

Operating Instructions iTHERM TrustSens Calibration Monitoring

Memograph M RSG45 in connection with iTHERM TrustSens TM371/TM372 and the Field Data Manager (FDM) software



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1 About this document

1.1 Document function

NOTICE

This manual contains an additional description for a special software option.

These additional instructions are not a substitute for the Operating Instructions pertaining to the device!

- Refer to the Operating Instructions and other documentation for detailed information.

Available for all device versions via:

- Internet: www.endress.com/deviceviewer
- Smartphone/tablet: Endress+Hauser Operations app

1.2 Symbols

1.2.1 Safety symbols

DANGER

This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

WARNING

This symbol alerts you to a potentially dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

CAUTION

This symbol alerts you to a potentially dangerous situation. Failure to avoid this situation can result in minor or medium injury.

NOTICE

This symbol alerts you to a potentially harmful situation. Failure to avoid this situation can result in damage to the product or something in its vicinity.

1.2.2 Symbols for certain types of information

Symbol	Meaning	Symbol	Meaning
	Forbidden Procedures, processes or actions that are forbidden.		Tip Indicates additional information.
	Reference to documentation		Reference to page
	Reference to graphic		Series of steps

1.3 Change history

RSG45 device software Version/date	Software modifications	iTHERM TrustSens Calibration Monitoring Operating Instructions
V2.04.xx / 09.2018	Original software	BA01887R/01.18
V2.04.06 / 10.2022	Bug fixes	BA01887R/02.22
V2.04.09/05.2025	Bug fixes	BA01887R/03.25

1.4 Registered trademarks

HART®

Registered trademark of the HART FieldComm Group, Austin, USA

2 Product description

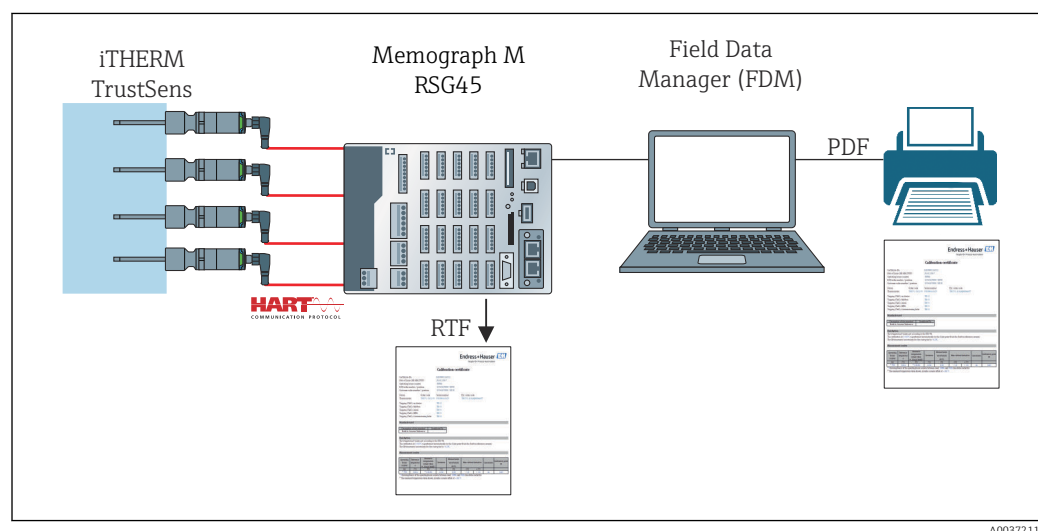
This manual describes the "iTHERM TrustSens Calibration Monitoring" functionality of the Memograph M RSG45. This functionality is only available if one or more iTHERM TrustSens TM37x thermometers are connected to the Memograph M RSG45 via the HART interface.

The Memograph M RSG45 application package contains the following functions:

- Up to 20 iTHERM TrustSens TM371/TM372 can be evaluated via the HART interface
- If a self-calibration is detected: The related values (temperature during self-calibration, deviation from target value, status information, etc.) are entered as an event in the Memograph M RSG45 logbook with a timestamp

i Note: This functionality is **not** designed to read out the internal circular buffer (350 self-calibrations) of the connected iTHERM TrustSens TM37x. Rather, new calibrations now occurring are logged online, time-stamped with the RSG45 real-time clock and saved.

- Display of self-calibration data on the Memograph M RSG45 screen or online via the Web server
- Generation of calibration history with a "Calibration ID" (number of self-calibrations performed)
- Generation of a calibration certificate as an RTF file ("Rich Text Format") directly at the Memograph M RSG45
- Evaluation, analysis and further processing of the calibration data using "Field Data Manager" (FDM) analysis software
- Data management, storage and handling of certificate data fully complies with the requirements of FDA 21 CFR Part 11.

