Selecting Smart Temperature Transmitters for General, Hazardous and Process Safety Applications

Temperature measurements involve the largest segments of all process measurements and their accuracy and reliability affects the efficient operation, safety, and long-term cost of an operating facility. For many applications, the temperature of a process needs to be monitored by temperature transmitters, and selecting and installing temperature transmitters for an application can be a difficult task. Not only do engineers and technicians need to take into consideration meeting economical requirements of a project, but also meeting comprehensive safety and potentially difficult or remote installation requirements. So, what goes into the selection of a modern, smart temperature transmitter?

Data delivery

Transmitters have historically delivered process data over a 4-20mA output, which is limited to only one piece of data. Today, facilities are relying on smart temperature transmitters for multiple applications to gather more data and allow technicians and

engineers to make better decisions. These modern transmitters can deliver multiple pieces of process and instrument data on a current based digital carrier. The data delivery protocols include HART, Profibus, Foundation Fieldbus, MODBUS and others. Smart temperature transmitters have expanded capabilities such as device intelligence, dual sensor input for backup and fail-over protection, corrosion detection, and provide instrument diagnostics to help determine optimal maintenance periods.

HART is the predominant digital instrument protocol, and is widely used in process and instrumentation systems. With unilateral support from nearly all mainstream device manufacturers and continuing updates and revisions, there are more than 40 million HART devices installed worldwide. Such wide acceptance means that HART devices and protocol are used in facilities ranging from small automation applications up to highly sophisticated industrial applications. HART enabled devices superimpose a digital signal on their 4-20mA process signal. The HART digital signal can contain additional process measurements and other variables such as instrument status, diagnostic data, alarms, calibration values, and alert messages. Smart temperature transmitters that generate HART communication protocol data, commonly send that data to a BPCS, PLC or other HART master for analysis and diagnostics.

Operating characteristics

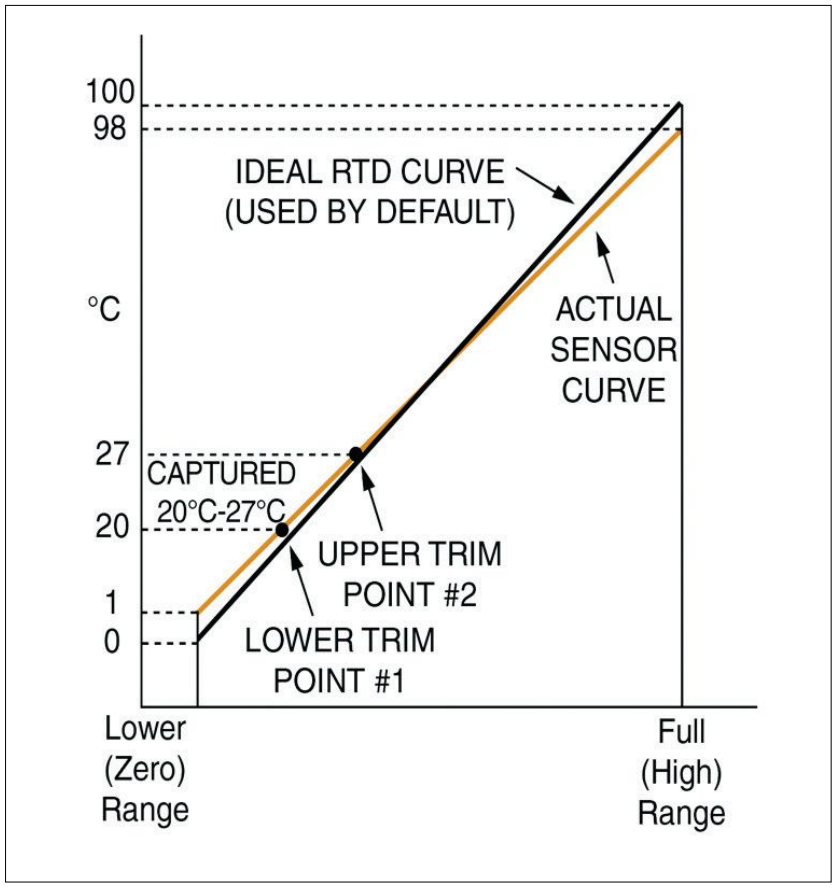
The need for accuracy is driven by the specific application. In general, more error is generated by the sensor than the measuring instrument. To eliminate the temperature transmitter as an error source there are several related operating characteristics that you want to consider: 1) input accuracy, 2) input resolution and 3) measurement stability.

