

Temperature measurement

Thermometers and transmitters for the process industry





Endress+Hauser – Your partner

Endress+Hauser is a global leader in measurement instrumentation, services and solutions for industrial process engineering

With dedicated sales centers and a strong network of partners, Endress+Hauser guarantees competent worldwide support. Our production centers in twelve countries meet your needs and requirements quickly and effectively. The Group is managed and coordinated by a holding company in Reinach, Switzerland. As a successful family-owned business, Endress+Hauser is set to remain independent and self-reliant.

Endress+Hauser provides sensors, instruments, systems and services for level, flow, pressure and temperature measurement as well as analytics and data acquisition. The company supports you with automation engineering, logistics and IT services and solutions. Our products set standards in quality and technology.

We work closely with the chemical, petrochemical, food and beverage, oil and gas, water and wastewater, power and energy, life science, primary and metal, renewable energy, pulp and paper and shipbuilding industries. Endress+Hauser helps customers to optimize their processes in terms of reliability, safety, economic efficiency and environmental impact.



E-direct - Purchase preconfigured basic field instruments or system components easily.
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To learn more about Endress+Hauser, visit:
www.endress.com

Competence center for temperature measurement, temperature engineered solutions and system products

Endress+Hauser Wetzlar is one of the leading producers of temperature measurement, temperature engineered solutions and system products worldwide.

The company employs more than 630 associates worldwide. 360 of which are working in our headquarters Nesselwang (Germany), where our products are developed and produced.

Associated Product Centers in Pessano (Italy), Greenwood (USA), Suzhou (China), Aurangabad (India) and Benoni (South Africa) guarantee customer proximity with products and services.



Temperature measurement by Endress+Hauser – Because we understand

Its expansive, globally available portfolio of standard thermometers, temperature transmitters and engineered solutions makes Endress+Hauser one of the leading international complete providers of temperature measuring technology for process automation. The large vertical range of production and the high degree of in-house development, ranging from primary sensors and electronics to customized special solutions, make a crucial difference here.

As a reliable and close partner for our customers, we utilize our wealth of product and solution expertise to develop innovative products that produce excellent customer benefits. These products include the world's first self-calibrating thermometer iTHERM TrustSens and unique inserts such as the iTHERM QuickSens and StrongSens, excellent temperature transmitters like the iTEMP TMT162 - SIL2/3 and even multi-point solutions for 2D/3D measurements in digesters. As your expert partner in all issues related to temperature measuring technology, we make a crucial contribution to making your processes more reliable and efficient and increasing the quality of the end products.



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Fuel for thought

With vast experience in the oil & gas sector, we help you to perform, comply and thrive

From exploration to refinery, from storage to distribution, from plant upgrades to new projects, we have the application expertise to help you succeed.

At a time when the sector faces skills shortages and regulations tightening, our organization is here across the full life cycle of your project always with your deadlines in mind. While complexity of facilities and processes are ever increasing, and downtime must be reduced, your competitiveness is enhanced with reliable, accurate and traceable asset information.

In short, you need to do more with less, benefiting from a stable partner who is here for the long haul and ready across the globe, offering:

- Assured plant safety
- Optimized return on investment
- Best-fit products, solutions and services

✓ Advantages at a glance

- Mitigating risks by using state of the art technology meeting highest demands with regard to Functional Safety (IEC 61508) and mechanical integrity (e.g. gastight feedthrough)
- Minimizing operational costs through efficient proof testing concepts, predictive maintenance and innovative data management
- Meeting internationally recognized standards and recommendations such as: API, OIML, ASME, NORSOK, NACE etc.
- Increasing plant availability with innovative technologies particularly designed for oil and gas industry applications

Product highlights



iTEMP TMT162

Field transmitter in dual-compartment housing with flameproof encapsulation

- SIL 2/3-certified for applications in safety instrumented systems
- Communication types: 4 to 20 mA, HART, PROFIBUS PA or FOUNDATION Fieldbus
- HART 7 version for quick data exchange and with extended diagnostic functions
- Optionally available with integrated overvoltage protection to protect the electronic components in the transmitter



TT511 VanStone thermowell

Drilled barstock thermowell with slip-on flange

- Design specifically created for the oil & gas and petrochemical industries meets the highest requirements
- Flexible application options in conjunction with RTD or TC thermometers
- Reliable plant operation due to load capacity calculations for the thermowell in accordance with DIN43772 or ASME PTC19.3 TW2010



TR66 / TC66

Resistance thermometers (RTD) or thermocouples for heavy-duty applications

- Barstock thermowell in line with the ASME standard for high process pressures, temperatures and flow velocities.
- Flexibility through optionally installed head transmitters with various communication types 4...20 mA, HART, PROFIBUS PA or FOUNDATION Fieldbus
- Special resistance thermometers (RTD) or thermocouples for various applications



T13 / T53

Resistance thermometers (RTD) or thermocouples for heavy-duty applications

- Barstock thermowell in line with the ASME standard for high process pressures, temperatures and flow velocities.
- Flexibility through optionally installed head transmitters with various communication types
- Approvals for potentially explosive atmospheres in accordance with CSA and FM
- Vibration resistance of the measuring element up to 60g



iTHERM StrongSens

Highly vibration-resistant RTD insert

- Available in many RTD thermometers
- Vibration resistance of the measuring element up to 60g
- Also suitable for applications in hazardous areas



iTEMP TMT82

HART7 temperature transmitter

- Maximum reliability, availability and accuracy
- SIL 2/3-certified in accordance with IEC61508:2010
- Fast and tool-free wiring using spring terminal technology
- As a head transmitter, DIN rail device or in the field housing



iTHERM MultiSens Flex TMS0x / MultiSens Linear TMS0x

Linear and three-dimensional Multipoint RTD or TC thermometers

- Flexible design especially developed for the requirements of the oil & gas and petrochemical industries
- Monitoring of a large number of temperature measuring points
- Diagnostic chamber as secondary process barrier for improved process safety

Further customer-specific temperature engineered solutions

- Surface temperature measurement with SkinPoint thermometer
- High-precision multipoint thermometers for measuring the average and local temperature in silos and storage applications



Global chemicals, competitive and safe

Get the extra project skill and know-how you need to boost your plant's safe performance

You gain concrete benefits from a partner who has first-hand knowledge of your sector's issues around the globe: on increased safety, on environmental protection, on over-supply leading to cost pressure and on finding engineering support and service when required. You can rely on our help to become more competitive in your line of business.

With a long history of industry firsts we have grown with the sector by listening, acting and innovating to better serve you with:

- Safety, built in
- The technology to lead
- Best-fit project management

✓ Advantages at a glance

- Meeting internationally recognized standards/recommendations: NAMUR, WHG, ASME, NACE, IEC 17025, MID, OIML
- Internationally accepted hazardous area approvals: ATEX, IECEx, FM/CSA, NEPSI, TIIS, INMETRO
- Use of state of the art technology – functional safety according to IEC 61508 (up to SIL 3)
- Uniform operating safety by design concepts for simple and safe operations
- Optimized material availability and minimized stocks through inventory management solutions

Product highlights



TR10 / TR13

Modular, universal thermometer

- Robust design, flexible configuration
- Also suitable for applications in hazardous areas
- Fast response times with reduced/tapered thermowell tip



TR15 / TC15

Robust temperature measuring technology, ideal for steam or gas applications

- For high process pressures and temperatures in demanding applications
- Fast response times with reduced/tapered thermowell tip
- Head transmitter with simple communication type selection



iTHERM MultiSens Slim TMS21

Minimally invasive, wetted multipoint thermometer

- Adaptable customer-specific design (dimensions, material, linear or flexible)
- Monitoring of a large number of temperature measuring points
- Simple installation thanks to only one process connection



TH13 / TH14 / T14

Best-in-class temperature measuring technology in US design

- High flexibility through modular assembly
- Robust design for extremely harsh ambient conditions



iTEMP TMT8x

Temperature transmitter with various communication protocols

- Maximum reliability, availability and accuracy
- Fast and tool-free wiring using spring terminal technology
- Suits any application thanks to the different communication protocols (Foundation Fieldbus, HART, Profibus PA)



iTEMP TMT162

Field transmitter in dual-compartment housing with flameproof encapsulation

- SIL 2/3-certified for applications in safety instrumented systems
- Communication types: 4-20 mA, HART, PROFIBUS PA or FOUNDATION Fieldbus
- HART 7 version for quick data exchange and with extended diagnostic functions

Temperature measurement for critical applications

The most important parameter for ensuring safe operation of a turbine is to measure the temperature of the superheated steam at its inlet. An incorrect signal, triggered by a faulty temperature sensor, and the safety PLC can cause the complete system to switch over to emergency mode. This causes the boiler and turbine to restart, which wastes time and money. The iTEMP TMT82 and TMT162 temperature transmitters are certified by TÜV for SIL 2/3 applications in accordance with IEC61508:2010 and can solve this problem.

To ensure maximum availability and reliability, the devices are equipped with two inputs for temperature sensors, enabling operation with redundant sensors. If one of the two temperature sensors returns a faulty signal, the system automatically switches to the backup sensor and a diagnostic message is sent via HART. This notifies the control room of the sensor failure. On the other hand, the 4...20 mA output continues to return a valid measured value, which ensures uninterrupted operation of the system.





Extracting more from less

In a world of lower grades, skills gaps and excavation challenges - we can help you hit your targets

We've seen how lower grades are driving an acute need for ever-better automation and controls. You are also facing emerging skills gap, requiring better-informed industry partners. At the same time, energy costs are only going one way, and the legislative environment is becoming increasingly stringent.

Tough challenges call for experienced heads who can:

- Reduce your metal and mineral production costs
- Keep your plant safe
- Boost compliance and responsibility

✓ Advantages at a glance

- Complete product basket for all applications, specifically in harsh environments
- Advanced diagnostic functionalities to make the process more safe and reliable
- Savings in raw material, water, energy and labor through accurate data of critical and quality relevant points in your process

Product highlights



TR15 / TC15

Robust temperature measuring technology, ideal for steam or gas applications

- For high process pressures and temperatures in demanding applications
- Fast response times with reduced/ tapered thermowell tip
- Head transmitter with simple communication type selection
- Suitable for use in hazardous areas



TAF11 / TAF12S/D/T / TAF16

Modular high temperature thermometers

- Robust design due to multiple ceramic or metallic thermowells
- Selection of high-temperature thermocouples
- Selection of durable thermowell materials that offer greater resistance to wear and chemicals
- Flexible product selection thanks to modular design
- Replaceable spare parts optimize life cycle costs



iTEMP TMT82

HART 7 temperature transmitter

- Maximum reliability, availability and accuracy
- SIL 2/3-certified in accordance with IEC61508:2010
- Fast and tool-free wiring using spring terminal technology
- Maximum accuracy due to sensor-transmitter matching
- As a head transmitter, DIN rail device or in the field housing

Tile manufacturing in a rotary kiln

The clay manufacturing application in the rotary kiln for tile production requires a specially adapted TAF16. A thermowell made of a nickel/cobalt alloy, which features high wear and corrosion resistance at high temperatures, is used to protect the sensor. A wireless HART module ensures reliable signal transmission from the rotary kiln to the control room. Special reflective discs are installed between the process connection and terminal head to protect the electronics from overheating due to strong heat emission. This allows the thermometer to be used optimally in various sections of the kiln, from the drying area at 300 °C to the combustion area with temperatures up to 1000 °C.

Your benefit: This method can be used to double the operating times of the sensors in this process.

- Easy data transfer using a wireless SWA70 module
- Reduced heat emission using suitable reflective discs
- Suitable thermowell materials for high resistance to erosion and corrosion





Nourishing your productivity

Your global partner for accurate measurements and expert support in food and beverages automation

From hygiene regulations and food safety to the basic demands of reliability and uptime, high quality food & beverage producers profit from our experience in more than 100 countries.

Get it right the first time and make your safe choice:

- Constant food quality & compliance
- Resources savings
- An expert partner

Advantages at a glance

- The world's first self-calibrating thermometer reduces process risks and costs
- Other modular, accurate, safe and reliable hygienic thermometers which enable quick recalibration thanks to iTHERM QuickNeck technology
- Best-in-class hygienic design
- Innovative thermowells with optimum hygienic properties

Product highlights



iTHERM TM411 / TM412

Forward-looking, hygienic thermometer with modular design

- Maximum possible variability for any demands
- Groundbreaking technologies for extremely easy handling, maximum process reliability and efficiency



iTHERM TM401 / TM402 (E-direct)

Hygienic, modular thermometer - Basic technology

- Developed specifically for use in hygienic and aseptic applications
- Best cost/performance ratio and fast delivery time



Easytemp TMR35 (E-direct)

Hygienic compact thermometer

- Compact, fast and precise
- Ideal for short immersion depths when installing in areas with small nominal pipe diameters



iTHERM TrustSens TM371 / TM372

World's first self-calibrating thermometer

- Minimizes risks and costs
- 100% compliance and audit-proof documentation
- No undetected failures



iTHERM QuickSens

Shortest response times worldwide:

- Fast, high-precision measurements
- Minimization of the needed immersion length
- Use of thermowells without affecting the measuring performance



iTEMP TMT180 / TMT181

4...20 mA temperature head transmitters

- Best cost/performance ratio
- High accuracy

Heating processes

A frequently used heating process for preserving milk is called (flash) pasteurization (high-temperature short-time HTST processing).