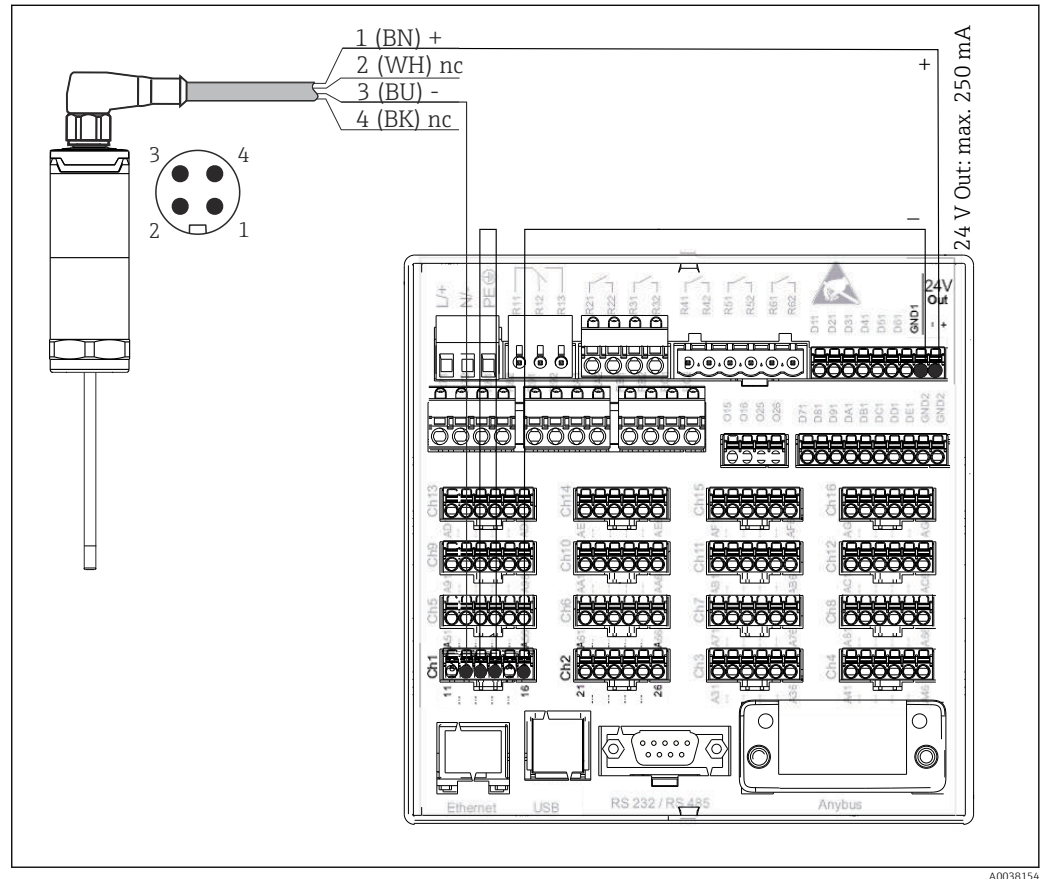


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1 Function chart: Memograph M RSG45 with "iTHERM TrustSens Calibration Monitoring"

3 Electrical connection of iTHERM TrustSens TM37x to Memograph M RSG45

It is recommended to connect the iTHERM TrustSens TM37x to the Memograph M RSG45 using a "point-to-point connection". This allows up to 20 iTHERM TrustSens TM37x devices to be connected to the Memograph M RSG45.



2 Connection example: iTHERM TrustSens TM37x connected to Memograph M RSG45 via HART input card and internal transmitter power supply.

If the power supply has been connected correctly and the measuring instrument is ready for operation, the LED on the iTHERM TrustSens TM37x is lit green.

i A HART Multidrop configuration is also possible but is **not** recommended due to the slower update rate. Up to 5 iTHERM TrustSens TM37x can be connected per HART input using Multidrop.

i For details, see the Operating Instructions for the iTHERM TrustSens TM37x and Memograph M RSG45

Both the digital HART values and the 4 to 20 mA signal can be evaluated at every input of the Memograph M RSG45. The 4 HART values (PV, SV, TV, QV) of a sensor can be evaluated and the analog HART value (PV) can be measured via the digital HART signal. These values can be used in the Memograph M RSG45 with the standard functions (mathematics, logging, visualization, etc.).

i Note:

The number of internal data channels in the Memograph M RSG45 is limited to 40. If all 4 HART values are read for each connected iTHERM TrustSens TM37x, a maximum of 10 iTHERM TrustSens TM37x can be connected to a Memograph M RSG45. If, on the other hand, only 2 HART values are evaluated, a maximum of 20 iTHERM TrustSens TM37x devices can be connected to a Memograph M RSG45.

