:

   $$R_T = R_0(1+AT)$$

   T = -50°C to 200°C (-58°F to 392°F)

   $$R_T = R_0[1+AT-B(T+6.7)+CT^2]$$

   T = -180°C to -50°C (-292°F to -58°F)

   These coefficients A, B and C are used for the linearization of nickel or copper resistance thermometers (RTD). The exact values of the coefficients derive from the calibration data and are specific to each sensor.

   Sensor transmitter matching using one of the above-named methods significantly improves the temperature measurement accuracy of the entire system. This is due to the fact that to calculate the temperature measured, the transmitter uses the specific data pertaining to the connected sensor instead of using the standardized curve data of a sensor.

Non-Repeatability (per EN 61298-2):

Physical Input Measuring Range of Sensors		Non-Repeatability
10 to 400 Ω	Cu10, Cu50, Cu100, Pt50, Pt100, Ni100, Ni120	15 mΩ
10 to 2000 Ω	Pt200, Pt500, Pt1000, Ni1000	100 ppm x measured value

Physical Input Measuring Range of Sensors		Non-Repeatability
-20 to 100 mV	Thermocouples type: C, D, E, J, K, L, N, U	4 μV
-5 to 30 mV	Thermocouples type: B, R, S, T	3 μV

Long-Term Stability: ≤ 0.1 °C/year (≤ 0.18 °F/year) in reference operating conditions

Influence of Ambient Temperature (Temperature Drift):

- Impact on accuracy when ambient temperature changes by 1 K (1.8°F):

Input 10 to 400 Ω	0.001% of the measured value, minimum 1 mΩ
Input 10 to 2000 Ω	0.001% of the measured value, minimum 10 mΩ
Input -20 to 100 mV	0.001% of the measured value, minimum 0.2 μV
Input -5 to 30 mV	0.001% of the measured value, minimum 0.2 μV

- Typical sensitivity of resistance thermometers:

Pt: 0.00385 * R_{nom}/K	Cu: 0.0043 * R_{nom}/K	Ni: 0.00617 * R_{nom}/K
Example for Pt100: 0.00385 x 100 Ω/K = 0.385 Ω/K		

- Typical sensitivity of thermocouples:

B: 10 μV/K	C: 20 μV/K	D: 20 μV/K	E: 75 μV/K	J: 55 μV/K	K: 40 μV/K
L: 55 μV/K	N: 35 μV/K	R: 12 μV/K	S: 12 μV/K	T: 50 μV/K	U: 60 μV/K

Examples of calculating the measured error with ambient temperature drift:

Example 1:

- Input temperature drift ϑ = 10 K (18°F), Pt100, measuring range 0 to 100°C (32 to 212°F)
- Maximum process temperature: 100°C (212°F)
- Measured resistance value: 138.5 Ω (DIN EN 60751) at maximum process temperature

Typical temperature drift in Ω: (0.001% of 138.5 Ω) * 10 = 0.01385 Ω

Conversion to Kelvin: 0.01385 Ω / 0.385 Ω/K = 0.04 K (0.054°F)

Example 2:

- Input temperature drift Δϑ = 10 K (18°F), thermocouple type K, measuring range 0 to 600°C (32 to 1112°F)
- Maximum process temperature: 600°C (1112°F)
- Measured thermocouple voltages: 24905μV (see IEC 584)

Typical temperature drift in μV: (0,001% of 24905 μV) * 10 = 2.5 μV

Conversion to Kelvin: 2,5 μV / 40 μV/K = 0.06 K (0.11°F)

Influence of Reference Point (Cold Junction): Pt100 DIN EN 60751 Cl. B, internal reference point for thermocouples TC

Environmental Specifications

Ambient Temperature Limits:

-40 and +85°C (-40 and +185°F)

NOTE

To ensure proper operation, the ambient temperature limits at the housing should not be exceeded. This is particularly relevant when sensors/thermowells are directly connected to the housing and very high process temperatures are being measured. The transfer of heat from the process to the housing can be minimized by use of thermowell extensions, or in extreme cases, by using a remote housing installation.

Storage Temperature Limits: -40 and +100°C (-40 and 212°F)

Altitude: up to 4000 m (4374.5 yd) above mean sea level in accordance with IEC 61010-1, CSA 1010.1-92

Climate Class: Per IEC 60654-1, Class C

Humidity:

- Condensation as per IEC 60 068-2-33 permitted
- Maximum relative humidity: 95% as per IEC 60068-2-30

Shock and Vibration Resistance:

- Basic Transmitter Module, Housing and Sensor Mounting Code BB: 10 to 2000 Hz for 5g as per IEC 60 068-2-6
- RTT80 Housing and Sensor Mounting Codes CC, EE, GG, JJ, LL, NN, QQ, SS, and WW: 19 mm (0.75 in) Double Amplitude from 5 to 9 Hz, 0 to 30 m/s^2 (0 to 3 “g”) from 9 to 500 Hz
- RTT80 Housing and Sensor Mounting Codes DD, FF, HH, KK, MM, PP, RR, TT, and YY: 10 m/s^2 (1 g) maximum.

Electromagnetic Compatibility (EMC):

- CE EMC compliance

  The device meets all of the requirements mentioned in IEC 61326, Amendment 1, 1998 and NAMUR NE21.

  This recommendation is a consistent and practical way of determining whether the devices used in laboratories and in process control systems are immune to interference, thus increasing their functional safety.

ESD (electrostatic discharge)	IEC 61000-4-2	6 kV cont., 8 kV air	
Electromagnetic fields	IEC 61000-4-3	0.08 to 4 GHz	10 V/m
Burst (fast transients)	IEC 61000-4-4	1 kV	
Surge	IEC 61000-4-5	1 kV asym.	
Conducted RF	IEC 61000-4-6	0.01 to 80 MHz	10 V

Measuring Category: Measuring category II as per IEC 61010-1. The measuring category is provided for measuring on power circuits that are directly connected electrically with the low-voltage network.

Degree of Contamination: Degree 2 contamination as per IEC 61010-1. Normally only nonconductive contamination occurs. Temporary conductivity through condensation is possible.

Mechanical Construction

Dimensions: Refer to DP 020-580.

Transmitter Terminals:

- Screw terminals are provided with latches at the fieldbus terminals for easy connection of handheld terminal.
- Wire version: Rigid or flexible
- Conductor cross-section: ≤ 2.5 mm^2 (14 AWG)

Materials used for Basic Transmitter:

- Basic Transmitter Module Housing: Polycarbonate (PC), complies with UL94 HB (fire prevention characteristics)
- Screw terminals: Nickel-plated brass and gold-plated contact
- Potting: PU, complies with UL94 V0 WEVO PU 403 FP / FL (fire prevention characteristics)

Housing Specifications:

Table 5. Housing Specifications

Housing Code	Material and Finish	IEC/NEMA Rating	Explosion-proof and Flameproof	Mounting Configuration	Field Wiring Entrances on Housing
Basic Module					
BB	Encapsulated plastic	IP20 (a)	No	Basic Transmitter Module (b) (DIN Form B package)	None
Universal Housing					
LL	Low copper aluminum alloy; epoxy coated	IP66/67 NEMA 4X	Yes	Universal housing with integral sensor and thermowell	1/2 NPT
MM	Stainless steel	IP66/67 NEMA 4X	Yes	Universal housing with integral sensor and thermowell	1/2 NPT
SS	Low copper aluminum alloy; epoxy coated	IP66/67 NEMA 4X	Yes	Universal housing for surface or pipe mounting, remote sensor (c)	1/2 NPT
TT	Stainless steel	IP66/67 NEMA 4X	Yes	Universal housing for surface or pipe mounting, remote sensor (c)	1/2 NPT
WW	Low copper aluminum alloy; epoxy coated	IP66/67 NEMA 4X	Yes	Universal housing with integral bare sensor	1/2 NPT
YY	Stainless steel	IP66/67 NEMA 4X	Yes	Universal housing with integral bare sensor	1/2 NPT
Dual Compartment Housing					
CC	Low copper aluminum alloy; epoxy coated	IP66/67 NEMA 4X	Yes	Dual-compartment housing with integral bare sensor	M20
DD	Stainless steel	IP66/67 NEMA 4X	Yes	Dual-compartment housing with integral bare sensor	M20
EE	Low copper aluminum alloy; epoxy coated	IP66/67 NEMA 4X	Yes	Dual-compartment housing with integral sensor and thermowell	M20

Table 5. Housing Specifications (Continued)

Housing Code	Material and Finish	IEC/NEMA Rating	Explosion-proof and Flameproof	Mounting Configuration	Field Wiring Entrances on Housing
FF	Stainless steel	IP66/67 NEMA 4X	Yes	Dual-compartment housing with integral sensor and thermowell	M20
GG	Low copper aluminum alloy; epoxy coated	IP66/67 NEMA 4X	Yes	Dual-compartment housing for surface or pipe mounting, remote sensor (c)	M20
HH	Stainless steel	IP66/67 NEMA 4X	Yes	Dual-compartment housing for surface or pipe mounting, remote sensor (c)	M20
JJ	Low copper aluminum alloy; epoxy coated	IP66/67 NEMA 4X	Yes	Dual-compartment housing with integral bare sensor	1/2 NPT
KK	Stainless steel	IP66/67 NEMA 4X	Yes	Dual-compartment housing with integral bare sensor	1/2 NPT
NN	Low copper aluminum alloy; epoxy coated	IP66/67 NEMA 4X	Yes	Dual-compartment housing with integral sensor and thermowell	1/2 NPT
PP	Stainless steel	IP66/67 NEMA 4X	Yes	Dual-compartment housing with integral sensor and thermowell	1/2 NPT
QQ	Low copper aluminum alloy; epoxy coated	IP66/67 NEMA 4X	Yes	Dual-compartment housing for surface or pipe mounting, remote sensor (c)	1/2 NPT
RR	Stainless steel	IP66/67 NEMA 4X	Yes	Dual-compartment housing for surface or pipe mounting, remote sensor (c)	1/2 NPT

a. The basic module, although encapsulated, has exposed terminals not protected from the environment.

b. The basic module is typically used for replacement and spares purposes; it can also be mounted to a surface or to a DIN rail using a clip (Option -D1).

c. Surface or pipe mounted using mounting set options -M1 or -M2.

WARNING

For all RTT80-F Transmitters with an aluminum housing:
When used in a potentially explosive atmosphere requiring apparatus of equipment category 1 G, the transmitter must be installed so that, even in the event of rare instances, an ignition source due to impact or friction between the enclosure and iron/steel is excluded. This shall be considered during installation, particularly if the equipment is installed in a zone 0 location.

Electrical Certification Rating

The electrical certification is printed on the agency label which is located on the basic module and on the transmitter housing (if applicable). The Electrical Safety Design Code is also included as part of the model code on the data label which is located on the basic module or on the transmitter housing (if applicable). See Figure 2 and Figure 3 for examples of typical agency and data labels. For a complete explanation of the model code, see PL 008-680.

Electrical Safety Specifications

NOTE

These transmitters have been designed to meet the electrical safety description listed in Table 6. For detailed information or status of testing laboratory approvals/certifications, contact Invensys.

Table 6. Electrical Safety Specifications

Testing Laboratory, Type of Protection, and Area Classification	Model Code Option
Non-hazardous area	ZZ
CSA IS, I/1+2/ABCD	CA
CSA NI, 1/2/ABCD	CN
CSA Explosionproof, Class I, Division 1, BCD; Dust-ignitionproof, Class II, Division 1, EFG, Class III, Division 1. Also zone certified, Cl I, Zone 1, EX d IIC (a)	CD
ATEX II 1G Ex ia IIC T4/T5/T6	AA
ATEX II 2 G Ex d T6 Gb Ta = -40°C to 70°C II 2 D Ex tb T85C Db (a)	AD
IECEx Ex ia IIC T4/T5/T6	EA
IECEx Ex d T6 Gb Ta = -40°C to 70°C Ex tb T85C Db (a)	ED
FM IS, I/1+2/ABCD	FA
FM NI, I/2/ABCD	FN
FM Explosionproof, Class I, Division 1, Groups B, C, and D; Dust-ignitionproof, Class II, Division 1, Groups E, F, and G, Class III Division 1 (a)	FD

a. Not available with the basic module (Housing and Sensor Mounting Code BB).

All relevant data for hazardous areas can be found in separate safety documentation:

- ♦ MI 020-580, RTT80 I/A Series Temperature Transmitter Intrinsic Safety (CSA/FM) Connection Diagrams
- ♦ MI 020-581, RTT80 I/A Series Temperature Transmitter Intrinsic Safety (ATEX/IECEx) Connection Diagrams

ATEX Compliance Documents

Directive 94/9/EC – Equipment or Protective Systems Intended for Use in Potentially Explosive Atmospheres.

Also, compliance with the essential health and safety requirements has been assured by compliance with the following documents as stated in the compliance certificate:

PTB 12ATEX2006

II 2G Ex ia IIC T6..T4 Ga, T6; Ta (- 40°C to 55°C); T5; Ta (-40°C to 70°C), T4; Ta (-40°C to 85°C)

EN 60079-0:2009; EN 60079-11:2007

FM 13ATEX0068X

II 2 GD Ex d IIC T6 Gb Ta (-40°C to 70°C)

Ex tb IIIC T85°C Db Ta (-40°C to 70°C)

EN 60079-0:2009; EN 60079-1:2007; EN 60079-31:2009

IECEx Compliance Documents

IECEx PTB 12.0046

Ex ia IIC T6..T4 Ga, T6; Ta (-50°C to 46°C)

T5; Ta(- 50°C to 60°C), T4; Ta (-50°C to 60°C)

IEC 60079-0:2007-10 (edition 5); IEC 60079-11:2011 (edition 6); IEC 60079-26:2006 (edition 2)

IECEx FMG 14.0005X

Ex d IIC T6 Gb Ta = -40°C to 70°C

Ex tb IIIC T85°C Db Ta = -40°C to 70°C

IEC 60079-0:2007-10 (edition 5); IEC 60079-1:2007(edition 6); IEC 60079-31:2013 (edition 2)

Warnings

! WARNING

Do not open while circuits are energized.

! WARNING

Do not open when energized or when an explosive atmosphere may be present.

! WARNING

Substitution of components may impair intrinsic safety or Division 2 approvals.

! WARNING

The certificate numbers have an 'X' suffix which indicates that special conditions of installation and use apply. Those installing or inspecting this equipment must have access to the contents of the certificate or these instructions. The conditions listed in the certificate are reproduced below.

1. Some models have the main electronics enclosure manufactured from aluminum alloy. In rare cases, ignition sources due to impact and friction sparks could occur. This shall be considered during installation, particularly if the equipment is installed in a zone 0 location.

2. When installed in flammable dust zones, under certain extreme circumstances an incendive electrostatic charge may build up on the painted surfaces, which are non-conducting. Therefore, the user/installer shall implement precautions to prevent the build up of electrostatic charge, for example, locate the equipment where a charge-generating mechanism (such as wind-blown dust) is unlikely to be present and clean with a damp cloth.

3. When installed in a flammable dust zone, the installer shall ensure that the cable entry maintains the dust-tightness (IP6X) of the enclosure.

For explosionproof certifications:

! WARNING

Keep cover tight while circuits are energized unless area is known to be nonhazardous.

! WARNING

To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.

2. Installation

The following material provides information and procedures for installing the RTT80 Transmitter. For dimensional information, refer to DP 020-580.

Installation shall be carried out in accordance with the applicable code of practice (typically IEC 60079-14) by suitably trained personnel.

There are no special checking or maintenance conditions. All explosion-protected equipment should be periodically inspected in accordance with the applicable code of practice (typically IEC 60079-17). The interval between inspections should not normally exceed 3 years, unless justification for a longer interval is given.

With regard to explosion safety, it is not necessary to check for correct operation.

NOTE

Use a suitable thread sealant on all connections.

! CAUTION

Bare sensor or thermowell mounting to the 316 ss housing should not be used in high vibration areas.

! CAUTION

The RTT80 is only certified for use in ambient temperatures marked on the equipment and should not be used outside this range.

! CAUTION

The maximum process pressure indicated on the marking must not be exceeded.

! CAUTION

The maximum permitted ambient temperature of the RTT80 temperature transmitter is 80°C. To avoid the effects of process temperature and other thermal effects, care shall be taken to ensure that the electronics housing temperature does not exceed an ambient temperature of 80°C.

Mounting

The transmitter is offered in a basic configuration or with universal or dual compartment housing options. The basic transmitter can be mounted on a flat surface or on a DIN rail using a simple clip.

The transmitter is also offered with either a rugged universal housing, which accommodates the electronics and terminations in a single compartment, or a dual-compartment housing, which isolates and seals the wiring terminals from the electronics compartment. The transmitter in a field housing can be pipe mounted, surface mounted, mounted directly to a bare sensor, or thermowell mounted. See Figure 4 through Figure 8.

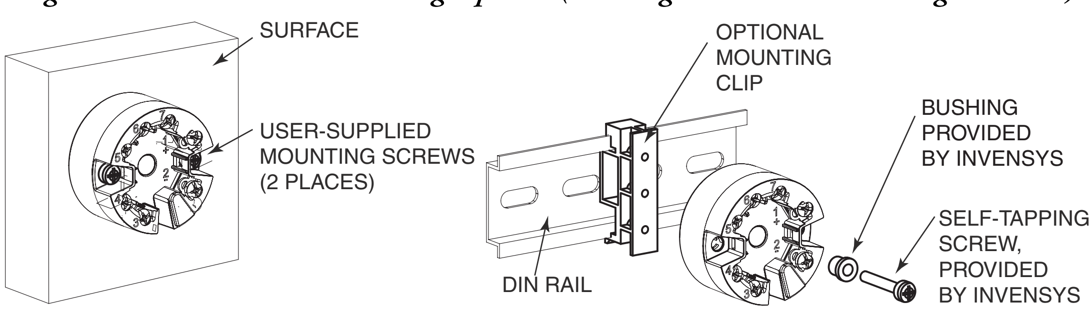
For extremely high process temperatures, a remote mounted sensor is recommended. Also, the mounting stability can influence how the sensor is attached to the transmitter. If the process vessel is highly insulated and the thermowell has considerable lagging, a remote mounted transmitter attached to a 50 mm (2 inch) pipe is recommended. When mounting the transmitter, take into account the necessary room to remove the cover.

Requirements

1. For all versions, the sensor circuit is not infallibly galvanically isolated from the input circuit. However, the galvanic isolation between the circuits is capable of withstanding a test voltage of 500 V ac during 1 minute.
2. For RTT80-F with universal or dual compartment housings, be sure to use cable entries and blanking elements that are suitable for the application and are correctly installed.
3. For all versions with an ambient temperature ≥ 60°C, heat resistant cables with a rating of at least 20 K above the ambient temperature must be used.
4. For Type RTT80-F with Housing and Sensor Mounting Code BB, the transmitter must be mounted in an enclosure in order to provide a degree of ingress protection of at least IP20.
5. For Type RTT80-F with Housing and Sensor Mounting Code BB, the transmitter may only be installed in a potentially explosive atmosphere caused by the presence of combustible dust when mounted in a metal enclosure according to DIN 43729 that is providing a degree of protection of at least IP66/67 in accordance with EN 60529.

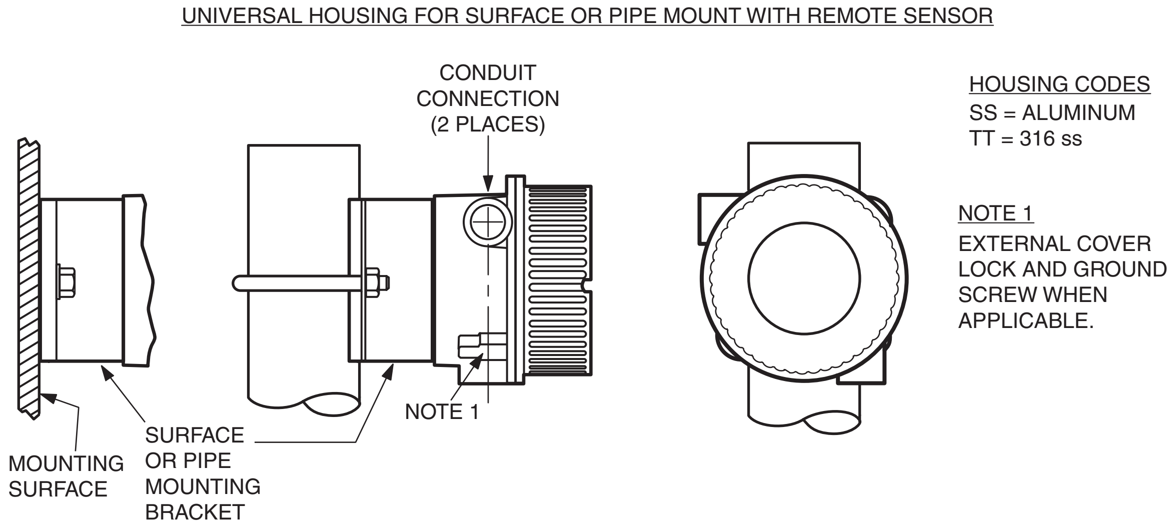
Basic Module Mounting Options

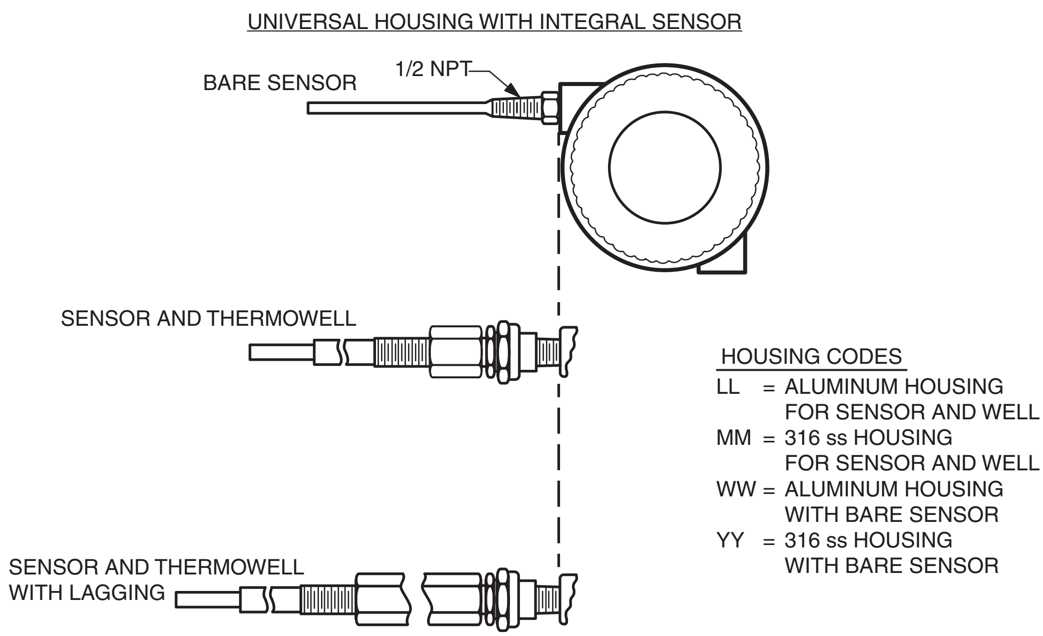
Figure 4. Basic Module Mounting Options (Housing and Sensor Mounting Code BB)



Universal Housing Mounting Options

Figure 5. Universal Housing Mounting Options (Housing and Sensor Mounting Codes SS, TT, LL, MM, WW, and YY)





Dual Compartment Housing Mounting Options

Figure 6. Dual Compartment Housing Mounting Options: Remote Sensor (Housing and Sensor Mounting Codes GG, HH, QQ, and RR)

DUAL COMPARTMENT HOUSING FOR SURFACE OR PIPE MOUNT WITH REMOTE SENSOR

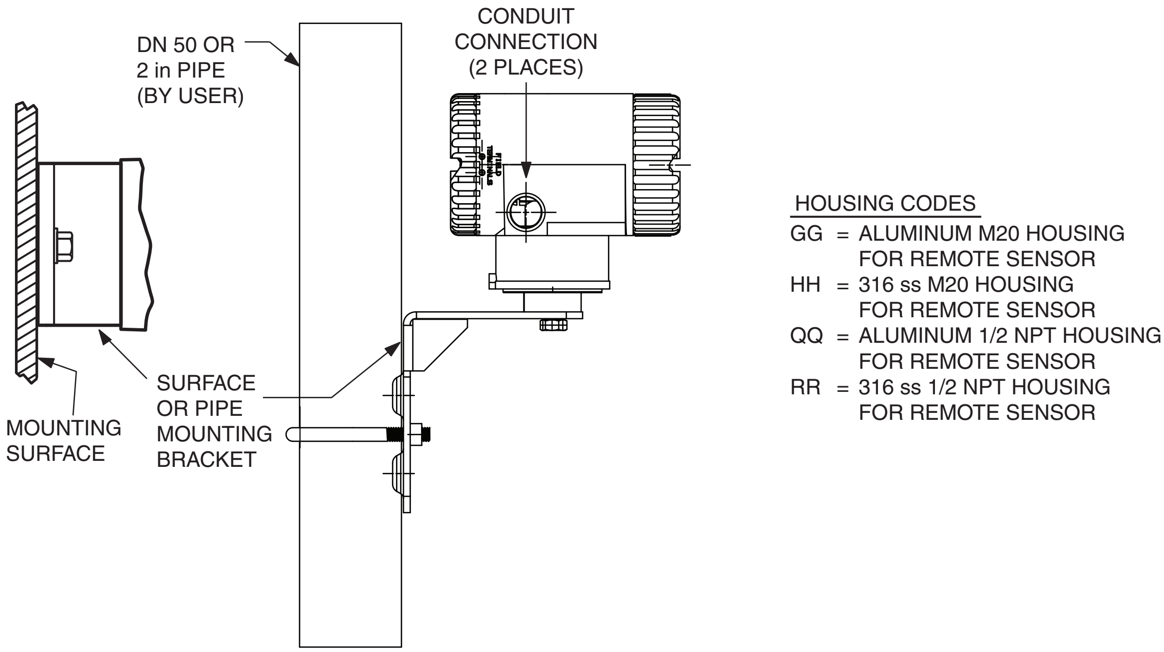
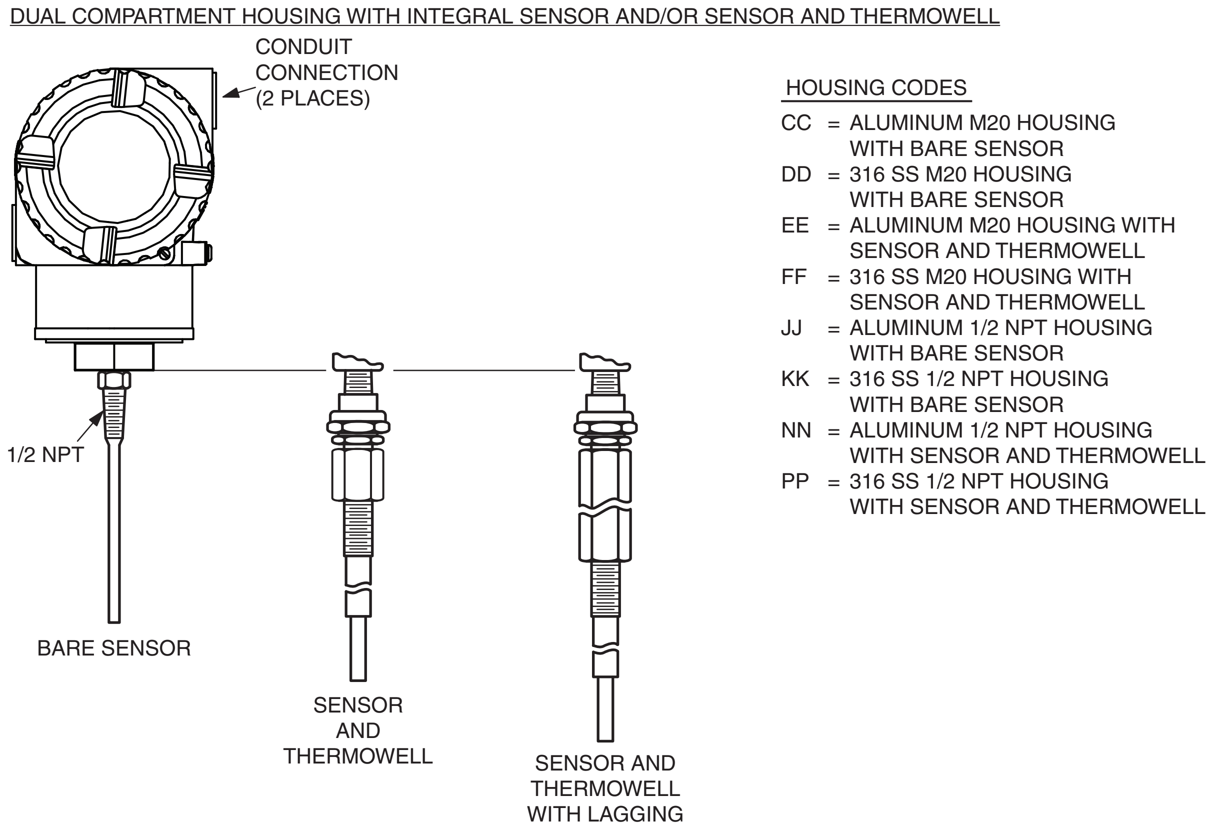
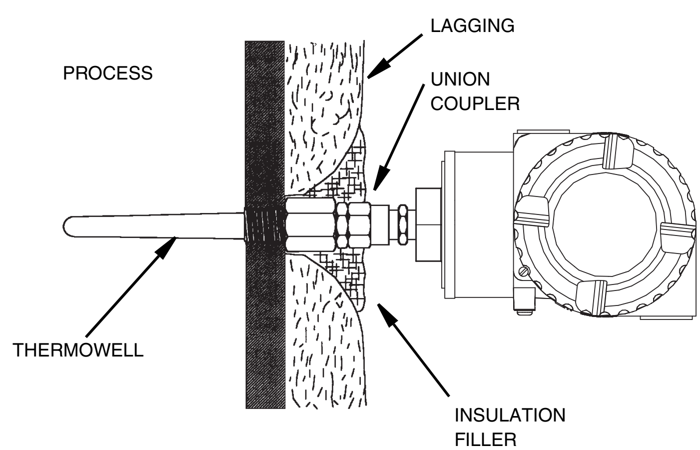


Figure 7. Dual Compartment Housing Mounting Options: Integral Sensor (Housing and Sensor Mounting Codes CC, DD, EE, FF, JJ, KK, NN, and PP)



Thermowell Mounting

Figure 8. Thermowell Mounting (Dual Compartment Housing Shown)



NOTE

The figure above is shown for illustrative purposes only. Conduit entrances should never be facing upward.

Cover Locks

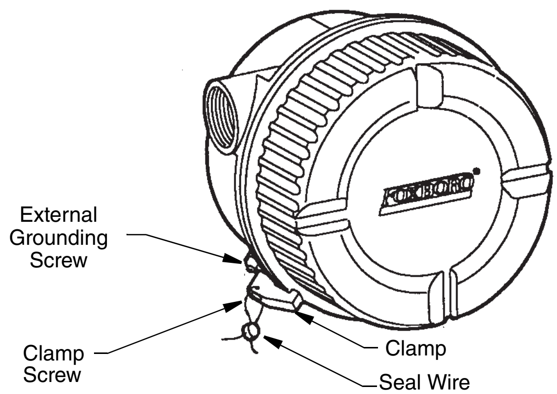
A cover lock is provided as standard with certain agency certifications and as part of the Custody Transfer Lock and Seal option. The type of lock varies with the housing used.