Heating is used to neutralize any dangerous microorganisms that may be in raw milk. As a result, this is one of the most critical processes in terms of food safety.

Exact compliance with temperature specifications is mandatory in guaranteeing the effectiveness of this process. Excessive temperatures should be avoided due to their effects on taste and energy consumption. However, specialists must also ensure that the temperature in the holder tube never drops below the specified minimum temperature.

This can be ensured by implementing fast, tight temperature control which, in turn, is based on the fastest possible recording of temperature fluctuations. Endress+Hauser provides the critical advantage with iTHERM QuickSens technology sensors, which are the fastest in the world. Additionally, iTHERM QuickNeck – a divisible neck tube with a quick-release fastener – enables fast, tool-free calibration on site. These technologies are examples of product innovations from the iTHERM TM411 thermometer series, which sets new benchmarks for hygienic applications.





The pulse of life sciences

Trust a reliable partner who puts quality, compliance and cost control at the heart of life sciences

It is a daily task to meet stringent GxP regulations and productivity goals throughout your product lifecycle. You can count on our world-class instruments, designed to ASME-BPE standards, but also our highly qualified engineering input and experienced service teams. We partner with you to generate process optimization, higher plant availability and continuous improvement.

Our excellence, gained at the heart of the sector, will help you to:

- Streamline your projects
- Attain operational experience
- Make the right decisions

✓ Advantages at a glance

- The world's first self-calibrating thermometer reduces process risks and costs
- Other modular, accurate, safe and reliable hygienic thermometers which enable quick recalibration thanks to iTHERM QuickNeck technology
- Best-in-class hygienic design
- Innovative thermowells with optimum hygienic properties

Product highlights



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Easytemp TMR35 (E-direct)

Hygienic compact thermometer

- Compact, fast and precise
- Ideal for short insertion depths when installing in areas with small pipe nominal diameters



iTHERM TrustSens TM371 / TM372

World's first self-calibrating thermometer

- Minimizes risks and costs
- 100% compliance and audit-proof documentation
- No undetected failures



iTEMP TMT82

HART 7 temperature transmitter

- Maximum reliability and availability
- Maximum accuracy due to sensor-transmitter matching
- 2 sensor inputs



iTHERM TT4xx

Innovative thermowell design for hygienic applications

- High-precision measurement thanks to optimized design
- Increased process safety and reliability due to assembly without welding seams and without dead spaces
- Numerous different pipe sizes available as standard

iTHERM QuickSens insert

Extremely small pipe nominal diameters are sometimes used in machines in the pharmaceutical industry. This poses unique challenges for temperature measurement. Typical hygienic process adaptations can only be used if they meet a certain minimum nominal diameter. For this reason, Endress+Hauser provides welding solutions in the form of a T-piece or cornerpiece with an integrated thermowell for hygiene-compliant integration of temperature measuring points in small pipes.

These small nominal diameters present the sensors with unique requirements. The position of the actual sensor element for standard measuring inserts is located 10...15 mm behind the tip. At very small immersion depths, this causes a crucial measurement error because the sensor here is located at the height of the pipe wall instead of in the center of the pipe.

Endress+Hauser has developed a special solution for this problem – the iTHERM QuickSens insert. This involves a special sensor design in which the primary sensor is soldered directly onto the insert tip. This enables immersion lengths up to seven times shorter and the shortest response times in the world.

This allows Endress+Hauser to provide innovative, cutting-edge technology – the iTHERM TM411 thermometer. This product guarantees the user maximum accuracy, process control and reliability and quality without compromises.





Water is our life

Water quality, discharges, regulations, the environment... just rely on a trusted partner

As budgets shrink and legislative demands soar, we bring expertise for challenging needs. Safe potable water... discharges, environmental penalties... water infrastructure for developing countries... energy monitoring... the rising quantities of sludge from wastewater treatment and the opportunities they create for biogas. We make sense of it all, with experienced thinking supported by process technology solutions for your every need.

Through working with water in over 100 countries, Endress+Hauser offers a refreshing alternative.

- Improve plant safety and availability
- Optimize costs in your internal water processes
- Support your risk and failure management



Advantages at a glance

- Cost-effective product and service portfolio for any applications, e.g. for drinking water, wastewater and sewage, desalination
- Meeting internationally recognized standards/ recommendations for drinking water applications
- Highest efficiency by easy commissioning, operation and maintenance of instruments

Product highlights



TR10

Modular, universal thermometer

- Robust design, flexible configuration
- Fast response times with reduced/tapered thermowell tip
- Head transmitter with simple communication type selection



TST434

Modular thermometer for inside/outside temperature measurement

- Robust terminal heads in accordance with DIN EN 50446 or stable plastic housings
- Easy and fast wall mounting
- Reliable temperature measurement with long-term stability



TH13

Best-in-class temperature measuring technology in US design

- High flexibility through modular assembly
- Robust design for extremely harsh ambient conditions



Easytemp TMR31 (E-direct)

Compact thermometer for industrial processes

- Compact, fast and precise
- Best cost/performance ratio and fast delivery time



iTEMP TMT180 / TMT181

4...20 mA temperature head transmitters

- Best cost/performance ratio
- High accuracy



iTEMP TMT112

HART DIN rail temperature transmitter

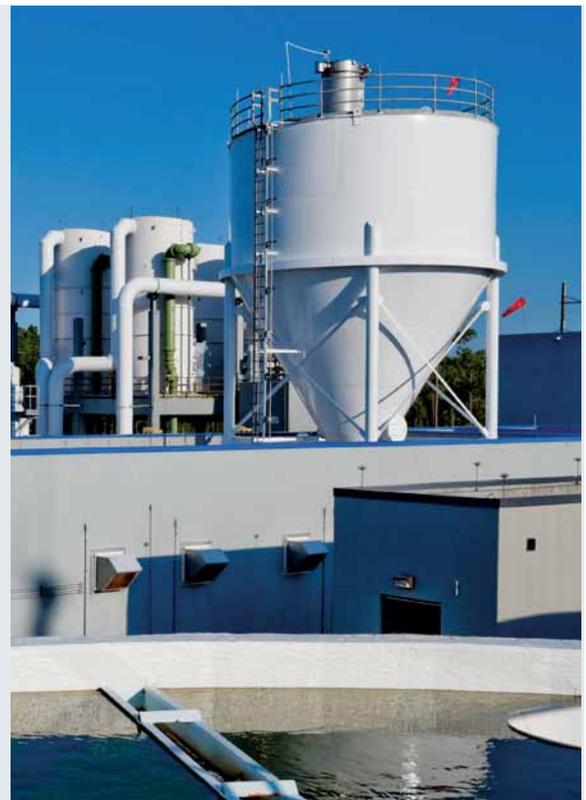
- Universally programmable with HART protocol
- High reliability - breakdown information in case of sensor break/short-circuit

Operate your digester safely and reliably

Reduce operating costs and optimize the energy balance. In sewage management, a strong trend toward sludge treatment can be seen worldwide. This can primarily be ascribed to more stringent local requirements, which prohibit introducing sewage sludge into the environment (bodies of water, fields). As a result, sewage sludge has become a considerable cost factor for plant operators. In these scenarios, sludge decomposition can provide a cost advantage because it can be used to reduce the amount of sludge by around 50% and is also a valuable energy source for biogas.

Anaerobic bacteria require stable process conditions

The bacteria has to be protected from critical process conditions while processes take place in the digester. It is crucial to maintain a constant temperature. Endress+Hauser provides a reliable, robust thermometer for precisely this purpose – the Omnigrad M TR10. A thermowell with a reduced/tapered tip guarantees fast, immediate responses to changes in temperature. An optional head transmitter with all common communication protocols increases measuring accuracy and reliability compared to directly wired sensors.





Power up your plant

Power plants play a vital role. We help minimize downtime whilst delivering safety and productivity

Your plant needs a multi-skilled, versatile partner. You need reliable solutions that meet your application requirements and industry quality standards. And you may need to upgrade ageing plants with proven and state-of-the-art technologies, to keep the output consistently high. As the industry shifts towards natural gas, renewables and the new market dynamics driven by shale gas, our mission is to provide the all-round support and experience you need. This includes elevated standards of safety for your staff. And the ability to meet even-higher environmental demands in flue gas cleaning processes such as SCR catalysts for nitrogen oxide reduction, electrostatic precipitators (ESPs) for particle separation, and limestone scrubbing processes for desulphurization.

When you choose us, you:

- Boost the efficiency of your plant
- Heighten safety
- Maintain expertise

✓ Advantages at a glance

- Functional safety: IEC 61508 SIL 2/3 certified
- Intelligent instruments with continuous self-monitoring
- Minimized downtime and highest safety through modern instrumentation

Product highlights



iTEMP TMT82

HART 7 temperature transmitter

- Maximum reliability, availability and accuracy
- SIL 2/3-certified in accordance with IEC61508:2010
- Fast and tool-free wiring using spring terminal technology
- Maximum accuracy due to sensor-transmitter matching
- As a head transmitter, DIN rail device or in the field housing



iTHERM StrongSens

Highly vibration-resistant RTD insert

- Available in many RTD thermometers
- Vibration resistance of the measuring element >60g
- Also suitable applications in hazardous areas



TR15 / TC15

Robust temperature measuring technology, ideal for steam or gas applications

- For high process pressures and temperatures in demanding applications
- Fast response times with reduced/tapered thermowell tip
- Flexibility through optionally installed head transmitters with various communication types



TAF11 / TAF12S/D/T / TAF16

Modular high-temperature thermometer

- Robust design due to multiple ceramic thermowells or metallic thermowells
- Selection of high-temperature thermocouples
- Selection of durable thermowell materials



TR88 / TC88

Modular, universal thermometer

- Robust design, flexible configuration
- RTD or TC inserts
- For installation in an existing thermowell
- Also suitable applications in hazardous areas



TST310 / TSC310

Cable thermometer for direct installation

- Robust design, flexible configuration
- RTD or TC elements
- Mineral-insulated stainless steel or nickel-based sheathed cable
- Also suitable applications in hazardous areas

Temperature measurement on the feed water pump

At temperatures of approximately 170 °C and a pressure of approximately 220 bar, the temperature measurement on the feed water pump is not a particularly demanding measurement.

However, the temperature sensor is subjected to strong vibrations and often has a short operating life as a result. Using a thermometer with a barstock thermowell in conjunction with a vibration-resistant iTHERM StrongSens insert leads to a durable solution. The sensor's fast response time and the excellent long-term stability contribute to reliable process control and short downtimes.



Thermometer product overview

Endress+Hauser offers a complete assortment of compact thermometers, modular thermometers, thermowells, measurement inserts and accessories for all types of process industries.