4 Configuration of iTHERM TrustSens TM37x

To ensure that the iTHERM TrustSens TM37x can be uniquely identified, the tag name (TAG) should be modified in the fieldbus. The factory setting is a combination of the product root and the serial number (e.g. EH_TM371_M903FA04487).

 For details on commissioning, see the Operating Instructions for the iTHERM TrustSens TM37x

4.1 Reading out measured values via the HART protocol

The measured values are assigned to the HART process variables as follows:

HART process variables	Measured value	Unit
Primary process variable (PV)	Temperature	°C/°F
Secondary process variable (SV)	Device temperature	°C/°F
Tertiary process variable (TV)	Number of self-calibrations	-
Quaternary process variable (QV)	Calibration deviation	°C/°F

 For information on the diagnostic behavior, see the iTHERM TrustSens TM37x Operating Instructions

5 Configuration of the Memograph M RSG45

 The DIN rail version of the Memograph M RSG45 can be configured using FieldCare or a Web server. Here it is advisable to connect the device to the PC via USB ("Ethernet via USB", IP: 192.168.1.212).

 For details, see Operating Instructions BA01338R (Memograph M RSG45)

In order to monitor the self-calibration function, the Memograph M RSG45 must read out the sensor temperature (PV) and the number of self-calibrations (TV). For this purpose, configure the corresponding inputs under **Expert → Communication → HART** and assign them to the universal inputs under (**Expert → Universal input x**).

Self-calibration monitoring is activated under **Expert → Application → Monitor self-calibration**. It is possible to either save every self-calibration that is detected in the event logbook, or the first calibration of the day.

 If "First of the day" is activated, the ID number may not be consecutive if several self-calibrations are performed in one day.

5.1 Operating items of Memograph M RSG45

Monitor	
Navigation	 Expert → Application → Monitor self-calibration → Monitor Direct access code: 560001-000
Description	Switch on monitoring
Options	Off, On

Factory setting Off

Save event

Navigation  Expert → Application → Monitor self-calibration → Save event
Direct access code: 560002-000

Description Specifies how often a detected self-calibration should be saved.

Options Always, First of the day

Factory setting Always

6 Operation at the Memograph M RSG45

 A self-calibration is not saved for the first self-calibration that is detected after setup or if the iTHERM TrustSens TM37x is replaced.

Self-calibrations that are performed when the Memograph M RSG45 is **switched off** are **not** saved.

Self-calibrations that are performed when the iTHERM TrustSens TM37x is **not** connected to the Memograph M RSG45 are **not** saved.

Self-calibrations that are performed while HART communication is **interrupted** are **not** saved.

6.1 Event logbook

Detected self-calibrations can be displayed in the event logbook on the Memograph M RSG45 or in a Web server.

 The time recorded in the event logbook is the time when the self-calibration is **finished**. The calibration process takes around 30 to 90 s (depending on the process temperature and cooling rate).

6.1.1 Event logbook on Memograph M RSG45 (panel-mounted device)

Call up the logbook via **Menu → Diagnostics → Event logbook**.

 The event logbook can be filtered for self-calibrations via **Menu → Operation → Search in trace**.

Event logbook		02.05.2018 11:38:29	USB: 3%
	EH_TM371_M7041504487: Self-calibration (ID=132)	02.05.2018 11:10:43	
□	Trustsens PV in 10,0..120,0 °C	02.05.2018 11:09:02	
☒	Trustsens PV out 10,0..120,0 °C	02.05.2018 11:04:11	
	New HART device detected: channel=14, device address=0..	02.05.2018 10:59:33	
🔧	560001-000 Monitor: "On"	02.05.2018 10:59:27	
	USB stick detected.	02.05.2018 10:59:18	
	USB stick has been removed.	02.05.2018 10:59:08	
🔧	560002-000 Save event: "always"	02.05.2018 10:58:36	
🔧	560002-000 Save event: "once a day"	02.05.2018 10:58:15	
	USB stick detected.	02.05.2018 10:57:04	
⌚	Power on	02.05.2018 10:56:51	
⌚	Power off	02.05.2018 10:56:39	
➤	Search more recent events		
➤	Search older events		
X	Back		
ESC		Go to...	Details Screenshot

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Select "Details" or press the navigator to display the details:

Event logbook		02.05.2018 11:38:49	
	EH_TM371_M7041504487: Self-calibration (ID=132)	02.05.2018 11:10:43	
□	Details		
☒	Date/time:	02.05.2018 11:10:54	
	Text:	EH_TM371_M7041504487: Self-calibration (ID=132)	
🔧	Serial number:	M7041504487	
	Device name:	iTHERM TM371/372	
	Operating hours:	614 h	
🔧	Reference temperature:	118,669 °C	
🔧	Measured temperature value:	118,680 °C	
	Deviation:	0,011 °C	
⌚	Meas. uncertainty (k=2):	0,349 °C	
⌚	Max. allowed deviation:	-0,800 0,800 °C	
➤	Assessment:	OK	
		ESC	Go to... RTF
X	Back		
ESC		Go to...	Help

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If an SD card or a USB stick is connected, a calibration certificate can be saved via the "RTF" option.

i If an SD card and a USB stick are connected simultaneously, the certificate is saved on the USB stick.

The certificate is always in English.

Calibration certificate

Endress+Hauser

People for Process Automation

General information

Certificate number

22.02.2019 17:06:01

E+H order number / position

88347352

Customer order number

3001649001/0180

Device information

Device name

TM371-1020/115

Order code

DEMO0300000

Serial number

TM371-AA0A0A1AAA0A1A

Extended order code

TM371-03-00-00

Tagging (TAG), fieldbus

Procedure

Description of the standard

Built-in ceramic reference

Certificate number

DEMO0300000_2017

Calibration method

The temperature values are according to the ITS-90. The calibration at 118,30°C is performed automatically on the Curie point from the built-in reference ceramic. The Measurement uncertainty for the Curie point is < 0,35°C.

Calibration

The measurement uncertainty was determined at twice the standard deviation.

Operating hours	Reference temperature	Measured temperature value ¹⁾	Deviation ²⁾	Measurement uncertainty (k=2)	Max. allowed deviation	Assessment	Calibration ID
(h)	(°C)	(°C)	(°C)	(°C)	(°C)		
46	118,30	118,30	0,00	0,35	-0,80 0,80	ok	40

¹⁾ The measured temperature value includes a sensor adjustment of 0,00°C.

²⁾ The calculation of the "Deviation" is based on unrounded values. Therefore, the difference of the rounded values of the "Measured temperature" and the "Reference temperature" can differ by up to one one-hundredth of a degree to the rounded value of the "Deviation".

The test unit has been calibrated and complies with the tolerances stated by the manufacturer. This certificate is generated electronically and is also valid without signature.

Endress+Hauser Wetzlar GmbH + Co.KG

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D-87484 Nesselwang

www.endress.com

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22.02.2019 17:06:08

3 Example: Calibration certificate

Endress+Hauser

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6.1.2 Event logbook on Web server

Call up the logbook via **Menu → Diagnostics → Event logbook**

 The event logbook can be filtered for self-calibrations via **Menu → Operation → Search in trace.**