With an advanced Smart temperature transmitter, you should expect input accuracy on the order of ±0.1°C (±0.18°F) for an RTD input. Preferably, input resolution is 20-bit or higher so you can sense minute changes in the sensor's temperature. You also want the transmitter to be stable so it is not the source of measurement drift. If you are reading the transmitter's data digitally, you can ignore the 4-20mA stability and look for Input-to-Digital five-year stability specifications around ±0.1 per cent of span for RTDs.

As for electrical isolation, even ungrounded thermocouples eventually go to ground so it is important your transmitter has sufficient input/output isolation to prevent ground loops. Continuous isolation of 500Vrms should be sufficient for most industrial environments and the isolation should have the ability to withstand a dielectric strength test for one minute with no breakdown.

When you encounter an application demanding the best accuracy possible you need to be able to calibrate out the final offset error in the RTD. You will want to select a transmitter that can trim to a bath calibrated

RTD. This is a simple process but it commonly results in the combined RTD / Transmitter uncertainty of about ±.025°F (±.014°C).



The THZ3 and TDZ3 can be set to measure the segment most critical to the process.

Installation needs: Hazardous area certifications

One of the most important things to consider when selecting a temperature transmitter is the location type, such as whether the transmitter will be located in a safe or hazardous area. Hazardous areas require additional demands for safe operation and temperature transmitters need to be selected that have the proper certifications. To obtain agency approvals, an instrument must be designed and manufactured to exacting specifications. Choose temperature transmitters with agency approvals according to the specific zone or class/division of hazardous area in which the transmitter will be placed and certified by agencies accepted in your region or country.

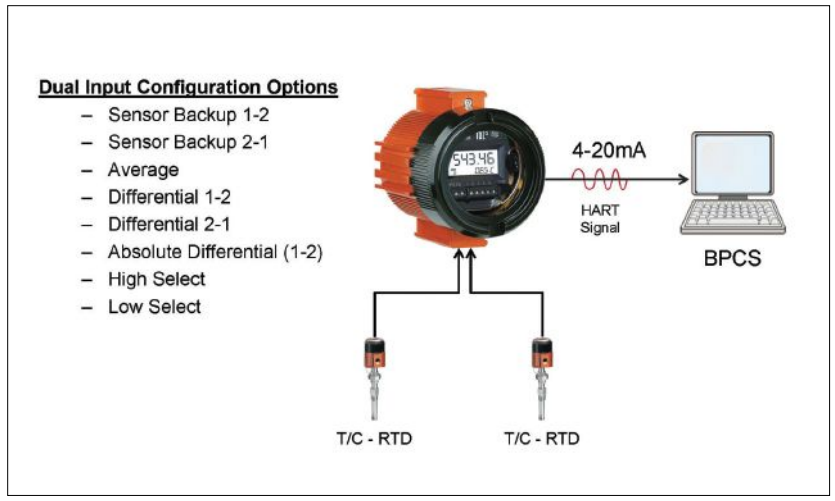
Your overall temperature measurement focus has to be on both the sensor and the transmitter. A field-mounted transmitter is typically supplied in a NEMA 7 enclosure as standard. You can then choose to install it with seals to make it explosion-proof or install it with an IS barrier in the safe area and make it suitable for use in intrinsically safe protection schemes. Usually the NEMA 7 enclosure provides protection from stray RFI (radio frequency interface) or EMI (electromagnetic interference). When mounting close to the process, be sure your transmitter's ambient temperature specs can handle the environment (-40°C to +85°C typical).

Another common strategy is to mount DIN-rail style temperature transmitters in remote thermocouple or RTD junction boxes. Typically, these are located in a Div 2 area, but it means your DIN-rail transmitters must carry that certification. For this environment, you also will want to look closely at your ambient temperatures and RF rejection.