Universal Housing Cover Locks

To lock the cover on the universal housing:

1. Tighten the cover on the housing until the flange on the cover comes into contact with the flange on the housing.
2. Place the clamp as shown below and tighten the clamp screw.
3. Insert the seal wire through the clamp and crimp the seal if applicable.

Figure 9. Universal Housing Cover Lock

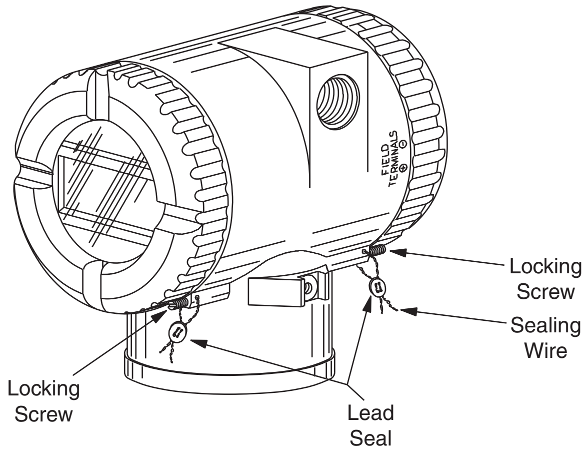


Dual Compartment Housing Cover Locks

To lock the covers on the dual compartment housing:

1. Tighten each cover on the housing until the flange on the cover comes into contact with the flange on the housing.
2. Tighten the locking screw as shown below and tighten the clamp screw.
3. Insert the seal wire through the clamp and crimp the seal if applicable.

Figure 10. Dual Compartment Housing Cover Locks



Wiring

Your transmitter must be installed to meet all local installation regulations, such as hazardous location requirements and electrical wiring codes. Persons involved in the installation must be trained in these code requirements. To maintain agency certification, your transmitter must also be installed in accordance with the agency requirements.

! WARNING

To maintain IEC IP66/67 and NEMA Type 4X protection on transmitters with universal or dual compartment housings, any unused conduit opening must be plugged with a metal plug. In addition, the threaded housing cover must be installed. Hand tighten the cover so that the O-ring is fully captured, making sure that the flange of the cover comes into contact with the flange of the housing

NOTE

It is recommended that you use transient/surge protection in installations prone to high levels of electrical transients and surges.

Input Connections

Terminal Assignment

There are seven terminals on the basic module for input and output connections. Terminals 1 and 2 are for bus power and measurement output and terminals 3 through 7 are for RTD, TC, ohm, or mV sensor inputs. See Figure 11.

In the dual-compartment housing with remote sensor, the bus and sensor connections are made through the terminal block in the customer connection side of the housing. The terminals are identified with the same numbers as the module connections and the wires are color-coded as indicated in Figure 12.

Figure 11. Input Connections on the Basic Module and Universal Housing

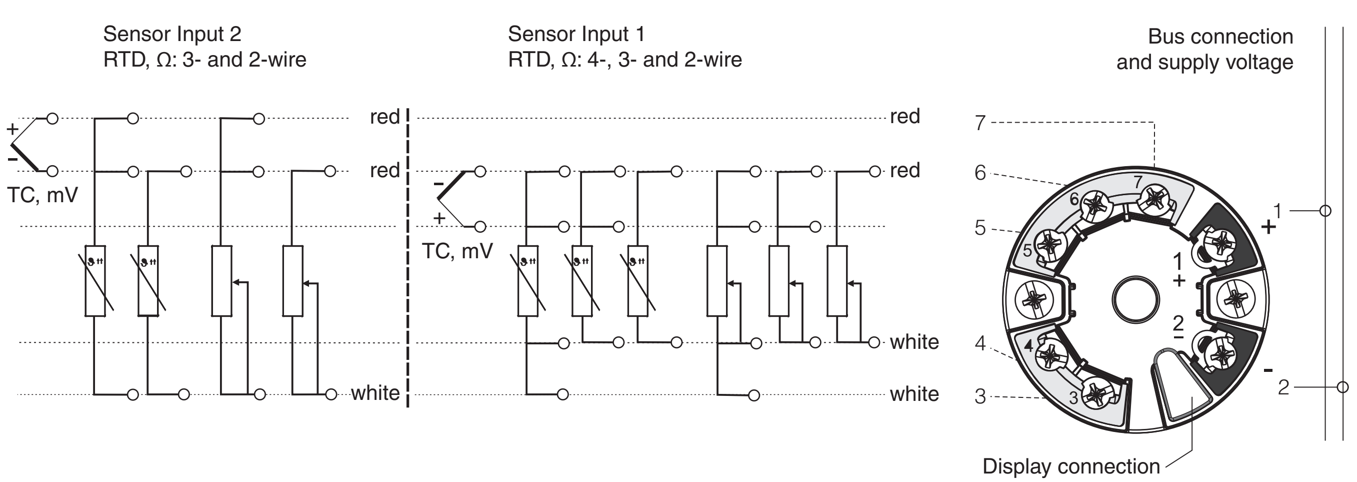
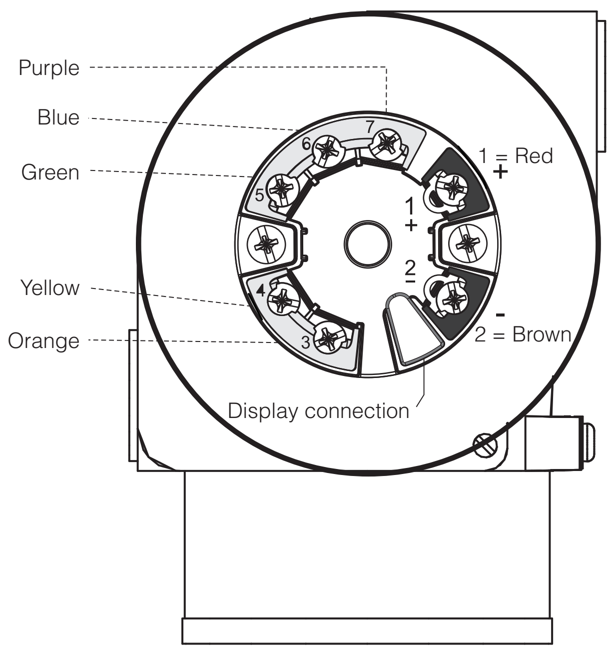


Figure 12. Dual Compartment Housing Wiring from the Terminal Block to the Module



Connecting the Sensor Cables

When connecting two sensors, ensure that there is no galvanic connection between the sensors (for example, caused by sensor elements that are not isolated from the thermowell). The resulting equalizing currents distort the measurements considerably. In this situation, the sensors must be galvanically isolated from one another by connecting each sensor separately to a transmitter. The device provides sufficient galvanic isolation (> 2 kV ac) between the input and output.

The following connection combinations are possible when both sensor inputs are assigned:

Table 7. Input Types

		Sensor 1			
		2-wire RTD	3-wire RTD	4-wire RTD	Thermocouple
Sensor 2	2-wire RTD	Ok	Ok	N/A	Ok
	3-wire RTD	Ok	Ok	N/A	Ok
	Thermocouple	Ok	Ok	Ok	Ok

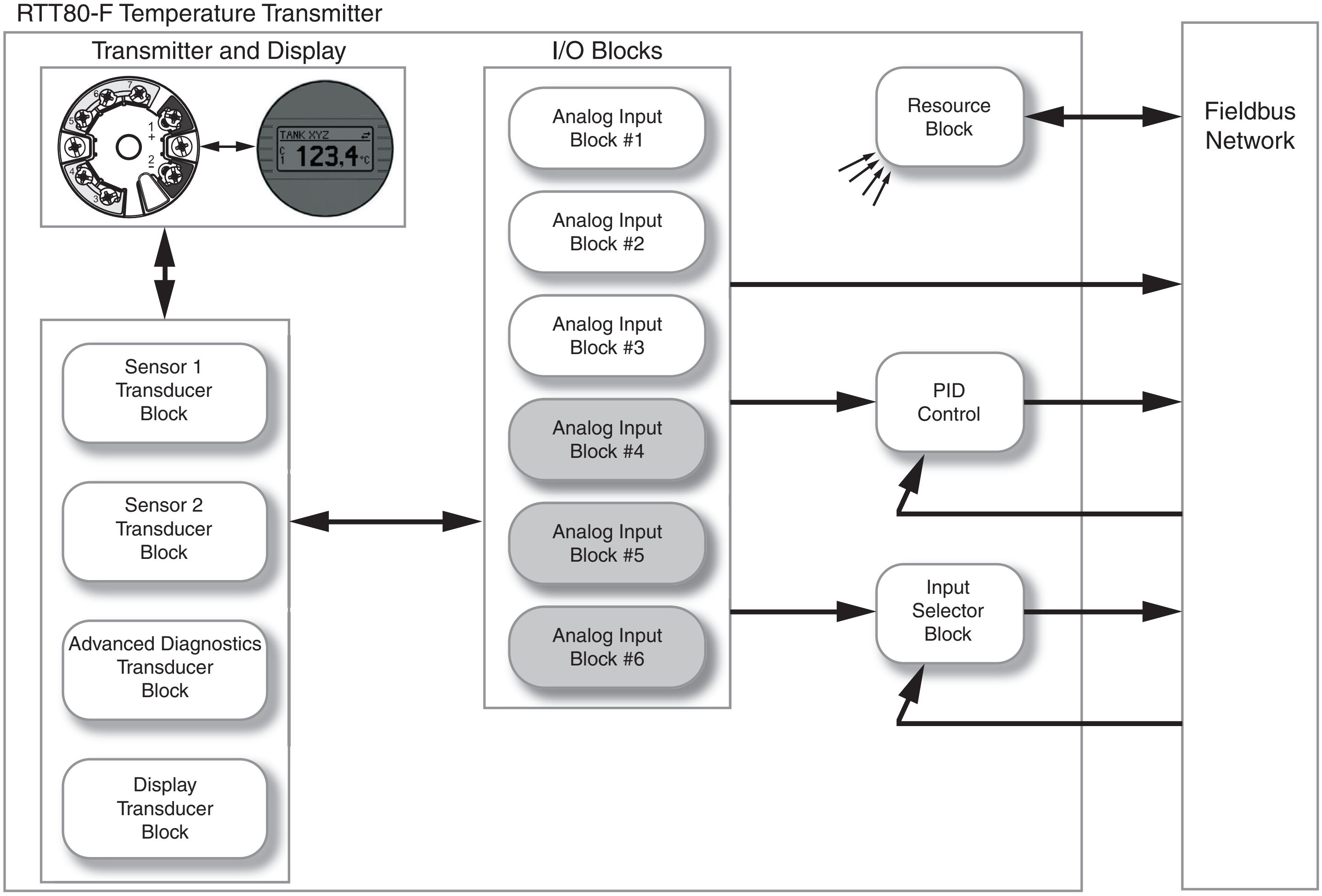
3. Configuration and Operation

RTT80-F Block Model

The RTT80-F uses the following FOUNDATION fieldbus block types:

- One Resource block, which contains all the device-specific features of the RTT80-F.
- Four Transducer blocks:
  - One Sensor 1 Transducer block
  - One Sensor 2 Transducer block
  - One Advanced Diagnostic Transducer block
  - One Display Transducer block
- Multiple Function blocks, each of which executes different application functions of the RTT80-F:
  - Three Analog Input Function Blocks, and three additional Analog Input Function Blocks that can be instantiated
  - One PID Function Block.
  - One Input Selector Function Block

Figure 13. RTT80-F Block Model



Resource Block

The Resource Block is used to define hardware specific characteristics of the Function Block Applications. It provides manufacturer name, device name, DD, block status, and hardware details. It also indicates how much resource (memory and CPU) is available and controls the overall device. All data is modeled within a controlled space so that no outside inputs into this block are required; that is, the Resource block cannot be linked to other blocks.

This parameter "set" is intended to be the minimum required for the function block application associated with the resource in which it resides. Some parameters that could be in the set, like calibration data and ambient temperature, are part of their respective transducer blocks.

Parameters `MANUFAC_ID`, `DEV_TYPE` `DEV_REV`, and `DD_REV` are required to identify and locate the DD so that Device Description Hosting Services can select the correct DD for use with the resource. The parameter `HARD_TYPES` is a read only bit string that indicates the types of hardware that are available to this resource. If an I/O block is configured that requires a type of hardware that is not available, the result is a block alarm for a configuration error.

Operating Mode

The "mode" is used to control major states of the resource, and is set by means of the MODE_BLK parameter group. The Resource Block supports the following operating modes:

- OOS (out of service) mode stops all function block execution. The actual mode of the function blocks is changed to OOS but the target mode is not changed.
- Auto (automatic) mode allows normal operation of the resource.
- Man (manual) mode shows that the resource is initialized or receiving a software download.

NOTE

The OOS block status is also displayed by means of the BLOCK_ERR parameter, described on page 61. In OOS mode, all write parameters can be accessed without restriction if write protection has not been enabled.

Block Status

The RS_STATE parameter contains the operational state of the Function Block Application for the resource containing this resource block.

- STANDBY: The Resource Block is in the OOS operating mode. It is not possible to execute the remaining function blocks.
- ONLINE LINKING: The configured connections between the function blocks have not yet been established.
- ONLINE: Normal operating status, the Resource Block is in the AUTO operating mode. The configured connections between the function blocks have been established.

RESTART Parameter

The RESTART parameter allows degrees of initialization of the resource. They are:

- Run: Passive state of the parameter
- Restart resource: Intended to clear up problems (for example, the memory management resource)
- Restart with defaults: Intended to wipe configuration memory. It works like a factory initialization.
- Restart processor: Provides a way to hit the reset button on the processor associated with the resource.

Nonvolatile Parameters

All nonvolatile parameters are saved in EEPROM and therefore used if the device is restarted.

Timeout for Remote Cascade Modes

Parameters SHED_RCAS and SHED_ROUT set the time limit for loss of communication from a remote device. These constants are used by all function blocks that support a remote cascade mode. The effect of a timeout is described in Mode Calculation. Shedding from RCAS/ROUT does not happen when SHED_RCAS or SHED_ROUT is set to zero.

Alert Notification

The MAX_NOTIFY parameter value is the maximum number of alert reports that this resource can have sent without getting a confirmation, corresponding to the amount of buffer space available for alert messages. You can set the number lower than that, to control alert flooding, by adjusting the LIM_NOTIFY parameter value. If LIM_NOTIFY is set to zero, no alerts are reported. The CONFIRM_TIME parameter is the time for the resource to wait for confirmation of receipt of a report before trying again. If CONFIRM_TIME = 0, the device does not retry.

FEATURES and FEATURE_SEL Parameters

These parameters determine optional behavior of the resource. FEATURES defines the available features and is read only. FEATURE_SEL is used to turn on an available feature by configuration. If a bit is set in FEATURE_SEL that is not set in FEATURES, the result is a block alarm for a configuration error. The device supports the following features: Reports supported, Fault State supported, and Soft Write lock supported.

Fault State for Whole Resource

If you set the SET_FSTATE parameter, the FAULT_STATE parameter indicates active and causes all output function blocks in the resource to go immediately to the condition chosen by the fault state Type I/O option. It can be cleared by setting the CLR_FSTATE parameter. The set and clear parameters do not appear in a view because they are momentary.

Write Lock

DIP switches on the optional local display allow device parameter write protection in the Analog Input Function Block to be disabled or enabled. When write protection is on, the device data cannot be altered via the Foundation fieldbus interface. Similarly, device data can be altered when write protection is off.

The WRITE_LOCK parameter shows the status of the hardware write protection. The following statuses are possible:

- LOCKED: The device data cannot be altered via the FOUNDATION fieldbus interface.
- NOT LOCKED: The device data can be altered via the FOUNDATION fieldbus interface.

If the write protection is disabled, the alarm priority specified in the WRITE_PRI parameter is checked before the status change is relayed to the fieldbus host system. The alarm priority specifies the behavior in the event of an active write protection alarm WRITE_ALM.

NOTE
If the option of a process alarm was not activated in the ACK_OPTION parameter, this process alarm must only be acknowledged in the BLOCK_ALM parameter.

Other Implemented Features

The CYCLE_TYPE parameter is a bit string that defines the types of cycles that this resource can do. CYCLE_SEL allows the configurator to choose one of them. If CYCLE_SEL contains more than one bit, or the bit is not set in CYCLE_TYPE, the result is a block alarm for a configuration error. MIN_CYCLE_T is the manufacturer specified minimum time to execute a cycle. It puts a lower limit on the scheduling of the resource.

The MEMORY_SIZE parameter declares the size of the resource for configuration of function blocks, in kilobytes. The FREE_SPACE parameter shows the percentage of configuration memory that is still available. FREE_TIME shows the approximate percentage of time that the resource has left for processing new function blocks, should they be configured.

Block Error

The BLOCK_ERR parameter reflects the following causes:

- ♦ Device Fault State Set - When FAULT_STATE is active
- ♦ Simulate Active - When the Simulate DIP switch is activated
- ♦ Out of Service - When the block is in OOS mode.

Transducer Blocks

The Transducer Block contains all of the manufacturer-specific parameters that define how the RTT80-F Transmitter functions. All the settings directly connected with the application (temperature measurement) are made here. They form the interface between sensor-specific measured value processing and the Analog Input function blocks required for automation. Selections, such as setting of input type, engineering units, defining the dual functionality when using the dual input, and so forth, are performed in this block. The Transducer Block allows you to select a large number of sophisticated functions. Therefore, the configuration of the transmitter must be carried out with greatest possible care.

A Transducer Block allows you to influence the input and output variables of a function block. The parameters of a Transducer Block include information on the sensor configuration, physical units, calibration, damping, error messages, as well as the device-specific parameters.

The RTT80-F ships with the following Transducer Blocks:

- ♦ Sensor 1 Transducer Block contains parameters and functions for Sensor 1 associated with measuring the input variables
- ♦ Sensor 2 Transducer Block contains parameters and functions for Sensor 2 associated with measuring the input variables
- ♦ Display Transducer Block contains parameters that allow display configuration
- ♦ Advanced Diagnostic Transducer Block contains parameters for monitoring and diagnosing issues.

Sensor 1 and Sensor 2 Transducer Blocks

The Sensor 1 and Sensor 2 Transducer Blocks analyze the signals of both sensors and display them as a physical variable (value, measured value status, and unit). Two physical measured values and an additional primary value which is mathematically calculated from the sensor values (the PRIMARY_VALUE) are available in each Sensor Transducer Block:

- ♦ The sensor value (SENSOR_VALUE) and its unit (SENSOR_RANGE • UNITS_INDEX)
- ♦ The value of the internal temperature measurement of the device (DEVTEMP_VALUE) and its unit (DEVTEMP_UNIT)
- ♦ The primary value (PRIMARY_VALUE • VALUE) and its unit (PRIMARY_VALUE_UNIT)

The internal temperature measurement of the reference junction is analyzed in both Transducer Blocks but both values are identical. A third value in the block, the PRIMARY_VALUE, is formed from the sensor values.

The rule for forming the PRIMARY_VALUE can be selected in the PRIMARY_VALUE_TYPE parameter. The sensor value can be mapped unchanged in PRIMARY_VALUE but there is also the option of forming the differential value or mean value for both sensor values. In addition, various additional functions for connecting the two sensors are also available.

These can help increase process safety, like the backup function or sensor drift detection.

- ♦ Backup Function

  If a sensor fails, the system automatically switches to the remaining sensor and a diagnostic message is generated in the RTT80. The backup function ensures that the process is not interrupted by the failure of an individual sensor and that an extremely high degree of measurement availability is achieved.

- ♦ Sensor Drift Detection

  If two sensors are connected and the measured values differ by a specified amount, the RTT80 generates a diagnostic message. The drift detection function can be used to verify the correctness of the measured values and for mutual monitoring of the connected sensors. Sensor drift detection is configured in the Advanced Diagnostic Transducer Block. See page 44.

The electronics can be configured for various sensors and measured variables by means of the SENSOR_TYPE parameter. See Table 2 and Table 3 for sensor types available.

If resistance thermometers or resistance transmitters are connected, the type of connection can be selected by means of the SENSOR_CONNECTION parameter. If the “two-wire” type of connection is used, the TWO_WIRE_COMPENSATION parameter is available. This parameter is used to store the resistance value of the sensor connection cables.

The resistance value can be calculated as follows:

- Total cable length: 100 m
- Conductor cross-section: 0.5 mm^2
- Conductor material: copper
- Resistivity of Cu: 0.0178 Ω * mm^2/m

R = 0.0178 Ω * mm^2/m * (2 * 100 m)/0.5 mm^2 = 7.12 Ω

Resulting measured error = 7.12 Ω / 0.385 Ω/K = 18.5 K

NOTE

The Transducer Blocks for sensor 1 and 2 have a Wizard (configuration assistant) for calculating the resistance of sensor cables with different material properties, cross-sections, and lengths.

When measuring temperature with thermocouples, the type of reference junction compensation is specified in the RJ_TYPE parameter. For the compensation, the internal terminal temperature measurement of the device (INTERNAL) can be used or a fixed value can be specified (EXTERNAL). This value has to be entered in the RJ_EXTERNAL_VALUE parameter.

The units displayed are selected with the PRIMARY_VALUE_UNIT and SENSOR_RANGE • UNITS_INDEX parameters. Ensure that the units selected physically suit the measured variables.

NOTE

The Sensor 1 and 2 Transducer Blocks each make the "Quick Setup" Wizard available to configure the measuring settings quickly and safely.

Sensor error adjustment can be performed with the sensor offset. Here, the difference between the reference temperature (target value) and the measured temperature (actual value) is determined and entered in the SENSOR_OFFSET parameter. This offsets the standard sensor characteristic in parallel and an adjustment between the target value and actual value is performed.

The Sensor 1 and 2 Transducer Blocks also give users the option of linearizing any sensor type by entering polynomial coefficients. The design provides for three types:

- Linear scaling of temperature-linear curve
- Linearization of platinum resistance thermometers with the aid of Callendar-Van Dusen coefficients
- Linearization of copper/nickel resistance thermometers (RTD)

Linear Scaling of Temperature-linear Curve

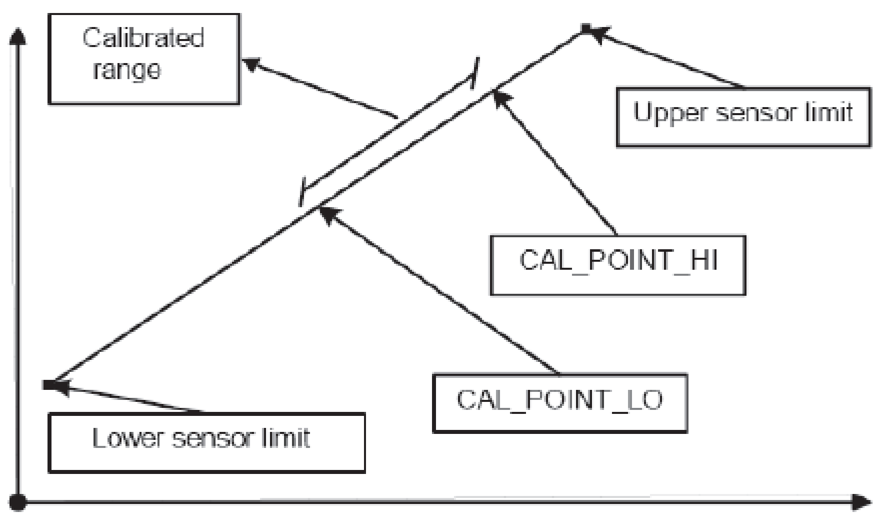
With the aid of linear scaling (offset and slope), the complete measuring point (measuring device and sensor) can be adapted to the desired process.

1. Switch the setting for the SENSOR_CAL_METHOD parameter to "user trim standard calibration". Then apply the lowest process value to be expected (for example, -10°C) to the sensor of the device. This value is then entered in the CAL_POINT_LO parameter. Make sure that the status for SENSOR_VALUE is "Good".

2. Now expose the sensor to the highest process value to be expected (for example, 120°C). Again, ensure the status is “Good” and enter the value in the CAL_POINT_HI parameter. The device now precisely shows the specified process value at the two calibrated points. The curve follows a straight line between the points.
3. The SENSOR_CAL_LOC, SENSOR_CAL_DATE, and SENSOR_CAL_WHO parameters are available to track sensor calibration. The place, date and time of calibration can be entered here as well as the name of the person responsible for the calibration.
4. To undo sensor input calibration, the SENSOR_CAL_METHOD parameter is set to “Factory Trim Standard Calibration”.

NOTE
Menu guidance via the “User Sensor Trim” Wizard is available for linear scaling. The “Factory Trim Settings” Wizard can be used to reset the scaling.

Figure 14. Linear Scaling of Temperature-Linear Curve



Linearization of platinum resistance thermometers with the aid of Callendar-Van Dusen coefficients

The coefficients R0, A, B, C can be specified in the CVD_COEFF_R0, CVD_COEFF_A, CVD_COEFF_B, CVD_COEFF_C parameters. To activate this linearization, select the “RTD Callendar Van Dusen” setting in the SENSOR_TYPE parameter. In addition, the upper and lower calculation limits have to be entered in the CVD_COEFF_MIN and CVD_COEFF_MAX parameters.

NOTE
The Callendar-Van Dusen coefficients can also be entered by means of the “Callendar Van Dusen” wizard.

Linearization of copper/nickel resistance thermometers (RTD)

The coefficients R0, A, B, C can be specified in the POLY_COEFF_R0, POLY_COEFF_A, POLY_COEFF_B, POLY_COEFF_C parameters. To activate this linearization, select the “RTD

Polynom Nickel" or "RTD Polynom Copper" setting in the SENSOR_TYPE parameter. In addition, enter the upper and lower calculation limits in the POLY_COEFF_MIN and POLY_COEFF_MAX parameters.

NOTE
The coefficients for nickel and copper polynoms can be entered with the aid of a wizard in the Sensor 1 and 2 Transducer Blocks.

Each of the values can be passed onto an AI function block or shown on the display. The AI and the Display Block make further options available for displaying and scaling measured values.

Default Configuration

The transmitter is shipped with a default configuration that suits the user's requirements in many cases. The configuration task has thus been reduced considerably. The complete list of configurable default configurations are shown in "FOUNDATION Fieldbus Parameters" on page 60 but briefly, it contains:

- SENSOR_TYPE: Pt100 Sensor IEC 751 (a=0.00385)
- PRIMARY_VALUE_UNIT: °C
- SENSOR_CONNECTION: 3-wire

Block Output Variables

The following table shows which output variables (process variables) the Transducer Blocks make available. The CHANNEL parameter in the Analog Input function block is used to assign which process variable is read in and processed in the downstream Analog Input function block.

Block	Process Variable	Channel Parameter (AI Block)	Channel
Sensor 1 Transducer Block	Primary Value	Primary Value 1	1
	Sensor Value	Sensor Value 1	3
	Device temperature value	Device temperature	5
Sensor 2 Transducer Block	Primary Value	Primary Value 2	2
	Sensor Value	Sensor Value 2	4
	Device temperature value	Device temperature	6

Operating Mode

The "mode" is used to control major states of the resource, and is set by means of the MODE_BLK parameter group, described on page 69. Transducer Blocks support the following operating modes:

- OOS (out of service) mode stops all function block execution. The actual mode of the function blocks is changed to OOS but the target mode is not changed.
- Auto (automatic) mode allows normal operation of the resource.
- Man (manual) mode shows that the resource is initialized or receiving a software download.

The OOS block status is also displayed by means of the BLOCK_ERR parameter, described on page 61.

Alarm Detection and Processing

The Transducer Block does not generate any process alarms. The status of the process variables is evaluated in the downstream Analog Input function blocks. If the Analog Input function block receives no input value that can be evaluated from the Transducer Block, then a process alarm is generated. This process alarm is displayed in the BLOCK_ERR parameter of the Analog Input function block (BLOCK_ERR = Input Failure).

The BLOCK_ERR parameter of the Transducer Block displays the device error that produced the input value that could not be evaluated and thus triggered the process alarm in the Analog Input function block.

Selecting the Units

The system units selected in the Transducer Blocks do not have any effect on the desired units that will be transmitted by means of the FOUNDATION fieldbus interface. This setting is made separately via the corresponding AI Block in the XD_SCALE parameter group. The unit selected in the Transducer Blocks is only used for the onsite display and for displaying the measured values within the Transducer Block in the configuration program in question.

Advanced Diagnostic Transducer Block

The “Advanced Diagnostic” Transducer Block is used to configure and display all the diagnostic functions of the transmitter. Such functions that are displayed here include:

- Corrosion detection
- Drift detection
- Ambient temperature monitoring

Corrosion Monitoring

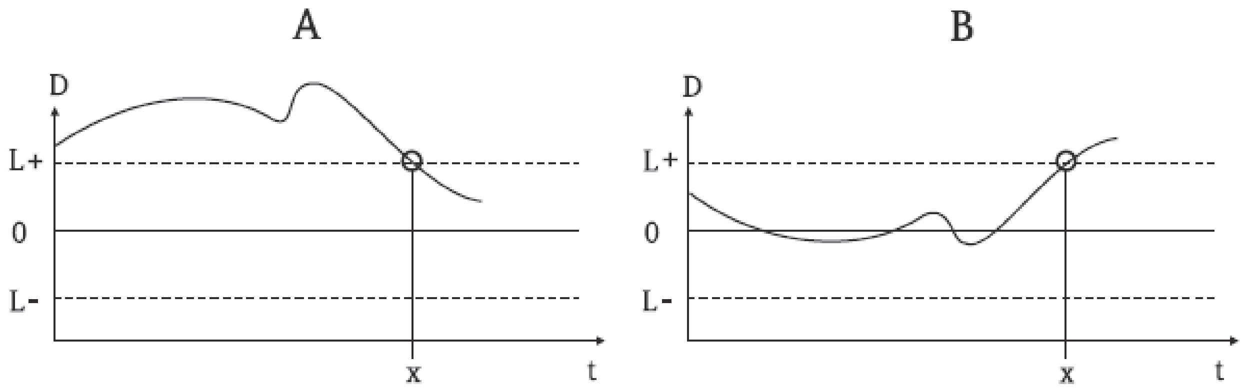
Sensor connection cable corrosion can lead to false measured value readings. The RTT80 offers the ability to detect any corrosion before a measured value is affected. Corrosion monitoring is only possible for RTDs with a 4-wire connection or thermocouples. Refer to “Corrosion Monitoring” on page 114 for additional information.

Drift Detection

Drift detection can be configured with the SENSOR_DRIFT_MONITORING parameter. Drift detection can be enabled or disabled.

If drift detection is enabled and a drift occurs, an error or maintenance prompt is output. A distinction is made between 2 different modes (SENSOR_DRIFT_MODE). In the “Overshooting” mode, a status message is output if the limit value (SENSOR_DRIFT_ALERT_VALUE) for the drift is overshot, or, as the case may be, if the limit value is undershot in the “Undershooting” mode. See Figure 15.

Figure 15. Drift Detection



A = "Undershooting" mode
B = "Overshooting" mode
D = Drift
L+, L- = Upper (+) or lower (-) limit value
t = Time
x = Error or prompt for maintenance, depending on the configuration

In addition, the entire status information of the device and the maximum indicators of the two sensor values and the internal temperature are available.

Display Transducer Block

The Display Transducer Block allows you to show the measured values from Sensor 1 and Sensor 2 Transducer Blocks on the optional local display. You can configure the display to alternate between up to three values. The RTT80-F will display each value for a configurable number of seconds and then will automatically switch the display to the next value. Depending on the value selected, the corresponding units (°C, K, F, %, mV, R and Ω) will also appear on the display.