Device name : Memograph M
Device tag : Unit 1
Status signal :  OK

Cancel

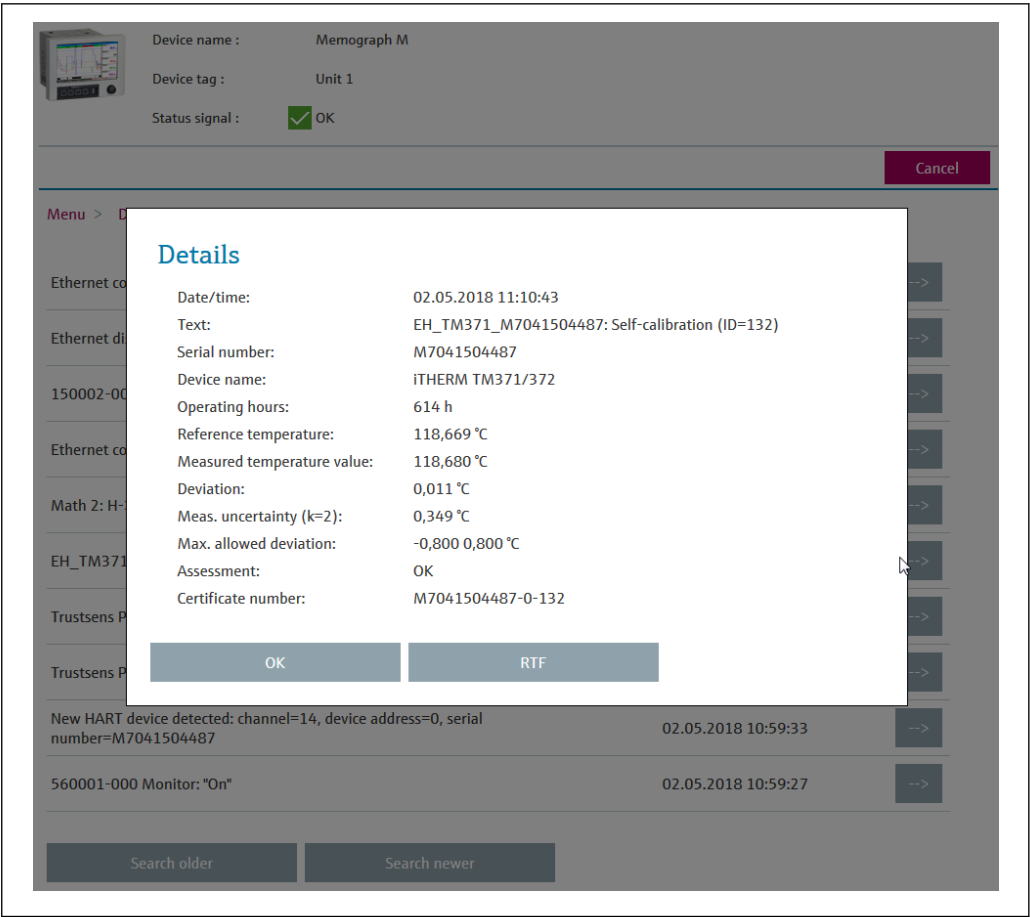
Menu > Diagnostics > Event logbook

Ethernet connected	02.05.2018 12:31:17	-->
Ethernet disconnected	02.05.2018 12:31:15	-->
150002-000 DHCP: "Yes"	02.05.2018 12:31:12	-->
Ethernet connected	02.05.2018 12:31:02	-->
Math 2: H->L	02.05.2018 11:39:00	-->
EH_TM371_M7041504487: Self-calibration (ID=132)	02.05.2018 11:10:43	 -->
Trustsens PV in 10,0..120,0 °C	02.05.2018 11:09:02	-->
Trustsens PV out 10,0..120,0 °C	02.05.2018 11:04:11	-->
New HART device detected: channel=14, device address=0, serial number=M7041504487	02.05.2018 10:59:33	-->
560001-000 Monitor: "On"	02.05.2018 10:59:27	-->

Search olderSearch newer

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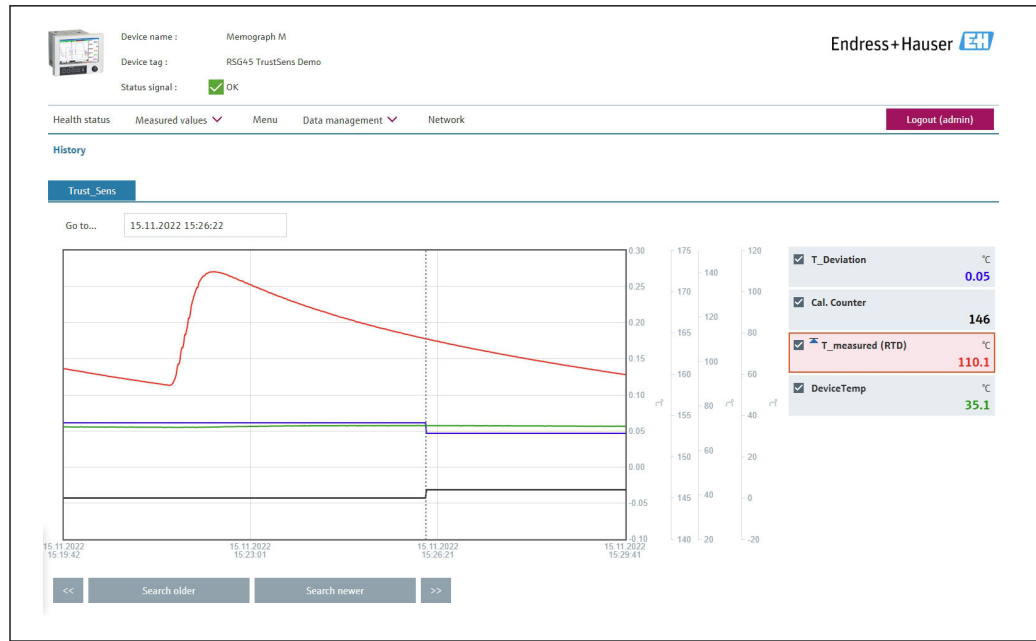
All the information relating to the calibration process is displayed in detail via "...":



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Via "RTF", a calibration certificate is generated, which can then be opened or saved locally. The self-calibration data logged in the Memograph M RSG45 are fully protected against data tampering (FDA-compliant) and remain in a tamper-proof format also for subsequent use. Responsibility for the data consistency of the generated RTF certificate passes to the user.