Product group	Cable sensor	Compact thermometer	Modular, industrial	Modular, heavy duty (XP/Ex d)
Design				
Description	Cable sensor	Compact thermometer (self-calibrating), Temperature switch	Modular thermometers for a wide range of industrial applications	Flameproof thermometers for Ex d applications
Application/sector	Universal	Universal, food & pharmaceutical	Universal, chemicals, energy	Universal, oil & gas, chemicals
Approval/certificates	ATEX Ex i, ATEX Ex nA, IECEx Ga Ex ia, NEPSI Ex ia	EHEDG, 3-A, FDA, ASME BPE	ATEX Ex i, ATEX Ex nA, FM/CSA IS, IECEx Ga/Gb Ex ia, NEPSI Ex ia	ATEX Ex i, Ex d; Ex nA; IECEx Ga/Gb Ex ia, Ex d; FM/CSA: IS, XP, NEPSI Ex ia, Ex d
Measuring ranges	RTD: -50 to +400 °C (-58 to +752 °F) TC: -40 to +1100 °C (-40 to +2012 °F)	RTD: -50 to +200 °C (-58 to +392 °F)	RTD: -200 to +600 °C (-328 to +1112 °F) TC: -40 to +1100 °C (-40 to +2012 °F)	RTD: -200 to +600 °C (-328 to +1112 °F) TC: -40 to +1100 °C (-40 to +2012 °F)
Process connection	For insertion, compression fittings, thread	Hygienic process connections and weld-in connections	For insertion, compression fittings, thread, flanges, weld-in connections	Thread, flanges, weld-in connections
For more detailed information, please see...	Pages 32 to 35		Pages 36 and 37	Pages 38 and 39



Modular, hygienic	High temperature	Temperature engineered solutions
		
<p>Modular thermometers with hygienic process connections</p>	<p>High temperature thermometers with metallic/ceramic thermowell and thermocouples</p>	<p>SkinPoint thermometers for incinerators, multipoint thermometers, application-specific solutions</p>
<p>Food & pharmaceuticals</p>	<p>Energy, primaries industry, Metal processing, flue gas</p>	<p>Oil & gas, energy, chemicals</p>
<p>ATEX Ex ia, ATEX Ex ta/tb IECEX Ga/Gb Ex ia FM/CSA IS EHEDG, 3-A, FDA ASME BPE NEPSI Ex ia</p>	<p>-</p>	<p>PED, CRN; ATEX Ex d; FM/CSA: XP</p>
<p>RTD: -200 to +600 °C (-328 to +1112 °F)</p>	<p>TC: 0 to +1800 °C (32 to +3272 °F)</p>	<p>RTD: -200 to +600 °C (-328 to +1112 °F) TC: -200 to +1700 °C (-328 to +3092 °F)</p>
<p>Practically all common hygienic process connections and weld-in connections</p>	<p>Flanges, gas-tight threaded couplings</p>	<p>Customer-specific solutions</p>
<p>Pages 40 and 41</p>	<p>Pages 44 and 45</p>	<p>Pages 46 and 47</p>



Construction of a thermometer

The mechanical construction of a thermometer used in process plants is the same for resistance thermometers and thermocouples and consists of the following components:

- Measurement insert with ceramic terminal block or head transmitter
- Thermowell
- Process connection
- Neck/lagging
- Terminal head with cable glands

DIN-Style



The **terminal head** is fitted to the thermowell or the neck of the thermometer.

Benefits:

- Protection and installation for terminal block or transmitter
- Cable entry and wiring
- Display (as option)



The **neck** or **lagging** is the connection between terminal head and process connection/thermowell.

Benefits:

- Protection of the head transmitter from overheating
- Guarantees access to the terminal head in the case of pipe insulation



The **process connection** is the connection between the process and the thermometer.

Normally used are:

- Threads
- Flanges
- Weld-in connections
- Compression fittings



The **thermowell** is the process wetted component of the thermometer.

Benefits:

- Increases the life cycle of the measurement insert through protection against process influence.
- Possible measurement insert exchange under process conditions.
- Mechanical stability against pressure and flow

US-Style



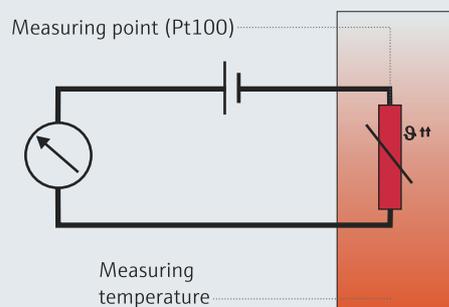
Measurement inserts

Basics and measurement principles

Temperature is the most frequently measured parameter in the process industry.

In electrical, contact thermometers two measurement principles have asserted themselves as a standard.

RTD - Resistance sensors



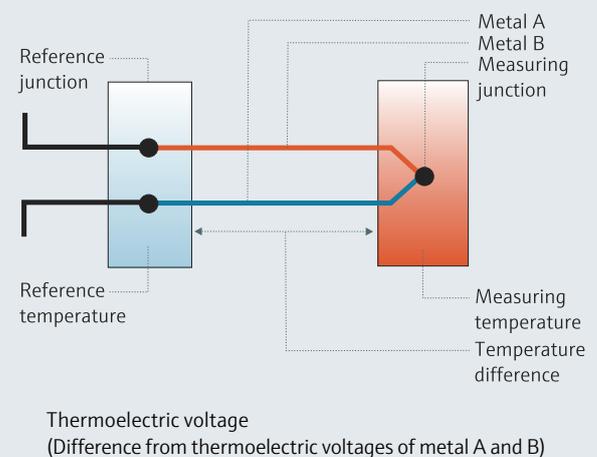
In RTD resistance sensors the electrical resistance changes with a change in temperature. They are suitable for the measurement of temperatures between $-200\text{ }^{\circ}\text{C}$ and approx. $600\text{ }^{\circ}\text{C}$ and stand out due to high measurement accuracy and long-term stability. The resistance sensor element most frequently used is a Pt100.

It is about a temperature-sensitive measuring resistance made of platinum with a resistance value of $100\ \Omega$ at $0\text{ }^{\circ}\text{C}$. The temperature coefficient is fixed with $\alpha = 0.003851\text{ }^{\circ}\text{C}^{-1}$. Pt100 sensors are manufactured in different formats:

- **Wire wound ceramic sensors:** In a ceramic tube there is a double coil with capillary ultra-pure platinum wire. This tube is sealed at the top and bottom by a ceramic protective coating. These sensors ensure good long-term stability of their resistance/temperature characteristic in the temperature range of up to $600\text{ }^{\circ}\text{C}$.
- **Thin-layer sensors:** In a vacuum a very thin platinum coating of about $1\ \mu\text{m}$ is sputtered onto a ceramic plate and is then photo-lithographically structured. The emerging platinum conductors form the sensor resistance. The advantages over the wire-wound versions are the smaller dimensions and the better vibration resistance. Thin-layer sensors are used for temperature measurements in temperature ranges of up to $500\text{ }^{\circ}\text{C}$.

As a standard, Endress+Hauser RTD resistance sensors fulfill the IEC 60751 accuracy class A.

TC - Thermocouples



A thermocouple is a component made of two different metals connected with each other at one end. An electrical potential (thermoelectric force) is caused due to the Seebeck effect at the open end if the connection and the free ends are exposed to different temperatures. With the help of the so-called thermocouples reference tables (see IEC 60584) the temperature at the connection (measuring junction) can be concluded.

Thermocouples are suitable for temperature measurement in the range of $0\text{ }^{\circ}\text{C}$ to $+1800\text{ }^{\circ}\text{C}$. They stand out due to the fast response time and high vibration resistance.

Sensor types

Resistance sensors (RTD)					
Model	iTHERM QuickSens	iTHERM StrongSens	Standard thin film	Wire wound (WW)	iTHERM TrustSens
Design					
Measurement range	-50 to +200 °C	-50 to +500 °C	-50 to +400 °C	-200 to +600 °C	-40 to +160 °C
Number of sensors		1x Pt100		1x/2x Pt100	1x Pt100
Electrical connection	3-/4-wires				Compact version, complete with electronics
Insert diameter	3 mm / 6 mm	6 mm		3 mm / 6 mm	
Accuracy	Class A / AA				< 0.22 °C (HART®-value)
Vibration resistance	3 mm: 3g 6 mm: >60g	> 60g		3g	
Response time t_{90} (for 1x Pt100)	3 mm: 0.75 s 6 mm: 1.5 s	6 mm: 9.5 s	3 mm: 5.5 s 6 mm: 13 s	3 mm: 5 s 6 mm: 11.5 s	3 mm: 5.4 s 6 mm: 17.9 s

Design

Measurement inserts consist of a SS316L stainless steel, Alloy 600 or Pyrosil tube inside. The internal leads (RTD) or thermal leads (TC) are placed and insulated from each other by magnesium oxide (MgO) powder.

The sensor is located at the tip of the measurement insert. The electrical contact at the top end of the measurement insert is made, in the simplest case, by the use of flying leads, a terminal block or a head transmitter. Measurement inserts are available with a single sensor or, for redundant measurement, with two sensors.

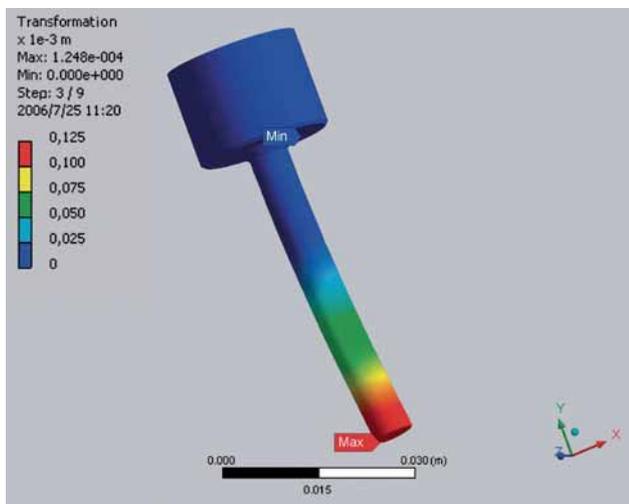
In order to guarantee thermal contact to the process the measurement inserts are pushed onto the base of the thermowell by means of two springs on the fixing screws or one spring on the collar (U.S. style: 'spring loaded').



Measurement insert:
Flying leads, US-Style 'spring loaded',
ceramic block and head transmitter

Thermowells

The thermowell is the process wetted part of the thermometer. Basically, thermowells are divided into protection tubes constructed from welded tubes and thermowells made of drilled barstock material.



Computer simulation showing the loading of a thermowell in process

Thermowell construction In many cases thermometers cannot be placed directly into the medium but need protection from rough process conditions. Furthermore the thermowell makes sure that an exchange of the measurement insert is possible without interrupting the process.

Correct construction and design of a thermowell requires exact calculations. The load capacity of thermowells in individual processes is calculated at Endress+Hauser according to the Dittrich /Kohler method which represents the basis of the DIN 43772.

The calculation can alternatively be carried out according to ASME / ANSI PTC 19.3, i.e. the Murdock method.

i Thermowell calculation tool

The "Sizing Thermowell Tool" can be found on the Endress+Hauser website for online calculation and engineering of all Endress+Hauser thermometer thermowells.

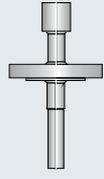
 Interested? Have a look: www.endress.com/applicator

- Select and size product
- Sizing & documentation
- Sizing thermowell

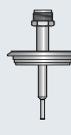
Fabricated thermowells

Model	TA414	TW10	TW11	TW12	TW13	TW251
Design						
Thermometer connection	Matched adapter for TST414	M24 x 1,5, 1/2" NPT				Compression fitting Ø9 mm
Process connection	G 1/2"	G 1/4", G 1/2", G 3/4", G 1", 1/2" NPT, 3/4" NPT		Without, TA50 with Ø9 mm or Ø11 mm	Flange according to EN 1092-1 or ASME	G 1/2", G 3/4", 1/2" NPT, weld-in adapter 25 x 30 mm, cylindrical or spherical
Neck/extension	Without	As per DIN 43772	Double nipple	Without	According to DIN 43772	Without
Material	1.4571	1.4435, 1.4571, 2.4819, 2.4816	1.4435, 1.4571	1.4435, 1.4571, 2.4816	1.4435, 1.4571, 2.4819, 2.4816	1.4435
Suitable for	Only TST414	Replacement thermowell for Tx10 and TST90	Replacement thermowell for TR11	Replacement thermowell for Tx12	Replacement thermowell for Tx13	Thermowell for TST410, TEC410, TST310 or TSC310
Order number for detailed technical information	TI228T/02	TI261T/02	TI262T/02	TI263T/02	TI264T/02	TI245T/02

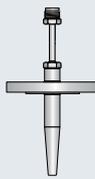
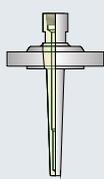
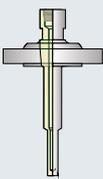
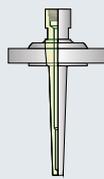
Fabricated thermowells

Model	TA535	TA540	TA541
Design			
Thermometer connection	G 1/2", 1/2" NPT	1/2" NPT, 3/4" NPT	1/2" NPT male
Process connection	G 1/2", G 3/4", 1/2" NPT, 3/4" NPT	Flange according to EN 1092 or ASME; thread 1/2" NPT, 3/4" NPT, 1" NPT	Flange according to EN 1092 or ASME; thread 3/4" NPT, 1" NPT
Neck/extension	50 to 500 mm	100 to 300 mm	80 to 300 mm
Material	1.4435	1.4401, 1.4749	1.4401
Suitable for	TR88, TC88, TR24, TR25	TR88, TMT162R, TC88, TMT162C	-
Order number for detailed technical information	TI00250T/09	TI01158T/09	

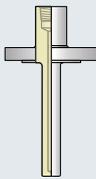
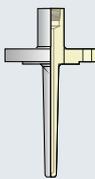
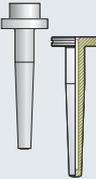
Thermowells for hygienic applications