To configure the Display Transducer Block, you need to configure the following parameters (where <*num*> is 1, 2, or 3):

- `DISPLAY_SOURCE_<num>` allows you to select the value you want to display
- `DISP_VALUE_<num>_FORMAT` allows you to configure the number of decimal places
- `ALTERNATING_TIME` allows you to select the number of seconds each value will appear on the display (0 to 60 seconds)

For example, suppose you wanted to see the display alternate between the following three values, and wanted to display each value for 12 seconds:

Value 1:

Measured value to be displayed:	Primary Value of Sensor Transducer 1 (PV1)
Measured value unit:	°C
Decimal Places	2

Value 2:

Measured value to be displayed:	DEVTEMP_VALUE
Measured value unit:	°C
Decimal Places	1

Value 3:

Measured value to be displayed: Sensor Value (measured value) of Sensor Transducer 2 (SV2)

Measured value unit: °C

Decimal Places 2

To achieve this, you would set the Display Transducer Block as follows:

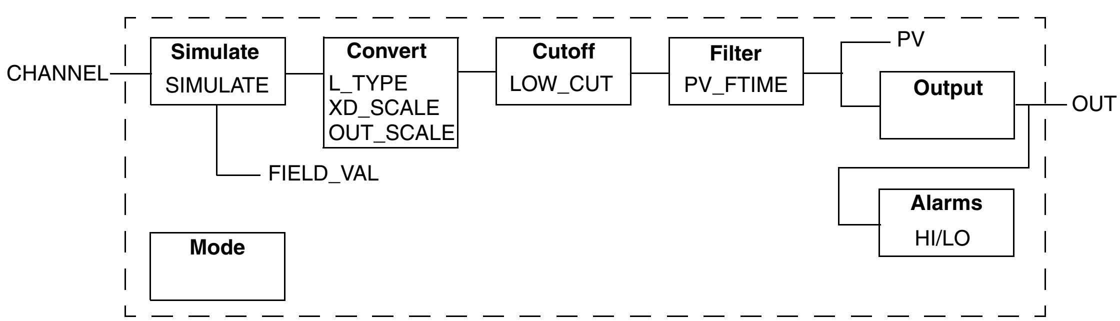
Parameter	Value
DISP_SOURCE_1	‘Primary Value 1’
DISP_VALUE_1_DESC	TEMP PIPE 11
DISPLAY_VALUE_1_FORMAT	‘xxx.xx’
DISP_SOURCE_2	‘DEVTEMP_VALUE’
DISP_VALUE_2_DESC	INTERN TEMP
DISPLAY_VALUE_2_FORMAT	‘xxxx.x’
DISP_SOURCE_3	‘Sensor value 2’
DISP_VALUE_3_DESC	PIPE 11 BACK
DISPLAY_VALUE_3_FORMAT	‘xxx.xx’
ALTERNATING_TIME	12

Analog Input (AI) Function Block

In the Analog Input (AI) function block, the process variables of the Transducer Blocks are prepared for subsequent automation functions (for example, linearization, scaling, and limit value processing). The automation function is defined by connecting up the outputs.

The RTT80-F has three Analog Input (AI) Blocks that must be configured individually, and three additional blocks that can be instantiated. The AI Block takes the manufacturer input data, selected by channel number, and makes it available to other function blocks at its output.

Figure 16. Analog Input Block Schematic



Transducer scaling (`XD_SCALE`) is applied to the value from the channel to produce the `FIELD_VAL` in percent. The `XD_SCALE` units code must match the channel units code or the an error message is generated. The `OUT_SCALE` is normally the same as the transducer, but if `L_TYPE` is set to `Indirect` or `Ind Sqr Root`, `OUT_SCALE` determines the conversion from `FIELD_VAL` to the output. `PV` and `OUT` always have identical scaling.

OUT_SCALE provides scaling for PV. The PV is always the value that the block places in OUT if the mode is Auto. If Man is allowed, you can write a value to the output. The status prevents any attempt at closed loop control using the Man value, by setting the Limit value to Constant.

The LOW_CUT parameter has a corresponding "Low cutoff" option in the IO_OPTS bit string. If the option is true, any calculated output below the low cutoff value is changed to zero. This is only useful for zero-based measurement devices, such as flow. The PV filter, whose time constant is PV_FTIME, is applied to the PV and not the FIELD_VAL.

Equations:

FIELD_VAL = 100*(channel value - EU@100%)/(EU@100% - EU@0%) [XD_SCALE]

Direct: PV = channel value

Indirect: PV = (FIELD_VAL/100)*(EU@100% - EU@0%) + EU@0% [OUT_SCALE]

Ind Sqr Root: PV = sqrt(FIELD_VAL/100)*(EU@100% - EU@0%) + EU@0% [OUT_SCALE]

Supported Modes

OOS, Man, and Auto

Alarm Types

Standard block alarms plus HI_HI, HI, LO_LO, and LO alarms applied to OUT.

Mode Handling

Standard transition in and out of OOS.

Standard transition from Man to Auto and back.

Status Handling

The status values described in Output parameter Formal Model of Part 1 apply with the exception of the control substatus values. The Uncertain - EU Range Violation status is always set if the OUT value exceeds the OUT_SCALE range and no worse condition exists. The following options from STATUS_OPTS apply, where Limited refers to the sensor limits:

Propagate Fault Forward
Uncertain if Limited
BAD if Limited
Uncertain if Man mode.

Initialization

The PV filter must be initialized. Other than that, no special initialization is required. This is a pure calculation algorithm.

PID Function Block

A PID function block contains the input channel processing, the proportional integral differential control (PID) and the analog output channel processing. The configuration of the PID function block depends on the automation task. The PID block can carry out basic controls, feedforward control, cascade control, and cascade control with limiting.

Figure 17. PID Block Parameter Summary

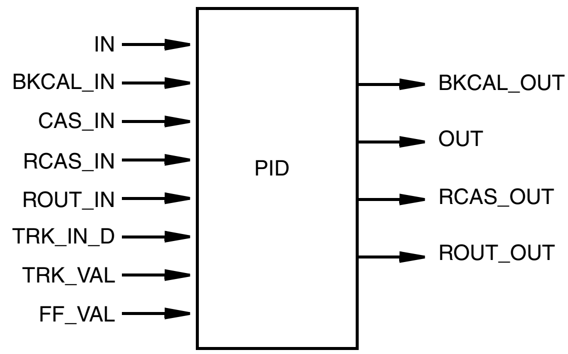
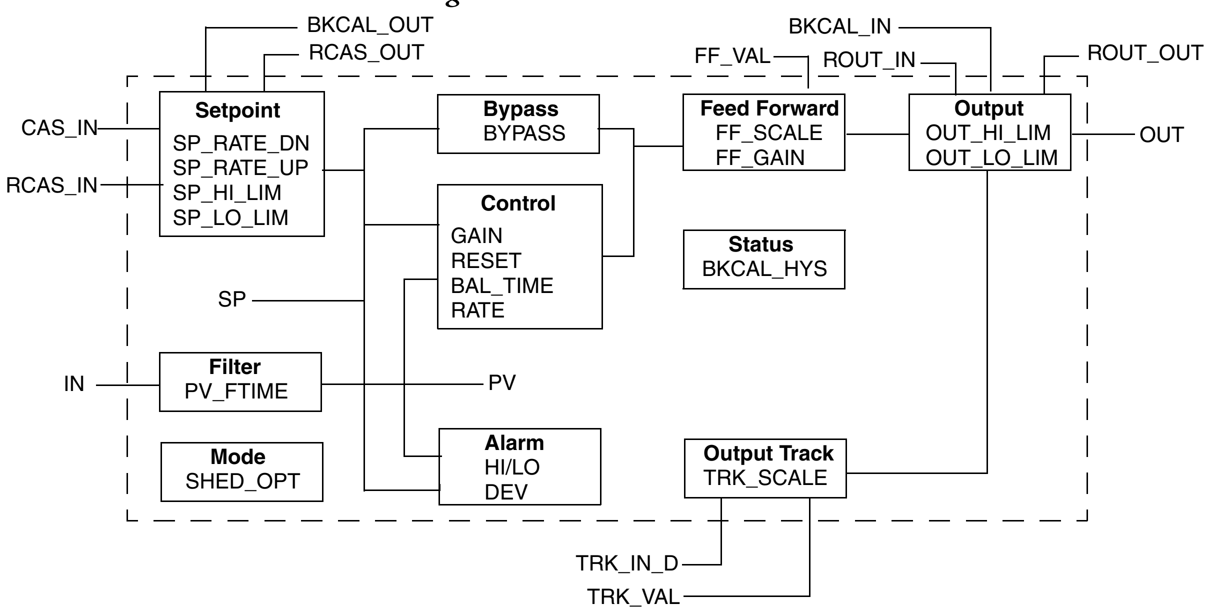


Figure 18. PID Block Schematic



The process value to be controlled is connected to the `IN` input. This value is passed through a filter whose time constant is `PV_FTIME`. The value is then shown as the `PV`, which is used in conjunction with the `SP` in the PID algorithm. A PID does not integrate if the limit status of `IN` is constant. A full PV and DV alarm subfunction is provided. The `PV` has a status, although it is a Contained parameter. This status is a copy of the `IN` status unless `IN` is good and there is a PV or block alarm.

The full cascade SP subfunction is used with rate and absolute limits. There are additional control options which cause the `SP` value to track the `PV` value when the block is in an actual mode of `IMan`, `LO`, `Man`, or `Rout`. Limits do not cause SP-PV tracking.

There is a switch for BYPASS, which is available to the operator if the Bypass Enable control option is true. BYPASS is used in secondary cascade controllers that have a bad PV. The Bypass Enable option is necessary because not all cascade control schemes are stable if BYPASS is true. BYPASS can only be changed when the block mode is Man or OOS. While it is set, the value of SP, in percent of range, is passed directly to the target output, and the value of OUT is used for BKCAL_OUT. When the mode is changed to Cas, the upstream block is requested to initialize to the value of OUT. When a block is in Cas mode, then on the transition out of BYPASS, the upstream block is requested to initialize to the PV value, regardless of the "Use PV for BKCAL_OUT" option.

GAIN, RESET, and RATE are the tuning constants for the P, I, and D terms, respectively. GAIN is a dimensionless number. RESET and RATE are time constants expressed in seconds. There are existing controllers that are tuned by the inverse value of some or all of them, such as proportional band and repeats per minute. The human interface to these parameters should be able to display your preference. The Direct Analog control option, if true, causes the output to increase when the PV exceeds the SP. If false, the output decreases when the PV exceeds the SP. It makes the difference between positive and negative feedback, so it must be set properly and never changed while in automatic mode. The setting of the option must also be used in calculating the limit state for BKCAL_OUT.

The output supports the feed-forward algorithm. The FF_VAL input brings in an external value which is proportional to some disturbance in the current loop. The value is converted to percent of output span using the values of parameter FF_SCALE. This value is multiplied by the FF_GAIN and added to the target output of the PID algorithm. If the status of FF_VAL is Bad, the last usable value is used because this prevents bumping the output. When the status returns to Good, the block adjusts its integral term to maintain the previous output.

The output supports the track algorithm.

There is an option to use either the SP value after limiting or the PV value for the BKCAL_OUT value.

Supported Modes

OOS, IMan, LO, Man, Auto, Cas, RCas, and Rout

Alarm Types

Standard block alarm plus standard HI_HI, HI, DV_HI, DV_LO, LO, and LO_LO alarms applied to PV

Mode Handling

Standard transition in and out of OOS

Status Handling

Standard, plus the following things for the control selector. If Not Selected is received at BKCAL_IN, the PID algorithm should make necessary adjustments to prevent windup.

Initialization

Standard

Input Selector Function Block

The signal selector block (Input Selector block = ISEL) provides selection of up to four inputs and generates an output based on the configured action.

Configuration

Hardware Settings

DIP switches on the rear of the display are used to enable and disable hardware write protection and the simulation mode (for the Analog Input block), and to rotate the display 180 degrees. When write protection is active, parameters cannot be modified. The current write protection status is displayed in the `WRITE_LOCK` parameter (see “Write Lock” on page 38).

The simulation mode via the hardware setting must be changed before the software setting.

! CAUTION

Protect the terminals from electrostatic discharge. Failure to observe this may result in destruction or malfunction of parts of the electronics.

To set the DIP switches, proceed as follows:

1. Open the cover of the terminal head or field housing.
2. Remove the attached display from the transmitter by gently pulling the display away from the module.
3. Configure the DIP switch on the rear of the display according to your preferences. Setting the DIP switch to ON enables the associated function, and setting it to OFF disables the associated function.
4. Fit the display onto the transmitter in the correct position, making sure the pins on the module are aligned with the header on the display. The transmitter accepts the settings within one second.
5. Secure the cover back onto the terminal head or field housing.

NOTE

The DIP switch settings are no longer valid as soon as the display is removed from the transmitter.

Figure 19. Display DIP Switches

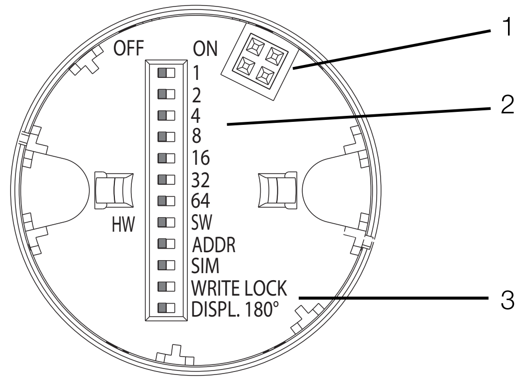


Table 8. Display DIP Switches

Display	Information
1	Connector to RTT80 transmitter
2	DIP switches 1 through 64, HW/SW, ADDR ACTIVE – Factory use only
3	SIM, WRITE LOCK, DISP 180° - Set to ON/OFF

Function Check

Before commissioning the measurement point make sure that all final checks have been carried out. Refer to "Post-Connection Check and Troubleshooting" on page 86.

NOTE

1. The FOUNDATION fieldbus interface's technical data must be maintained in accordance with IEC 61158-2 (MBP).
2. The bus voltage of 9 to 32 V and the current consumption of approximately 11 mA at the measuring device can be checked using a normal multimeter.

Switching on the Measuring Device

Once the final checks have been successfully completed, it is time to switch on the supply voltage. The RTT80-F transmitter performs a number of internal test functions after power-up. As this procedure progresses, the following sequence of messages appears on the display:

1. Display and firmware version (FW)
2. Device name as well as the firmware version, hardware version, and device revision of the RTT80-F transmitter
3. Sensor configuration
4. Current measured value or current status message

   If the switch-on procedure fails, the appropriate status message is displayed, depending on the cause. A detailed list of the status messages, as well as the measures for troubleshooting, can be found in Chapter 4, "Maintenance and Troubleshooting"
   .

The device is operational after approximately 8 seconds and the attached display after approximately 16 seconds. Normal measuring mode commences as soon as the switch-on procedure is completed. Various measured values and/or status values appear on the display.

Commissioning

Device Description

The following files are required for commissioning and configuring the network:

- Device description (DD): *.sym, *.ffo, *.sy5, *.ff5
- Network configuration: Common File Format (*.cff)

These files are available for download from
http://iom.invensys.com/EN/Pages/Foxboro_MandI_DocTools_DeviceDescriptors.aspx

Device ID

In the case of the FOUNDATION fieldbus™, the device is identified in the host or configuration system by means of the device ID (`DEVICE_ID`). The `DEVICE_ID` is a combination of the manufacturer ID, device type, and device serial number. It is unique and can never be assigned twice. The `DEVICE_ID` of the RTT80-F is `385884C035-XXXXXXXXXXX`, where:

- Manufacturer ID (`MANUFAC_ID`) = 385884
- Device type (`DEV_TYPE`) = C035
- XXXXXXXXXXX = 11-digit serial number

Configuration Wizards

For quick and reliable transmitter configuration, a wide range of configuration wizards are available to guide you through the configuration of the most important parameters of the Transducer Blocks.

The following wizards are available:

Name	Block	Description
Configuration Wizards		
Quick setup	Sensor Transducer	Configuration of the sensor input with sensor-relevant data
Quick setup	Display Transducer	Menu-guided configuration of the display unit
Set to OOS mode	Resource, Sensor Transducer, Display Transducer, Advanced Diagnostic Transducer, AI, PID, and ISEL	Allows you to set the block to “Out of Service” mode
Set to auto mode	Resource, Sensor Transducer, Display Transducer, Advanced Diagnostic Transducer, AI, PID, and ISEL	Allows you to set the block to “AUTO” mode
Restart	Resource	Device restart with various options as to which parameters are to be reset to default values
Sensor drift monitoring configuration	Advanced Diagnostic Transducer	Settings for drift or differential monitoring with 2 connected sensors

Name	Block	Description
Calc.- wizard for 2-wire compensation value	Sensor Transducer	Calculation of the conductor resistance for two-wire compensation
Set all TRD to OOS mode	All transducer blocks	Sets all transducer blocks to “Out Of Service” mode at the same time
Set all TRD to auto mode	All transducer blocks	Sets all transducer blocks to “Auto” mode at the same time
Show recommended action	Resource	Shows the recommended action for the currently active condition
Calibration Wizards		
User sensor trim configuration	Sensor Transducer	Menu guidance for linear scaling (offset + slope) to adapt the measuring point to the process
Factory trim settings	Sensor Transducer	Reset scaling to the “Factory Standard Trim”
RTD-Platin configuration Call.-Van Dusen	Sensor Transducer	Entry of Callendar-Van Dusen coefficients
RTD-Copper configuration	Sensor Transducer	Entry of coefficients for polynom copper
RTD-Nickel configuration	Sensor Transducer	Entry of coefficients for polynom nickel

Initial Commissioning

The following procedure covers most typical installations. For complex or advanced situations, you must reconfigure other parameters for your application.

1. Make sure your transmitter is wired according to the diagrams shown in Figure 11 and Figure 12.
2. Open the configuration program.
3. Load the device description files or the CFF file into the host system or the configuration program. Make sure you are using the right system files described in “Device Description” on page 52.
4. Note the `DEVICE_ID` on the device nameplate for identification in the process control system. See “Device ID” on page 52.
5. Switch the device on. See “Switching on the Measuring Device” on page 51.
6. The first time you establish a connection, the device reacts as follows in the configuration system:
   - RTT80-F<*serial number*> (tag name `PD_TAG`)
   - 385884C035-<*serial number*> (`DEVICE_ID`)
   - Block structure:

Display Text	Base Index	Description
RS_<*serial number*>	400	Resource Block
TB_S1_<*serial number*>	500	Transducer Block temperature sensor 1
TB_S2_<*serial number*>	600	Transducer Block temperature sensor 2
TB_DISP_<*serial number*>	700	Display Transducer Block
TB_ADVDIAG_<*serial number*>	800	Advanced Diagnostic Transducer Block
AI_1_<*serial number*>	900	Analog Input function block 1
AI_2_<*serial number*>	1000	Analog Input function block 2
AI_3_<*serial number*>	1100	Analog Input function block 3
PID_<*serial number*>	1200	PID function block

Display Text	Base Index	Description
ISEL_*<serial number>*	1300	Input Selector function block

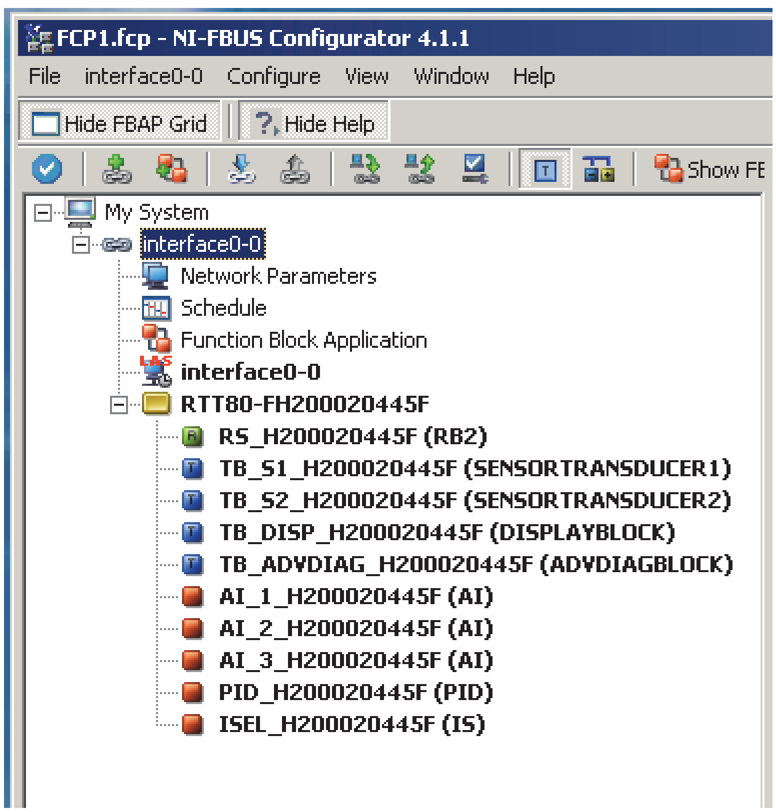
7. The device is delivered from the factory with the bus address "247" and is thus in the address range between 232 and 247 reserved for readdressing field devices. You must assign a lower bus address to the device for commissioning. You can modify the address, but it must be a unique value on the H1 wiring segment. Ensure that the address is within the valid address range of the host system. Right click on the device and select `Set Address`. Select a new Device Address from the drop down menu. Make sure the `Set to OOS` block is checked. Click `Set`. Wait until the Set Address operation is complete before modifying different parameters.

! CAUTION

Ensure that all devices on a wiring segment have a unique address within the range of the host system recommended addresses.

8. Using the `DEVICE_ID` noted, identify the field device and assign the desired tag name (`PD_TAG`) to the fieldbus device in question. The factory setting is `RTT80-F<serial number>`.

Figure 20. NI-FBUS Configurator Screen Display after Establishing a Connection



In the figure above, the device designation in the configurator, `RTT80-F<serial number>`, is the factory setting for the tag name, `PD_TAG`.The entries below the `PD_TAG` represent the block structure.

Configuring the Resource Block

1. Open the Resource Block.
2. When the device is delivered, the hardware write protection is disabled so the write parameters can be accessed via the FF. Check the status via the `WRITE_LOCK` parameter:
    - ♦ Write protection enabled = LOCKED
    - ♦ Write protection disabled = NOT LOCKED
3. Disable the write protection if necessary. See “Hardware Settings” on page 50.
4. Enter the desired name for the block (optional). The factory setting is RS_<*serial number*>.
5. Set the operating mode in the `MODE_BLK` parameter group (TARGET parameter) to AUTO.

Configuring the Transducer Blocks

The individual Transducer Blocks comprise various parameter groups arranged by device-specific functions:

Temperature sensor 1	Transducer Block `TB_S1_`<*serial number*> (base index: 500)
Temperature sensor 2	Transducer Block `TB_S2_`<*serial number*> (base index: 600)
Onsite display functions	Transducer Block `TB_DISP_`<*serial number*> (base index: 700)
Advanced diagnostics	Transducer Block `TB_ADVDIAG_`<*serial number*> (base index: 800)

NOTE

In the following text, the parameters shown first are those that are displayed on your computer screen. Those shown in parenthesis are the standardized fieldbus terms.

1. Enter the desired name for each block (optional). For factory settings, see the table above.
2. Configure the sensor characteristics in Sensor 1 and Sensor 2 Transducer Blocks.
3. Configure `Prim Val Unit` (`PRIMARY_VALUE_UNIT`) to `K`, `°C`, `°F`, or `°R` if sensor is an RTD or thermocouple, `Ohm` or `kOhm` if sensor is resistance, `V`, `mV`, or `µV` if sensor is voltage or `%` if sensor is a potentiometer.
4. If the sensor is an RTD or resistance, configure `Connection Type 1` (`SENSOR_CONNECTION`) to the correct number of sensor wires. If two sensors are used, set `Connection Type 2` (`SENSOR_CONNECTION_2`) to the correct number of sensor wires for the second sensor.
5. If Sensor 1 is a 2-wire RTD or resistance, enter a value in ohms in `Line Compensation 1` (`COMP_WIRE1`) to compensate for the line resistance. If Sensor 2 is a 2-wire RTD, enter a similar value in `Line Compensation 2` (`COMP_WIRE2`).
6. If the only sensor is a thermocouple, configure `Reference Junction` (`RJ_TYPE`) as:

- No Reference if cold junction compensation (CJC) is not used
- Internal if internal compensation is to be used
- External if a fixed value is to be used for CJC. Also configure Ext Reference Junction Temperature (EXTERNAL_RJ_VALUE) with that value.
- Sensor, 2-wire if reference junction temperature is measured by a 2-wire RTD. Also enter a value in ohms in Reference Line Compensation (RJ_COMP_WIRE) to compensate for the line resistance.
- Sensor, 3-wire if reference junction temperature is measured by a 3-wire RTD.

7. If an RTD is used with a thermocouple, Reference Junction (RJ_TYPE) can only be set to No Reference, Internal, or External.
8. If Sensor 1 is a potentiometer, configure Connection Type 1 (SENSOR_CONNECTION) to the correct number of sensor wires (3- or 4-wire). Then enter the wire resistance for two wires (in ohms) in Line Compensation 1 (COMP_WIRE1).
9. If two potentiometers are used, set Connection Type 2 (SENSOR_CONNECTION_2) to 2-wire. Then enter the wire resistance for two wires (in ohms) in Line Compensation 2 (COMP_WIRE2).
10. Configure Measure Type (SENSOR_MEAS_TYPE) to one of the following:

    Sensor 1
    Sensor 2
    Sensor 1 - Sensor 2 (difference)
    Sensor 2 - Sensor 1 (difference)
    Average [(Sensor 1 + Sensor 2)/2]
    Average Sensor 1 or Sensor 2 [(Sens 1 + Sens 2)/2] but one sensor if other is bad
    Sensor 1, Sensor 2 not available
    Sensor 1, Sensor 2 if Sensor 1 is bad
    Sensor 2, Sensor 1 if Sensor 2 is bad

11. If you want to adjust the process value connected to a sensor, add the bias by entering it in Bias of Channel 1 (BIAS_1) for sensor 1 and Bias of Channel 2 (BIAS_2) for sensor 2. The resulting values are shown in Process Temperature Channel 1 (SECONDARY_VALUE_1) for sensor 1 and Process Temperature Channel 2 (SECONDARY_VALUE_2) for sensor 2.
12. Enter the maximum and minimum sensor values for the appropriate sensor in the following parameters:

    Sensor Value Max 1 (MAX_SENSOR_VALUE_1)
    Sensor Value Min 1 (MIN_SENSOR_VALUE_1)
    Sensor Value Max 2 (MAX_SENSOR_VALUE_2)
    Sensor Value Min 2 (MIN_SENSOR_VALUE_2)

13. Select the sensor error detection capability for each sensor as Disabled (not used), Lead breakage detection, Short circuit detection, or Wire breakage and short circuit detection in the following parameters:

For Sensor 1: `Sensor Wire Check 1` (SENSOR_WIRE_CHECK_1)
For Sensor 2: `Sensor Wire Check 2` (SENSOR_WIRE_CHECK_2)
For RJ Sensor: `RJ Sensor Wire Check` (SENSOR_WIRE_CHECK_RJ)

14. The factory default for the MODE_BLK•Normal parameter is Auto. If for some reason you want the transmitter to start in the Out Of Service mode, or other selection when power is first applied, set the parameter to the desired action.
15. Write your changes to the transmitter using the `Write Changes` button at the bottom of the display.
16. Set the operating modes in the MODE_BLK parameter group (TARGET parameter) to AUTO.
17. Repeat these steps for the remaining Transducer blocks.

For information on using the Advanced Diagnostics Transducer block, see Chapter 4, “Maintenance and Troubleshooting” . For information on the Display Transducer Block, refer to page 45.

Configuring the Analog Input Function Blocks

The device has three AI blocks and three AI blocks that can be instantiated and assigned to the different process variables as desired. The following section describes an example for the Analog Input function block 1 (base index 900).

1. Enter the required name for the Analog Input function block (optional). The factory setting is `AI_#_<serial number>`.
2. Open Analog Input function block 1.
3. Set the operating mode in the MODE_BLK parameter group (TARGET parameter) to OOS, indicating that the block is out of service.
4. Use the CHANNEL parameter to select the process variable that should be used as the input value for the function block algorithm (scaling and limit value monitoring functions). The following settings are possible:

CHANNEL	Uninitialized
	Primary Value 1
	Primary Value 2
	Sensor Value 1
	Sensor Value 2
	Device temperature

5. In the XD_SCALE parameter group, select the desired engineering unit as well as the block input range for the process variable in question.

NOTE
Faulty parameterization: Make sure that the engineering unit selected suits the measured variable of the process variable chosen. Otherwise, the BLOCK_ERR parameter displays the “Block Configuration Error” error message and the operating mode of the block cannot be set to AUTO.

6. In the L_TYPE parameter, select the type of linearization for the input variable (direct, indirect, indirect square root). Refer to “Linearization Type (L_TYPE)” on page 78.

NOTE

If the “Direct” linearization type is selected, the settings in the OUT_SCALE parameter group are not taken into account. The engineering units selected in the XD_SCALE parameter group take precedence.

7. Use the following parameters to define the limit values for the alarm and warning messages:

HI_HI_LIM	Limit value for the upper alarm
HI_LIM	Limit value for the upper warning
LO_LIM	Limit value for the lower warning
LO_LO_LIM	Limit value for the lower alarm

The limit values entered must be within the value range specified in the OUT_SCALE parameter group.

8. In addition to the actual limit values, specify the behavior in the event of limit value overshoot by “alarm priorities” (HI_HI_PRI, HI_PRI, LO_PRI, LO_LO_PRI parameters). Reporting to the fieldbus host system only occurs if the alarm priority is greater than 2.

9. In addition to settings for the alarm priorities, you can also define digital outputs for limit value monitoring. Here, these outputs (HIHI_ALM_OUT_D, HI_ALM_OUT_D, LOLO_ALM_OUT_D, LO_ALM_OUT_D parameters) are set from 0 to 1 when the limit value in question is overshot. Configure the general alarm output (ALM_OUT_D parameter), where various alarms can be grouped together, accordingly via the ALM_OUT_D_MODE parameter. Then configure the behavior of the output in the event of an error using the Fail Safe Type parameter (FSAFE_TYPE) and, depending on the option selected (FSAFE_TYPE = “Fail Safe Value”), specify the value to be output in the Fail Safe Value parameter (FSAFE_VALUE).

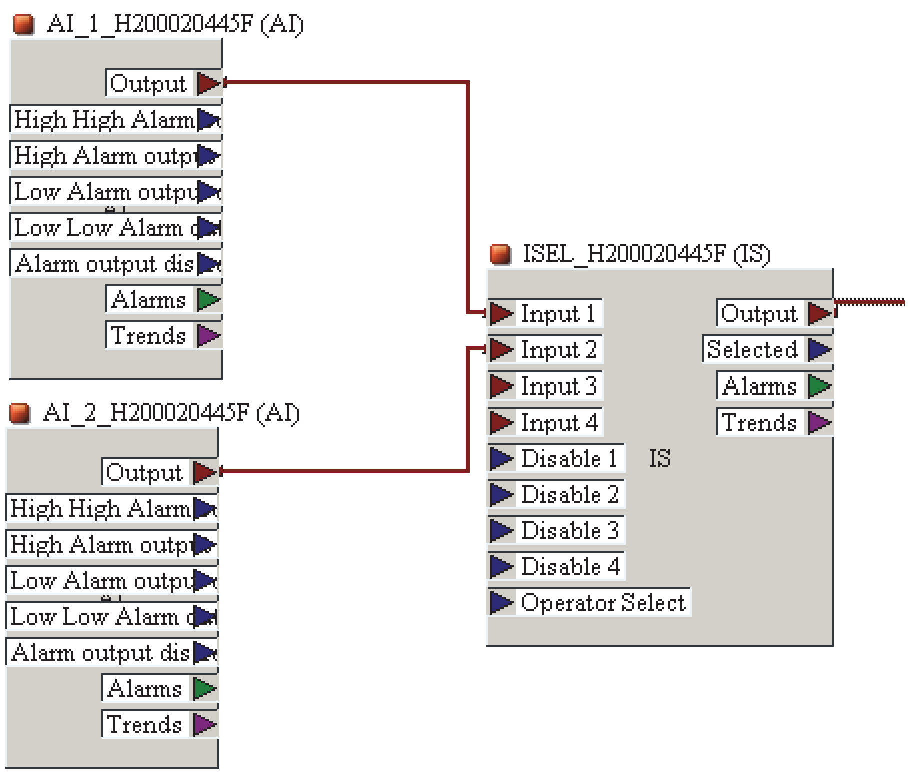
Alarm Limit Value	HIHI_ALM_OUT_D	HI_ALM_OUT_D	LOLO_ALM_OUT_D	LO_ALM_OUT_D
PV ≥ HI_HI_LIM	1	x	x	x
PV < HI_HI_LIM	0	x	x	x
PV ≥ HI_LIM	x	1	x	x
PV < HI_LIM	x	0	x	x
PV > LO_LIM	x	x	0	x
PV ≤ LO_LIM	x	x	1	x
PV > LO_LO_LIM	x	x	x	0
PV ≤ LO_LO_LIM	x	x	x	1

10. Configure the system and connect function blocks. This final overall system configuration is necessary so that the operating mode of the Analog Input function block can be set to AUTO and the field device is integrated in the system application.