Event logbook: The calibration process is displayed as a line chart in the data logging history via "-->":



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- 4 Visualization of a self-calibration (example). Note: The measured values displayed depend on the specific configuration. The calibration time indicated on the cursor line, coinciding with an increase in the calibration counter and change in the calibration deviation value, is the time when the calibration process ended.

6.2 Analysis via mathematics functions (option)

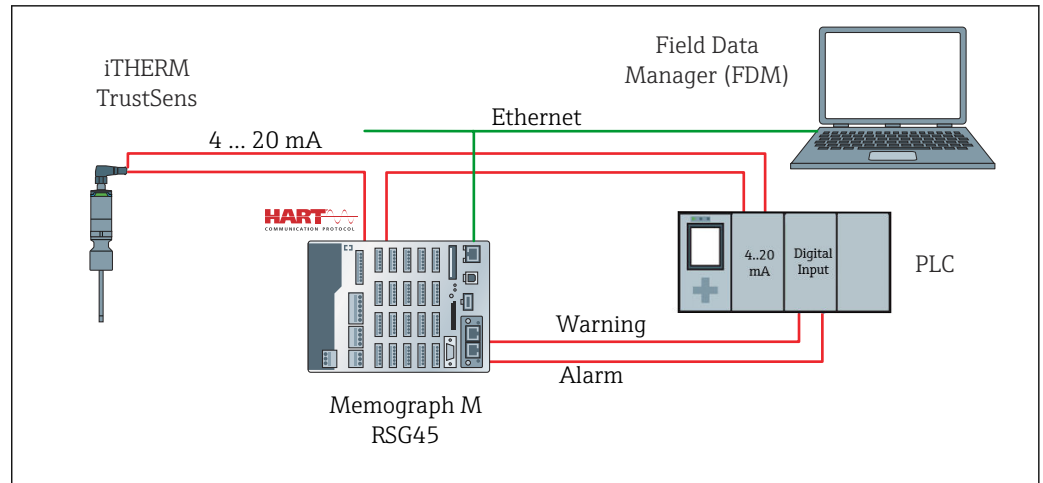
With the mathematics package, the digital HART values (PV, SV, TV, QV) of the iTHERM TrustSens TM37x or the results of other math channels can be linked mathematically. A formula with up to 200 characters can be created using a formula editor. Once entered, the user can then check the plausibility of the formula.

A control input or a relay can also be switched via a limit value on a mathematics channel (e.g. to signal an alarm in the event of temperature overrange detection or calibration deviations).

 For details on the mathematics functions and error messages, see Operating Instructions BA01338R (Memograph M RSG45)

6.3 iTHERM TrustSens TM37x status evaluation

In addition to simply logging the self-calibrations performed by connected iTHERM TrustSens TM37x thermometers, it is also possible to forward an evaluation of the current device state to a PLC or control center in order to trigger warnings or actions.



- 5 The iTHERM TrustSens TM37x is connected to the 4 to 20 mA/HART inputs of the Memograph M RSG45. Optionally, the 4 to 20 mA signal can also be looped to a PLC for process control. Memograph M RSG45 evaluates the device status (measured value status) and outputs a message to the PLC via relay outputs or the fieldbus (optional) in the event of a warning/error. The iTHERM TrustSens TM37x can be configured and commissioned, for example, using the "FieldCare" PC software tool and via the Ethernet port of the Memograph M RSG45 using Ethernet-to-HART communication.

In addition to transmitting the measured value, the iTHERM TrustSens TM37x also transmits status information with one of the following statuses via HART:

- Status OK - good
- Warning - poor accuracy or manual fixed
- Alarm (error) - bad

If several iTHERM TrustSens TM37x sensors are connected, the status is a "collective status" for all the sensors. This means that as soon as an alarm-related event occurs in one of the sensors, this is detected and signaled by the Memograph M RSG45 via the relay output, for example. The Memograph M RSG45 does not assess which event has occurred (calibration error, maximum permissible error, alarm limit, cable break, calibration interval, etc.). If necessary, the details regarding the events can be read out of the sensors with FieldCare (DTM).

For each event, the behavior for alarm or warning messages can be defined in the iTHERM TrustSens TM37x. The setting affects the measured value status (see above) and the behavior of the current output.

 For details, see the iTHERM TrustSens TM37x Operating Instructions, Section 9.3 Diagnostics information

 In addition, there are also "Status Signal" settings in which HART-specific diagnostic messages can be defined for each event. These are needed, for example, for detailed analysis of the device status of iTHERM TrustSens TM37x (see above).