Model	TT411	TT412	TT411/412
Design			
Thermometer connection	M24x1.5, G3/8", iTHERM QuickNeck	1/2" NPT, iTHERM QuickNeck	G3/8", 1/2" NPT
Process connection	Clamp as per ISO 2852, DIN 11851, Varivent, weld-in adapter, thread, Ingold, SMS 1147, APV inline	Clamp as per ASME BPE or ISO 2852, Varivent, T-section, corner piece, weld-in adapter, thread	DIN 11865 series A, B, C
Neck/extension	As per DIN 43772, 65 mm	Variable or predefined	Predefined
Material	1.4404, 1.4435; 1.4435+316L, delta ferrite < 1%	316L	1.4404, 1.4435, 1.4435+316L, delta ferrite < 0.5%
Suitable for	TM411, TM371	TM412, TM372	TM411, TM412, TM371, TM372, TMR35
Order number for detailed technical information	TI01099T/09	TI01350T/09	TT411: TI01099T/09 TT412: TI01350T/09

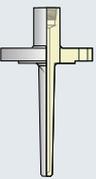
Barstock thermowells

Model	TW15	TA550/TA555	TA556	TA557	TA560	TA562
Design						
Thermometer connection	M24 x 1.5, 1/2" NPT male	1/2" NPT	3/4" NPT	1/2" NPT		1/2" NPT, 1/2" BSP
Process connection	Flange according to EN 1092/ASME, or weld-in	Flange according to ASME, thread 3/4" NPT (TA550), 1" NPT (TA555)	Flange according to ASME, thread 1" NPT		Thread 3/4" NPT	Thread 3/4" NPT, 1/2" NPT, G1/2"
Neck/extension	40 to 400 mm	50 to 300 mm			45 to 300 mm	
Material	1.4435, 1.4571, 2.4819, 2.4816	1.4401, 1.4435, 1.4571				
Suitable for	TR15 / TC15	TR88 / TC88, TMT162R / TMT162C, TR62 / TC62, TR65 / TC65, TST90				
Order number for detailed technical information	TI00265T/02	TA550: TI153T/02 TA555: TI154T/02	TI155T/02	TI156T/02	TI159T/02	TI00230T/02

Barstock thermowells

Model	TA565/TA566	TA570	TA571	TA572	TA575	TA576	TT511
Design							
Thermometer connection	½" NPT	½" NPT, ½" BSP			½" NPT		
Process connection	1" NPT	Weld-in			Flange according to EN 1092 or ASME		Collar flange according to EN 1092 or ASME
Neck/extension	30 to 300 mm	30 to 400 mm			50 to 300 mm	50 to 400 mm	25 mm (type 1)
Material	1.4401, 1.4435, 1.4571						1.4401, 1.4571
Suitable for	TR88 / TC88, TMT162R / TMT162C, TR62 / TC62, TR65 / TC65, TST90						
Order number for detailed technical information	TA565:TI160T/02 TA566: TI177T/02	TI01162T/09			TI01128T/09		TI01135T/09

US Barstock thermowells

Model	TU51	TU52	TU53	TU54
Design				
Thermometer connections	½" NPT	½" NPT	½" NPT	½" NPT
Process connection	Weld-in Ø ¾", Ø1"	Socket weld process connections	Thread ½" NPT, ¾" NPT, 1" NPT	Flange according to ASME
Neck/ extension	1"-6" cylindrical	1"-6" cylindrical	1"-6" hexagonal	1"-6" cylindrical
Material	SS316	SS316	SS316	SS316
suitable for	T15, T55	T15, T55	T15, T55	T15, T55

Process connections

The process connection is the connection between the process and the thermometer.
The following process connections are those most commonly used in the process industries:



Thread: The most commonly used thread types are NPT-, G- and M-threads:

- The ANSI B 1.20.1 NPT thread is a U.S. thread norm for self-sealing pipe threads. Sealing is achieved through conical threads.
- G threads are cylindrical pipe threads and seal using the sealing area above the thread.
- M threads are metric threads which are used at low process pressures. M threads are frequently used on thermometers that are to be screwed into already existing thermowells on site.



Welded joint: The thermowell is directly welded into the container or pipe wall via a welding sleeve or a welding adapter.

Compression fitting: The thermometer is put into a sleeve in the compression fitting and then clamped using either a reusable compression ring or a non-detachable olive.

The compression fitting is either screwed or welded into the process.



Flange: Flanges are subject to the DIN or ANSI / ASME standards. They are classified according to material, diameter and pressure rating.

To fulfill the strongly varying process conditions a variety of sealing geometries are available.

Process connections for hygienic and aseptic application

Seals in hygienic process connections must be replaced at fixed intervals. Fast and simple exchange of the complete thermometer as well as simple cleaning in the process have led to special hygienic process connections for the Food & Life Sciences industry.

Connection	Clamp according to ISO 2852	DIN 11851	DIN 11864	SMS	Weld-in adapter	Screw-in adapter	Varivent	Ingold	Metallic sealing connection
Design									
Size	DN8/18 DN12/21,3 DN25/38 DN40/51 Tri-Clamp 1/2", 3/4", 1 1/2", 2"	DN 25 DN 32 DN 40 DN 50	DN 25 DN 40	DN 25	Cylindrical or spheric cylinder 30 x 40 mm	G 1", as for Liquiphant M	DN32/125, D = 68 mm DN25, D = 50 mm DN10/15, D = 31 mm	25 x 30 mm, 25 x 50 mm	M12x1.5, G 1/2"
Available for	Metrical design: TM401, TM411, TMR35, TTR35 Imperial design: TM402, TM412								

Terminal heads

The terminal heads, in which the terminal block or transmitter is installed, differ in shape and material depending on the application. Materials used are: Plastic, varnished aluminum or stainless steel. All terminal heads have an internal form according to DIN 43729 (form B). Various threads for thermometer connection (M24, NPT $\frac{1}{2}$ ") or cable connection (M20, NPT $\frac{1}{2}$ " , NPT $\frac{3}{4}$ " , G $\frac{1}{2}$ ") are available. Moreover, a large selection of cable glands and connectors is available.

TA30A	IP	TA30A double cable entry	IP	TA30H	IP	TA30H double cable entry	IP
	66/ 67		66/ 67		66/ 67		66/ 67
Form B standard (optional with display)		(also with display)					
TA30D	IP	TA21E	IP	TA20B	IP	TA30R	IP
	66		65		65		IP 69K
Form BUZH						(without display)	
TA30P	IP	TA30S	IP	TA30H SS	IP		IP
	65		66		66/ 68	(with display)	66/ 68

Terminal heads offering maximum comfort

- With high or low cover.
- With screw-on cover even in explosion-proof version (XP).
- Cover with display window for process value and diagnostic messaging display.
- Internal and external grounding screws.
- Simple connection cable feed by means of a spiral cable guide well.
- Easy access to mounting platform for head transmitter or terminal block installation.
- Simple identification due to explicit nameplate positioning.
- Double cable entry
- Optional with wall or pipe mounting
- Connectors

iTHERM TA30R - Stainless steel terminal head for hygienic applications



Benefits at a glance:

- Improved handling, reduced installation and maintenance costs by optimal access to the terminals
- Optional display - safety due to on-site process display
- High cover version for installation of two transmitters, optional
- Protection class IP69K - optimal protection even when using high-pressure cleaners



Transmitter

The task of transmitters is the transformation of the sensor signal into a stable and standardized signal. In the past, transmitters were built using analog technology. In the meantime digital technology has gained acceptance, however, because it offers better measurement accuracy at simultaneously higher flexibility.



Transmitters are typically offered in three distinctive types of housing:

- As DIN rail mounted devices suitable for panel installation.
- As head transmitters for direct installation in thermometer terminal heads.
- As field transmitters for direct connection in the process areas.

Transmitters are configurable and support both numerous resistance sensor types and thermocouples. In order to obtain the highest measurement precision, linearization characteristics for every type of sensor are stored in the transmitter.

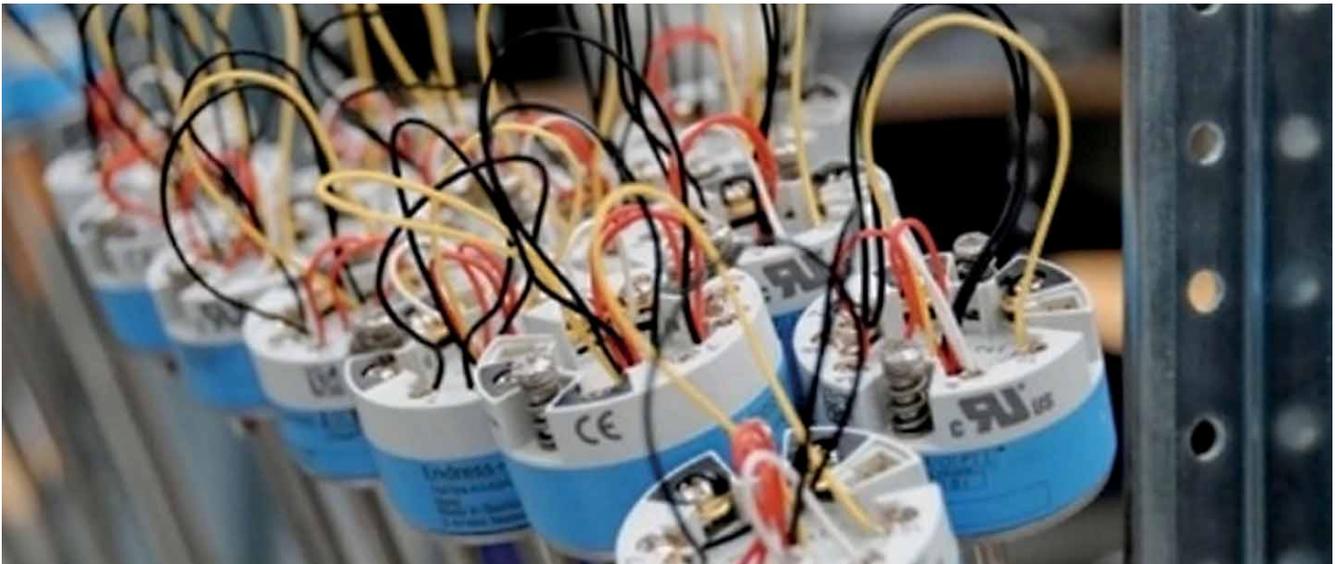
In addition, the measurement accuracy in modern transmitters can be improved by use of a specific 'sensor-transmitter-matching' software. The complete measuring chain consisting of transmitter and sensor is then matched with each other.

On the one hand, the standardized output signal in the process measurement is a 4...20 mA signal, but also the internationally standardized field buses, such as HART®, PROFIBUS® and FOUNDATION™ Fieldbus are used. The HART® protocol serves mainly for a more convenient operation in combination with the 4 to 20 mA analog measured signal. PROFIBUS® and FOUNDATION™ Fieldbus, however, transfer the real measured value digitally and therefore offer cost savings by simplifying the wiring.

The plug-on display TID10 can be used in connection with a TMT82, TMT84 or TMT85 head transmitter. Simply plug it onto the head transmitter and the display will be switched on.

It displays information regarding the actual measured value, the measurement point identification and events of fault in the measurement chain. DIP-switches can be found on the rear of the display. This enables the hardware set-up such as the PROFIBUS® device address. With the optional field housing TA30x the device is suitable for use in the field, even a use for Ex d applications is possible without problems.

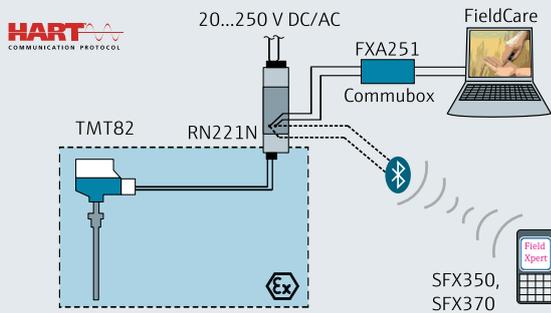




Device configuration

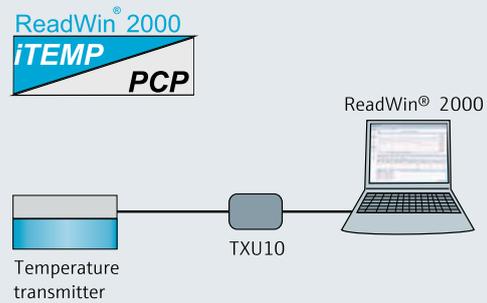
HART®

HART® signal for on-site or centralized device set-up using a hand-held terminal or PC. Operation, visualization and maintenance at the PC using FieldCare, AMS, PDM or ReadWin 2000 software.