    For this purpose, use configuration software like the NI-FBUS Configurator from National Instruments to connect the function blocks to the desired control strategy (mostly using graphic display) and then specify the time for processing the individual process control functions.

The following figure illustrates an example of connecting Function blocks using the NI-FBUS configuration software for an averaging function. The output parameter of the Input Selector Block (OUT) is connected to two temperature inputs (the OUT parameters of Analog Input Blocks 1 and 2).

Figure 21. Connecting Function Blocks with NI-FBUS Configuration Software



Now that the Transducer Block is configured, the Analog Input Blocks can be configured. There are three identical AI Blocks in the transmitter, and three additional AI blocks that can be instantiated. The configurator procedure is identical for all AI Blocks.

1. Open Analog Input Block #1 and click on the `OOS` box to put the transmitter Out Of Service. Make sure that the `MODE_BLK•Actual` value reads `OOS`. Ignore this step if the `Actual` value reads `OOS`.
2. Set the `CHANNEL` parameter any of the following depending upon what measurement you want to use for this AI Block:
   - Primary Value
   - Sensor 1 Value
   - Sensor 2 Value
   - Internal Temperature (the cold junction measurement inside the transmitter)
3. The `L_TYPE` determines whether the selected value from the Transducer Block is passed directly through the AI Block, or if the value is rescaled based upon the 0% and 100% values entered in the `OUT_SCALE` parameter in the next step. Direct should be used in virtually all applications.

4. If the L_TYPE in step #28 was set for Direct, skip this step. If the L_TYPE was Indirect, set the OUT_SCALE sub-parameters to the desired values for proper scaling. Indirect Sq Root should **never** be used for a temperature measurement.
5. Set the XD_SCALE sub-parameters to the measurement values of the channel parameter assigned to this AI Block in Step #27.
6. Set the IO_OPTS parameter to the desired options by adding check marks in the appropriate boxes.
7. Set the STATUS_OPTS parameter to the desired options by adding check marks in the appropriate boxes.
8. The factory default for the MODE_BLK•Normal parameter is Auto. If for some reason you want the transmitter to start in the Out Of Service mode, or other selection when power is first applied, set the parameter to the desired action.
9. Review the ALARM_SUM•Disabled parameter. There are a wide variety of selections in the drop down box, such as Disc Alm Disabled, HiHi Alm Disabled, and so forth. The factory default is that all alarms have a check mark which disables all of the “Fieldbus Alarms” in the transmitter.
10. Write your changes to the transmitter using the Write Changes button at the bottom of the display.
11. Set the Target Mode in the AI#1 Block to Auto using the Auto button. MODE_BLK•Actual should change to Auto
12. Close the AI Block. In the dialog box, Click on Yes.
13. Repeat these steps for the remaining Analog Input Blocks.
14. Once you have specified the active LAS, download all the data and parameters to the field device.
15. Set the operating mode in the MODE_BLK parameter group (TARGET parameter) to AUTO. This is only possible, however, under two conditions:
    - The function blocks are correctly connected to one another.
    - The Resource Block is in the AUTO operating mode.

FOUNDATION Fieldbus Parameters

Parameters that can be viewed or configured from the FOUNDATION fieldbus host are listed in the following sections. A glossary of parameter terms is included in MI 014-900, Fieldbus Overview.

Resource Block Parameters

NOTE

The table below shows read-only parameters in gray text, and configurable parameters in black text

Table 9. Resource Block FOUNDATION Fieldbus Parameters

Param. Index	Parameter Name	Capability	Factory Default	Description & Comments
1	Static Revision (ST_REV)		2	The revision status of the static data appears on the display. The revision status is incremented on each modification of static data.
2	Tag Description (TAG_DESC)	32 characters maximum	blank	User-supplied string that describes the block's application; writeable when the block is in AUTO or OOS mode.
3	Strategy (STRATEGY)	0 to 6,5535	0	Setting this parameter allows you to organize blocks into groups. Enter the same numerical value into the STRATEGY parameter of the individual blocks you wan to group. Writeable when the block is in AUTO or OOS mode.
4	Alert Key (ALERT_KEY)	1 to 255	0	Represents the plant unit ID. The value set in this parameter can be reported in alarm messages and allows HMI software to sort and filter alarms. Writeable in AUTO or OOS mode.
5	Block Mode (MODE_BLK)	Auto, Man, OOS Also ROut, RCas, Cas, LO, and IMan if PID control is used	**Target**: Auto **Permitted**: Auto l OOS **Normal**: Auto	This parameter stores the actual, target, permitted, and normal modes of the block. The Resource Block supports the following operating modes: • AUTO (automatic): execution of the remaining blocks (ISEL, AI and PID function block) is permitted. • OOS (out of service): execution of the remaining blocks (ISEL, AI, and PID blocks) is blocked. These blocks cannot be set to AUTO mode. The current operating status of the Resource Block is also shown via the RS_STATE parameter.
6	Block Error (BLOCK_ERR)	• SIMULATE ACTIVE: Simulation is possible in the Analog Input function block via the SIMULATE parameter (refer to the hardware write protection configuration information on page 50.) • OUT OF SERVICE: The block is in the "Out of Service" mode		Read only parameter that displays the active block errors on the display.

Table 9. Resource Block FOUNDATION Fieldbus Parameters (Continued)

Param. Index	Parameter Name	Capability	Factory Default	Description & Comments
7	Resource State (RS_STATE)	• STANDBY The Resource Block is in the OOS operating mode; it is not possible to execute the remaining blocks. • ONLINE LINKING The configured connections between the function blocks have not yet been made. • ONLINE Normal operating status, the Resource Block is in the AUTO operating mode. The configured connections between the function blocks are established.		Displays the current operating status of the Resource Block.
8	Test Read Write (TEST_RW)			Read/Write test parameters - only used for conformance testing
10	Manufacturer ID (MANUFAC_ID)		0x00385884	Read only parameter that displays the manufacturer identification number
11	Device type (DEV_TYPE)	0xc035	0xc035	Read only parameter that displays the device identification number in hexadecimal numerical format.
12	Device Revision (DEV_REV)			Read only parameter that displays the revision number of the device
13	DD Revision (DD_REV)			Read only parameter that displays the revision number of the ITK-tested device description
14	Grant Deny (GRANT_DENY)	Program, Tune, Alarm, Local, Operate	Grant: 0 Deny: 0	Options that control access to operating, tuning, and alarm parameters by host computers or local control panels.
15	Hard Types (HARD_TYPES)	Scalar Input, Discrete Input		Read only parameter that displays the input signal type for the Analog Input function block

Table 9. Resource Block FOUNDATION Fieldbus Parameters (Continued)

Param. Index	Parameter Name	Capability	Factory Default	Description & Comments
16	RESTART	• Uninitialized • Run • Resource • Defaults • Processor • Factory • Order configuration • Default blocks	Run	Allows the initiation of a manual restart: • Run uninitialized • Run • Resource: restarts the Resource block • Defaults: Restarts with the specified default values (only FF bus parameters) • Processor: Restarts processor • Factory: all device parameters are reset to default values • Order configuration: resets all device parameters to the condition at delivery • Default blocks: sets all blocks back to the condition at delivery for example, preinstanced blocks Parameter is writeable when the block is in Auto or OOS mode.
17	Features (FEATURES)	• Reports • Faultstate • Hard W Lock • Change Bypass in Auto • MVC Report Distribution supported • Multi-bit Alarm (Bit-Alarm) support		Read only parameter that displays all the resource block options supported by the device.
18	Feature Selection (FEATURES_SEL)	• Reports: broadcasts alerts and alarms • Faultstate: supports FAULT_STATE in output blocks • Hard W Lock: supports hard write locks • Change Bypass in Auto: bypass is allowed in manual and automatic modes • MVC Report Distribution supported: allows multivariable reports • Multi-bit Alarm (Bit-Alarm) Support: alarms are set for each bit in BLOCK_ERR • Defer Inter-Parameter Write Checks	• Reports • Faultstate • Hard W Lock • Change Bypass in Auto • MVC Report Distribution supported	This parameter allows you to select or deselect supported RTT80 Resource Block options defined in the FEATURES parameter. Writeable when the block is in Auto or OOS mode.
19	Cycle Type (CYCLE_TYPE)	• SCHEDULED: Timed block execution method • BLOCK EXECUTION: Sequential block execution method • MANUF SPECIFIC: Manufacturer specified		Read only parameter that displays the block execution methods supported by the resource.

Table 9. Resource Block FOUNDATION Fieldbus Parameters (Continued)

Param. Index	Parameter Name	Capability	Factory Default	Description & Comments
20	Cycle Selection (CYCLE_SEL)	Scheduled, Block execution, Manuf specific	Scheduled	Allows you to select or deselect block execution options defined in the CYCLE_TYPE parameter used by fieldbus host system.
21	Minimum Cycle Time (MIN_CYCLE_T)	3200	3200	Read only parameter that displays the shortest cycle interval of which the resource is capable. This parameter is displayed in 1/32 of a millisecond.
22	Memory Size (MEMORY_SIZE)		0 Kbytes	Read only parameter that displays the available configuration memory for configuring Function Blocks, in kilobytes.
23	Nonvolatile Cycle Time (NV_CYCLE_T)		21120000	Interval between writing copies of non-volatile parameters to non-volatile memory in units of 1/32 of a millisecond. A setting of zero indicates that the parameters will be written immediately when they are changed. At the end of NV_CYCLE_T, only those parameters that have changed will be updated in non-volatile memory. The time interval displayed relates to storage of the following dynamic device parameters: • OUT • PV • FIELD_VAL • SP These values are stored in the nonvolatile memory every 11 minutes.
24	Free Space (FREE_SPACE)		0%	Read only parameter that displays the percentage of free system memory available for further configuration of Function blocks. **Note**: Since the function blocks of the device are preconfigured, this parameter always displays the value 0.
25	Free Time (FREE_TIME)		0	Read only parameter that displays the percentage of free system time available to process additional blocks. **Note**: Since the RTT80 function blocks are preconfigured, this parameter always displays the value 0.

Table 9. Resource Block FOUNDATION Fieldbus Parameters (Continued)

Param. Index	Parameter Name	Capability	Factory Default	Description & Comments
26	Shed Remote Cascade (SHED_RCAS)		640000	Specifies the timeout in units of 1/32 of a millisecond for write attempts to function blocks in the RCas operating mode. When the monitoring time elapses, the function block changes from the RCas operating mode to the operating mode selected in the SHED_OPT parameter. This parameter is writeable in the AUTO and OOS operating modes.
27	Shed Remote Out (SHED_ROUT)		640000	Specifies the timeout in units of 1/32 of a millisecond for write attempts to PID blocks in the ROut operating mode. When the monitoring time elapses, the PID block changes from the ROut operating mode to the operating mode selected in the SHED_OPT parameter. This parameter is writeable in the AUTO and OOS operating modes.
28	Fault State (FAULT_STATE)	Clear Active	1	Read only parameter that displays the current status of the condition set by loss of communication to or the propagation of a loss of communication to an output block's CAS_IN, CAS_IN_D, RCAS_IN, or RCAS_IN_D parameter while in the corresponding mode. This parameter indicates the Fault State condition is being simulated by the Resource block via the SET_FSTATE parameter. This parameter is cleared by the CLR_FSTATE parameter. When the Fault State condition exists, then output function blocks will perform their FSTATE actions if the “Fault State supported” bit is set in the FEATURE_SEL parameter.
29	Set Fault State (SET_FSTATE)	Uninitialized Off Set	Off	Manually set a faultstate condition by selecting Set. Manually setting a faultstate condition is only supported if the “Fault State supported” bit is set in the FEATURE_SEL parameter. This parameter is writeable in the AUTO and OOS operating modes.
30	Clear Fault State (CLR_FSTATE)	Uninitialized Off Clear	Off	Clear faultstate conditions by selecting Clear. This parameter is writeable in the AUTO and OOS operating modes.
31	Max Notify (MAX_NOTIFY)		4	Read only parameter that displays the maximum number of unconfirmed event reports possible.

Table 9. Resource Block FOUNDATION Fieldbus Parameters (Continued)

Param. Index	Parameter Name	Capability	Factory Default	Description & Comments
32	Limit Notify (LIM_NOTIFY)	0 to 4	4	Maximum number of unconfirmed event reports that can exist at the same time. If set to zero, no alerts are reported. This parameter is writeable in the AUTO and OOS operating modes.
33	Confirm Time (CONFIRM_TIME)		640000	Specifies the amount of time the resource will wait, in units of 1/32 of a millisecond, for the confirmation of receipt of an event report. If the RTT80 does not receive confirmation within this time, the event report is sent to the fieldbus host system again. This parameter is writeable in the AUTO and OOS operating modes.
34	Write Lock (WRITE_LOCK)	• Locked: Device data cannot be modified • Not Locked: Device data can be modified • Uninitialized	Not Locked	Read only parameter that displays the current write protection configuration. (Write protection is set using DIP switches on the local display).
35	Update Event (UPDATE_EVT)	• Unacknowledged: Set to Acknowledged to acknowledge that the alarm has been noticed. • Update State: reported or not reported • Time Stamp: MM/DD/YYYY HH:M • Static Revision: ST_REV after parameter was updated • Relative Index: relative index of the parameter that was updated or 0 if more than one parameter was changed.		Parameter that provides an alert generated by any change to the block's static data. Unacknowledged is writeable if the block is in AUTO or OOS operating mode.
36	Block Alarm (BLOCK_ALM)	• Unacknowledged: Set to Acknowledged to acknowledge that the alarm has been noticed • Alarm State: gives indication that host has received alert • Time Stamp: MM/DD/YYYY HH:MM:SS • Subcode: cause of the alert (bit number in BLOCK_ERR) • Value: the value of the associated parameter		The current block status appears on the display with information on pending configuration, hardware or system errors, including information on the alarm period (date, time) when the error occurred. Only Unacknowledged is writeable. The block alarm is triggered in the event of the following block errors: • SIMULATE ACTIVE • OUT OF SERVICE **Note**: If the option of the alarm has not been enabled in the ACK_OPTION parameter, the alarm can only be acknowledged via this parameter.

Table 9. Resource Block FOUNDATION Fieldbus Parameters (Continued)

Param. Index	Parameter Name	Capability	Factory Default	Description & Comments
37	Alarm Summary (ALARM_SUM)	• Current: active status of each alarm • Unacknowledged: unacknowledged state of each alarm • Unreported: unreported status of each alarm • Disabled: set to Disabled or Enabled to disable or enable each alarm	All alarms disabled	Displays the current status of the process alarms in the Resource Block. Disabled is used to set the disabled state of each alarm. Only Disabled is writeable. **Note**: In addition, the process alarms can be disabled in this parameter group.
38	Acknowledge Option (ACK_OPTION)	Enable, Disable	All disabled	Used to select whether alarms associated with the block are automatically acknowledged
39	Write Priority (WRITE_PRI)	0 to 15 as follows: • 0: The write protection alarm is not evaluated • 1: No report to the fieldbus host system in the event of a write protection alarm • 2: Reserved for block alarms. • 3-7: The write protection alarm is output with the appropriate priority (3 = low priority, 7 = high priority) to the fieldbus host system as a user notice. • 8-15 = The write protection alarm is output with the appropriate priority (8 = low priority, 15 = high priority) to the fieldbus host system as a critical alarm	0	Priority of the alarm generated by clearing the write lock (WRITE_ALM)
40	Write Alarm (WRITE_ALM)	• Unacknowledged: Set to Acknowledged to acknowledge that the alarm has been noticed • Alarm State: gives indication that host has received alert • Time Stamp: MM/DD/YYYY HH:MM:SS • Subcode: cause of the alert • Value: the value of WRITE_LOCK		Displays the status of the write protected alarm. Unacknowledged is writeable when the block is in the AUTO or OOS operating mode. The alarm is triggered if the write protection is disabled.
41	ITK Version (ITK_VER)		6	Read only parameter that displays the version number of the supported ITK test
42	Capability Level (CAPABILITY_LEVEL)		1	Read only parameter that indicates the capability level that the RTT80 supports
43	Compatibility Revision (COMPATIBILITY_REV)		2	Read only parameter that indicates until which previous Device Revision the RTT80 is compatible

Table 9. Resource Block FOUNDATION Fieldbus Parameters (Continued)

Param. Index	Parameter Name	Capability	Factory Default	Description & Comments
44	Electronic Name Plate Version (ENP_VERSION)		02.02.00	Version of the ENP (electronic name plate)
45	Device Tag (DEVICE_TAG)		RTT80-FH200020445F	Read only parameter that displays the tag name/device TAG
46	Serial Number (SERIAL_NUMBER)		FH200020445F	Read only parameter that displays the device serial number
47	Extended order code (ORDER_CODE_EXT)		RTT80-F	Read only parameter that displays the extended order code of the device
48	Extended order code part2 (ORDER_CODE_EXT_ PART2)			Read only parameter that displays the second part of the extended order code, always empty in this device (therefore sometimes not displayed in host systems)
49	Order Code / Identification (ORDER_CODE)	Read only	RTT80-F	Read only parameter that displays the order code for the device
49	Firmware Version (FIRMWARE_ VERSION)		02.00.00	Read only parameter that displays the version of the device software
75	Block Error Description 1 (BLOCK_ERR_DESC_1)			Read only parameter that displays further information for solving block errors: • Simulation permitted: Simulation is allowed due to activated hardware simulation switch • Failsafe active: Failsafe mechanism in an AI block is active

Sensor 1 and Sensor 2 Transducer Block Parameters

Table 10. Sensor 1 and Sensor 2 Transducer Block User Configurable Fieldbus Parameters

Parameter Name	Capability	Factory Default	Description & Comments
Static Revision (ST_REV)		0	The revision level of the static data associated with the function block The revision status is incremented on each modification of static data.
Tag description (TAG_DESC)	32 characters, maximum	blank	User description of the block application; write access with AUTO and OOS operating modes
Strategy (STRATEGY)	0 to 6,5535	0	Setting this parameter allows you to organize blocks into groups. Enter the same numerical value into the STRATEGY parameter of the individual blocks you wan to group. Writeable when the block is in AUTO or OOS mode.
Alert Key (ALERT_KEY)	1 to 255	0	Represents the plant unit ID. The value set in this parameter can be reported in alarm messages and allows HMI software to sort and filter alarms. Writeable in AUTO or OOS mode.
Block Mode (MODE_BLK)	Auto, Man, OOS Also ROut, RCas, Cas, LO, and IMan if PID control is used	**Target**: Auto **Permitted**: Auto | Man | OOS **Normal**: Auto	This parameter stores the actual, target, permitted, and normal modes of the associated Transducer Block. The Sensor 1 and 2 Transducer Blocks initiate in Auto mode, and support the following operating modes: • AUTO (automatic): block is executed • OOS (out of service): process variable is updated, but the status of the process variable changes to BAD • MAN (manual): process variable is updated, and status shows that the resource block is "Out of Service.
Block Error (BLOCK_ERR)	• Other • Input Failure		Read only parameter that reflects the error status associated with the hardware or software components associated with a block
Update Event (UPDATE_EVT)	• Unacknowledged: Set to Acknowledged to acknowledge that the alarm has been noticed • Update State: reported or not reported • Time Stamp: MM/DD/YYYY HH:MM:SS • Static Revision: ST_REV after parameter was updated • Relative Index: relative index of the parameter that was updated or 0 if more than one parameter was changed.		This parameter provides an alert generated by any change to the block's static data. Only Unacknowledged is writeable.

Table 10. Sensor 1 and Sensor 2 Transducer Block User Configurable Fieldbus Parameters (Continued)

Parameter Name	Capability	Factory Default	Description & Comments
Block Alarm (BLOCK_ALM)	• Unacknowledged: Set to Acknowledged to acknowledge that the alarm has been noticed • Alarm State: indicates whether the alert is active and whether it has been reported • Time Stamp: MM/DD/YYYY HH:MM:SS • Subcode: cause of the alert • Value: the value of the parameter at the time the alert was detected		Used for all configuration, hardware, connection failures, or system problems in the block. Only Unacknowledged is writeable.
Transducer Directory Entry (TRANSDUCER_ DIRECTORY)		0	Read only parameter that specifies the number and starting indexes of the transducers in the Transducer block.
Transducer Type (TRANSDUCER_TYPE)		Custom sensor transducer	Read only parameter that identifies the Transducer block
Transducer Type Version (TRANSDUCER_TYPE_VER)		0xFF01	Read only parameter that identifies the Transducer block version in the format XXYY, where: • XX is the major revision of the transducer specification on which the transducer is based • YY = manufacturer revision
Transducer Error (XD_ERROR)	0: No Error 22: I/O Failure	0	Read only parameter that Transducer error code used in conjunction with the “Other” BLOCK_ERR bit set. I/O failures are caused by a communication failure between the Fieldbus board and the Sensor board.
Collection Directory (COLLECTION_DIRECTORY)		0	Read only parameter that specifies the number and starting indices of the collections in the transducer directory

Table 10. Sensor 1 and Sensor 2 Transducer Block User Configurable Fieldbus Parameters (Continued)

Parameter Name	Capability	Factory Default	Description & Comments
Primary value type (PRIMARY_VALUE_TYPE)	Sensor Transducer 1: PV = • Sensor Value 1 (SV1) • SV1 - SV2: Difference • 0.5*(SV1+SV2): Average • 0.5*(SV1+SV2) Redundancy: Average of Sensor Value 1 or Sensor Value 2 in the event of a sensor error in the other sensor. • SV1 (or SV2): Backup function: If sensor 1 fails, the value of sensor 2 automatically becomes the Primary Value. • SV1 (SV2 if SV1 > T): PV changes from SV1 to SV2 if SV1 is greater than T (THRESHOLD_VALUE parameter) Sensor Transducer 2: PV = • Sensor Value 2 (SV2) • SV2 - SV1: Difference • 0.5*(SV2+SV1): Average • 0.5*(SV2+SV1) Redundancy: Average of Sensor Value 2 or Sensor Value 1 in the event of a sensor error in the other sensor. • SV2 (or SV1): Backup function: If sensor 2 fails, the value of sensor 1 automatically becomes the Primary Value. • SV2 (SV1 if SV2 > T): PV changes from SV2 to SV1 if SV2 is greater than T (THRESHOLD_VALUE parameter)	Sensor Transducer 1: PV = Sensor Value 1 (SV1) Sensor Transducer 2: PV = Sensor Value 2 (SV2)	Math function to calculate PRIMARY_VALUE; write access in OOS operating mode.
Primary value (PRIMARY_VALUE)	• Primary value is calculated from PRIMARY_VALUE_TYPE • Status is normally Good_NonCascade (QUALITY) NonSpecific (SUBSTATUS), and NotLimited (LIMITS)		Read only parameter that stores the measured value and status available to Analog Input function blocks.
Primary value unit (PRIMARY_VALUE_UNIT)	°C, °F, K, °R, mV, Ohm, or %	°C	Unit of primary value and other values (RJ value and minimum and maximum indicators). This parameter is writeable in AUTO and OOS operating modes. **Note**: The measurement range and engineering units are configured with an existing link in the relevant Analog Input function block using the XD_SCALE parameter group.
Threshold value (THRESHOLD_VALUE)	-270°C to +2450°C	0.00	Value for switching in the threshold PV mode. This parameter is writeable in the OOS operating mode.
PV1/PV2 maximum indicator (PV_MAX_INDICATOR)		-10000	Maximum indicator for PV is stored in the nonvolatile memory in intervals of 10 minutes. Can be reset.

Table 10. Sensor 1 and Sensor 2 Transducer Block User Configurable Fieldbus Parameters (Continued)

Parameter Name	Capability	Factory Default	Description & Comments
PV1/PV2 minimum indicator (PV_MIN_INDICATOR)		10000	Minimum indicator for PV is stored in the nonvolatile memory in intervals of 10 minutes. Can be reset.
Sensor value (SENSOR_VALUE)	Sensor Transducer 1: • Sensor value = Actual measured value of the sensor connected to the S1 terminal group • Status = Status of this value Sensor Transducer 2: • Sensor value: Actual measured value of the sensor connected to the S2 terminal group • Status = Status of this value		Read only parameter that stores the actual measured value and status from Sensors 1 and 2.
Sensor Type (SENSOR_TYPE)	Available types for Sensors 1 and 2 include the options in Table 2 (RTD types), Table 3 (thermocouple types), or No Sensor.		Configuration of the sensor type. • Transducer Block for Sensor 1: Settings for sensor input 1 • Transducer Block for Sensor 2: Settings for sensor input 2 **Note**: Observe the wiring diagram (Figure 11) in the section titled “Input Connections” when connecting the individual sensors. In the case of 2-channel operation, the possible connection options in “Connecting the Sensor Cables” on page 32 also have to be observed.
Sensor connection (SENSOR_CONNECTION)	Sensor Transducer 1: • 2-wire • 3-wire • 4-wire Sensor Transducer 2: • 2-wire • 3-wire	3-wire	Sensor connection mode for resistance thermometers and resistance transmitters; writeable in OOS operating mode. **Note**: This parameter is only applicable to RTD or resistance sensor types.
Sensor range (SENSOR_RANGE)	• EU at 100% (EU_100): upper sensor range limit • EU at 0% (EU_0): lower sensor range limit • UNITS_INDEX: unit of the SENSOR_VALUE • DECIMAL: places after the decimal point for the SENSOR_VALUE; does not affect the measured value display.	• 850.00 • -200.00 • °C • 2	Physical measuring range of the sensor; writeable in OOS operating mode.
Sensor offset (SENSOR_OFFSET)	The following values are permitted: • -10 to +10 for Celsius, Kelvin, mV and Ohm • -18 to +18 for Fahrenheit, Rankine		Offset of the SENSOR_VALUE; writeable in the OOS operating mode. **Note**: changing the primary value unit will also change the offset unit.
Two 2-wire compensation (TWO_WIRE_ COMPENSATION)	0 to 30 ohms	0	Correction value for compensation of the cable resistance when using 2-wire sensor connection; writeable in OOS operating mode. **Note**: This parameter is only applicable to RTD or resistance sensor types.

Table 10. Sensor 1 and Sensor 2 Transducer Block User Configurable Fieldbus Parameters (Continued)

Parameter Name	Capability	Factory Default	Description & Comments
Sensor serial number (SENSOR_SN)			Serial number of the sensor; writeable in the AUTO and OOS operating modes.
Sensor maximum indicator (SENSOR_MAX_INDICATOR)			Maximum indicator of the SENSOR_VALUE; stored in the nonvolatile memory in intervals of 10 minutes and can be reset in AUTO or OOS operating mode.
Sensor minimum indicator SENSOR_MIN_ INDICATOR			Minimum indicator of the SENSOR_VALUE; stored in the nonvolatile memory in intervals of 10 minutes and can be reset in AUTO or OOS operating mode.
Mains filter (MAINS_FILTER)		50 Hz	Mains filter for the A/D converter; select the power filter to compensate the influence of mains frequency on the RTT80 measurement. THis parameter is dependent on matching frequency of individual power networks. This parameter is writeable in OOS operating mode.
Device temperature (DEVTEMP_VALUE)	• Value: value of the internal temperature measurement. This temperature value can be used for cold junction compensation. • Status: Status is normally Good_NonCascade (QUALITY) NonSpecific (SUBSTATUS), and NotLimited (LIMITS)		Read only parameter that stores the internal device temperature measurement
Reference junction type (RJ_TYPE)	• NO_REFERENCE: No temperature compensation is used. • INTERNAL: Internal reference junction temperature is used for the temperature compensation. • EXTERNAL: RJ_EXTERNAL_VALUE is used for the temperature compensation.	Internal reference	Reference junction measurement for temperature compensation; write access with OOS operating mode. **Note**: This parameter is only applicable when a thermocouple type is selected in Sensor Type.
Device temperature value unit (DEVTEMP_UNIT)	The unit corresponds to the SENSOR_RANGE.UNITS_INDEX	°C	Read only parameter that stores the unit of the internal device temperature.
Reference junction external value (RJ_EXTERNAL_VALUE)	Value in PRIMARY_VALUE_UNIT (in °C for mV or ohm)	0	Value for temperature compensation. This parameter is only applicable when RJ_TYPE is set to External. **Note**: This parameter is only applicable when a thermocouple type is selected in Sensor Type.
Device temperature maximum indicator (DEVTEMP_MAX_ INDICATOR)			Maximum indicator of the internal device temperature is stored in the nonvolatile memory in intervals of 10 minutes. This parameter is writeable in AUTO or OOS operating mode.