Configuration of the diagnostic behavior (fault behavior) in the iTHERM TrustSens TM37x:

"Alarm": Current output outputs an error current.

Measured value status: "bad"; Memograph M RSG45 displays the error "F100". (If error F100 occurs, dashes appear on the display in the place of all HART values. The calibration counter value is displayed correctly, however.).

"Warning": Current output outputs the measured value.

Measured value status: "poor accuracy", Memograph M RSG45 displays valid measured values and the warning message "M960" and signals this via text, the relay output or the fieldbus output.

"Disabled": The current output outputs the last valid measured value. Memograph M RSG45 displays the measured value (otherwise no action is performed).

Status evaluation in Memograph M RSG45:

A math channel of the Memograph M RSG45 is used to monitor the device statuses of all connected iTHERM TrustSens TM37x devices (option: mathematical function).

The following setup example shows how the measured value statuses are monitored in channels 1-12 for 12 connected iTHERM TrustSens TM37x devices:

Step 1: Configure the mathematics channel for analysis

A mathematics channel to read in the status information is created under **Menu → Setup → Advanced setup → Application → Maths:**

Menu > Setup > Advanced setup > Application > Maths

> Status_Check (1) (active)	> 2 (2)	> Maths 3
> Maths 4	> Maths 5	> Maths 6
> Maths 7	> Maths 8	> Maths 9
> Maths 10	> Maths 11	> Maths 12

Menu > Setup > Advanced setup > Application > Maths > Status_Check (1) (active)

Function

i

Formula editor

▼

Channel ident.

i

Status_Check

Formula

i

minAI(5;1;12)

Formula editor

The result is

i

Instantaneous value

▼

Plot type

i

Average

▼

Engineering unit

i

Decimal point

i

One (X.Y)

▼

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The formula **minAI(5;1;12)** returns the lowest value for input channels 1-12 and writes the aggregate value for the device statuses of the connected iTHERM TrustSens TM37x units 1-12 to the **Status_check** result.

Step 2: Evaluation of the Status_check via the limit function

Two limit values for a warning and an error are created and configured under **Menu → Setup → Advanced setup → Application → Limit values :**

Menu > Setup > Advanced setup > Application > Limits

Add limit value

i

No

▼

Delete limit value

i

No

▼

> TrustS_Warning (1) (active)

> TrustS_Alarm (2) (active)

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Relay 1 switches if the status is < 1. A warning or alarm is signaled:

Menu > Setup > Advanced setup > Application > Limits > TrustS_Warning (1) (active)

Channel/value

i

Status_Check

▼

Type

i

Lower set point

▼

Identifier

i

TrustS_Warning

Set point

i

1

Hysteresis (abs.)

i

0

Time delay

i

0

s

Switches

i

Relay 1

▼

LV messages

i

Do not acknowledge

▼

Save event

i

Yes

▼

Event text LV on

i

TrustSens Warning

Event text LV off

i

TrustSens OK

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Relay 2 switches if the status is < 0.5. An alarm (fault) is signaled:

Menu > Setup > Advanced setup > Application > Limits > TrustS_Alarm (2) (active)

Channel/value	 Status_Check v
Type	 Lower set point v
Identifier	 TrustS_Alarm
Set point	 0.1
Hysteresis (abs.)	 0
Time delay	 0 s
Switches	 Relay 2 v
LV messages	 Do not acknowledge v
Save event	 Yes v
Event text LV on	 TrustSens Alarm
Event text LV off	 Alarm inactive

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The example provided above can be individually adapted to the application. If, for example, only two iTHERM TrustSens TM37x devices are used, they can also be evaluated via 2 math channels and two additional relays.

Similarly, the **Status_Check** output value can be transmitted by fieldbus to a PLC or control system for further processing.

7 FDM function description and activation

7.1 Description of functions

The Field Data Manager (FDM) software contains the following functionalities for "iTHERM TrustSens Calibration Monitoring":

- Evaluation, analysis and further processing of calibration data
- Reading of the Memograph M RSG45 logbook with the related values for self-calibration (temperature during self-calibration, deviation from target value, status information, etc.)
- Generation of a calibration certificate as a PDF file directly in the FDM software
- Printout of the calibration certificate

7.2 Activation



For details on the basic functions, see the online help in the FDM software and Operating Instructions BA00288R



Prerequisite:

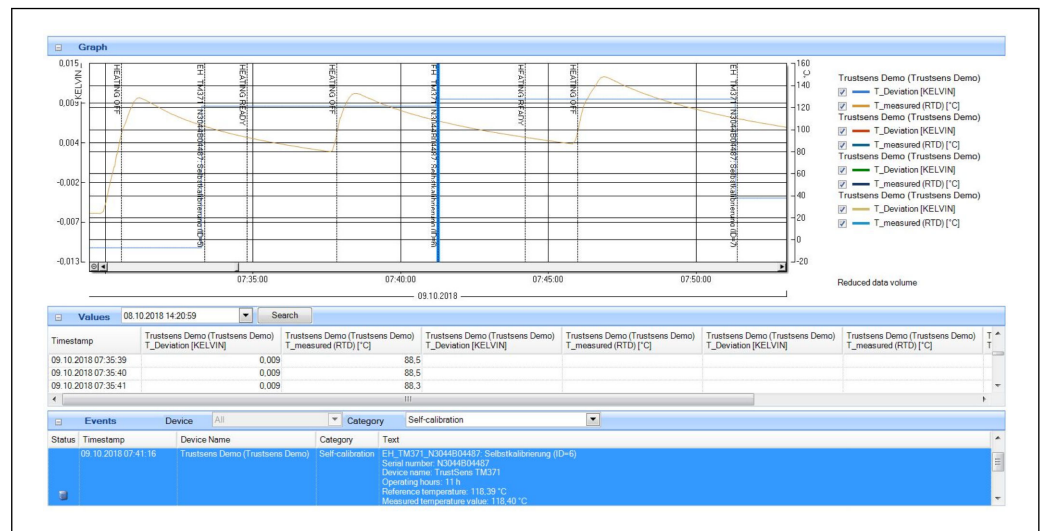
At least one iTHERM TrustSens TM37x must be connected to the Memograph M RSG45.

Simultaneous access to Memograph M RSG45 via a Web server and FDM software is only possible if different interfaces (USB/Ethernet) are used.

Procedure for activating the "iTHERM TrustSens Calibration Monitoring" function in the Field Data Manager (FDM) software":

1. Connect Memograph M RSG45 with the PC running the Field Data Manager (FDM) software.
2. Create the device in the FDM software.
3. Read out the data as explained in Chapter 2 of the FDM Operating Instructions. The data records for self-calibration are saved in the event logbook.
4. Create a new visualization or open a visualization already saved.
5. In the "Events" screen, filter for "Self-calibration" (see screenshot → 17)

A certificate of the selected self-calibration can be generated in PDF format saved by right-clicking the mouse.



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Procedure for activating the automatic function in the Field Data Manager (FDM) software:

1. Step 1 of 3: Select the job type: Under **Data management** → **Automatic** → **Automatic new/edit** select the **Calibration PDF export** function.
2. Step 2 of 3: Select the device: Press **Next** to select the device.
3. Step 3 of 3: Settings to automatically export the certificate to PDF format: Press **Next** to select the desired interval (e.g. Daily) and the location for the generated certificate (PDF).
4. In the FDM Tray Icon application, activate the **Calibration PDF export** function under **Automatic**.

The automatic function in the Field Data Manager (FDM) software to automatically export calibration certificates to PDF format is now activated.

 In the Field Data Manager (FDM) software an automatic "Device readout" function must be created with a time base of 2 min, for example.

 For details, see the online help in the FDM software and Operating Instructions BA00288R

8 Diagnostics and troubleshooting

The device informs you of faults or incorrect entries using plain text on the screen. During display operation (measured value display), the error codes are displayed in the upper right-hand corner of the screen.

 Detailed error messages and troubleshooting can be found in the **Diagnostics and troubleshooting** section of the Operating Instructions.

8.1 Access to connected HART devices via FieldCare

If FieldCare and Memograph M RSG45 iTHERM TrustSens Calibration Monitoring are being operated in parallel (FieldCare via HART tunneling) and FieldCare accesses a HART device during data transmission between Memograph M RSG45 and iTHERM TrustSens TM37x (after a self-calibration), FieldCare can time out for up to 15 s. Communication between Memograph M RSG45 and iTHERM TrustSens TM37x has higher priority in the system. After this time, communication is possible again between FieldCare and the HART device without any restrictions.

8.2 Diagnostic information on the Memograph M RSG45

Diagnostic code	Event text	Description	Remedy
M986	Unable to read out self-calibration: channel=x, device address=y	The device was unable to read out the necessary data to determine the self-calibration.	Check the settings, check communication with the HART device
M987	The device does not support self-calibration: channel=x device address=y	The connected device was replaced during operation. This device does not support self-calibration, however.	

8.3 Troubleshooting on the Memograph M RSG45

Under **Diagnostics → Self-calibration**, a list of all the devices currently being monitored by the Memograph M RSG45 is displayed.



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