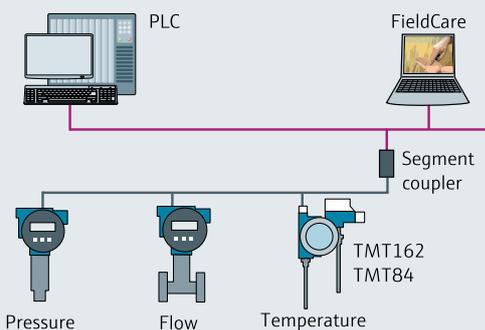
PC programmable (PCP)

Online configuration with SETUP connector and operating software.



Fieldbus

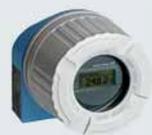
Temperature transmitter for PROFIBUS® PA and FOUNDATION™ Fieldbus enables data exchange and operation using standardized fieldbus protocols.



Endress+Hauser is one of the pioneers in fieldbus technology and plays a worldwide leading role in the application of the HART®, PROFIBUS® DP/PA and FOUNDATION™ fieldbus technology.

- Accredited PROFIBUS® competence center
- Engineering of field bus networks
- System integration checks
- Training courses, seminars
- Customer service
- Endress+Hauser's own fieldbus laboratory

iTEMP temperature transmitters at a glance

Head and DIN rail transmitters					
Typ					
Model	TMT181 TMT121/ TMT111	TMT182 TMT122/ TMT112	TMT82	TMT84	TMT85
Design					
DIN rail					
Special features	PC- interface, universal	HART® interface, SIL2, universal	HART®, 2-channel, back-up, drift, SIL2/3, universal	PROFIBUS® PA, 2-channel, back-up, drift, universal	FOUNDATION™ Fieldbus, 2-channel, back-up, drift, universal
RTD input	Pt50/100/500/1000 Ni100/500/1000 Cu50/100 GOST: Pt50/100, Cu50/100, Polynom RTD	Pt100/500/1000, Ni100/500/1000, Polynom RTD	Pt100/200/500/1000 Ni100/120/1000 Cu10/50/100 (Cu50 for TMT82) GOST: Pt50/100, Cu50/100 (Cu50 for TMT82) Polynom RTD, Callendar/Van Dusen		
TC input	B, C, D, R, S, E, J, K, L, N, T, U (additionally type A for TMT82)				
Ω input	10...2000 Ω				
mV input	-10...100 mV	-10...75 mV	-20...100 mV		
Accuracy (Pt100)	≤ 0.2 K		digital: 0.1 K analog: 0.03% of the set span		
Approvals	ATEX: Ex ia, FM/CSA: IS, UL to 3111-1, Dust-Ex Zone 22, GL ship building approval, GOST, NEPSI		ATEX: Ex ia, FM/CSA: IS, Staub-Ex Zone 22; NEPSI, IEC Ex		
Order number for Technical Information	T100070R/09 T100087R/09 T100135R/09	T100078R/09 T100090R/09 T100114R/09	T101010T/09	T100138R/09	T100134R/09

Field transmitters

Type	  		
Model	TMT162	TMT142	TMT125
Design			
DIN rail			
Special features	Illuminated display, 2-chamber device, 2-channel, back-up, drift, (SIL2/3, NE89 for HART®), with overvoltage protection as option for the HART® version	Illuminated display, rotatable, universal	For up to 8 input channels, universal
RTD input	Pt100/200/500/1000 Ni100/120/1000 Cu10/50/100 GOST: Pt50/100, Cu50/100 (not for TMT142) Polynom RTD, Callendar/Van Dusen		Pt50/100/200/500/ 1000 Ni100/120/200 Cu10
TC input	B, C, D, R, S, E, J, K, L, N, T, U		B, E, J, K, N, R, S, T
Ω input	0 to 2000 Ω		0 to 5200 Ω
mV input	-20 to 100 mV		-100 to 150 mV
Accuracy (Pt100)	digital: 0.1 K analog: 0.02% of the set span	≤ 0.2 K (≤ 0.15 K)	≤ 0.2 K
Approvals	ATEX: Ex ia, Ex d, FM/CSA: IS, XP, DIP, Dust-Ex Zone 21, GL ship building approval, GOST (for HART®), NEPSI, IEC Ex	ATEX: Ex ia Ex d, FM/CSA: IS, XP, DIP, NEPSI, IEC Ex	ATEX: Ex ia, Ex nA, FM: IS NI, NEPSI, IEC Ex
Order number for Technical Information	TI00086R/09	TI00107R/09	TI00131R/09

E-direct transmitters

Model	TMT180	TMT80	TMT187/127	TMT188/128
Design + DIN rail				
Input	RTD: Pt100	RTD: Pt100, 1000 TC: B, K, N, R, S	RTD: Pt100	TC: B, C, D, E, J, K, L, N, R, S, T, U, MoRe5-MoRe41
Accuracy	≤ 0.2 K or 0.08%	RTD: 0.2 K or 0.08% TC Typ K, N: typ. 1.0 K or 0.15% TC Typ S, B, R: typ. 2.0 K or 0.15%	0.2 K or 0.08%	0.2 K or 0.08%
Order number for Technical Information	TI00088R/09	TI00153R/09	TI00076R/09 TI00095R/09	TI00077R/09 TI00096R/09

Compact thermometers

Simple, fast and economical Cost efficiency and optimal use of space indicate modern process measuring technology. Particularly OEM applications require fast delivery times, reliable operation as well as simple assembly and calibration of the measurement technology used.

The compact families completely fulfill these requirements. They are easily commissioned, measure reliably, and when required convert into standard signals and alert at alarm limit violation.

- Precise primary sensors, long-term stable electronics.
- Robust construction in stainless steel, compatible connection technology.
- Versatile process adapters, flexible sensor lengths.
- Simplest assembly as well as on-site and PC parameter set-up.
- Patented sensor concept

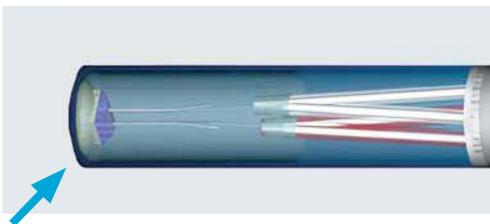
Output signals Direct access to the primary signal using highgrade cables in 3- or 4-wire connection or 4...20 mA access at the standard connection socket – all selectable.

The electronics The dimensions of the freely programmable measurement PCB in the Easytemp TMR31 are only 40 x 18 mm. The Thermophant TTR31 can be set up using push buttons and switches in the case of an alarm limit violation.



The process connections Stainless steel compression fittings, inch and metric threads ensure complete compatibility. Hygienic process adapters and thermowells fulfill the EHEDG-, 3A- and FDA requirements.

The sensors Vibration-proof integrated thin-film Pt100 sensors guarantee the highest operational security at the fastest response times.



Fast response sensor:
Thin film RTD with optimized thermal contact

Temperature switch
Thermophant TTR31



Compact thermometer
Easytemp TMR31 -
with electronics and large
immersion length



Cable probes and compact thermometers overview

Type	Cable probes metric style and US-style					Compact thermometer metric style and US-style		
Model	TST310	TSC310	TH12	TH52	TH56	TTR31/TTR35 (E-direct)	TMR31/TMR35 (E-direct)	TM371/TM372
Design								
Special features	Compact thermometer with non-detachable cable for plug-in or screw-in connection		Compact RTD resistance thermometer with non-detachable cable for plug-in or screw-in connection	Compact TC thermometer with non-detachable cable (TH52) or plug (TH56) for plug-in or screw-in connection		Temperature switch with 1/2 PNP switching outputs, 4 to 20 mA	Compact thermometer with integrated transmitter. Short immersion length, very fast response times	Compact thermometer for hygienic and aseptic applications. Outstanding sensor technology with self-calibrating function, HART®-Protocol
Approvals	ATEX Ex ia, ATEX Ex nA, IECEx Ga Ex ia, NEPSI Ex ia			-		UL 61010B-1 and CSA C22.2 No. 1010.1-92	UL as per 3111-1, GL	EHEDG, ASME BPE, FDA, 3-A, EC 1935/2004, EC 2023/2006, EU 10/2011 - CE/EAC, CRN, CSA General purpose
Principle	RTD	TC	RTD	TC		RTD		
Measurement range	-50 to +400 °C	Type J: -40 to +750 °C Type K: -40 to +1100 °C	-50 to +200 °C (-58 to +392 °F)	Type J: -346 to +1330 °F (-210 to +720 °C) Type K: -454 to +2100 °F (-270 to +1150 °C)		-50 to +150 °C (-58 to +302 °F)	-50 to +200 °C (-58 to +392 °F)	-40 to +160 °C (-40 to +320 °F)
Process pressure	≤ 100 bar (dependent on process connection)							
Material	1.4404	1.4404, 2.4816	SS316L			1.4404		316L, 1.4435+316L, Delta Ferrit <1%
Order number for Technical Information	TI00085T/09 TI00255T/09		TI00108R/09	TI00111R/09		TI00105R/09	TI00123R/09	TI01292T/09



Monitoring of a supply pipework using compact thermometers and temperature switches

iTHERM TrustSens

World's first self-calibrating thermometer

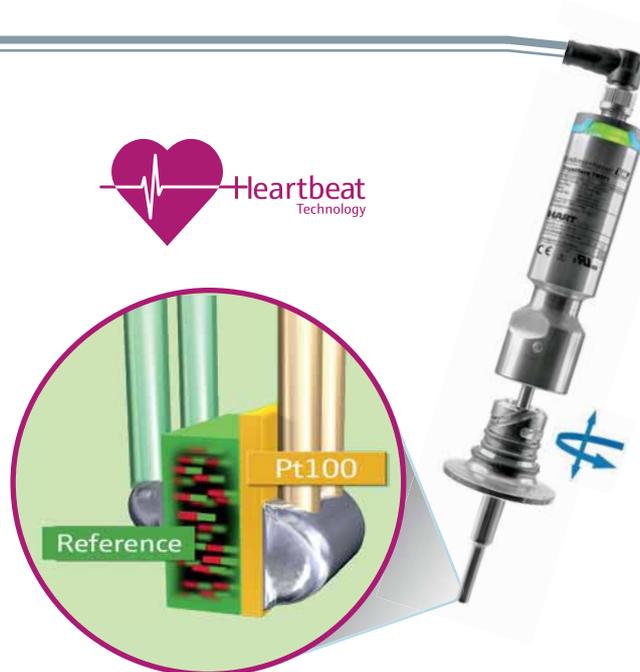
100% compliance – 0% complexity

The new iTHERM TrustSens TM371 and TM372 enable continuous, traceable monitoring thanks to the fully automated inline self-calibration function without process interruption. This results in high product safety, increases plant availability and helps reduce risk and costs. The hygienic thermometer is designed for users in the pharmaceutical and food & beverage industries who require absolute compliance with FDA and/or GMP regulations.

At the heart of the temperature probe is a unique sensor unit consisting of a primary Pt100 temperature sensor and a highly accurate, integrated reference with long-term stability. The reference sensor uses a physical fixed point on the basis of the Curie temperature and therefore serves to regularly calibrate the primary sensor. The self-calibration is triggered fully automatically at a temperature of 118 °C (Curie point of the integrated reference), a process typically occurring during each steam sterilization (SIP) of the plant. This ensures that the constantly high measuring accuracy of the temperature sensor is permanently monitored throughout its entire life cycle.