Table 10. Sensor 1 and Sensor 2 Transducer Block User Configurable Fieldbus Parameters (Continued)

Parameter Name	Capability	Factory Default	Description & Comments
Device temperature minimum indicator (DEVTEMP_MIN_ INDICATOR)			Minimum indicator of the internal device temperature is stored in the nonvolatile memory in intervals of 10 minutes. This parameter is writeable in AUTO or OOS operating mode.
Transducer number (TRANSDUCER_NUMBER)			Read only parameter that stores the transducer block number.
Sensor Status (SENSOR_STATUS)			Read only parameter that displays the Sensor status
Block Error Description 1 (BLOCK_ERR_DESC_1)		0x0000	Read only parameter that displays further information for solving block errors: • Simulation permitted: Simulation is allowed due to activated hardware simulation switch • Failsafe active: Failsafe mechanism in an AI block is active
Sensor Calibration Parameters			
Calibration highest point (CAL_POINT_HI)		850	Upper point for linear characteristic calibration (affects offset and slope); writeable in OOS operating mode. **Note**: To write to this parameter, SENSOR_CAL_METHOD must be set to "User Trim Standard Calibration".
Calibration lowest point (CAL_POINT_LO)		-200	Lower point for linear characteristic calibration (affects offset and slope); writeable in OOS operating mode. **Note**: To write to this parameter, SENSOR_CAL_METHOD must be set to "User Trim Standard Calibration".
Calibration minimum span (CAL_MIN_SPAN)		10	Span of the measuring range, depending on the sensor type set; writeable in OOS operating mode.
Calibration unit (CAL_UNIT)		°C	Read only parameter that stores the unit for sensor calibration.
Sensor calibration method (SENSOR_CAL_METHOD)	• Factory trim standard calibration: Sensor linearization with the factory calibration values • User trim standard calibration: Sensor linearization with the values CAL_POINT_HI and CAL_POINT_LO	Factory trim standard	Last method used to calibrate device; writeable in OOS operating mode **Note**: The original linearization can be established by resetting this parameter to "Factory Trim Standard Calibration". For linear characteristic calibration, the Transducer Block makes a wizard available (User Sensor Trim).
Sensor calibration location (SENSOR_CAL_ LOC)			Location where the sensor calibration was last performed
Sensor calibration date (SENSOR_CAL_ DATE)	MM/DD/YY HH:MM:SS		Date and time of the last calibration

Table 10. Sensor 1 and Sensor 2 Transducer Block User Configurable Fieldbus Parameters (Continued)

Parameter Name	Capability	Factory Default	Description & Comments
Sensor calibration who (SENSOR_CAL_ WHO)			Person performing last calibration
Sensor Linearization Parameters			
Callendar Van Dusen A (CVD_COEFF_A)		0.0039083	Sensor linearization based on the Callendar Van Dusen method; writeable in the OOS operating mode. **Note**: The CVD_COEFF_XX parameters are used for calculating the response curve if “RTD Callendar Van Dusen” is set in the SENSOR_TYPE parameter. Both Transducer Blocks make a wizard available for configuring the parameters based on the “Callendar Van Dusen method”.
Callendar Van Dusen B (CVD_COEFF_B)		-5.775E-07	
Callendar Van Dusen C (CVD_COEFF_C)		-4.183E-12	
Callendar Van Dusen R0 (CVD_COEFF_R0)	Value in ohms	100	
Callendar Van Dusen Measuring Range Maximum (CVD_COEFF_MAX)		100	Upper calculation limit for Callendar Van Dusen linearization; writeable in the OOS operating mode.
Callendar Van Dusen Measuring Range Minimum (CVD_COEFF_MIN)		0	Lower calculation limit for Callendar Van Dusen linearization; writeable in the OOS operating mode.
Polynom Coeff. A (POLY_COEFF_A)		0.0054963	Sensor linearization of copper/nickel resistance thermometers (RTD); writeable in the OOS operating mode. **Note**: The POLY_COEFF_XX parameters are used for calculating the response curve if “RTD Polynom Nickel or RTD Polynom Copper” is set in the SENSOR_TYPE parameter.
Polynom Coeff. B (POLY_COEFF_B)		6.7556E-06	
Polynom Coeff. C (POLY_COEFF_C)		9.2004E-09	
Polynom Coeff. R0 (POLY_COEFF_R0)	Value in ohms	100	
Polynom (Nickel/ Copper) Measuring Range Maximum (POLY_COEFF_MAX)		100	Upper calculation limit for the RTD polynom (nickel/copper) linearization; writeable in the OOS operating mode.
Polynom (Nickel/ Copper) Measuring Range Minimum (POLY_COEFF_MIN)		0	Lower calculation limit for the RTD polynom (nickel/copper) linearization.

Display Transducer Block Parameters

Table 11. Display Transducer Block User Configurable Parameters

Parameter	Capability	Factory Default	Description
Alternating time (ALTERNATING_TIME)	6 to 60 s	6	Entry (in s) as to how long a value should be shown on the display before switching to the next display value. Writeable in the AUTO or OOS operating mode.
Display value 1 (DISP_VALUE_1)	• Value: the selected measured value • Status: status of the value		Read only parameter that displays the selected measured value and the associated status.
Display value 2 (DISP_VALUE_2)			
Display value 2 (DISP_VALUE_2)			
Display source 1 (DISP_SOURCE_1)	• Off • Primary Value 1 • Sensor Value 1 • Primary Value 2 • Sensor Value 2 • Device temperature	Primary value 1	To select the source of the value that is displayed; writeable in the AUTO or OOS operating mode. **Note**: If all 3 display channels are switched off (Off option), the value for primary value 1 automatically appears on the display. If this value is not available (for example, the No Sensor option selected in the Sensor Transducer Block 1 parameter SENSOR_TYPE), primary value 2 is displayed.
Display source 2 (DISP_SOURCE_2)		Off	
Display source 3 (DISP_SOURCE_3)		Off	
Display value description 1 (DISP_VALUE_1_ DESC)	Up to 16 characters	P1	Enter a description of the displayed value. **Note**: The value is not shown on the display.
Display value description 2 (DISP_VALUE_2_ DESC)		S1	
Display value description 3 (DISP_VALUE_3_ DESC)		RJ	
Display format 1 (DISP_VALUE_ 1_FORMAT)	Possible settings are: • 0: xxxxx • 1: xxxx.x • 2: xxx.xx • 3: xx.xxx • 4: Auto	Auto	For selecting the number of places displayed after the decimal point. The maximum number of decimal places possible always appears on the display.
Display format 2 (DISP_VALUE_ 2_FORMAT)		Auto	
Display format 3 (DISP_VALUE_ 3_FORMAT)		Auto	

Advanced Diagnostic Transducer Block Parameters

Refer to "Diagnostic Parameters in the Advanced Diagnostic Transducer Block" on page 97.

Analog Input (AI) Block Parameters

Table 12. Analog Input (AI) Block User Configurable Fieldbus Parameters

Parameter Name	Capability	Factory Default	Description & Comments
OUT • Value			Primary analog value calculated as a result of executing this function
SIMULATE			Simulates the transducer analog input or output to the block
Simulate Value		0	Used for the transducer value when simulate is enabled
Simulate En/Disabled		Disabled	Enable/disable simulation
Transducer Scale (XD_SCALE)			Scale of the value obtained from the transducer
EU_100		Per Sales Order(1)	Engineering units value at 100% of range
EU_0		Per Sales Order(1)	Engineering units value at 0% of range
Units_Index	K, °C, °F, °R, V, mV, µV, Ohm, kOhm, or %	Per Sales Order(1)	Engineering units
Decimal		2	Number of digits to the right of the decimal point
Output Scale (OUT_SCALE)			
EU_100		Per Sales Order(1)	Value in engineering units for range at 100%
EU_0		Per Sales Order(1)	Value in engineering units for range at 0%
Units_Index	K, °C, °F, °R, V, mV, µV, Ohm, kOhm, or %	Per Sales Order(1)	Engineering units
Decimal	0 to 4	2	The number of digits displayed to the right of the decimal point
Grant Deny (GRANT/DENY)	Program, Time, Alarm, Local, Operate		Options for controlling access of host computer to operating, tuning, and alarm parameters
I/O Options (IO_OPTS)	Low Cutoff, Units Conversion	0	Options to alter input and output block processing
Status Options (STATUS_OPTS)	Propagate Fault Fwd, Uncertain if Limited, Bad if Limited, Uncertain if Man	0	Options for block processing of status
CHANNEL	Primary value 1, Primary value 2, Sensor value 1, Sensor value 2, Device temperature 1, Device temperature 2	Primary value 1	Logical channel connected to this block; defines the transducer to be used going to or from the physical world.

Table 12. Analog Input (AI) Block User Configurable Fieldbus Parameters (Continued)

Parameter Name	Capability	Factory Default	Description & Comments
Linearization Type (L_TYPE)	• Uninitialized • Direct: values passed by the Transducer block can be used directly by the AI block • Indirect: values passed by the Transducer block to the AI block are in different units and must be converted linearly • Indirect Sq Root: values passed by the Transducer block to the AI block are in different units and must be converted using the input range defined for the Transducer and the associated output range	Direct	Determines if value is to be used directly or converted
Low Cutoff (LOW_CUT)		0	Limit used in square root processing **Note**: a value of zero percent of scale is used in block processing if the Transducer value falls below this limit, in percent of scale. This feature can be used to eliminate noise near zero from a flow sensor.
Process Value Filter TIme (PV_FTIME)	0 to 100 s	0	Filter time constant in seconds
(ALARM_SUM • Disabled)	Enable, Disable	All alarms disabled	The disabled state of each alarm
Acknowledge Option (ACK_OPTION)	• HiHi Alm Auto Ack • Hi Alm Auto Ack • LoLo Alm Auto Ack • Lo Alm Auto Ack • Blk Alm Auto Ack • Fail Alm Auto Ack • Off Spec Alm Auto Ack • Main Alm Auto Ack • Check Alm Auto Ack	Off for all alarm types	Selection of which alarms will be automatically acknowledged
Alarm Hysteresis (ALARM_HYS)	0 to 50% of the PV span	0.5	Amount the PV must return within the alarm limits before the alarm condition clears. Alarm hysteresis is expressed as a percent of the span of the PV.
(HI_HI_PRI)	0 to 15	0	Priority of the High-High alarm
(HI_HI_LIM)		+INF	Setting for High-High alarm in engineering units
(HI_PRI)	0 to 15	0	Priority of the High alarm
(HI_LIM)		+INF	Setting for High alarm in engineering units
(LO_PRI)	0 to 15	0	Priority of the Low alarm
(LO_LIM)		-INF	Setting for Low alarm in engineering units
(LO_LO_PRI)	0 to 15	0	Priority of the Low-Low alarm
(LO_LO_LIM)		-INF	Setting for Low-Low alarm in engineering units

PID Block Configurable Parameters

Table 13. PID Block User Configurable Fieldbus Parameters

Parameter Name	Capability	Factory Default	Description & Comments
PID CONTROL BLOCK			
Tag description (TAG_DESC)	32 characters, maximum	blank	User description of the block application; write access with AUTO and OOS operating modes
Strategy (STRATEGY)	0 to 6,5535	0	Setting this parameter allows you to organize blocks into groups. Enter the same numerical value into the STRATEGY parameter of the individual blocks you wan to group. Writeable when the block is in AUTO or OOS mode.
Alert Key (ALERT_KEY)	1 to 255	0	Represents the plant unit ID. The value set in this parameter can be reported in alarm messages and allows HMI software to sort and filter alarms. Writeable in AUTO or OOS mode.
Block Mode (MODE_BLK)	Auto, Man, OOS, Rout, Rcas, Cas, LO, IMan	OOS	Mode requested by the operator
SP • Value			Analog setpoint of this block
OUT • Value			Primary analog value calculated as a result of executing this function
PV_SCALE			Scale of the PV parameter
EU_100		Per Sales Order(1)	Engineering units value at 100% of range
EU_0		Per Sales Order(1)	Engineering units value at 0% of range
Units_Index	K, °C, °F, °R, V, mV, µV, Ohm, kOhm, or %	Per Sales Order(1)	Engineering units
Decimal	0 to 4	1	No. of digits to the right of the decimal point
OUT_SCALE			Scale of the output of this block
EU_100		Per Sales Order(1)	Engineering units value at 100% of range
EU_0		Per Sales Order(1)	Engineering units value at 0% of range
Units_Index	K, °C, °F, °R, V, mV, µV, Ohm, kOhm, or %	Per Sales Order(1)	Engineering units
Decimal	0 to 4	1	No. of digits to the right of the decimal point
GRANT/DENY	Program, Time, Alarm, Local, Operate		Options for controlling access of host computer to operating, tuning, and alarm parameters

Table 13. PID Block User Configurable Fieldbus Parameters (Continued)

Parameter Name	Capability	Factory Default	Description & Comments
CONTROL_OPTS	Bypass Enable, SP-PV Track Man, SP-PV Track ROut, SP-PV Track LO-IMan, SP Track retain, Direct acting, Balance Ramp, Track enable, Track in manual, PV for BK_Cal_Out, Bias may be adjusted, Current IN_1 to OUT_SCALE, Retract SP to limits in Cas and RCas, No output limits in Man	0	Options to alter calculations in a control block
STATUS_OPTS	IFS if Bad IN, IFS if Bad CAS_IN, Uncertain as Good, Propagate Fail Fwd, Propagate Fail Bkwd, Target to Man if Bad IN, Uncertain if limited, Bad if Limited, Uncertain if Man, No select if not Auto, No select if not Cas	0	Options for block processing of status
IN • Value			Primary input value of the block
PV_FTIME		0	Time constant of a single exponential filter for the PV in seconds
BYPASS	Uninitialized, On, Off	0	Use this parameter to bypass the normal control algorithm. When bypass is set, the setpoint value (in percent) will be directly transferred to the output. To prevent a bump on transfer to/from bypass, the setpoint will automatically be initialized to the output value or process variable, respectively, and the path broken flag will be set for one execution.
CAS_IN • Value			Remote setpoint value
SP_RATE_DN	PV/second	+INF	Ramp rate at which downward setpoint changes are acted upon in Auto mode. If the ramp rate is set to zero or the block is in a mode other than Auto, the setpoint will be used immediately.
SP_RATE_UP	PV/second	+INF	Ramp rate at which upward setpoint changes are acted upon in Auto mode. If the ramp rate is set to zero or the block is in a mode other than Auto, the setpoint will be used immediately.
SP_HI_LIM		100	Setpoint high limit
SP_LO_LIM		0	Setpoint low limit
GAIN		0	Used by the block algorithm in calculating the block output
RESET		+INF	Integral time constant in seconds per repeat
BAL_TIME		0	Specifies the time for the internal working value of bias or ratio to return to the operator set bias or ratio, in seconds. it may be used to specify the time constant at which the integral term will move to obtain balance when the output is limited and the mode is Auto, Cas, or RCas.

Table 13. PID Block User Configurable Fieldbus Parameters (Continued)

Parameter Name	Capability	Factory Default	Description & Comments
RATE		0	Derivative time constant in seconds
BKCAL_IN • Value			Value and status from a lower block's BKCAL_OUT
OUT_HI_LIM		100	Limits the maximum output value
OUT_LO_LIM		0	Limits the minimum output value
BKCAL_HYS		0.5	Amount the output must be away from its output limit before the limit status is turned off (in % of span of the output
RCAS_IN • Value			Target setpoint and status provided by a supervisory host to an analog control or output block
ROUT_IN			Target setpoint and status provided by a host to the control block for use as the output
SHED_OPT	Uninitialized, NormalShed_NormalReturn, NormalShed_NoReturn, ShedToAuto_NormalReturn, ShedToAuto_NoReturn, ShedToManual_NormalReturn, ShedToManual_NoReturn, ShedToRetainedTarget_ NormalReturn, ShedToRetainedTarget_NoReturn	0	Action to be taken on remote control device timeout
TRK_SCALE			Scale data associated with TRK_VAL
EU_at_100%		100	Engineering units value at 100% of scale
EU_at_0%		0	Engineering units value at 0% of scale
Units_Index		°C	Engineering units
Decimal		1	No. of digits to the right of the decimal point
TRK_IN_D	Discrete state 0 - 16		Used to initiate external tracking of the block output to the value specified in TRK_VAL
TRK_VAL			Input used as the track value when external tracking is enabled by TRK_IN_D
FF_VAL			The feedforward value
FF_SCALE			Feedforward input
EU_at_100%			Engineering units value at 100% of scale
EU_at_0%			Engineering units value at 0% of scale
Units_Index			Engineering units
Decimal			No. of digits to the right of the decimal point
FF_GAIN		0	Gain that the feedforward input is multiplied by before it is added to the calculated control output
ALARM_SUM • Disabled	Enable, Disable	All alarms disabled	The disabled state of each alarm

Table 13. PID Block User Configurable Fieldbus Parameters (Continued)

Parameter Name	Capability	Factory Default	Description & Comments
ACK_OPTION	Unack Alarm 1 - 16	0	Selection of which alarms will be automatically acknowledged
ALARM_HYS	0 - 50	0.5	% by which the PV must return within alarm limits (%)
HI_HI_PRI	0 - 15	0	Priority of the High-High alarm
HI_HI_LIM		+INF	Setting of High-High alarm in engineering units
HI_PRI	0 - 15	0	Priority of the High alarm
HI_LIM		+INF	Setting of High alarm in engineering units
LO_PRI	0 - 15	0	Priority of the Low alarm
LO_LIM		-INF	Setting for Low alarm in engineering units
LO_LO_PRI	0 - 15	0	Priority of the Low-Low alarm
LO_L0_LIM		-INF	Setting of Low-Low alarm in engineering units
DV_HI_PRI		0	Priority for the high deviation alarm
DV_HI_LIM		+INF	Setting of high deviation alarm in engineering units
DV_LO_PRI		0	Priority for the low deviation alarm
DV_LO_LIM		-INF	Setting of low deviation alarm in engineering units

(1) Transmitter parameters are configured for 0 to 100°C if calibrated range is not provided with the order.

Operation

Data Transfer

The RTT80-F carries out two types of data transfer:

- ♦ Scheduled data transfer uses a fixed schedule for transferring and processing all time-critical process data (for example, continuous measurement)
- ♦ Device parameters that are not time-critical for the process and diagnosis information are only transferred to the fieldbus when needed. This data transfer is always carried out in the intervals between timed communication.

Optional Local Display

The display can be ordered with the transmitter, or as an accessory for subsequent mounting. The optional display contains several pieces of information as illustrated in Figure 22 below:

Figure 22. Optional Local Display Information

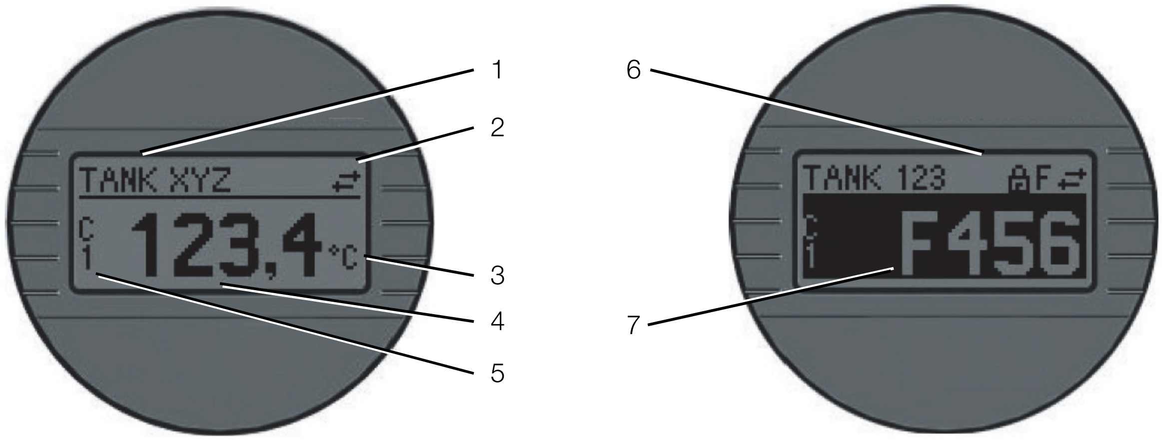


Table 14. Optional Local Display Information

Item No.	Function	Description
1	Displays the TAG	TAG, 12 characters long.
2	Communication symbol	The communication symbol appears when read and write-accessing via the FOUNDATION fieldbus protocol.
3	Unit display	Unit display for the measured value displayed.
4	Measured value display	Displays the current measured value.
5	Channel display C1 or C2, P1, S1, RJ	Displays S1, for example, for a measured value from sensor 1.
6	Configuration locked symbol	This symbol appears when configuration is locked via the hardware.
7	Warning or error message	If a warning occurs, the display alternates between the measured value and the warning code. If an error occurs, the display alternates between the error code and "- - - -", which indicates that no valid measured value is available. See "Status Messages" on page 108.

4. Maintenance and Troubleshooting

The RTT80-F Transmitter basic unit has no moving parts and is a completely sealed unit. If there is a problem, refer to the following troubleshooting section for possible corrective actions.

CAUTION

The basic transmitter is completely sealed unit and cannot be repaired. Any attempt to open the basic transmitter voids the warranty.

DANGER

For non-intrinsically safe installations, to prevent a potential explosion in a Division 1 hazardous area, deenergize the transmitter before you remove the threaded housing cover. Failure to comply with this warning could result in an explosion resulting in severe injury or death.

Calibration

The Sensor Calibration parameters in the Transducer Block can be used if the transmitter output needs to be adjusted to the sensor signal (for example, when the temperature sensor does not correspond to the ideal values for a selected temperature range). The results depend on the accuracy of the calibrator or reference equipment. In the calibration procedure, you apply two "known good" signals to the transmitter and write the "should have been" parameters. The sensor calibration changes the slope of the linearization curve so that the curve is adjusted to the connected sensor.

`SENSOR_CAL_METHOD` parameter in Sensor 1 or Sensor 2 Transducer Blocks defines the use of either `Factory trim standard` (the factory defined values calculated according to the valid norms) or `User trim standard` (the sensor calibrated values) in the transmitter for the sensor. During sensor calibration, `SENSOR_CAL_METHOD` must be set to `Factory trim standard`.

In the following example, a temperature calibration for Sensor 1 is described. However, the principle can be used for any input type or combination of input types since the calibration can be done for each of the sensor inputs.

Example:

To obtain an accurate temperature measurement in the range 0 - 100°C, apply an accurate temperature source at the low end of the range (for example 5°C) as the low calibration point and one at the high end of the range (for example 95°C) as the high calibration point.

1. Set `SENSOR_CAL_METHOD` in the Sensor 1 Transducer Block to `Factory trim standard`.

2. Apply 5°C to the sensor and set `CAL_POINT_LO` in the Sensor 1 Transducer Block to 5.00.
3. Apply 95°C to the sensor and set `CAL_POINT_HI` in Sensor 1 Transducer Block to 95.00.
4. Calibration is complete.

To use this new user calibration, set `SENSOR_CAL_METHOD` in the Sensor 1 Transducer Block to `User trim standard` or to use the factory calibration, set `SENSOR_CAL_METHOD` to `Factory trim standard`.

Post-Connection Check and Troubleshooting

After installing the device, perform the following post-connection checks if you experience any errors:

1. Are the measuring device or the cables damaged? Check for visual damage on the device and all cabling.
2. Does the supply voltage match the specification on the nameplate? Both should be 9 to 32 V dc.
3. Are the proper voltage polarities connected as marked on the transmitter?
4. Do the cables used comply with the specifications?
5. Do the cables have adequate strain relief?
6. Are the power supply and signal cables correctly connected? See “Input Connections” on page 31.
7. Are all the screw terminals well tightened? See “Input Connections” on page 31.
8. Are all the cable entries installed, tightened and sealed? Cable run with “water trap”?
9. Are all the housing covers installed and tightened?
10. Electrical connection of FOUNDATION fieldbus:
    a. Are all the connecting components (T-boxes, junction boxes, connectors, and so forth) connected with each other correctly?
    b. Has each fieldbus segment been terminated at both ends with a bus terminator?
    c. Has the maximum length of the fieldbus cable been observed in accordance with the FOUNDATION fieldbus specifications?
    d. Has the maximum length of the spurs been observed in accordance with the FOUNDATION fieldbus specifications?
    e. Is the fieldbus cable fully shielded (90%) and correctly grounded?

Replacing the Transmitter

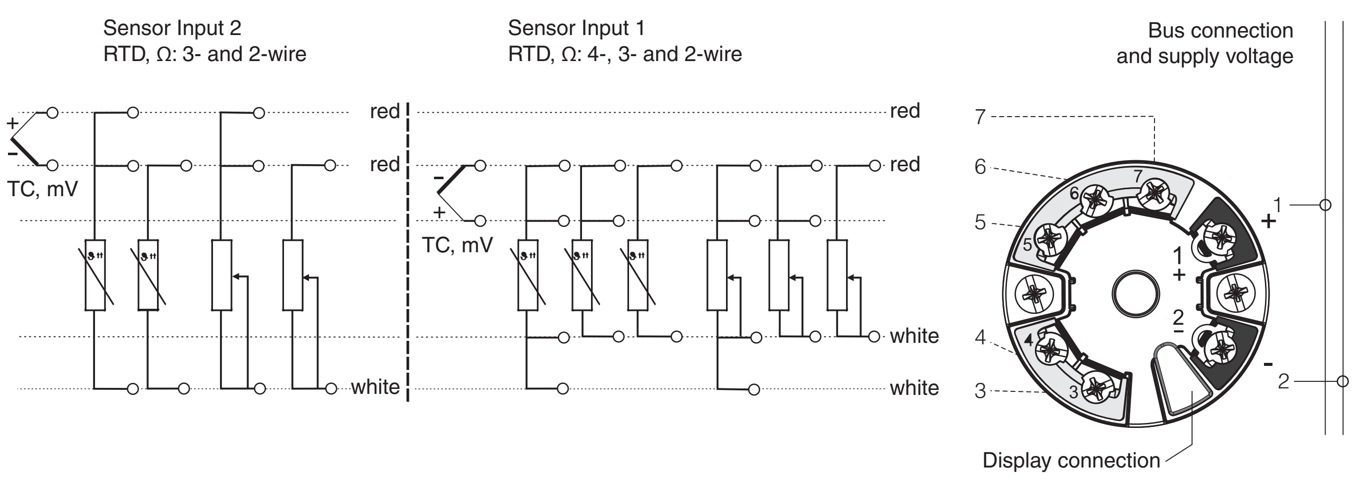
DIN Rail Mounted Units

1. Turn off the transmitter power source.
2. If the optional display is present, unplug the display from the transmitter by gently pulling it away.
3. Disconnect all wires from the transmitter noting which wire went to each terminal.
4. Remove the transmitter by removing the screw and the bushing that secures it to the DIN Clip.
5. Install the new transmitter by reversing Steps 1 to 4 above and torque the screw to 8 ±1 in-lb.

Universal Housing Mounted Units

1. Turn off the transmitter power source.
2. Remove the housing cover (if applicable).
3. If the optional display is present, unplug the display from the transmitter by gently pulling it away.
4. Disconnect all wires from the transmitter noting which wire went to each terminal.

Figure 23. Input Connections



5. Remove the transmitter by removing the two screws that secure it to the housing.
6. Install the new transmitter by reversing Steps 1 to 5 above and torque the screws to 8 ±1 in-lb.

NOTE
It is recommended that the screws be replaced when the transmitter is replaced.

CAUTION

When replacing housing cover, tighten the cover so that the flange of the cover comes in contact with the flange on the housing.

Dual Compartment Housing Mounted Units

1. Turn off the transmitter power source.
2. Remove the housing cover.
3. If the optional display is present, unplug the display from the transmitter by gently pulling it away.
4. Disconnect all the color-coded wires from the transmitter, and note which wire went to each terminal:

Terminal 1	Red
Terminal 2	Brown
Terminal 3	Orange
Terminal 4	Yellow
Terminal 5	Green
Terminal 6	Blue
Terminal 7	Purple

5. Remove the transmitter by loosening the two screws that secure it to the mounting plate.
6. Install the new transmitter by reversing Steps 1 to 5 above and torquing the screws to 7 ±1 in-lb.

NOTE

It is recommended that the screws be replaced when the transmitter is replaced.

CAUTION

When replacing housing covers, tighten each cover so that the flange of the cover comes in contact with the flange of the housing.

Diagnostics

Diagnostic error messages may be manifested either by the optional display or by a means of device interface, such as DD or DTM.

Diagnostic errors are communicated in four levels as listed below:

Table 15. Diagnostic Errors

Diagnostic Symbol	Category	Description
F	Device Failure	The measured value is no longer valid.
M	Maintenance Required	The measurement is valid but device maintenance should be scheduled soon.
C	Service Mode	The device is operating correctly but it has been taken out of service and the measurement may not be valid.
S	Out of Specification	The device is operating outside of prescribed specification limits. Measurement may be valid.

Some diagnostic events may be configured to one or more of the above categories.

Diagnostic severity can be categorized as described below:

Table 16. Diagnostic Severity

Severity	Behavior
Alarm	The measurement is interrupted. The device will take on the failure condition that has been prescribed (that is, failsafe). Diagnostic messages will reference the Device Failure (F) category.
Warning	The device continues to communicate a measurement. Diagnostic message will reference the Maintenance Required (M), Service (C) or Out of Specification (S) category.

Some diagnostic events may be user-configured for severity.

Configuration of Event Behavior according to FOUNDATION Fieldbus Field Diagnostics

The device supports the FOUNDATION fieldbus Field Diagnostics configuration. Among other things this means:

- The diagnostic category according to NAMUR recommendation NE107 is transferred via the fieldbus in a manufacturer-independent form
  - F: Failure
  - C: Function check
  - S: Out of specification
  - M: Maintenance required
- The diagnostic category of the predefined event groups can be adapted by the user according to the requirements of the respective application.
- Certain events can be separated from their group and can be treated separately:
  - 042: Sensor corrosion
  - 103: Drift
  - 901: Ambient temperature too low
  - 902: Ambient temperature too high

- Additional information and troubleshooting measures will be transferred with the event message via the fieldbus.

It has to be ensured that the option Multi-bit Alarm Support is activated in the parameter FEATURE_SEL from the Resource Block.

Event Groups

The diagnostic events are divided into 16 default groups according to the source and the importance of the event. A default event category is assigned to each group ex works. One bit of the assignment parameters belongs to each event group. The following table defines default assignments of event messages to the respective group.

Table 17. Event Groups

Event Weighting	Default Event Category	Event Source	Bit	Events of this Group
Highest weighting	Failure (F)	Sensor	31	• F041: Sensor line break • F043: Sensor short circuit
		Electronics	30	• F221: Reference measurement • F261: Device electronic • F283: Memory error
		Configuration	29	• F431: Reference values • F437: Configuration error
		Process	28	• not used with this device
High weighting	Function check (C)	Sensor	27	• not used with this device
		Electronics	26	• not used with this device
		Configuration	25	• C402: Device initialization • C482: Simulation active • C501: Device reset
		Process	24	• not used with this device
Low weighting	Out of specification (S)	Sensor	23	• not used with this device
		Electronics	22	• not used with this device
		Configuration	21	• S502: Special linearization
		Process	20	• S901: Ambient temperature too low1) • S902: Ambient temperature too high1
Least weighting	Maintenance required (M)	Sensor	19	• M042: Sensor corrosion (a) • M101: Fallen below sensor limit • M102: Sensor limit exceeded • M103: Sensor drift/ difference (a) • M104: Backup active
		Electronics	18	• not used with this device
		Configuration	17	• not used with this device
		Process	16	• not used with this device

a. This event can be removed from this group and treated separately. For additional information on the “Configurable area”, refer to the description on page 91.

Assignment Parameters

The assignment of event categories to event groups is done via four assignment parameters. These are found in the block RESOURCE (RB2):

- FD_FAIL_MAP: for event category Failure (F)
- FD_CHECK_MAP: for event category Function check (C)
- FD_OFFSPEC_MAP: for event category Out of specification (S)
- FD_MAINT_MAP: for event category Maintenance required (M)

Each of these parameters consists of 32 bits with the following meaning:

- Bit 0: reserved by the Fieldbus Foundation (“check bit”)
- Bits 1...15: Configurable area; certain diagnostic events can be assigned independently from the event group they belong to. In this case they are removed from the event group and their behavior can be configured individually. The following parameters can be assigned to the configurable area of this device:
    - 042: Sensor corrosion
    - 103: Drift
    - 901: Ambient temperature too low
    - 902: Ambient temperature too high
- Bits 16...31: Standard area; these bits are firmly assigned to event groups. If the bit is set to 1 this event group is assigned to the respective event category.

The following table indicates the default setting of the assignment parameters. The default setting has a clear assignment between the event weighting and the event category (that is, the assignment parameter).