"Heartbeat Technology" in temperature measurement

The integrated smart electronics feature varied diagnostics functions, which are categorized in line with the NE 107 NAMUR recommendation and transmitted via HART® communication. Furthermore, status signals are indicated locally by means of the LED integrated in the device. In addition to the automated calibration, and therefore verification of the thermometer's measuring accuracy, data from the last 350 calibrations is stored directly in the device (FIFO memory). This makes it possible to access a long device and process history, which can be used as the basis for predictions and the early determination of trends. These features guarantee continuous, fully autonomous device self-diagnostics. The iTHERM TrustSens is therefore ready for Industry 4.0 applications.



i iTHERM QuickNeck

Removable neck tube with quick fastener:

- Tool-free removal of the thermometer
- IP69K protection

✓ Documentation

- Built-in memory for 350 calibration points
- FieldCare by Endress+Hauser makes issuing calibration certificates possible at any time
- The automatically generated documentation is 100% audit-proof

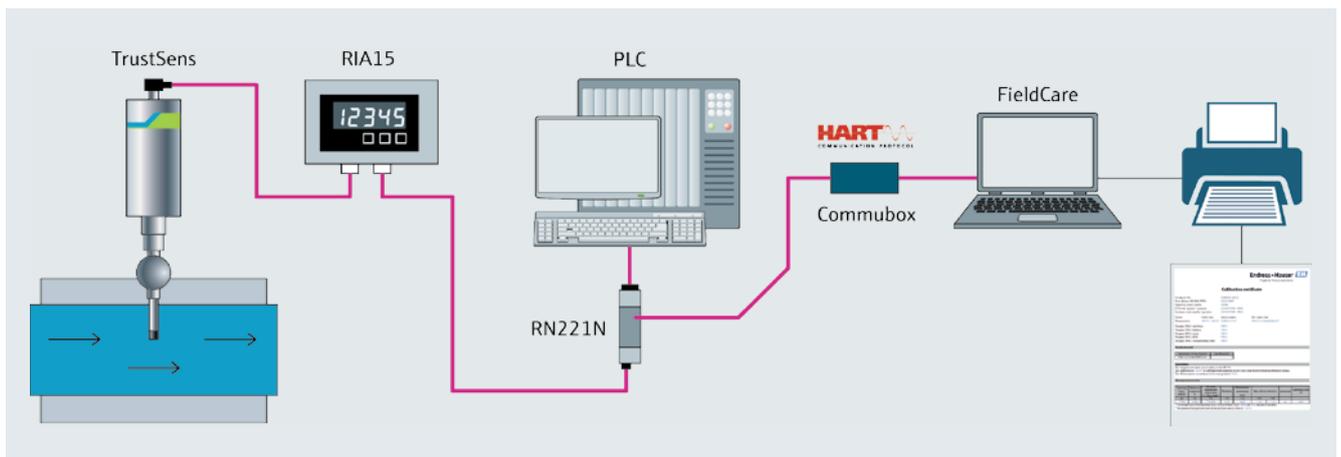
Self-calibration with TrustSens

- **Self-check:** TrustSens features a built-in reference sensor that cyclically monitors the primary Pt100 temperature sensor during the active process.
- **Operation:** The process is not interrupted. Maintenance personnel is only required when the sensor reports a malfunction.
- **Reference measurement:** The reference sensor uses the fixed Curie temperature point at 118 °C (239 °F) to trigger a self-calibration. This typically occurs for example during a steam cleaning cycle.



For more information please visit www.endress.com/trustsens

Integrated product and service offering



Data Management Memograph M RSG45	<ul style="list-style-type: none"> ▪ Tamper-proof data storage and access (FDA 21 CFR 11) in combination with FDM Software MS20, Field Data Manager Software by Endress+Hauser ▪ HART® gateway functionality; Up to 40 HART® devices connected at a time ▪ Communication capabilities: Modbus, PROFIBUS DP, PROFINET, EtherNet/IP
Display unit RIA15	<ul style="list-style-type: none"> ▪ Display of 4 to 20 mA measured values or HART® process variables ▪ The RIA15 can be used to display TrustSens values such as: temperature, electronic temperature, calibration counter, calibration offset ▪ Loop-powered; Voltage drop ≤ 1 V (HART® ≤ 1.9 V)
Field Data Manager Software MS20	<ul style="list-style-type: none"> ▪ Automatic service for report generation, printing reports, read out of data, storing of data, secure export, pdf generation ▪ Create reports and templates ▪ Read out measured data via online interface or from mass storage ▪ Online visualization of instantaneous values ("live data")
Commubox TXU10 Commubox FXA195	<p>Quick and easy link between TrustSens and PC via USB interface for fast device configuration</p> <p>Intrinsically safe HART® communication with FieldCare via USB interface</p>
Endress+Hauser Service	<ul style="list-style-type: none"> ▪ Commissioning service ensures optimal startup and reliable base for future self-checks ▪ Technical experts are always on call to support with product queries

✓ Advantages at a glance

- Maximized process safety through self-calibration and Heartbeat Technology
- No production downtime due to fully automated and traceable inline self-calibration
- Fully automated documentation - audit-proof
- Highest measuring accuracy through characteristic adjustment (Sensor-Transmitter Matching)
- International certifications and approvals: EHEDG, ASME BPE, FDA, 3-A, 1935/2004, 2023/2006, 10/2011, CE, CRN, CSA General Purpose
- Measuring range: -40 to $+160$ °C (-40 to $+320$ °F)
- More than 50 sterile and hygienic process connections as standard

Industry applications:

- Life Sciences
- Food & Beverage

Modular industrial thermometers

Endress+Hauser offers a broad portfolio of temperature measurement technology for comprehensive solutions for almost all branches of industry. The measurement principles used are RTD resistance sensors and thermocouples. Important points for the inclusion of the measurement point into the process are the protection of the thermometers through thermowells and the process connection.

These thermometers are mainly used in the chemical industry, but they also find their use in other areas of the process industry, both in core as well as peripheral processes.

Type	Metric design								
Model	TR10	TR11	TR12	TR13	TR15	TR88	TC10	TC12	TC13
Design									
Thermowell armature	Thermowell, thread with neck	Thermowell, thread without neck	Thermowell, compression fitting	Thermowell, flange with neck	Weld-in thermowell, flange with neck	Without thermowell, thread with neck	Thermowell, thread with neck	Thermowell, compression fitting	Thermowell, flange with neck
Measurement insert	MgO-sheathing, exchangeable; diameter: 6 mm, 3 mm								
Sensor measurement range	RTD: -200 to +600 °C						TC: Type J, Type K 0 to +1100 °C		
Ex approvals	ATEX I GD Ex ia ATEX 1/2 GD Ex ia, Ex nA IECEx Ga/Gb Ex ia NEPSI Ex ia								
Process connection	Thread		Compression fitting	Flange according to DIN and ANSI	Flange according to DIN and ANSI or for welding	Threaded connection to existing thermowell	Thread	Compression fitting	Flange according to DIN and ANSI
Thermowell	Fabricated thermowell out of tubing with welded tip				Drilled barstock thermowell	-	Fabricated thermowell out of tubing with welded tip		
Thermowell material	1.4435, 1.4571, 2.4819, 1.4816					-	1.4435, 1.4571, 2.4819, 1.4816		
Order number for Technical Information	T100256 T/09	T1257 T/02	T101118 T/09	T101097 T/09	T101100 T/09	T101098 T/09	T1274 T/02	T101118 T/09	T101097 T/09



Metric design		Imperial design							
TC15	TC88	TH11	TH13	TH14	TH15	TH51	TH53	TH54	TH55
									
Weld-in thermowell, flange with neck	Without thermowell, thread with neck	Without thermowell, with nipple	Thermowell, with nipple	Thermowell, with nipple, flange	Without thermowell, with nipple		Thermowell, with nipple	Thermowell, with nipple, flange	Without thermowell, with nipple
MgO-sheathing, exchangeable; diameter: 6 mm, 3 mm		MgO-sheathing, exchangeable; diameter: 6 mm							
TC: Type J, Type K 0 to +1100 °C		RTD: -328 to 1112 °F (-200 to +600 °C)				TC: Type J, Type K, Type E, Type N, Type T -330 to +1600 °F (-200 to +870 °C)			
ATEX I GD Ex ia ATEX 1/2 GD Ex ia, Ex nA IECEX Ga/Gb Ex ia NEPSI Ex ia		-	CSA (IS, NI)			-	CSA (IS, NI)		
Flange according to DIN and ANSI or for welding	Threaded connection to existing thermowell	Thread or compression fitting, fixed or movable	Thread or for welding	Flange according to ANSI	Threaded connection to existing thermowell	Thread or compression fitting, fixed or movable	Thread or for welding	Flange according to ANSI	Threaded connection to existing thermowell
Drilled barstock thermowell	-	-	Drilled barstock thermowell		-	-	Drilled barstock thermowell		-
1.4435, 1.4571, 2.4819, 1.4816	-	-	SS316 or Alloy 600		-	-	SS316L, Alloy 600, Alloy C276, Titan, Alloy 400		-
TI01100 T/09	TI01098 T/09	TI00108 R/09	TI00110R/24			TI00111 R/09	TI00112R/09		

Modular heavy duty thermometers

The Oil & Gas industry is divided into the areas, “Up-stream – exploration and support”, “Mid-stream – transportation” and “Downstream – processing”. Different, very high requirements are made in these areas on the measurement technology used.



Requirements at a glance



with display

Terminal head/Communication

Field transmitter with display in 316L stainless steel for off-shore applications

Terminal head with screw cap (aluminum or stainless steel)

PC-programmable, with HART® protocol, PROFIBUS® PA or FOUNDATION™ Fieldbus

Neck/Extension

Coupling piece with integrated flame path barrier, Nipple-Union-Nipple (NUN)

Process connection

Flange according to ASME/ANSI, “full penetration welding”, “Greylock” connections, weld-in connections

Process wetted parts/thermowell

Process wetted parts in stainless steel: 316L / 1.4404, 316Ti / 1.4571 or Alloy C276 / 2.4819; barstock material for highest process pressures



without display

Heavy Duty Product Overview

Type	Metric design						Imperial design		
Model	TR61/TC61	TR62/TC62	TR63/TC63	TR65/TC65	TR66/TC66	TMT162R/C, TMT142R/C	T13/T53	T14/T54	T15/T55
Design									
Special features	Fabricated thermowell	For screwing into an existing thermowell	Fabricated thermowell with flange	Without thermowell - direct medium contact	Barstock thermowell	Fabricated or barstock thermowell, with field transmitter TMT162 (2-channel) or TMT142 (1-channel)	Stepped thermowell and spring loaded measurement insert	Fabricated thermowell with flange and spring loaded measurement insert	For screwing into an existing thermowell
Approvals	ATEX Ex d, ATEX Ex ia, IECEx						FM/CSA XP Class 1, Div. 1		
Measurement principle	RTD, TC: Type J or K						RTD, TC: Type J, Type K, Type E, Type N, Type T		
Measurement range	RTD: -328 to 1112 °F (-200 to +600 °C) TC: -40 to 2012 °F (-40 to +1100 °C)						RTD: -58 to +392 °F (-50 to +200 °C) TC: -328 to +1600 °F (-200 to +870 °C)		
Process pressure	≤ 100 bar	Dependent on thermowell	≤ 80 bar	≤ 100 bar	≤ 480 bar	dependent on process connection			
Material	1.4404/SS316L; 1.4571/SS316Ti; 2.4819/Alloy C276	Dependent on thermowell	1.4404/SS316L; 1.4749/SS446; 2.4816/Alloy 600	1.4404/SS316L	Wetted parts 1.4404/SS316L; 1.4749/SS446; 2.4819/Alloy C276 Alloy 400 2.4816/Alloy 600		1.4404/SS316L, 2.4816/Alloy 600, 2.4819/Alloy C276, Titanium, Alloy 400	Dependent on thermowell	
Process connection	Thread, compression fitting, flange	Thread	Thread, compression fitting, flange	Thread, compression fitting	Thread, flange		Thread, welded connection	Flange	Thread
Output signal	4 to 20 mA, HART®, PROFIBUS® PA, FOUNDATION™ Fieldbus						4 to 20 mA, HART®, PROFIBUS® PA, FOUNDATION™ Fieldbus		
Order number for Technical Information	TR61, TC61: TI01029T	TR62, TC62: TI01024T	TR63, TC63: TI01030T	TR65, TC65: TI01031T	TR66, TC66: TI01032T	TMT162R: TI266T/02 TMT162C: TI267T/02 TMT142R: TI128R/09 TMT142C: TI129R/09	T13, T14, T15: TI00126R/09 T53, T54, T55: TI00127R/09		

Approvals/certificates/tests

- **NACE (MR0175):** Suitability test of materials for acid gas surroundings by approval test EN 10204, 3.1 listed in the NACE standard MR0175.
- **Dye penetrant testing:** Dye penetrant testing according to the ASME V and ASME VIII guidelines.
- **X-ray test certificate:** X-ray test certificate for thermowell welding seams in accordance with ASME V – ASME VIII.
- **Thermowell calculation:** Thermowell calculation according to ASME PTC 19.3 using customer specific pressure, temperature and flow rate values.
- **Helium leakage test:** Sealing tightness test.
- **Pressure test:** Thermowell internal and external pressure test according to PED (Pressure Equipment Directive) in Europe or CRN (Canadian Registration Number) in North- and Central America.

Modular hygienic thermometers

The innovative iTHERM thermometers of the new, modular hygienic line have been designed to meet the requirements of the Food & Life Sciences industries and comply with highest quality standards.

For the first time a comprehensive, global product portfolio with a large selection of process connections, transmitters and further constructive variants is offered. All products - both metric and imperial - are available with the relevant international approvals.