Table 18. Default Setting of Assignment Parameters

Event Weighting	Default Range																Configurable Area
	Highest weighting				High weighting				Low weighting				Least weighting				
Event source (a)	S	E	C	P	S	E	C	P	S	E	C	P	S	E	C	P	
Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15...1
FD_FAIL_MAP	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
FD_CHECK_MAP	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0
FD_OFFSPEC_MAP	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0
FD_MAINT_MAP	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0

a. S: Sensor; E: Electronics; C: Configuration; P: Process

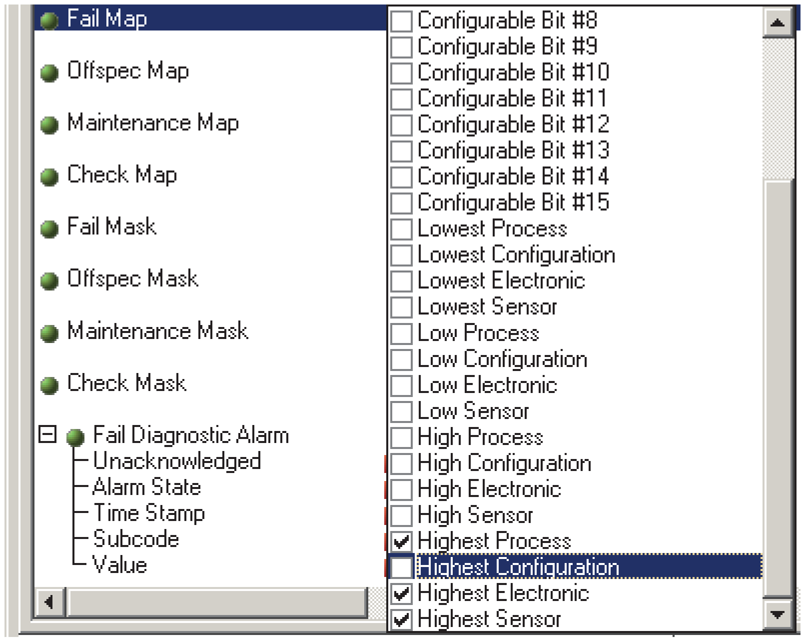
In order to change the diagnostic behavior of an event group, proceed as follows:

1. Open assignment parameter to which the group is currently assigned to.
2. Change the bit of the event group from 1 to 0. In configuration systems this is done by deactivating the respective check box.
3. Open assignment parameter to which the group shall be assigned.
4. Change the bit of the event group from 0 to 1. In configuration systems this is done by activating the respective check box.

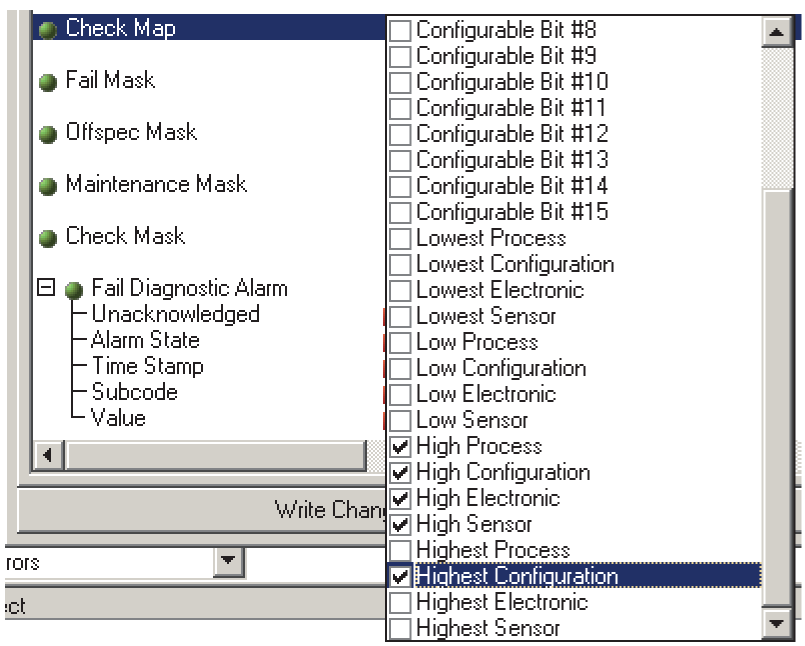
Example

The group Highest weighting/Configuration error contains the events `431: Reference values` and `437: Configuration error`. These are to be categorized as Function check (C) and no longer as Failure (F).

Search for the group `Highest Configuration` in the Resource Block in the parameter `FD_FAIL_MAP` and deactivate the corresponding check box.



Then search for the group `Highest Configuration` in the parameter `FD_CHECK_MAP` and activate the corresponding check box.



NOTE
Care has to be taken that the corresponding bit is set in at least one of the assignment parameters for each event group. Otherwise no category will be transmitted with the event via the bus, and the control system will normally ignore the presence of the event.

NOTE
The detection of diagnostic events is parameterized with the MAP parameters (F, C, S, M); however not the transfer of messages to the bus. The latter is done with the MASK parameters. The Resource Block has to be set in the Auto mode so that the status information is transmitted to the bus

Configurable Area

The event category can be individually defined for the following events - independent of the event group to which they are assigned by default:

- 042: Sensor corrosion
- 103: Drift
- 901: Ambient temperature too low
- 902: Ambient temperature too high

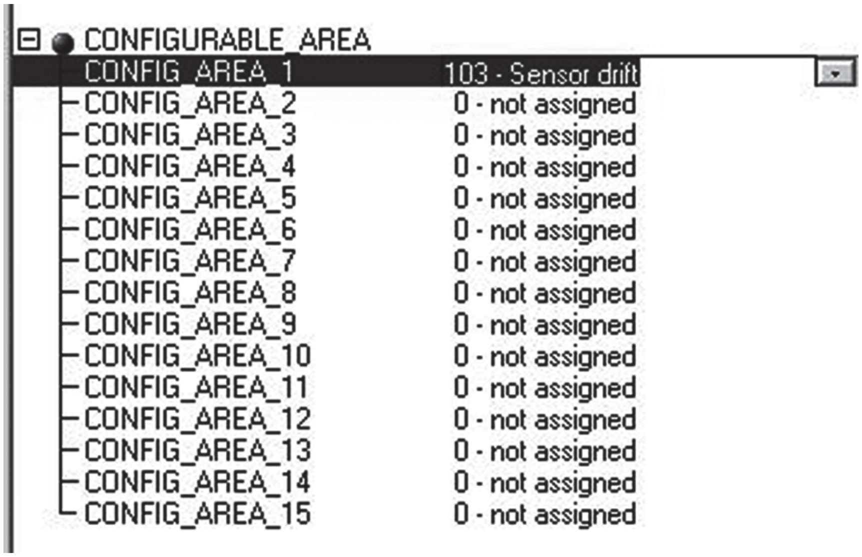
First, in order to change the event category the event has to be assigned to the bits 1 to 15. The parameters ConfigArea_1 to ConfigArea_15 in the Advanced Diagnostic (ADVDIAG)Transducer Block are used for this. Then the corresponding bit can be set from 0 to 1 in the desired assignment parameter.

Example

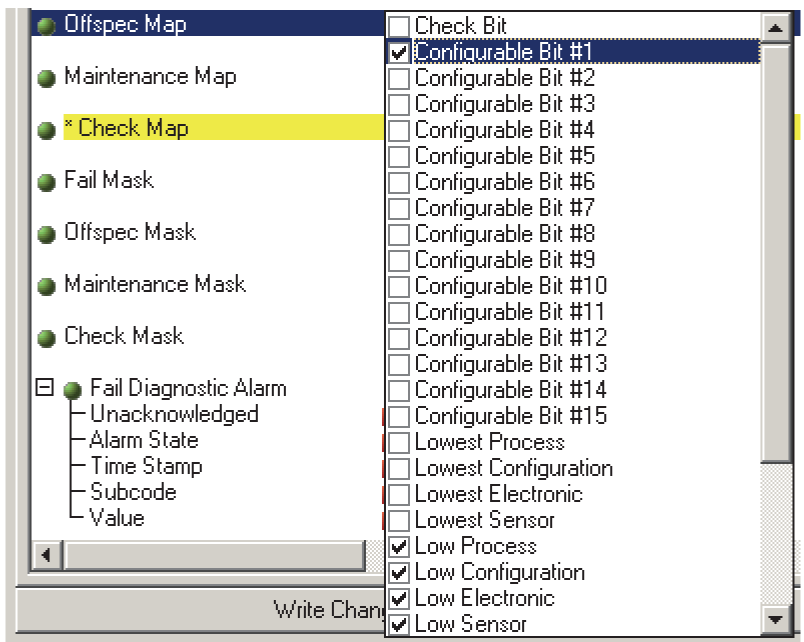
The diagnostic event 103 “Drift” should no longer be categorized as Maintenance required (M) but as Out of specification (S). Furthermore, the status of the measurement value should display BAD.

1. Navigate to the `CONFIGURABLE_AREA` parameter in the Advanced Diagnostic Transducer Block. By default, all bits have the value `0 - not assigned`.

2. Select one of these bits (for example: Configurable Area Bit 1) and select the Drift option from the corresponding selection list and press Enter..



Move to the Resource Block and activate the concerning bit (here: Configurable Area Bit 1) in the parameter FD_OFFSPEC_MAP.



Now the measurement value can be additionally set for this event. With the parameter STATUS_SELECT_103 the measurement value BAD can be selected via the selection menu.

Cause and Remedy of a Diagnostic Event

In the parameter FD_RECOMMEN_ACT in the Resource Block a description is displayed for the currently active diagnostic event with the highest priority. This description has the following setup:

- Diagnostic number: Diagnostic text with channel (ch x):troubleshooting recommendations separated with hyphens

Example for the diagnostic event sensor break:

```
41:Sensor break ch01:Check electrical connection - Replace
sensor - Check configuration of the connection type
```

The value transmitted via the bus has the following setup:

```
XXYYY
```

where:

- XX = channel number
- YYY = diagnostic number

The value for the above mentioned example sensor break is `01041`.

Transmission of Event Messages to the Bus

The transmission of event messages must be supported by the respective control system used.

Event Priority

Event messages are only transmitted to the bus if they have the priority 2 to 15. Events with priority 1 will be displayed but not transmitted to the bus. Events with priority 0 are ignored. In the factory setting the priority of all events is 0. The priority can be individually adapted for the four assignment parameters. Four PRI parameters (F, C, S, M) from the Resource Block are used for this.

Suppression of Certain Events

The transmission of certain events to the bus may be suppressed via a mask. In this case these events are displayed but not transmitted to the bus. This mask can be find in the MASK parameters (F, C, S, M). The mask serves as a negative mask, that means: if a field is marked the related events are not transmitted to the bus.

FOUNDATION Fieldbus Diagnostic Parameters

Diagnostic Parameters in the Resource Block

Table 19. Field Diagnostic Parameters in the RTT80 Resource Block

Parameter Index	Parameter	Write Access with Operating Mode	Factory Default	Description
51	Fail Active (FD_FAIL_ACTIVE)	Read only		Reflect the error conditions that are being detected as active as selected for this category
52	Offspec Active (FD_OFFSPEC_ACTIVE)	Read only		Reflect the error conditions that are being detected as active as selected for this category
53	Maintenance Active (FD_MAINT_ACTIVE)	Read only		Reflect the error conditions that are being detected as active as selected for this category

Table 19. Field Diagnostic Parameters in the RTT80 Resource Block (Continued)

Parameter Index	Parameter	Write Access with Operating Mode	Factory Default	Description
54	Check Active (FD_CHECK_ACTIVE)	Read only		Reflects the error conditions that are being detected as active as selected for this category
55	Fail Map (FD_FAIL_MAP)	AUTO - OOS		Enable or disable conditions to be detected as active for this alarm category
56	Offspec Map (FD_OFFSPEC_MAP)	AUTO - OOS		Enable or disable conditions to be detected as active for this alarm category
57	Maintenance Map (FD_MAINT_MAP)	AUTO - OOS		Enable or disable conditions to be detected as active for this alarm category
58	Check Map (FD_CHECK_MAP)	AUTO - OOS		Enable or disable conditions to be detected as active for this alarm category
59	Fail Mask (FD_FAIL_MASK)	AUTO - OOS		Allow to suppress any single or multiple conditions
60	Offspec Mask (FD_OFFSPEC_MASK)	AUTO - OOS		Allow to suppress any single or multiple conditions
61	Maintenance Mask (FD_MAINT_MASK)	AUTO - OOS		Allow to suppress any single or multiple conditions
62	Check Mask (FD_CHECK_MASK)	AUTO - OOS		Allow to suppress any single or multiple conditions
63	Fail Diagnostic Alarm (FD_FAIL_ALM)	AUTO - OOS		Are used primarily to broadcast a change in the associated active conditions
64	Offspec Alarm (FD_OFFSPEC_ALM)	AUTO - OOS		Are used primarily to broadcast a change in the associated active conditions
65	Maintenance Alarm (FD_MAINT_ALM)	AUTO - OOS		Are used primarily to broadcast a change in the associated active conditions
66	Check Alarm (FD_CHECK_ALM)	AUTO - OOS		Are used primarily to broadcast a change in the associated active conditions
67	Fail Priority (FD_FAIL_PRI)	AUTO - OOS		Allow to specify the priority of this alarm category
68	Offspec Priority (FD_OFFSPEC_PRI)	AUTO - OOS		Allow to specify the priority of this alarm category
69	Maintenance Priority (FD_MAINT_PRI)	AUTO - OOS		Allow to specify the priority of this alarm category
70	Check Priority (FD_CHECK_PRI)	AUTO - OOS		Allow to specify the priority of this alarm category
71	Field Diagnostic Simulate (FD_SIMULATE)	AUTO - OOS		Used as the field diagnostic condition when the simulation is enabled
72	Recommended Action (FD_RECOMMEN_ACT)	Read only		A device enumerated summarization of the most severe condition or conditions detected

Diagnostic Parameters in the Advanced Diagnostic Transducer Block

The following table shows the user configurable parameters for the Advanced Diagnostic Transducer Block.

Table 20. Advanced Diagnostic Transducer Block Parameters

Parameter	Capability	Factory Default	Description
Corrosion detection (CORROSION_DETECTION)	• Off • On	On	Turning corrosion detection on allows the RTT80 to recognize any sensor connection cable corrosion before measured values are affected. Writeable when the block is in the OOS operating mode. **Note**: This parameter is only applicable for RTD 4-wire connections and thermocouples (TC).
Sensor drift monitoring (SENSOR_DRIFT_MONITORING)	• Off: Sensor deviation monitoring off; diagnostic event 103 has been deactivated • On: Sensor deviation monitoring on; when occurring, diagnostic event 103 and the associated category are displayed	Off	This parameter allows you to monitor any deviations that occur between the measured values for sensors 1 and 2. Deviation between SV1 and SV2 is displayed according to the Field Diagnostic configuration of the “103-Drift” diagnostic event. This parameter is writeable when the block is in OOS operating mode.
Sensor drift mode (SENSOR_DRIFT_MODE)	• Undershooting: a diagnostic event is generated if the sensor drift alert value is undershot • Overshooting: a diagnostic event is generated if the sensor drift alert value is overshot	Off	Select whether a status is generated if the value set in the SENSOR_DRIFT_ALERT_VALUE parameter is undershot (Undershooting) or overshot (Overshooting). Writeable when the block is in OOS operating mode. **Note**: This parameter is only applicable when Sensor drift monitoring is on.
Sensor drift alert value (SENSOR_DRIFT_ ALERT_VALUE)	0 to 999°C (0 to 1830.2°F)	999.0	Limit value of the permitted deviation between the measured values of sensors 1 and 2.
System Alarm delay (SYSTEM_ALARM_DELAY)	0 to 10 s	2	Alarm hysteresis: Value as to the time a device status (Failure or Maintenance) and measured value status (Bad or Uncertain) is delayed until the status is output. Writeable when the block is in the OOS operating mode. **Note**: This setting does not affect the display.

Table 20. Advanced Diagnostic Transducer Block Parameters (Continued)

Parameter	Capability	Factory Default	Description
Actual Status Category / Previous Status Category (ACTUAL_STATUS_CATEGORY / PREVIOUS_STATUS_CATEGORY)	0 t		Current/last status category • Good: No errors detected • F: Failure; Error detected • C: Function check; Device is in the service mode • S: Out of Spec.; Device is being operated outside the specifications • M: Maintenance required • Not categorized: No Namur category has been selected for the current diagnostic event

Table 20. Advanced Diagnostic Transducer Block Parameters (Continued)

Parameter	Capability	Factory Default	Description
Actual Status Number / Previous Status Number (ACTUAL_ STATUS_ NUMBER / PREVIOUS_ STATUS_ NUMBER)			Current/past status number: • 000 NO_ERROR: No error is present • 041 SENSOR_BREAK: Sensor rupture • 043 SENSOR_SHORTCUT: Sensor short circuit • 042 SENSOR_CORROSION: Corrosion of connections or sensor cables • SENSOR_UNDERUSAGE: Measured value of the sensor is below the linearization range • SENSOR_OVERUSAGE: Measured value of the sensor is above the linearization range • 104 BACKUP_ACTIVATED: Backup function activated due to sensor failure • 103 DEVIATION: Sensor drift detected • 501 DEVICE_PRESET: Reset routine in progress 482 SIMULATION: Device is in the simulation mode • 402 STARTUP: Device is in the startup/initialization phase 502 LINEARIZATION: Linearization incorrectly selected or configured • 901 AMBIENT_TEMPERATURE_ LOW: Ambient temperature too low; DEVTEMP_VALUE < -40°C (-40°F) • 902 AMBIENT_TEMPERATURE_ HIGH: Ambient temperature too high; DEVTEMP_VALUE > 85°C (185°F) • 261 ELECTRONICBOARD: Electronics module/hardware faulty • 431 NO_CALIBRATION: Calibration values lost/modified • 283 MEMORY_ERROR: Contents of memory inconsistent • 221 RJ_ERROR: Error in reference junction measurement/internal temperature measurement

Table 20. Advanced Diagnostic Transducer Block Parameters (Continued)

Parameter	Capability	Factory Default	Description
Actual Status Channel/ Previous Status Channel (PREVIOUS/ ACTUAL_ STATUS_ CHANNEL)			• ACTUAL_STATUS_CHANNEL displays the channel that currently has the error with the highest value. • PREVIOUS_STATUS_CHANN EL indicates the channel where an error last occurred.
Actual Status Description / Previous Status Description (PREVIOUS/ ACTUAL_ STATUS_DESC)			Displays the descriptions of the current and previous error status **Note**: The descriptions can be taken from the description for the Actual Status Number/ Previous Status Number parameter.
Actual Status Count (ACTUAL_STATUS_COUNT)			A read only parameter that displays the number of status messages currently pending in the device
PV1 max. indicator PV1_MAX_INDICATOR)		-10000	Maximum indicator for the maximum value to occur for PV1. Writeable when the block is in the AUTO or OOS operating mode, this parameter can be reset by writing an arbitrary value to it.
PV1 min. indicator (PV1_MIN_INDICATOR)		+10000	Maximum indicator for the minimum value to occur for PV1. Writeable when the block is in the AUTO or OOS operating mode, this parameter can be reset by writing an arbitrary value to it.
PV2 max. indicator (PV2_MAX_INDICATOR)			Maximum indicator for the maximum value to occur for PV2. Writeable when the block is in the AUTO or OOS operating mode, this parameter can be reset by writing an arbitrary value to it.
PV2 min. indicator (PV2_MIN_INDICATOR)			Maximum indicator for the minimum value to occur for PV2. Writeable when the block is in the AUTO or OOS operating mode, this parameter can be reset by writing an arbitrary value to it.
Sensor 1 max. indicator (SV1_MAX_INDICATOR)			Maximum indicator for the maximum value to occur at sensor 1. Writeable when the block is in the AUTO or OOS operating mode, this parameter can be reset by writing an arbitrary value to it.
Sensor 1 min. indicator (SV1_MIN_INDICATOR)			Maximum indicator for the minimum value to occur at sensor 1. Writeable when the block is in the AUTO or OOS operating mode, this parameter can be reset by writing an arbitrary value to it.

Table 20. Advanced Diagnostic Transducer Block Parameters (Continued)

Parameter	Capability	Factory Default	Description
Sensor 2 max. indicator (SV2_MAX_INDICATOR)			Maximum indicator for the maximum value to occur at sensor 2. Writeable when the block is in the AUTO or OOS operating mode, this parameter can be reset by writing an arbitrary value to it.
Sensor 2 min. indicator SV2_MIN_INDICATOR)			Maximum indicator for the minimum value to occur at sensor 2. Writeable when the block is in the AUTO or OOS operating mode, this parameter can be reset by writing an arbitrary value to it.
Device Temperature (RJ) max. indicator (DEVTEMP_MAX_INDICATOR)			Maximum indicator for the maximum value to occur at the internal reference temperature measuring point. Writeable when the block is in the AUTO or OOS operating mode, this parameter can be reset by writing an arbitrary value to it.
Device Temperature (RJ) min. indicator (DEVTEMP_MIN_INDICATOR)			Maximum indicator for the minimum value to occur at the internal reference temperature measuring point. Writeable when the block is in the AUTO or OOS operating mode, this parameter can be reset by writing an arbitrary value to it.
CONFIG_AREA_1 ...CONFIG_AREA_15		OOS	The configurable area of the FOUNDATION fieldbus Field Diagnostics. One of the four diagnostic events: • 42 - Corrosion • 103 - Drift • 901 - Ambient temperature too low • 902 - Ambient temperature too high can be separated from the factory configured diagnostic group and can be categorized individually. By setting to one of the Field Diagnostic Bits 1-15 the category for this Bit can be configured to the categories F, C, S, M in the Resource Block (“Configurable Area” on page 93)
STATUS_SELECT_42		OOS	The value status (BAD, UNCERTAIN, GOOD) for the respective diagnostic event can be configured
STATUS_SELECT_103		OOS	
STATUS_SELECT_901		OOS	
STATUS_SELECT_902		OOS	
DIAGNOSIS_SIMULATION_ENABLE		OOS	Activating or deactivating of the simulation of an diagnostic event
DIAGNOSIS_SIMULATION_NUMBER		AUTO - OOS	Selection of the diagnostic event to be simulated

Display

The optional display will annunciate a diagnostic event.

In the event of a warning, the display will alternate between the diagnostic code number preceded by the category (M, C, or S) symbol and the configured measurement. For example, a corroded sensor that is configured for a Maintenance category will display "M042" on black background alternating with the measurement in a normal format (black characters on green background).

In the event of an alarm, the display will alternate between the diagnostic code number preceded by the "F" symbol and "----" to indicate no measurement. For example, a broken sensor with no redundancy will display "F041" on black alternating with "----" in black characters on green background.

See Table 21 for diagnostic codes and descriptions.

The optional display will show the current diagnostic with the highest priority. If more than one diagnostic is active, all current diagnostic messages can be read using a Device Interface.

Device Interface

Diagnostic messages can be read via a device interface, such as a hand-held configurator or Field Device Tool frame application. More detailed information is available with these interfaces.

See "Configuration" on page 50 for details of configuring diagnostics. See Chapter 5, "RTT80 Configuration with a Device Type Manager" for RTT80 diagnostics DTM screens.

Table 21. Diagnostic Codes

Diagnostic Code	Displayed Text	Description / Action	Category	Severity
Input Diagnostics				
001	Device Error	Device has failed. Replace the module.	F	Alarm
006	Sensor Redundancy Active	Backup measurement is active. Check primary sensor.	M	Warning
041	Sensor Broken	Sensor input is bad. Check sensor and replace if necessary. Check sensor configuration.	F	Alarm
042	Sensor Corroded	Input indicates potential sensor corrosion. Check sensor connections and replace sensor if necessary.	M or F	Alarm or Warning
043	Short Circuit	Input indicates potential sensor shorting. Check sensor connections and replace sensor if necessary.	F	Alarm
044	Sensor Drift	Sensor input is drifting between sensors. Check sensor connections. Check process temperature.	M, F or S	Alarm or Warning
045	Operating Range	Measurement is outside of operating range. Check ambient temperature. Check external reference measurement.	F	Alarm
101	Sensor Value Too Low	Sensor input is below expected level. Check sensor type. Check process temperature. Replace sensor if necessary.	F	Alarm
102	Sensor Value Too High	Sensor input is above expected level. Check sensor type. Check process temperature. Replace sensor if necessary.	F	Alarm
104	Backup Active	Sensor 2 has become primary measurement. Check Sensor 1.	M	Warning

Table 21. Diagnostic Codes (Continued)

Diagnostic Code	Displayed Text	Description / Action	Category	Severity
105	Calibration Interval	Calibration countdown timer has expired. Perform calibration or deactivate counter.	M or F	Alarm or Warning
106	Backup Not Available	Backup is configured but Sensor 2 input does not appear to be valid. Check Sensor 2 connections or replace Sensor 2 if necessary. If backup is not intended, reconfigure Current Output.	M	Warning
Electronics Diagnostics				
201	Electronics Error.	Device has failed. Replace the module.	F	Alarm
221	Electronics Reference	Internal electrical references have failed. Replace the module	F	Alarm
241	Electronics Software.	Internal software algorithms have failed. Restart or reset the device or replace the module.	F	Alarm
261	Electronics Module	Display module has failed. Replace the display.	F	Alarm
262	Module Connection	Check electrical connection between transmitter module and display module. Replace display if necessary.	M	Warning
283	Memory Content	emory is corrupted. Replace the module.	F	Alarm
301	Supply Voltage	Voltage is outside operating limits. Check bus/power connections. Check power supply.	F	Alarm
Configuration Diagnostics				
401	Factory Reset	Device is resetting. Please wait until initialization is complete.	C	Warning
402	Configuration Initialization	Configuration is being initialized in the transmitter. Please wait until initialization is complete	C	Warning
411	Upload/Download	Configuration data is be written to the transmitter. Please wait until initialization is complete.	C	Warning
431	Factory Calibration	Device has lost its factory calibration data. Replace electronics module.	F	Alarm
435	Linearization	Problem with sensor linearization data. Check configuration of sensor parameters. Check configuration of sensor linearization. Replace electronics module.	F	Alarm
437	Configuration	Check sensor configuration. Check transmitter settings. Replace electronics module.	F	Alarm
451	Data Handling	Data transfer in progress. Please wait.	C	Warning
483	Simulation Input	Raw sensor input is being simulated. End simulation.	C	Warning
484	Simulation Measured Value	Conditioned digital measurement is being simulated. End simulation.	C	Warning
485	Simulation Current Output	mA output is being simulated. End simulation.	C	Warning
Process Diagnostics				
803	Current Loop	Current loop detected. Check wiring or replace electronics module.	F	Alarm
842	Process Limit	Configured limit has been exceeded. Check the adjusted range of the current output.	M, F or S	Alarm or Warning
925	Device Temperature	Operating temperature range has been exceeded. Check ambient temperature.	S or F	Warning

Troubleshooting Guidelines

Guidelines on what to do if a FOUNDATION fieldbus network is not working are described in this section.

In the context of this section, this means that the network is either dead (no apparent communication) or slow (too many communication retries). Also, one or more devices on an otherwise working network may appear dead or slow. These conditions may be caused by incorrect installation, incorrect setup (incorrect commissioning), or malfunctioning devices. Other problems, such as a device transmitting bad data (with correct FOUNDATION fieldbus), are not physical layer problems and are therefore outside the scope of this document.

General Troubleshooting Checklist

Always start troubleshooting with the checklists below if faults occur after start up or during operation. This takes you directly to the cause of the problem and the appropriate remedial measures.

Check display (optional, attachable LC display)	
No display visible	• Check the supply voltage at the RTT80 transmitter (Terminals + and -). • Check whether the retainers and the connection of the display module are correctly seated on the RTT80 transmitter. Refer to "Hardware Settings" on page 50. • If available, test the display module with other suitable transmitters. • If the display module is defective, replace module. • If the transmitter is defective, replace transmitter.
Onsite error messages on the display	
Refer to "Status Messages" on page 108.	
Faulty connection to the fieldbus host system	
No connection can be made between the fieldbus host system and the measuring device. Check the following points:	
Fieldbus connection	Check the data cable.
Fieldbus voltage	Check that a minimum bus voltage of 9 V dc is present at the +/- terminals. The permitted range is 9 to 32 V dc.
Network structure	Check permissible fieldbus cable length and number of spurs.
Basic current	Is there a basic current of a minimum of 11 mA?
Terminating resistors	Has the FOUNDATION fieldbus H1 been terminated correctly? Each bus segment must always be terminated with a bus terminator at both ends (start and finish). Otherwise there may be interference in data transmission.
Current consumption Permissible feed current	Check the current consumption of the bus segment: The current consumption of the bus segment in question (= total of basic currents of all bus users) must not exceed the maximum permissible feed current of the bus power supply unit.
Error messages in the FF configuration system	
Refer to "Status Messages" on page 108.	

<table>
<tr><th colspan="2">Problems when configuring function blocks</th></tr>
<tr><td>Transducer Blocks:
The operating mode cannot be set to AUTO.</td><td>Check whether the operating mode of the Resource Block is set to AUTO → MODE_BLK parameter group / TARGET parameter.
Faulty parameterization: Make sure that the unit selected suits the process variable chosen in the SENSOR_TYPE parameter. Otherwise the BLOCK_ERR parameter displays the “Block Configuration Error” error message. In this state, the operating mode cannot be set to AUTO.</td></tr>
<tr><td>Analog Input function block:
The operating mode cannot be set to AUTO.</td><td>There can be several reasons for this. Check the following points one after another:
• Check whether the operating mode of the Analog Input function block is set to AUTO: MODE_BLK parameter group / TARGET parameter. If not and the mode cannot be changed to AUTO, first check the following points.
• Make sure that the CHANNEL parameter (select process variable) has already been configured in the Analog Input function block. The option CHANNEL = 0 (uninitialized) is not valid.
• Make sure that the XD_SCALE parameter group (input range, unit) has already been configured in the Analog Input function block.
• Make sure that the L_TYPE parameter (linearization type) has already been configured in the Analog Input function block.
• Check whether the operating mode of the Resource Block is set to AUTO. MODE_BLK parameter group / TARGET parameter.
• Make sure that the function blocks are correctly connected together and that this system configuration has been sent to the fieldbus users.</td></tr>
<tr><td>Analog Input function block:
Although the operating mode is set to AUTO, the status of the AI output value OUT is “BAD” or “UNCERTAIN”.</td><td>Check whether an error is pending in the Transducer Block “Advanced Diagnostic”: Transducer Block “Adv. Diagnostic”, “Actual Status Category” and “Actual Status Number” parameters. See Table 22.</td></tr>
<tr><td>Parameters cannot be changed or
No write access to parameters.</td><td>• Parameters that only show values or settings cannot be changed!
• If hardware write protection is enabled, disable it. See “Hardware Settings” on page 50.
Write protection: You can check whether the hardware write protection is enabled or disabled via the WRITE_LOCK parameter in the Resource Block: LOCKED = write protection enabled UNLOCKED = write protection disabled.
• The block operating mode is set to the wrong mode. Certain parameters can only be changed in the OOS (out of service) mode or the MAN (manual) mode. Set the operating mode of the block to the desired mode via the MODE_BLK parameter group.
• If the value entered is outside the specified input range for the parameter in question, enter a suitable value and increase input range if necessary.</td></tr>
<tr><td>Transducer Blocks:
The manufacturer-specific parameters are not visible.</td><td>The device description file (DD) has not yet been loaded to the host system or the configuration program? If not, download the file to the configuration system. For information on where to obtain the DD, refer to “Device Description” on page 52.
In addition, make sure you are using the correct system files for integrating field devices into the host system.</td></tr>
<tr><td>Analog Input function block:
The output value OUT is not updated despite a valid “GOOD” status.</td><td>If simulation is active, deactivate simulation by means of the SIMULATE parameter group.</td></tr>
<tr><th colspan="2">Other errors (application errors without messages)</th></tr>
<tr><td>Some other error has occurred.</td><td>Refer to “Application Errors Without Messages” on page 115 for possible causes and remedial measures.</td></tr>
</table>

Reduction to Known Working State

Although the technique may be obvious, a powerful troubleshooting approach is to reduce the size of the network until you reduce it to something that works. At the junction box, for example, you can disconnect major sections of the network. When satisfied that the remainder works, add the sections back one at a time until you can identify the offending section. Then begin picking the offending section apart just as you did the whole network.

Remember that connecting and disconnecting things from the live network may cause momentary communication problems. Do not confuse these with the network problem you're trying to find.

Addressing

Incorrect addressing makes a device appear dead. Make sure you have ruled this out before you begin looking for installation problems.

Works on Bench But Not in Network

If a field device works on the test bench but not in the network, this can be caused by incorrect addressing. If this device has the same address as another device already on the network, it will appear to work when removed from the network and fail when reconnected.

Another possibility is that the device has malfunctioned and is causing heavy loading of the network. Other devices may or may not communicate with this device connected. The loading is not apparent when the device is operating by itself, but when the device is added to an already loaded network, it causes excessive loading. This can be examined by using an oscilloscope. The scope must be a differential type (or battery operated) and must be set to ac coupling to view the wave packets (one packet = one message) traveling on the network. If the packets become greatly attenuated when the offending device is connected, then it is likely that the device has failed.

Open Trunk

If the trunk has become open at some point, either through accident or careless maintenance, the network may appear to work some of the time and not at other times, depending on whether devices try to communicate across the break. Master software will probably be capable of quickly providing a list of devices that are "present" versus those that have disappeared. This narrows down the location of the break.

Other evidence of a break can be gathered with an oscilloscope. (The scope must be of a type and must be set up as described earlier.) A break means that only one terminator will be present, which will usually cause almost double the normal signal level. This situation exists at both sides of the break.

Hand-held Master Works at One End of Trunk But Not Other End

Suppose that a master connected at end A of the trunk talks to devices also connected at end A, but the same master connected at end B of the trunk cannot talk to devices connected at end B. This may indicate that the network is shorted or shorted to ground or too heavily loaded at the non-working end (end B). It may also mean that one of the trunk conductors is continuous throughout the trunk, but that the other is broken with one side of the break open and the other side of the break shorted to the other trunk conductor.

Working Network Suddenly Stops

Assume that no communication occurs on a network that was previously OK. This could mean that a device has malfunctioned and is short-circuiting the network. It could also mean that a device has malfunctioned and is jabbering (transmitting continuously and not allowing any other communication). Both of these conditions may be observable with an oscilloscope. (The scope must be of a type and must be set up as described earlier.) A short circuit will often not be a perfect short, so that highly attenuated packets may still be seen. Jabbering will appear to be one long packet with no observed breaks.

If a device has short-circuited or is causing excessive loading to the extent that it prevents or slows all network traffic, it may not be easy to find. If it is network powered, it may present a short circuit at communication frequencies but not at dc. It may be necessary for you to remove devices one by one to find the offender.

Test Equipment

A network analyzer may be useful. It performs somewhat the same functions as a master, but may have more diagnostic capability. For example, it should be able to tell you quickly if devices have been addressed, but do not answer. The analyzer is itself a FOUNDATION fieldbus/PROFIBUS device and must be specifically designed for bus used.

An oscilloscope is useful for observing the quality of the signal packets. Various specific uses of the oscilloscope were given earlier. The scope should be differential or should be battery operated to avoid grounding one side of the network through a scope probe. Use probes that have at least 1 Megohm input resistance and less than 1000 pf input capacitance.

A DVM is useful for checking connections. The ohmmeter function can tell you whether the network has been shorted or whether one side is shorted to ground. Before making such measurements, however, you may have to disconnect the power supply in a network powered bus. Shutting off the power is not enough. The reason is that the power supply may contain dc paths that, although ineffective at communication frequencies, have all three conductors (the two network lines and ground) connected. There may be devices other than the power supply that also create this deceptive situation. Consult the manufacturer's specifications or temporarily disconnect a suspect device before using the ohmmeter. The DVM is also useful in checking supply voltage in powered networks. The DVM input capacitance should be less than 1000 pf.

Switch Mode Checklist

1. Verify that the block is scheduled. (Note that Resource Block and Transducer Block are always scheduled.)
2. Verify that Resource/Physical Block is in Auto Mode.
3. Verify that requested mode is permitted.

Schedule Download Checklist

1. Verify that all blocks in the network have different tags.
2. Verify that no two blocks from the same devices are scheduled to be executed at the same time.
3. Verify that there is enough time for block execution.

Status Messages

The device displays warnings or alarms as status messages. If errors occur during commissioning or measuring operation, these errors are displayed immediately. This takes place in the configuration program by means of the parameter in the Adv. Diagnostic Block or on the mounted display. A distinction is made here between the following 4 status categories:

Status Category	Description	Error Category
F	Fault detected (“Failure”)	ALARM
C	Device is in the service mode (“Function check”)	WARNING
S	Specifications not observed (“Out of specification”)	
M	Maintenance necessary (“Maintenance required”)	

WARNING Error Category

With “M”, “C” and “S” status messages, the device tries to continue measuring (uncertain measurement!). If a display unit is attached, the display alternates between the main measured value and the status in the form of the letter in question plus the defined error number.

ALARM Error Category

The device does not continue measuring when the status message is “F”. If a display unit is attached, the display alternates between the status message and “- - - -” (no valid measured value available). Depending on the setting of the Fail Safe Type parameter (FSAFE_TYPE), the last good measured value, the incorrect measured value or the value configured under Fail Safe Value (FSAFE_VALUE) is transmitted via the fieldbus with the status “BAD” for the measured value. The fault state is displayed in the form of the letter “F” plus a defined number. The status message can also apply for just one channel (for example, F041 - Sensor break). The second channel is still fully functional.

NOTE

In both instances, the system outputs the sensor that generates the status, for example, "C1", "C2". If no sensor name is displayed, the status message does not refer to a sensor but refers to the device itself.

Abbreviations of the output variables:

- ♦ SV1 = Sensor value 1
- ♦ SV2 = Sensor value 2
- ♦ PV1 = Primary value 1
- ♦ PV2 = Primary value 2
- ♦ DT = Device temperature

Table 22. Status Messages

Default Cat.	No.	Status Messages ACTUAL_STATUS_ NUMBER in the 'Advanced Diagnostics' Transducer Block Local Display	Error Messages in the Sensor Transducer Block	Sensor Transducer Block Measured Value Status (Default)	Cause of Error or Resolution	Output Variables Affected
F-	041	Device status message (FF): Sensor line break F-041 Local display: F-041	BLOCK_ERR = Other | Input Failure	QUALITY = BAD	Cause of error: Electr. interruption of sensor or sensor wiring Incorrect setting for type of connection in the SENSOR_ CONNECTION parameter Remedy: Re 1.) Reestablish electr. connection or replace sensor. Re 2.) Configure correct type of connection.	SV1, SV2 also PV1, PV2 depending on the configuration
			Transducer_error = Mechanical failure	SUBSTATUS = Sensor failure		
M-	042	Device status message (FF): Sensor corrosion M-042 Local display: M-042 ↔ Measured value	BLOCK_ERR = Other	QUALITY = UNCERTAIN (configurable)	Cause of error: Corrosion detected on the sensor terminals. Remedy: Check wiring and replace if necessary.	SV1, SV2 also PV1, PV2 depending on the configuration
			Transducer_Error = No error	SUBSTATUS = Sensor conversion not accurate		
F-	043	Device status message (FF): Sensor shortcut F-043 Local display: F-043	BLOCK_ERR = Other | Input Failure	QUALITY = BAD	Cause of error: Short circuit detected at the sensor terminals. Remedy: Check sensor and sensor wiring.	SV1, SV2 also PV1, PV2 depending on the configuration
			Transducer_error = Mechanical failure	SUBSTATUS = Sensor failure		

Table 22. Status Messages (Continued)

Default Cat.	No.	Status Messages ACTUAL_STATUS_ NUMBER in the 'Advanced Diagnostics' Transducer Block Local Display	Error Messages in the Sensor Transducer Block	Sensor Transducer Block Measured Value Status (Default)	Cause of Error or Resolution	Output Variables Affected
M-	101	Device status message (FF): Under-usage of sensor range M-101 Local display: M-101 ↔ Measured value	BLOCK_ERR = Other Transducer_Error = No error	QUALITY = UNCERTAIN SUBSTATUS = Sensor conversion not accurate	Cause of error: Physical measuring range undershot. Remedy: Select suitable sensor type.	SV1, SV2 also PV1, PV2 depending on the configuration
M-	102	Device status message (FF): Exceedence of sensor range M-102 Local display: M-102 ↔ Measured value	BLOCK_ERR = Other Transducer_Error = No error	QUALITY = UNCERTAIN SUBSTATUS = Sensor conversion not accurate	Cause of error: Physical measuring range overshot. Remedy: Select suitable sensor type.	SV1, SV2 also PV1, PV2 depending on the configuration
M-	103	Device status message (FF): Sensor drift detected M-103 Local display: M-103 ↔ Measured value	BLOCK_ERR = Other Transducer_Error = No error	QUALITY = UNCERTAIN (configurable) SUBSTATUS = Non-specific	Cause of error: Sensor drift has been detected (in accordance with the settings in the Advanced Diagnostics Block). Remedy: Check the sensor, depending on the application.	PV1, PV2 SV1, SV2
M-	104	Device status message (FF): Backup active M-104 Local display: M-104 ↔ Measured value	BLOCK_ERR = Other Transducer_Error = No error	QUALITY = GOOD / BAD SUBSTATUS = Non-specific	Cause of error: Backup function activated and an error was detected at one sensor. Remedy: Rectify sensor error.	SV1, SV2 also PV1, PV2 depending on the configuration
F-	221	Device status message (FF): Reference measurement F-221 Local display: F-221	BLOCK_ERR = Other Transducer_Error = General error	QUALITY = BAD SUBSTATUS = Device failure	Cause of error: Internal reference junction defective. Remedy: Device defective, replace	SV1, SV2, PV1, PV2, DT
F-	261	Device status message (FF): Electronic board defective F-261 Local display: F-261	BLOCK_ERR = Other Transducer_Error = Electronic failure	QUALITY = BAD SUBSTATUS = Device failure	Cause of error: Error in the electronics. Remedy: Device defective, replace	SV1, SV2, PV1, PV2, DT

Table 22. Status Messages (Continued)

Default Cat.	No.	Status Messages ACTUAL_STATUS_ NUMBER in the 'Advanced Diagnostics' Transducer Block Local Display	Error Messages in the Sensor Transducer Block	Sensor Transducer Block Measured Value Status (Default)	Cause of Error or Resolution	Output Variables Affected
F-	283	Device status message (FF): Memory error F-283 Local display: F-283	BLOCK_ERR = Other Transducer_Error = Data integrity error	QUALITY = BAD SUBSTATUS = Device failure	Cause of error: Error in memory. Remedy: Device defective, replace	SV1, SV2, PV1, PV2, DT
C-	402	Device status message (FF): Startup of device C-402 Local display: C-402 ↔ Measured value	BLOCK_ERR = Power up Transducer_Error = Data integrity error	QUALITY = UNCERTAIN SUBSTATUS = Non-specific	Cause of error: Device starting/initializing. Remedy: Message is only displayed during power-up.	SV1, SV2, PV1, PV2, DT
F-	431	Device status message (FF): No calibration F-431 Local display: F-431	BLOCK_ERR = Other Transducer_Error = Calibration error	QUALITY = BAD SUBSTATUS = Device failure	Cause of error: Error in calibration parameters. Remedy: Device defective, replace	SV1, SV2, PV1, PV2, DT
F-	437	Device status message (FF): Configuration error F-437 Local display: F-437	BLOCK_ERR = Other | Block configuration error Transducer_Error = Configuration error	QUALITY = BAD SUBSTATUS = Device failure	Cause of error: Incorrect configuration within the Sensor 1 and 2 Transducer Blocks. The parameter "BLOCK_ERR_DESC1" shows the cause of the configuration error. Remedy: Check the configuration of the sensor types used, units and the settings of PV1 and/or PV2.	SV1, SV2, PV1, PV2, DT
C-	482	Device status message (FF): Simulation Mode Active C-482 Local display: C-482 ↔ Measured value	BLOCK_ERR = Other Transducer_Error = No error	QUALITY = UNCERTAIN SUBSTATUS = Substitute	Cause of error: Simulation is active. Remedy: -	
C-	501	Device status message (FF): Device preset C-501 Local display: C-501 ↔ Measured value	BLOCK_ERR = Other Transducer_Error = No error	QUALITY = UNCERTAIN / GOOD SUBSTATUS = Non-specific/update event	Cause of error: Device reset is performed. Remedy: Message is only displayed during reset.	SV1, SV2, PV1, PV2, DT

Table 22. Status Messages (Continued)

<table>
<tr><th>Default Cat.</th><th>No.</th><th>Status Messages ACTUAL_STATUS_ NUMBER in the 'Advanced Diagnostics' Transducer Block Local Display</th><th>Error Messages in the Sensor Transducer Block</th><th>Sensor Transducer Block Measured Value Status (Default)</th><th>Cause of Error or Resolution</th><th>Output Variables Affected</th></tr>
<tr><td rowspan="2">S-</td><td rowspan="2">502</td><td rowspan="2">Device status message (FF):
Special Linearization
S-502

Local display:
S-502 ↔ Measured value</td><td>BLOCK_ERR = Other | Block Configuration Error</td><td>QUALITY = BAD</td><td rowspan="2">Cause of error:
Error in linearization.

Remedy:
Select valid type of linearization (sensor type).</td><td rowspan="2">SV1, SV2, PV1, PV2, DT</td></tr>
<tr><td>Transducer_Error = Configuration error</td><td>SUBSTATUS = Configuration error</td></tr>
<tr><td rowspan="2">S-</td><td rowspan="2">901</td><td rowspan="2">Device status message (FF):
Ambient temperature too low
S-901

Local display:
S-901 ↔ Measured value</td><td>BLOCK_ERR = Other</td><td>QUALITY = UNCERTAIN (configurable)</td><td rowspan="2">Cause of error:
Device temperature < -40 °C (-40 °F)

Remedy:
Observe ambient temperature as per specification.</td><td rowspan="2">SV1, SV2, PV1, PV2, DT</td></tr>
<tr><td>Transducer_Error = No error</td><td>SUBSTATUS = Non-specific</td></tr>
<tr><td rowspan="2">S-</td><td rowspan="2">902</td><td rowspan="2">Device status message (FF):
Ambient temperature too high
S-902

Local display:
S-902 ↔ Measured value</td><td>BLOCK_ERR = Other</td><td>QUALITY = UNCERTAIN (configurable)</td><td rowspan="2">Cause of error:
Device temperature > +85 °C (+185 °F)

Remedy:
Observe ambient temperature as per specification.</td><td rowspan="2">SV1, SV2, PV1, PV2, DT</td></tr>
<tr><td>Transducer_Error = No error</td><td>SUBSTATUS = Non-specific</td></tr>
</table>

Block Errors

The following table lists all of the possible error codes in the various function blocks. Not all error codes are possible in all of the blocks.

Condition Number	Name and Description
0	No error.
1	Block Configuration Error: (See Note 1)
2	Link Configuration Error: A link used in one of the function blocks is improperly configured.
3	Simulate Active: The Simulation jumper is enabled. This is not an indication that the I/O blocks are using simulated data.
4	Local Override:
5	Device Fault State Set:
6	Device Needs Maintenance Soon:
7	Input Failure/Process Variable Has Bad Status: The hardware is bad, an input is not connected, or a status is being simulated.
8	Output Failure: The output is bad based primarily upon a bad input.
9	Memory Failure: A memory failure has occurred in Flash, RAM or EEPROM memory.
10	Lost Static Data: Static data stored in non-volatile memory has been lost.
11	Lost NV Data: Non-volatile data stored in non-volatile memory has been lost.
12	Readback Check Failed:
13	Device Needs Maintenance Now:
14	Power Up: The Device was just powered - wait

Condition Number	Name and Description
15	Out Of Service: The actual mode is OSS, change to AUTO
16	Unspecified Error – An Unidentified Error occurred
17	General Error – cannot be specified per #18 to #25
18	Calibration Error: An error occurred during calibration of the device or a calibration error was detected during normal operation.
19	Configuration Error: An error occurred during configuration of the device or a configuration error was detected during normal operation.
20	Electronics Failure: An electronic component failed.
21	Mechanical Failure: A mechanical component failed.
22	I/O Failure: An I/O failure occurred.
23	Data Integrity Error: Data stored in the device is no longer valid due to a non-volatile memory checksum failure, a data verify after write failure, etc.
24	Software Error: The software has detected an error due to an improper interrupt service routine, an arithmetic overflow, a watchdog time-out, etc.
25	Algorithm Error: The algorithm used in the transducer block produced an error due to overflow, data reasonableness failure, etc.

(1) If the error is in the Transducer block, a feature in FEATURES_SEL is set that is not supported by FEATURES or an execution cycle in CYCLE_SEL is set that is not supported by CYCLE_TYPE
If the error is in the Analog Input Block, the selected channel carries a measurement that is incompatible with the EGU's selected in XD_SCALE, the L_TYPE parameter is not configured, or CHANNEL = zero.

Block Configuration Errors

Due to an incorrect setting, the device might display the event `437-configuration`. The parameter `BLOCK_ERR_DESC1` in the transducer blocks shows the cause of this configuration error.

Display	Description
Sensor 1 is 4 wire RTD and sensor 2 is RTD	If sensor 1 is configured as a 4-wire RTD, no RTD can be selected at sensor 2.
Sensor type 1 and sensor unit 1 do not match	The sensor type at channel 1 and the selected sensor unit do not match.
Sensor type 2 and sensor unit 2 do not match	The sensor type at channel 2 and the selected sensor unit do not match.
PV type calculation mode and "No Sensor" chosen	The PV is an interconnection of the two sensor inputs, however "No Sensor" is selected as sensor type.
PV type calculation mode, sensor 1 unit Ohm and sensor 2 unit not Ohm	The PV is an interconnection of the two sensor inputs, the sensor unit 1 is Ohm, however sensor unit 2 is not.
PV type calculation mode, sensor 2 unit Ohm and sensor 1 unit not Ohm	The PV is an interconnection of the two sensor inputs, the sensor unit 2 is Ohm, however sensor unit 1 is not.
PV type calculation mode, sensor 1 unit mV and sensor 2 unit not mV	The PV is an interconnection of the two sensor inputs, the sensor unit 1 is mV, however the sensor unit 2 is not.
PV type calculation mode, sensor 2 unit mV and sensor 1 unit not mV	The PV is an interconnection of the two sensor inputs, the sensor unit 2 is mV, however the sensor unit 1 is not.
Sensor 1 unit and PV unit do not match	The sensor unit 1 and the PV unit are not compatible.
Sensor 2 unit and PV unit do not match	The sensor unit 2 and the PV unit are not compatible.
Drift and "No Sensor" chosen	The sensor drift function has been activated however "No Sensor" was selected as sensor type.
Drift chosen and units do not match	The sensor drift function has been activated however the units of the two sensors are not compatible.

Corrosion Monitoring

NOTE
Corrosion monitoring is only possible for RTD with 4-wire connection and thermocouples.

Sensor connection cable corrosion can lead to false measured value readings. Therefore the RTT80 offers the ability to detect corrosion before a measured value is affected.

In the parameter `CORROSION_DETECTION` the corrosion setting can be configured:

- off (output of the error condition 041 Sensor break (default category: F) when reaching the alarm limit)
- on (output of the error condition 042 Sensor corrosion (default category: M) before reaching the alarm limit; this allows for preventive maintenance/troubleshooting to be done. An alarm message is output as of the alarm set point.)

The configuration of the corrosion detection is done via the Field Diagnostic Parameter in the Resource Block. Depending on the configuration of the error condition 042 - Sensor corrosion it is set which category will be displayed in case of corrosion.

If the corrosion detection is deactivated the condition F-041 is output when the alarm limit is reached.

The following table describes how the device behaves when the resistance in a sensor connection cable changes depending on whether the on or off option has been selected.

RTD	< ≈ 2 kΩ	2 kΩ ≈ < x< ≈ 3 kΩ	> ≈ 3 kΩ
off	---	---	ALARM (F-041)
on	---	depending on the configuration (F-/C-/S-/M-042)	ALARM (F-042)

TC	< ≈ 10 kΩ	10 kΩ ≈ < x< ≈ 15 kΩ	> ≈ 15 kΩ
off	---	---	ALARM (F-041)
on	---	depending on the configuration (F-/C-/S-/M-042)	ALARM (F-042)

The sensor resistance can affect the resistance data in the table. If all the sensor connection cable resistances are increased at the same time, the values given in the table are halved.

The corrosion detection system presumes that this is a slow process with a continuous increase in the resistance.

Application Errors Without Messages

NOTE
For sensor types, see Table 2 on page 14 and Table 3 on page 15.

Table 23. Application Errors for RTD Connections

Symptoms	Cause	Action/cure
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 SENSOR_CONNECTION device function
	Device programming is incorrect (scaling)	Change scaling
	Incorrect RTD configured	Change SENSOR_TYPE device function
	Sensor connection (two-wire), incorrect connection configuration compared to actual connection	Check the sensor connection/configuration of the transmitter
	The cable resistance of the sensor (two-wire) was not compensated	Compensate the cable resistance
	Offset incorrectly set	Check offset
	Sensor, sensing head defective	Check sensor, sensing head
	RTD connection incorrect	Connect the connecting cables correctly (observe polarity; see "Input Connections" on page 31)
	Programming	Incorrect sensor type set in the SENSOR_TYPE device function; change to the correct sensor type
	Device defective	Replace device

Table 24. Application Errors for Thermocouple Connections

Symptoms	Cause	Resolution
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 (scaling)	Change scaling
	Incorrect thermocouple type (TC) configured	Change SENSOR_TYPE to the correct thermocouple type
	Incorrect comparison measurement point set	Set the correct comparison measurement point
	Offset incorrectly set	Check offset
	Interference via the thermocouple wire welded in the thermowell (interference voltage coupling)	Use a sensor where the thermocouple wire is not welded
	Sensor incorrectly connected	Connect the connecting cables correctly (observe polarity; see "Input Connections" on page 31)
	Sensor, sensing head defective	Check sensor, sensing head
	Programming	Incorrect sensor type set in the SENSOR_TYPE device function; set the correct thermocouple (TC)
	Device defective	Replace device

Restart

The RESTART parameter in the Resource Block should only be used when the configuration in the transmitter has been incorrect and the user cannot fix the problem by using the troubleshooting information provided. In all cases, try cycling the power to the transmitter first. Then go back to the block with the problem and try to write the changes to the transmitter. If that does not clear the problem, proceed with the RESTART procedure.

! CAUTION

When you do a “Defaults” RESTART command in the Resource Block, the configured parameters will automatically default to the values predetermined by the Foundation, which are **not** the same as the factory defaults.

1. Open the Transducer Block and put it in the OOS mode.
2. In the Resource Block, select one of the following in the RESTART parameter:
   - Run – this is the default setting, the nominal state when not restarting
   - Resource – do not use
   - Defaults – Sets the parameters to the Foundation defaults
   - Processor – does a warm restart of the CPU.
3. Click on the Write Changes button. Wait until the RESTART parameter value goes back to Run.
4. Put the Transducer Block back into Auto mode (the RESTART selection will automatically default to the Run position).
5. Reconfigure the appropriate function blocks.

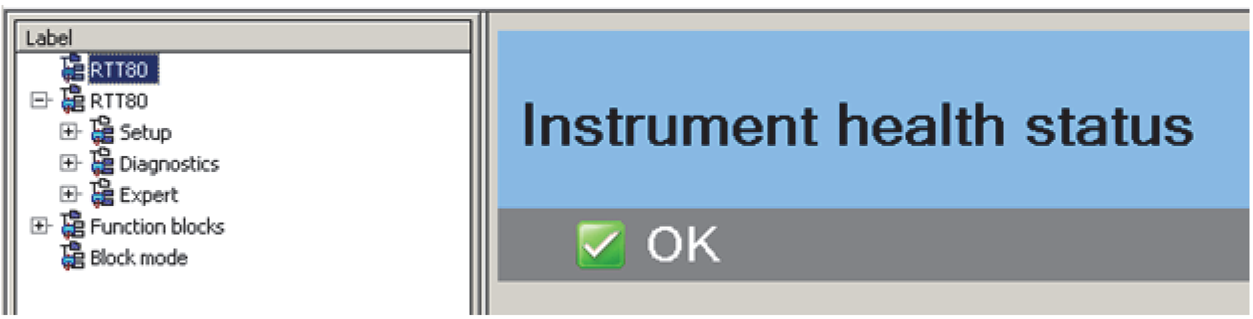
5. RTT80 Configuration with a Device Type Manager

This chapter is a guide to operation and configuration of the RTT80 with FOUNDATION fieldbus communications protocol using the Device Type Manager (DTM).

Main Screen

The main screen in the DTM is a high-level view of the DTM menu. The sections that follow will take the operator through the principal operation and configuration options.

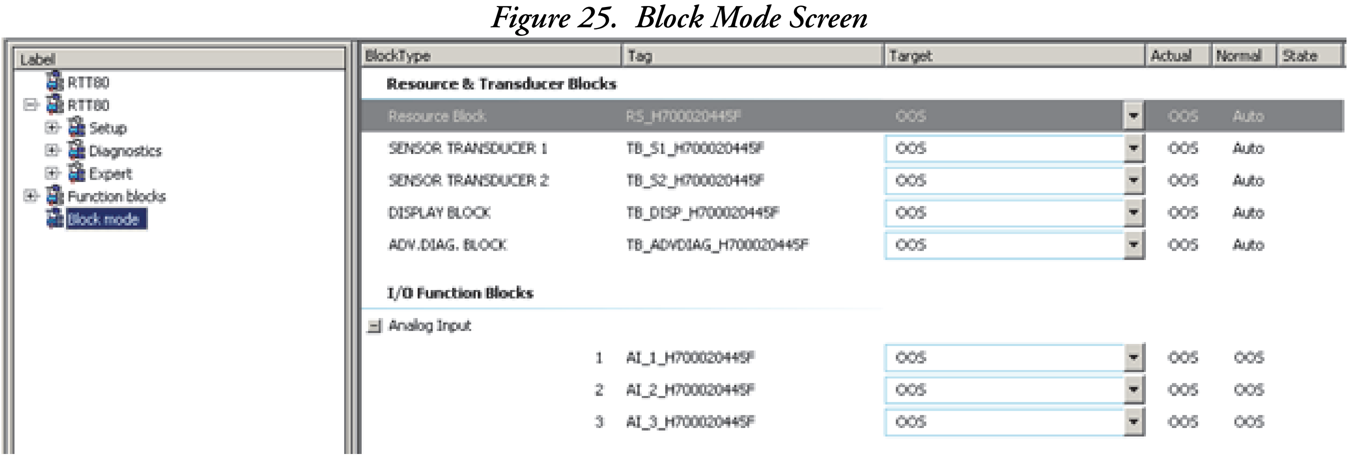
Figure 24. Main DTM Screen



Block Mode Screen

Before any parameters in the RTT80 can be changed using the DTM, it is necessary put the relevant block into the Out-of-Service (`OOS`) mode. This is accomplished in the `Block mode` by clicking and selecting from the drop-down menus in the `Target` column for the respective block. In the figure below, all the blocks are shown in the OOS mode.

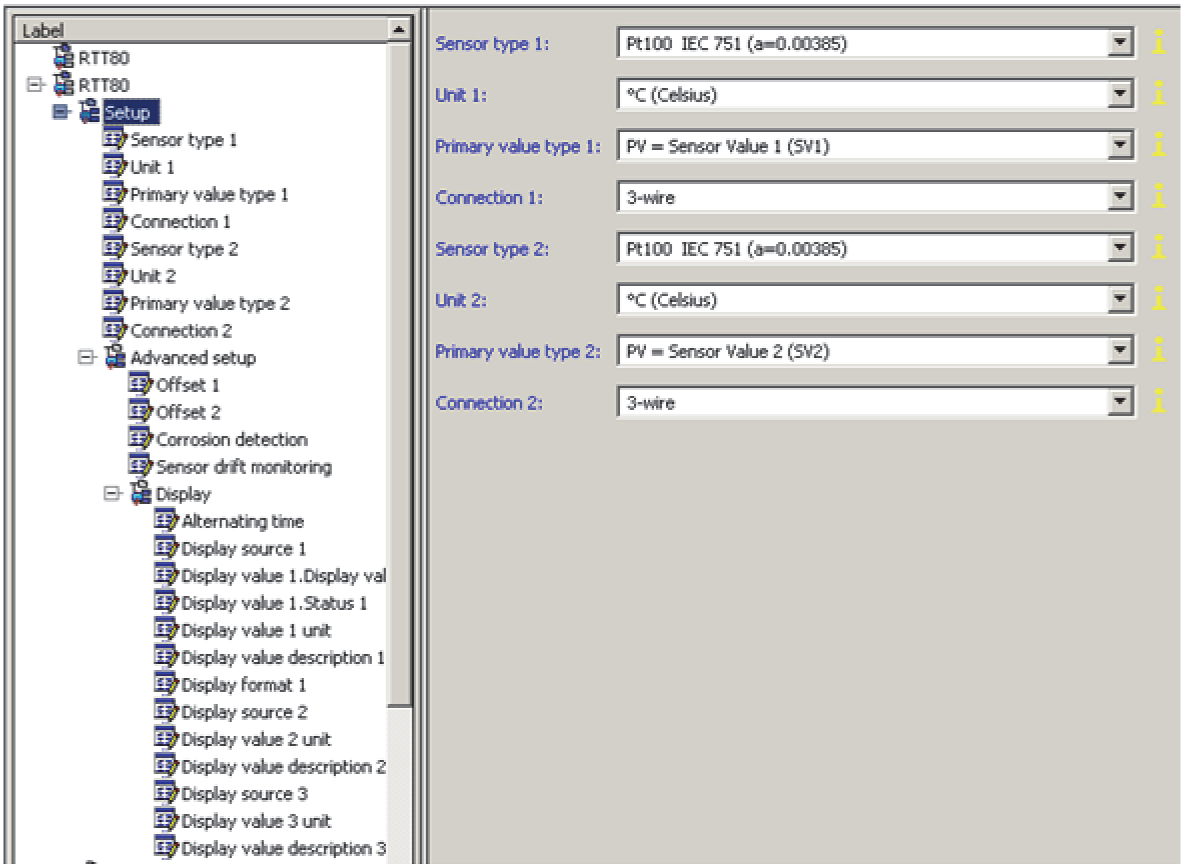
Figure 25. Block Mode Screen



Setup Screen

The `Setup` screen (below) and `Advanced setup` screen (Figure 27) allow configuration of some basic, high-level parameters: `Sensor type 1` and `2`, `Unit 1` and `2`, `Connection 1` and `2`, and `Primary value type 1` and `2`, and the `Display`. These parameters can also be configured along with additional parameters under the `Expert` screen, described on page 119.

Figure 26. Setup Screen

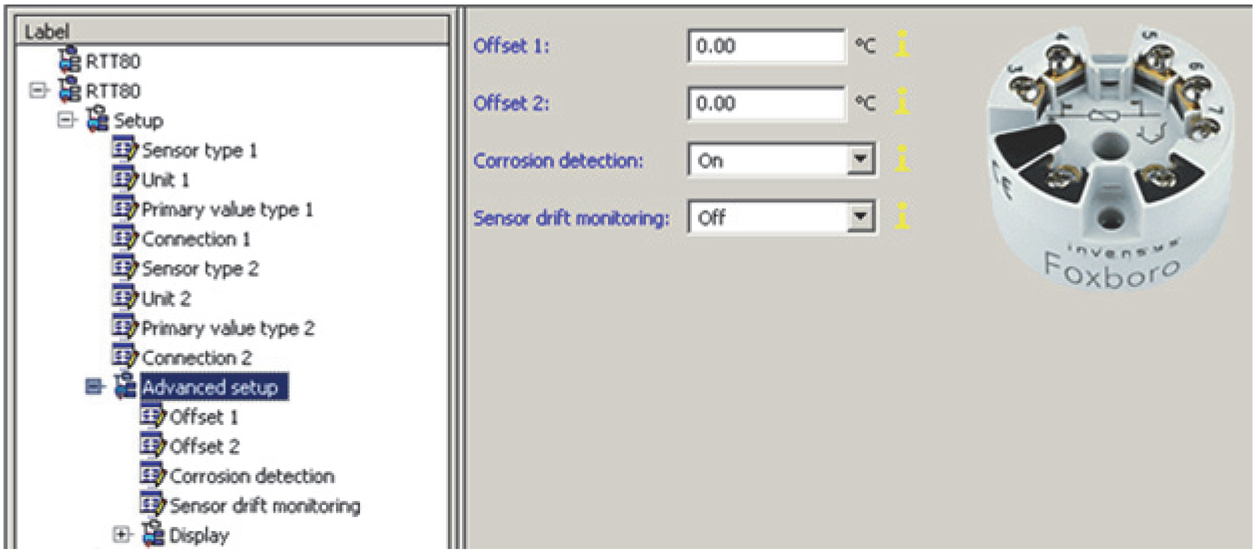


A list of selectable sensor types can be found in Table 2 on page 14 and Table 3 on page 15. Definitions and descriptions of the other configurable parameters on the setup screen can found in “FOUNDATION Fieldbus Parameters” on page 60.