The product choice is very simple:

- A consistent segmentation into **2 product structures** for **basic** (TM40x) and **advanced technology** (TM41x) supports the preselection of the suitable thermometer
- Support from a cost-free, graphical product configurator with integrated knowledge data base

All this saves time and costs and increases the planning security – misorders are practically impossible.

	Basic technology	Advanced technology
Device configuration	TM401 metric	TM411 metric
Insert	Not replaceable	Replaceable
Transmitter	1-channel; no display	1- or 2-channel; plug-on display (optional)
Ex-certificate	No	Yes (ATEX, IEC, FM, CSA, NEPSI)
Sensor	1x Pt100 standard thin film sensor	1x Pt100 standard thin film sensor, 1x Pt100 iTHERM QuickSens or StrongSens, 1x or 2x Pt100 wire wound
Extension neck	Standard	Standard, optional iTHERM QuickNeck

iTEMP Transmitter
Accurate and reliable measured value transmission

iTHERM QuickSens
Shortest response times worldwide:

- Fast, high-precision measurements
- Minimization of the needed insertion length
- Use of thermowells without affecting the measuring performance

iTHERM StrongSens
Unmatched robustness:

- Vibration resistance > 60g
- Automated, traceable production

iTHERM TA30R
Stainless steel terminal head:

- Optimal access to the terminals due to a low housing edge
- Optional display
- Protection class IP69K

iTHERM QuickNeck
Divisible neck with quick release:

- Removal of the insert without tools
- Protection class IP69K

A3
CERTIFIED
CHEDG
TYPE EL - CLASS I
FDA
ASME
SETTING THE STANDARD
1880 - 2005
Bioprocessing Equipment
STANDARDS COMMITTEE

Product overview modular hygienic thermometer

Type	Metric design		Imperial design	
Model	TM401 (E-direct)	TM411	TM402	TM412
Design				
Special feature	Basic technology	Advanced technology	Basic technology	Advanced technology
Certificates, compliance	EHEDG, 3-A, ASME BPE, FDA, TSE (produced without the use of animal fats)			
Measuring principle	RTD			
Measuring range	-50 to +200 °C (-58 to +392 °F)	-200 to +600 °C (-328 to +1112 °F)	-50 to +200 °C (-58 to +392 °F)	-200 to +600 °C (-328 to +1112 °F)
Process pressure	≤ 40 bar depending on process connection			
Material and surface finish	316L, Ra < 0.76 µm or < 0.38 µm	316L or 1.4435+316L, delta ferrite < 1%, Ra < 0.76 µm or < 0.38 µm; electropolished optional	316L, Ra < 0.76 µm or < 0.38 µm	316L or 1.4435+316L, delta ferrite < 1%, Ra < 0.76 µm or < 0.38 µm; electropolished optional
Response time	t ₉₀ : 7 s	t ₉₀ : 1.5 s	t ₉₀ : 9 s	t ₉₀ : 1.5 s
Process connection	Clamp as per ISO 2852, DIN 11851, DIN 11864-1, metallic sealing system, weld-in adapter, APV inline, Varivent®, Ingold fitting, SMS 1147, compression fitting; Additionally for TM41x: Neumo BioControl as well as T pipe section and corner pipe section as per DIN 11865			
Output signal	Pt100 3/4-wire; 1-channel iTEMP transmitter (4 to 20 mA; HART®)	Pt100 3/4-wire; 1-channel or 2-channel iTEMP transmitter (4 to 20 mA; HART®, FF, PA)	Pt100 3/4-wire; 1-channel iTEMP transmitter (4 to 20 mA; HART®)	Pt100 3/4-wire; 1-channel or 2-channel iTEMP transmitter (4 to 20 mA; HART®, FF, PA)
Order number for detailed technical information	TI01058T/09	TI01038T/09	TI01349T/09	TI01348T/09

E+H = °C Innovative temperature measurement

✓ Benefits at a glance

- Global portfolio (metric/imperial) with international certificates
- User friendliness and security from product choice to maintenance
- iTHERM inserts: automated production - worldwide unique. Complete traceability and constantly high product quality for reliable measurement values
- iTHERM QuickSens: shortest response times (t₉₀: 1.5 s) for optimal process control
- iTHERM StrongSens: unmatched vibration resistance (> 60g) for highest plant safety
- iTHERM QuickNeck: cost and time savings through toolfree, easy recalibration
- iTHERM TA30R: terminal head from 316L with improved handling for reduced installation and maintenance costs and highest protection class IP69K
- More than 50 hygienic process connections

Next level hygienic

Temperature measurement and system products

In this section you'll find a complete overview of the industry package and its application fit. Use this selection guide for selecting the right product according to your process requirements and challenges.

Temperature measurement technology				
Product	iTHERM TrustSens TM37x	iTHERM TM41x	iTHERM TM40x	EasytempTMR35
Design				
Calibration	■ ■ ■	■ ■	■	■
Response times	■	■ ■ ■	■	■ ■ ■
Communication 4 to 20 mA	✓	✓	✓	✓
HART	✓	✓	✓	-
PROFIBUS	-	✓	-	-
FOUNDATION fieldbus	-	✓	-	-
Ex	-	✓	-	-
Special feature	Self-calibration Heartbeat Technology	iTHERM QuickNeck iTHERM QuickSens iTHERM StrongSens	Cost/performance ratio	Compact dimensions Cost/performance ratio



System products

Product	Memograph M RSG45	Ecograph T RSG35	RMA42	RIA15	RIA14/16
Design					
Inputs	20 universal/HART®	12 universal	2 universal	-	-
Display	7" TFT	5.7" TFT	5-digit, 7-segment illuminated display	17 mm, 5-digit, 7-segment	26 mm, 5-digit, 7-segment
Data recording	✓	✓	-	-	-
Power supply	✓	✓	✓	Loop	Loop
4 to 20 mA communication	✓	✓	✓	✓	✓
HART	✓	-	-	✓	-
PROFINET	✓	-	-	-	-
EtherNet/IP	✓	-	-	-	-
Modbus	✓	✓	-	-	-



High temperature thermometers

In glass smelters, flue gas applications and in the brick and ceramics industries temperatures up to 1700 °C can occur. This requires special thermometers with ceramic thermowells and thermocouples made from special metals, such as platinum and rhodium.

The ceramic thermowell external and sandwich coatings act as diffusion barriers. They serve as protection of the measurement point from mechanical and chemical damages in the process, e.g. from abrasive gases.

The ceramic thermowell inner sheath is the ceramic capillary.

It has the purpose of feeding and insulating the thermo wires. A higher number of ceramic protection coatings increases the life time of the measurement point.

Influences on the life time are:

- Ceramic thermowell material and temperature limit values
- Temperature shocks in the process
- Gases and vapors
- Reducing and neutral atmospheres



High temperature measurement in cement production - with remote mounted head transmitter

Requirements at a glance



Terminal head

Form A terminal head
Form B terminal head

Process connection

Gas tight compression fitting, adjustable flange or flat face flange according to DIN 43734

Process wetted parts/thermowell

Ceramic thermowell - external and dividing coating as diffusion barrier,
Ceramic thermowell - internal coating as thermo wire feeder and insulation

Sensor/measurement insert

Thermocouples type J, K or type B, S, R for application at high temperatures, with ceramic or mineral coating



The diameter of the thermo wires for thermometers in the TAF series must be defined for high temperatures. The higher the process temperature is, the larger the thermowire diameter has to be chosen.

Product overview high temperature thermometers

Model	TAF11	TAF12S	TAF12D	TAF12T	TAF16
Design					
Special features	Temperature measurement in glass or ceramic furnaces. With thermowell and internal sheath made of ceramic	Temperature measurement in glass or ceramic furnaces. With ceramic thermowell	Temperature measurement in glass or ceramic furnaces. With thermowell and internal sheath made of ceramic	Temperature measurement in glass or ceramic furnaces. With thermowell and two internal sheaths made of ceramic	Temperature measurement in metal and cement industries or incinerators. With metal or ceramic thermowell, internal ceramic sheath
Measurement principle	1x or 2x TC				
Measurement range	Type B: 0 to +1820 °C Type J: -210 to +1200 °C Type K: -270 to +1300 °C Type N: -270 to +1300 °C Type S: -50 to +1768 °C Type R: -50 to +1768 °C		Type B: 0 to +1820 °C Type S: -50 to +1768 °C Type R: -50 to +1768 °C		Type J: -210 to +1200 °C Type K: -270 to +1300 °C Type N: -270 to +1300 °C Type S: -50 to +1768 °C
Max. immersion length/ diameter (mm)	1700 14, 16, 17, 22 24, 26,6	1500 9	1500 14, 15	1500 24, 26	2200 14, 15, 17,2, 18, 21,3, 26,7
Material:					
Thermowell	Ceramic C610, sinterized silicon carbide (SiC), special silicon nitride ceramic (SiN)	Ceramic C610, C799		Ceramic C530, C610, C799	AISI: 316L, 310, 304, 446, Alloy 600, Alloy 601; Alloy 800HT, Alloy C276, Kanthal AF and Kanthal Super, special nickel/cobalt alloy (NiCo), special silicon nitride ceramic (SiN)
Intermediate sheath	without	without	without	Ceramic C610, C799	without
Internal sheath	Ceramic C610	without	Ceramic C610, C799		
Process connection	Adjustable flange, gas tight compression fitting or stop flange according to DIN 50446				
Order number for Technical Information	TI00251T/09				

Materials

Among a various number of industry standard materials, e. g. ceramics as C530, C610 and C799 or metals like AISI 316L, 310, 304, 446, Alloy 600, Alloy 601, Alloy 800HT or Alloy C276, Kanthal AF and Kanthal Super Endress+Hauser offers exclusive special materials for high temperature measurement.

For further information concerning special materials please contact your Endress+Hauser sales representative.

Benefits at a glance

These exclusive special materials increase the life span of the sensors. This leads to:

- Cost savings for maintenance of the measuring point
- Quality improvements of the products
- Increased plant safety

The thermometer lines TAF11 and TAF16 have a modular design. The measurement inserts and thermowells can be ordered as spare parts via a standard order structure.

This saves costs,

- as only actually defective parts need to be exchanged
- due to optimized stock keeping

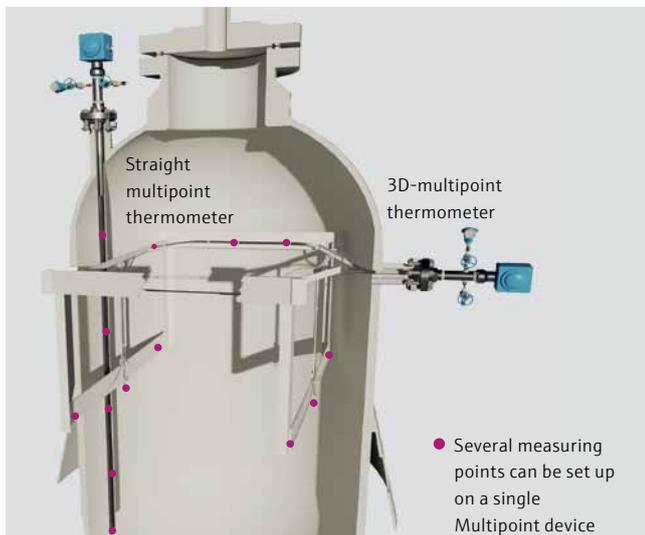
Temperature engineered solutions

Temperature engineered solutions comprise standardized and customer-specific devices that are developed for special and demanding applications, for example, Multipoint, SkinPoint (contactor sensor) and high temperature thermometers, as well as accessories such as thermowells and guiding brackets.

Temperature engineered solutions - including tests, accessories and service - are planned and executed specifically with the aim of satisfying challenging customer requirements. We use specific requirements, e.g. process data and approved documentation such as drawings and calculations, as the basis for our solutions.

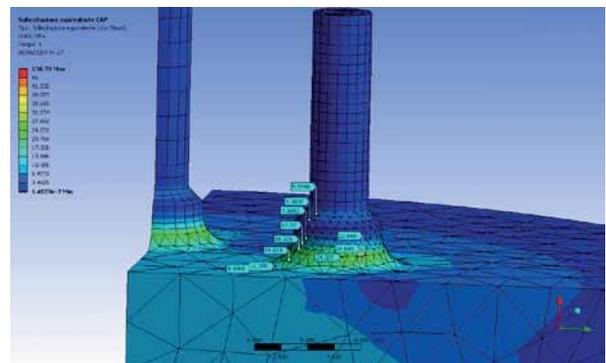
Temperature measurement in process reactors

Engineering services Endress+Hauser is a provider of technical solutions - therefore it is a matter of course that not only complete thermometers are provided but also the necessary engineering is implemented. "State-of-the-art" methods are used for engineering the solution e.g. the Finite Elements method, 3D-CAD models, etc.



The Endress+Hauser specialists also offer on-site supervision or installation in order to manage teams and lead to a correct installation. This ensures that experts are available from the beginning of the project up to start-up.

Moreover, Endress+Hauser offers support in the internal reactor design e.g. the engineering of the support options within the reactor. When engineering these support structures it is important that no channeling occurs which would lead to deterioration in the reactor performance. The necessary engineering information is obtained through onsite customer visits where the best solution is developed in cooperation with the process engineers.



Test of a diagnostic chamber

Diagnostic chamber concept

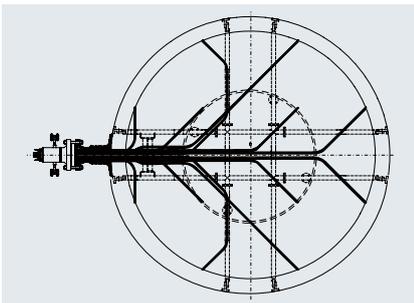
The diagnostic chamber is a very important component of some TES products, like TMS02 and TMS12, which allows to monitor continuously, through pressure and/or gas analysis, the complete product life cycle, enabling proactive maintenance strategies and safety monitoring.

✓ Advantages at a glance

- Defective thermocouples can be replaced without switching off the process
- Increased safety thanks to a diagnostic chamber able to contain the process in the event of leakages through the primary seals (PED certified chamber)

Multipoint assemblies iTHERM MultiSens

Multipoint assemblies are standard or customized products for several applications from low to high pressure process reactors. In these applications a temperature profile for control of the process in the reactor is measured and recorded. The challenge is to be less invasive as possible and to have an high number of temperature probes, enabling the shortest response time. Material selection, mechanical design and construction technics are the latest state-of-the-art in terms of product optimization, positioning Endress+Hauser as a global supplier continuously focused on reliable innovation.



Measurement point positioning in a process reactor (top view)



Multipoint connection flange

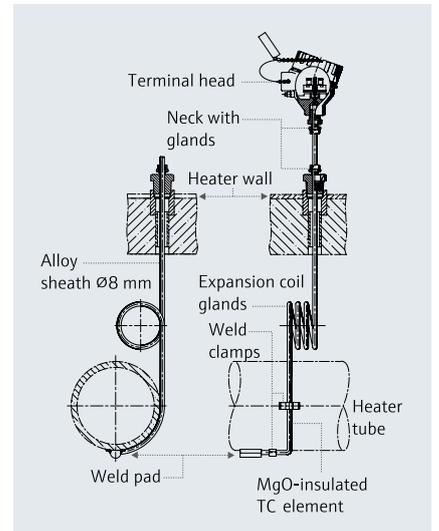


Installation of a multipoint assembly

SkinPoint thermocouples



Surface temperature measurement may be requested by industrial processes when hot surfaces of reactors or pipes have to be monitored and invasion into the pipe or reactor must be avoided. Coil furnaces and reactors are the typical chemical and petrochemical plant equipment where SkinPoints are installed. Continuous temperature detection and heat exchange monitoring of the process medium flowing through pipe bundles, without affecting the stream's steadiness, is fundamental to guarantee the whole process efficiency and to check for deposit rates within the pipes that affect the quality of the products. High temperatures, the existence of aggressive burning gases and differential expansions of the heat exchanger pipe bundles are very demanding conditions.



Approvals and certificates

High standards at the engineering design stages and different tests during the production as well as final tests and controls counteract an early wear and tear failure of the equipment.



Qualified electric arc welding



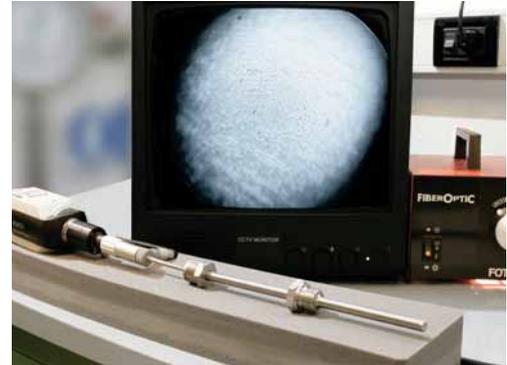
Diagnostic chamber, PED approval (2014/68/VE)

Test center

Extensive measurement and test equipment are available for safeguarding the quality and continuous optimization of the thermometer, thermowell and transmitters.

Here, for example, the quality of welding and soldered connections are visually tested with micro- and endo- scope and by X-ray examination.

Using dye penetration tests, ultrasound test, helium leakage test, pressure endurance test, insulation and vibration checks as well as various, non-destructive material tests the quality of materials and processing is proven.



Positive material identification (PMI) and optical quality control

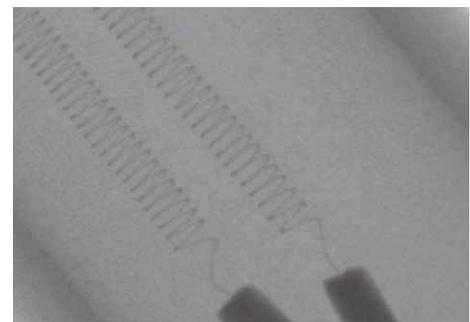


Performance test at 900 °C in a furnace and hydrostatic pressure test

The response time of measurement insert with and without thermowell is measured and tested in a water velocity test installation according to VDI/VDE 3522 or IEC EN 60751.



Checking the sensor response time in a water velocity test unit



Wire spiral of a wire wound sensor with approx. 20 µm wire diameter

Smallest details up to 1 µm in thermometers can be recognized with precise X-ray equipment without having to open it or to destroy it.

Calibration and approvals



Accredited calibration laboratory according to ISO 17025

With their know-how and excellent equipment (high stable temperature baths and furnaces, fixed point cells, precision thermometers) the accredited calibration laboratories realize calibration of thermometers to the lowest possible measurement uncertainty and traceable to national standards and the ITS90 international temperature scale:

- Fixed point calibration at the water triple point cell (0.01 °C) and the ice point (0.0 °C) with a measurement uncertainty of < 5 mK and at the nitrogen fixed point of -196 °C.
- Comparison calibration of resistance thermometers and thermocouples with precision thermometers from -80 to +400 °C in very homogenous and stable calibration baths (measurement uncertainty 20 to 100 mK) and up to 1500 °C in calibration furnaces with a measurement uncertainty of ≤ 500 mK.
- High precision resistance measurements (1 ppm accuracy) and thermo voltage measurements (sub-μV accuracy).
- Sensor-transmitter-matching for additional reduction of the thermometer measurement uncertainty.



Water triple point cell



ITS90 calibrated, SPRT (Standard Platinum Resistance Thermometer) reference thermometer



Ice bath zero point calibration

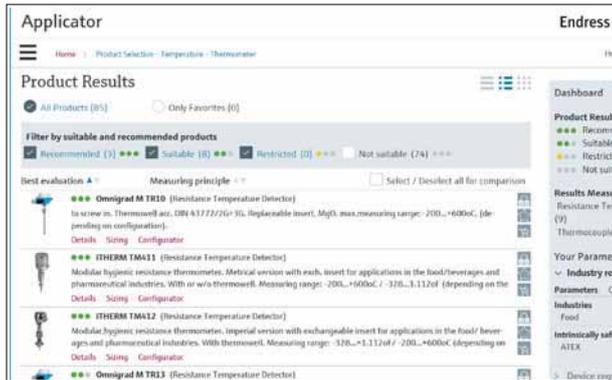


Certificates issued:

- Detailed works or Accredia-/DAkkS calibration certificates with measurement results according to ISO 17025, calibrating uncertainties according to GUM or DIN V ENV 13005 and identification curve approximations like Callendar/Van Dusen coefficients
- Testimonials in accordance with paragraph 3.1 EN 10204 regarding material compositions (if necessary with smelt composition), surface roughness and ferrite content

Planning, commissioning and maintenance tools

Temperature measurement technology is the oldest measuring principle with an correspondingly long history. Over the years more than 50 important standards to be observed by process industries have established themselves worldwide. Through these standards the individual components of a temperature measurement point such as the measurement insert, thermowell, terminal head, transmitter etc. are easily defined. With modern software tools it is possible today to manage the complexity and easily design the suitable thermometer for the right application.



Selection

Applicator selection

During the planning of measurement points the course is set right at the beginning, in the basic engineering phase. An optimally designed thermometer has many advantages:

- Reliable and accurate measured values
- Low risk of later device failures
- Constant process quality

For the choice of the suitable thermometer the most important parameters such as medium, pressure and temperature are requested in the Applicator Selection. With these details the tool makes an initial suggestion which can then be filtered further. The suggested device type technical data can be compared in a table. The result is a thermometer type which, on the one hand, meets all requirements but, on the other hand, is also not technically over dimensioned.

The efficient choice of a suitable thermometer saves engineering time and cost.

Configuration

Configurator

When configuring a measurement point numerous standards and guidelines must be taken into account. This software supports the necessary detailed engineering:

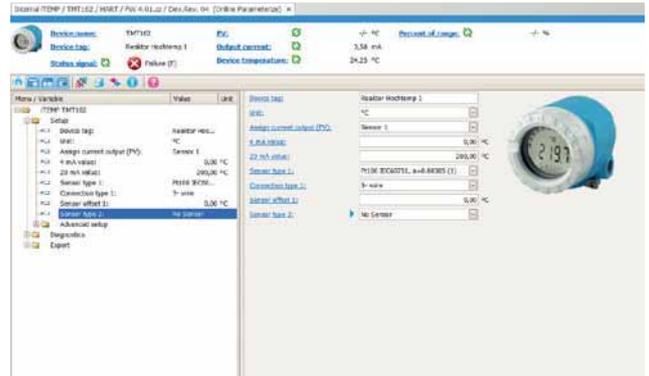
- Avoids time consuming catalog research.
- Automatically delivers the correct order code.
- Increases the engineering productivity.

The Configurator is a software which supports the configuration of the selected thermometer type by illustrations and a knowledge database in detail.

Not only all worldwide standards are deposited in the knowledge database for temperature measurement technology but also background information about the process industries, such as explosion protection and hygienic processes. The Configurator therefore leads to an ordering structure and increases the quality of the detail engineering.



Further information can be found under:
www.endress.com/applicator



Production

Common Equipment Record

When ordering a thermometer the result of the engineering is submitted to Endress+Hauser in form of an order structure. The associated data is not lost but is saved electronically as a birth certificate at the production of the thermometer. This database is called the “Common Equipment Record” and in turn is available to the customer for the complete life cycle of the thermometer.

This function is part of the Web supported Asset Management (W@M) software from Endress+Hauser. The customer can load all data to the device from the Internet and therefore optimize his own asset management. This is becoming more and more important in the process industries because, by optimizing supplies, considerable cost savings can be made in the life cycle of a production plant.

Therefore, in addition to the order details, the thermometer serial number and, if required, a measurement point identifier (TAG), calibration details and test certificates can be placed into the “Common Equipment Record”. Since the customer can access all this data during operation:

- Access to information on the measurement point is easy.
- Spare parts are quickly found during the operation phase.
- Down time is minimized.

Set-up

FieldCare and DeviceCare

For the operation and maintenance of field devices completely new prospects open up for the use of globally standardized “Field Device Technology” (FDT).

With the assistance of “Device Type Managers” (DTM):

- all commonly used field devices,
- independent from manufacturer,
- can be set up using an operating software.

The software FieldCare and DeviceCare is used for these worldwide FDT/DTM standards and therefore simplifies the parameter setting of thermometers and field devices.

Basis functions are:

- Maintenance of the connection to the field devices (point to point or per fieldbus systems)
- Easily read display of all device parameters
- Configuration of measurement devices (online and offline)
- Documentation of configuration and measurement point data (also in PDF format)
- Archiving and storage of device data as files (up-/download)
- Device status display for fast fault diagnosis

Furthermore FieldCare offers extended functions which support the asset management of the customer. There is an automatic interface to W@M and the birth certificate of the field device. All data from the engineering phase is therefore passed on electronically via “Common Equipment Record” up to the device commissioning. This not only saves time but also avoids faults caused by mix-up.

Further Information

- Calibration of thermometers
CP00004R
- Temperature engineered solutions
CP00003R
- System products and data
managers - FA00016K/09
- Tailor-made field instrumentation,
solutions and services
FI00001Z



Further documentation and order code for detailed information on thermometers, transmitters and thermowells see last lines of the tables inside.



See as download under:

www.endress.com/download

www.addresses.endress.com