Advanced Setup Screen

The Advanced setup screen, Figure 27, accessed through the `Setup` screen, allows you to set the `Offset 1` and `Offset 2` values and turn the `Corrosion detection` and `Sensor drift monitoring` features on or off.

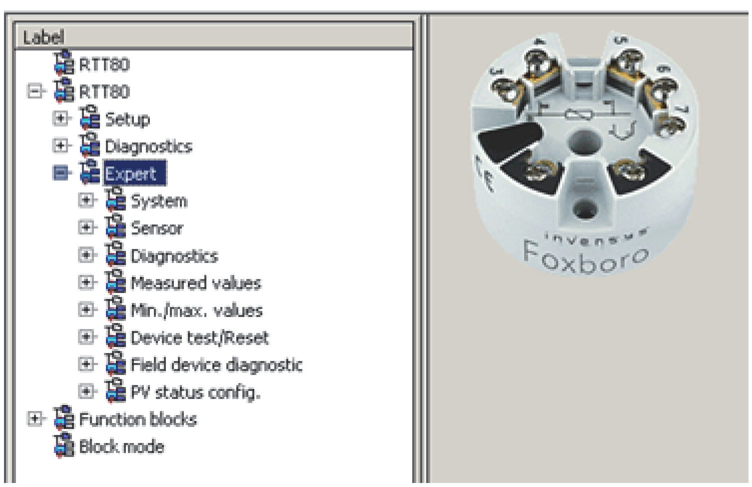
Figure 27. Advanced Setup Screen



Expert Screen

The `Expert` screen, shown below, allows navigation to the following screens: `System`, `Sensor`, `Diagnostics`, `Measured values`, `Min./max. values`, `Device test/Reset`, `Field device diagnostic`, and `PV status config`. Each is described below.

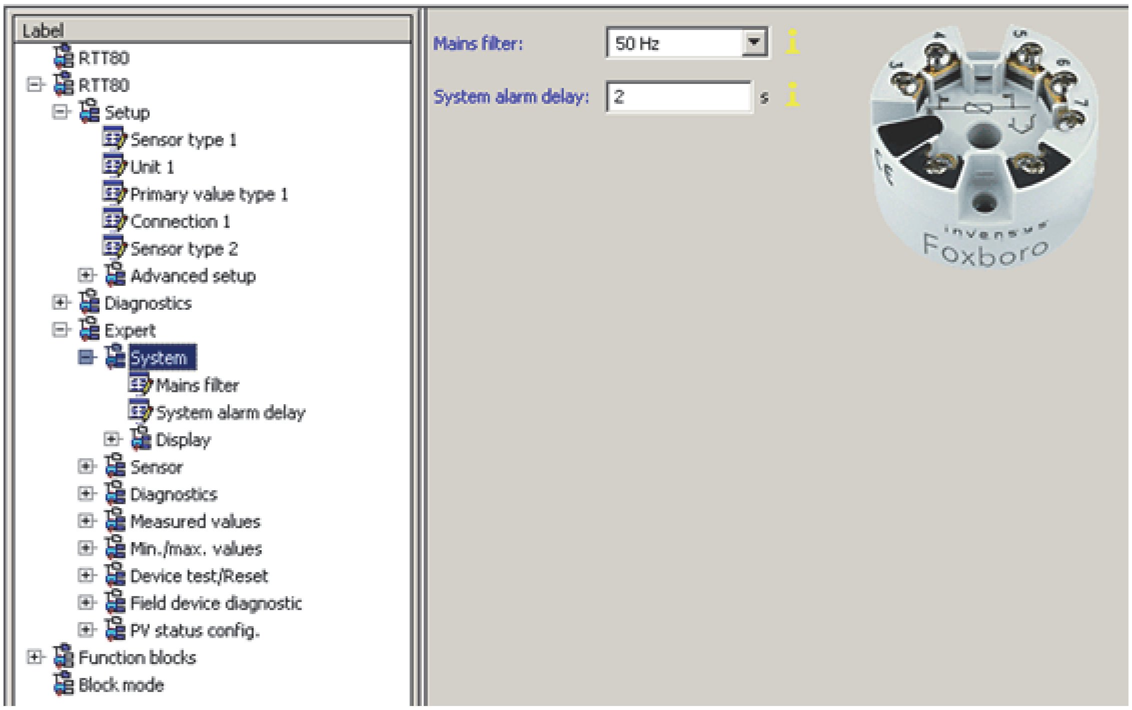
Figure 28. Expert Screen



System Screen

The `System` screen allows configuration of the `Mains filter` and `System alarm delay` and provides access to the `Display` screen.

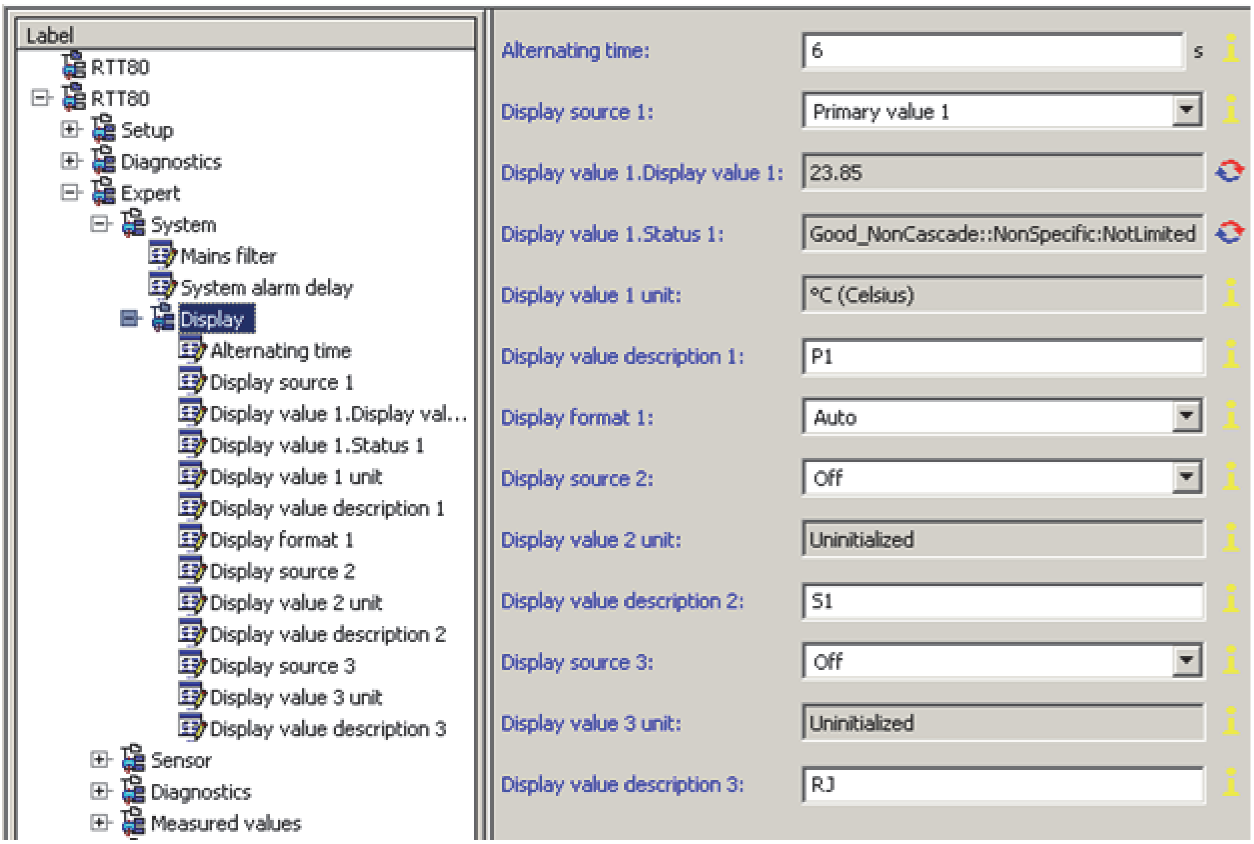
Figure 29. System Screen



Display Screen

The `Display` screen is found by navigating through the `Expert` and `System` menu selections, respectively. In the `Display` screen, information appearing on the display can be configured. In the following figure, the white fields can be configured, the gray cannot. Descriptions of these parameters and configuration examples can be found in "Display Transducer Block" on page 45.

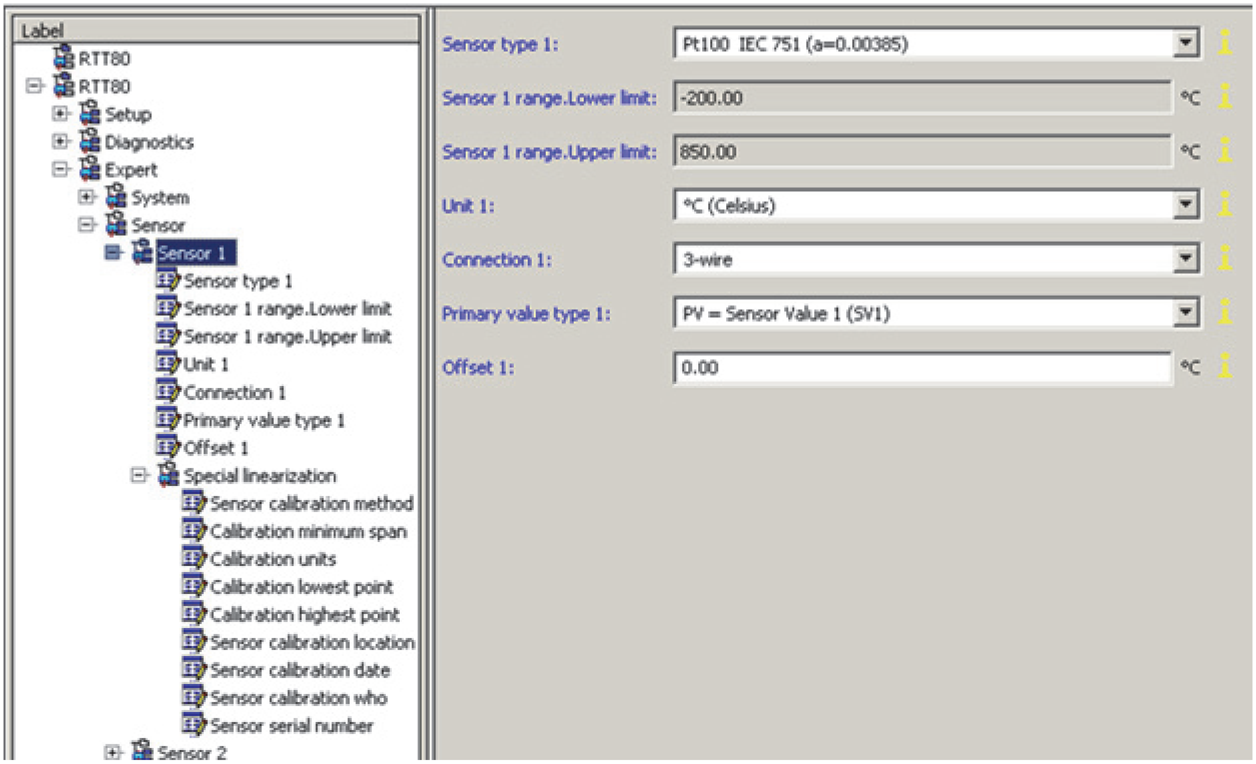
Figure 30. Display Screen



Sensor 1 and Sensor 2 Screens

Navigating through the `Expert` and then `Sensor` screens allows configuration of `Sensor 1` and `Sensor 2`. The `Sensor 1` menu is shown in the following figure. Descriptions of the parameters in the sensor screens can be found in "Sensor 1 and Sensor 2 Transducer Blocks" on page 40.

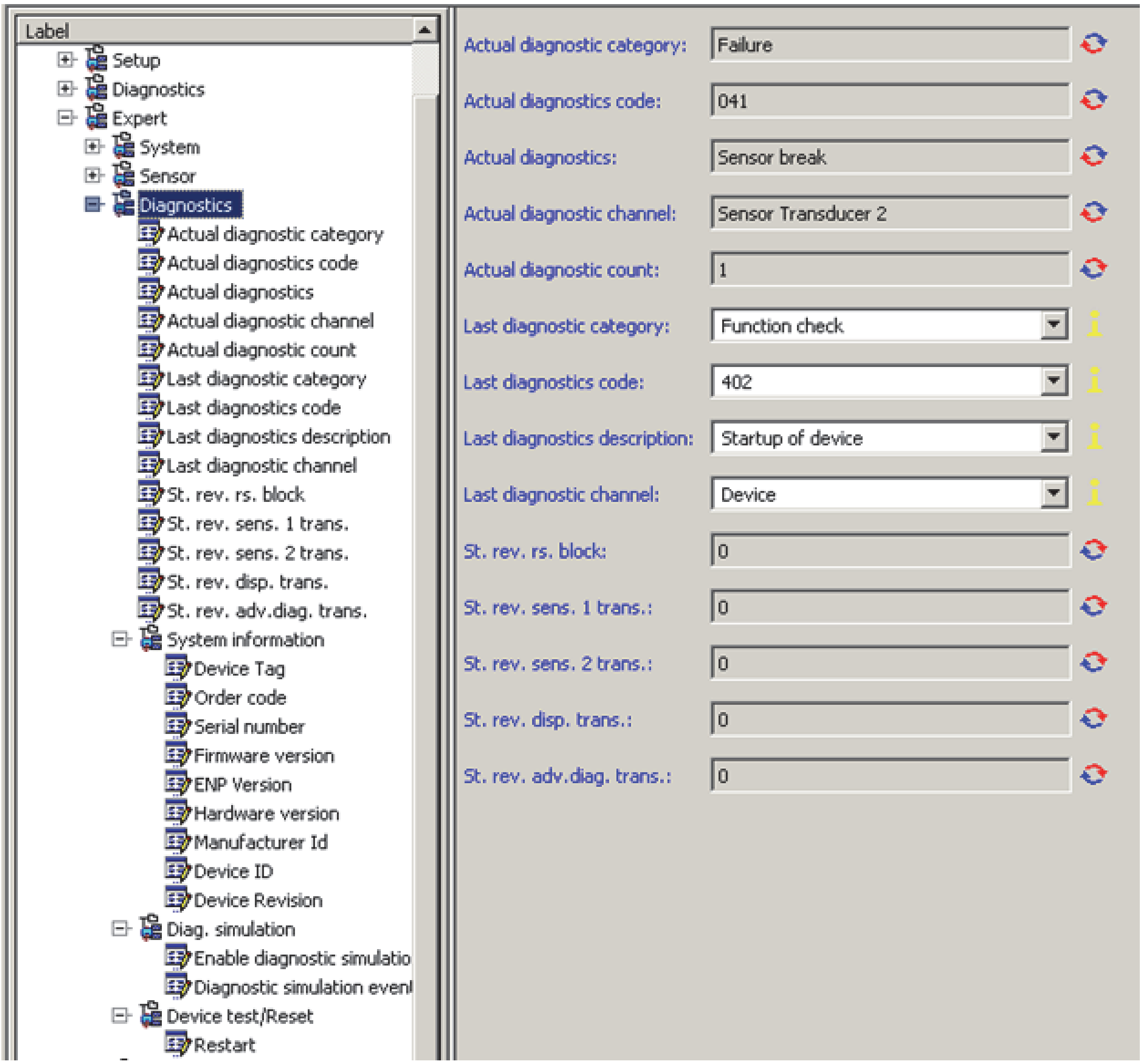
Figure 31. Sensor 1 Screen



Diagnostics Screen

The `Diagnostics` screen allows reading of the current and historical diagnostic information stored in the transmitter. It is accessible both through the `Expert` screen and at a higher menu level. The included information is shown in the figure below.

Figure 32. Diagnostics Screen

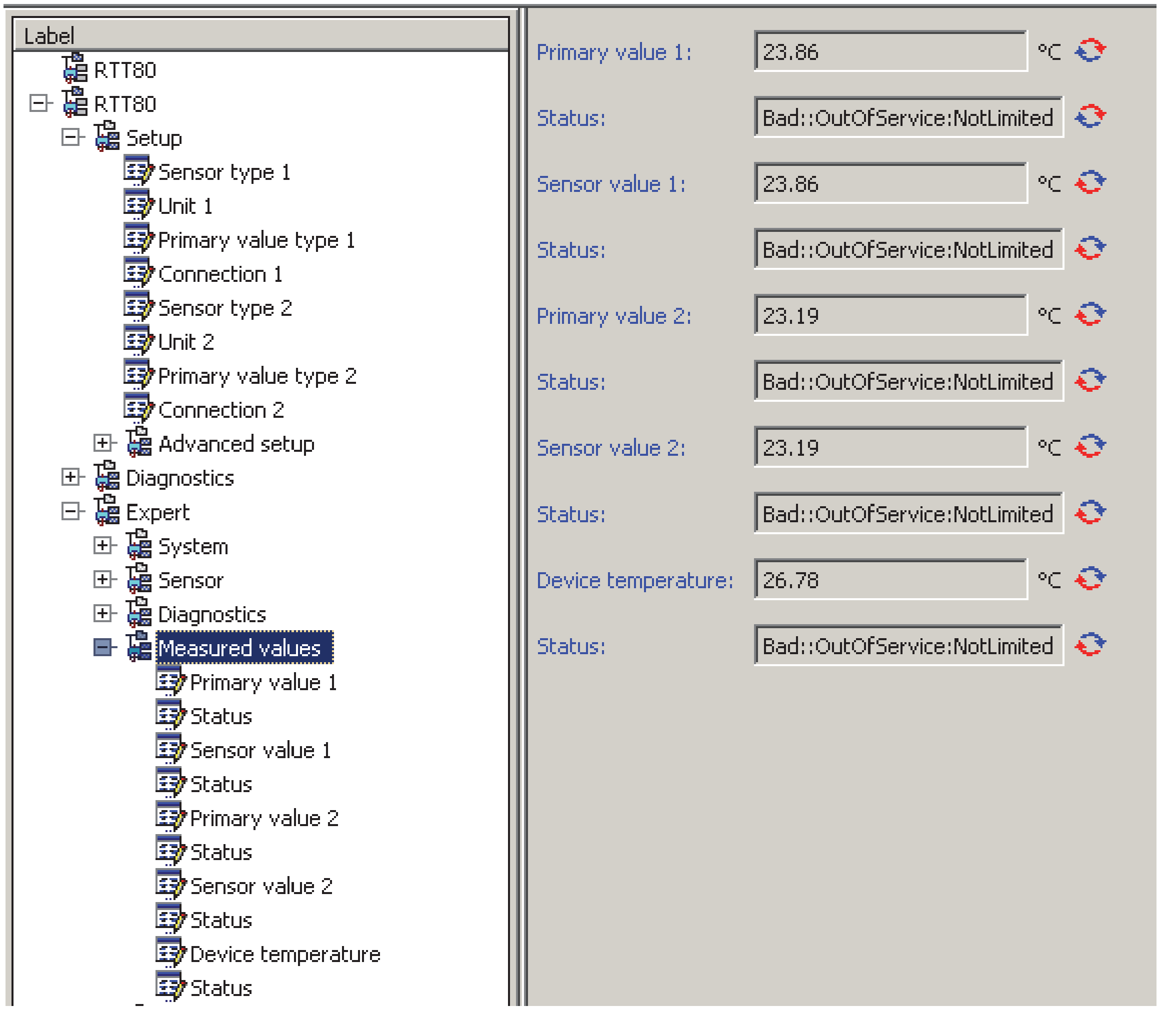


The `System information` sub-screen provides specific information about the transmitter to which the DTM is connected. The `Diag. simulation` sub-screen allows enabling or disabling of diagnostic simulation events. The `Device test/Reset` sub-screen allows a resetting of the transmitter to a variety of selectable states.

Measured Values Screen

The `Measured values` screen depicts read-only information related to the measurement and the quality of each input, including sensor value and primary value, as shown in the figure below.

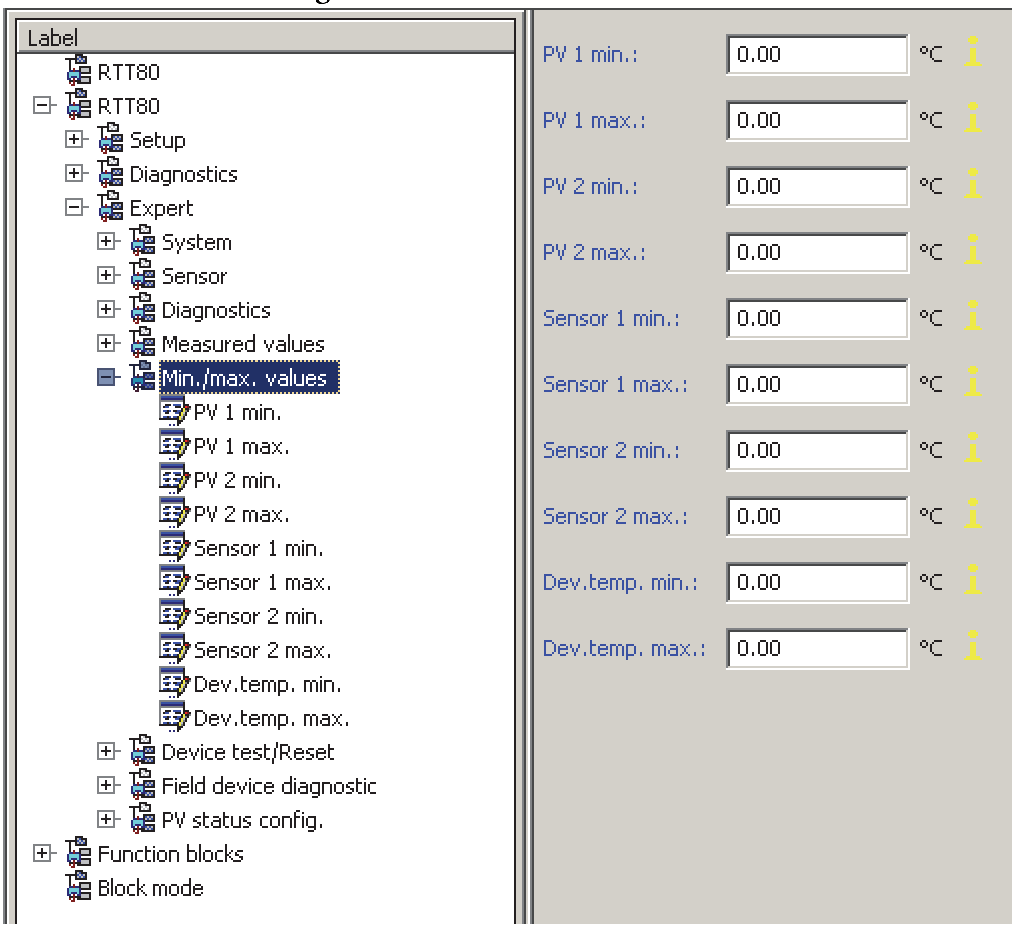
Figure 33. Measured Values Screen



Min./Max. Values Screen

The `Min./Max. values` screen is a read-only screen showing the minimum and maximum vales read by each measurement type, as shown below.

Figure 34. Min./Max. Values Screen



Function Block Screen

The Function block screen navigates to 3 sub-screens related to each Analog Input block. Each sub-screen allows complete configuration of the respective Analog Input function block, as shown in Figures 35 and 36.

Figure 35. Function Block Screen with Analog Input 1 Selected

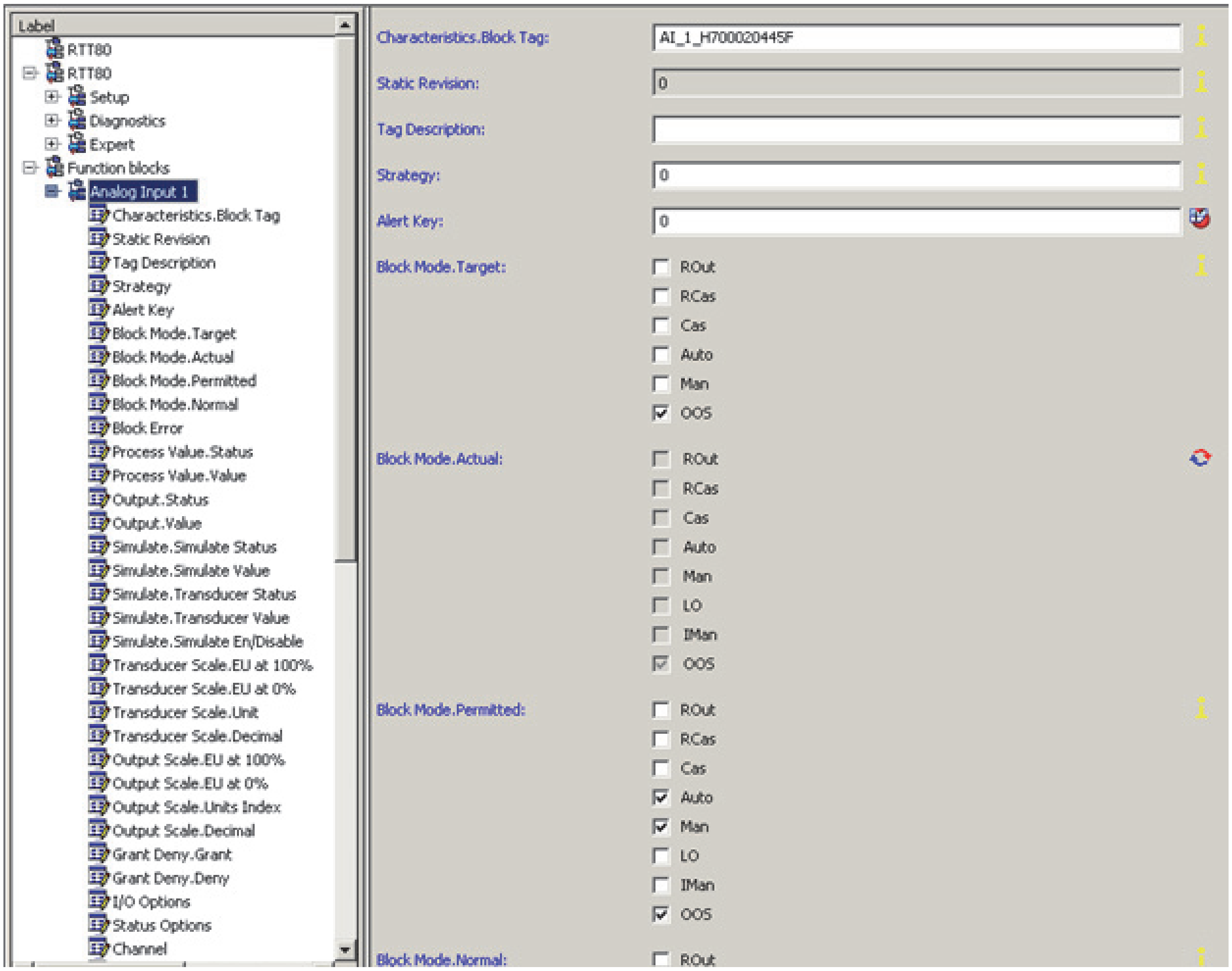
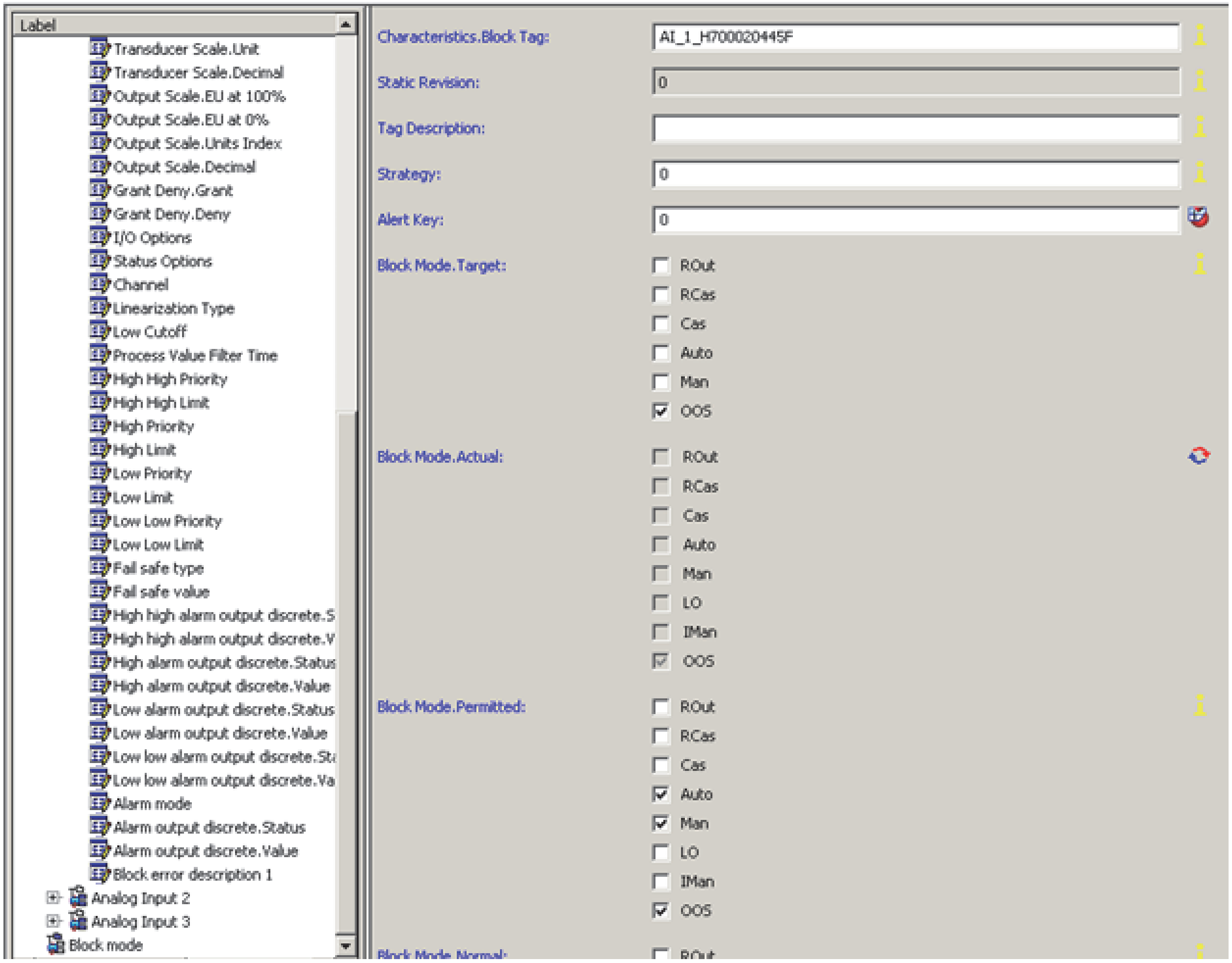


Figure 36. Continuation of Function Block Screen with Analog Input 1 Selected



Invensys
10900 Equity Drive
Houston, TX 77041
United States of America
http://www.invensys.com

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