If you want additional protection for your sensors and want an IS barrier for them, consider using an IS front-end on your DIN-rail temperature transmitters. This will reduce your product cost, save you installation space in the junction boxes and reduce your wiring time and cost.

Application: Dual input temperature transmitters

Smart temperature transmitters with dual sensor input improves your operations with advanced features that give you far more control over your temperature measurements and saves you money. When the transmitter has HART, you can read both sensors on one HART input on your BPCS or PLC. This cuts your wiring to the host system in half, and also saves you money by eliminating another input point.

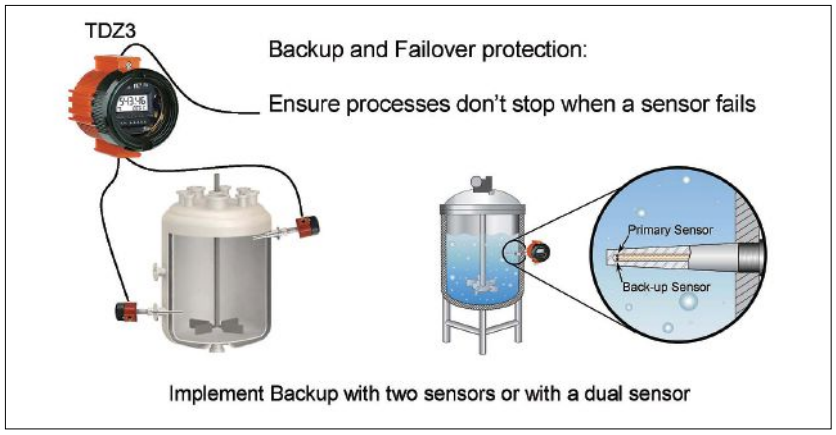


Dual input configuration.

These savings alone could actually cover the cost of the new dual input transmitter.

These smart transmitters can perform a lot of operations that used to require a BPCS or PLC. Instead of having to program these hosts, transmitters can now perform many functions like:

- Set either sensor as a candidate for a backup, when the other one fails. This gives you redundant sensors for critical control points;
- Average the readings from two sensors, such as in a pipeline where stratification is a concern;
- Use differential measurement to monitor a temperature difference across a heat exchanger, for example, or for BTU calculations; and
- Depending on whether you need to control cold temperature or hot, a smart transmitter can allow you to control from the hotter or colder sensor at the host as selected by the transmitter (select High or select Low).



Backup implementation with two sensors or with a dual sensor.

Diagnostics

Process units are designed to run for years. We certainly do not want our instrumentation interrupting those runs and that places value on the advanced diagnostics found in smart temperature transmitters. The diagnostics are very beneficial to ensuring your transmitter and sensors are operating properly, and can even predict failure. Examples of beneficial diagnostics:

- An input sensor failure alarm will tell you when one of the sensors has stopped operating within parameters. If the sensor is an RTD, we can often detect and report which wire has failed. As we saw above, if you are using redundant sensors you can hot swap a failed sensor;
- Transient voltages can be severe enough to be interpreted as a sensor failure. Nuisance trips are never pleasant and can be avoided with Broken Wire Hold-off. You can choose to tell the diagnostic to wait X seconds and retest to validate the diagnostic;
- Sensor drift alarms will trigger an alarm if your two sensors are wandering too far apart;
- Corrosion of thermocouple and three-wire RTD extension wires causes significant measurement error. You can monitor that extension wire corrosion and fire alarms if the resistance gets too great. This can be an early indication of impending sensor failure or that the measurement accuracy has become questionable;
- The ability to set band or range alarms on any of the device variables informs you when your parameter of interest is within or outside user preset limits; and
- Of course, there are dozens of diagnostic tests monitoring the transmitter's own electronic health.

Safety applications

If the transmitter will be used in a critical or dangerous process, a Safety Instrumented System (SIS) is often implemented by safety engineers to ensure functional process safety. Functional safety products are recommended for use in an SIS, and are approved by third-party agencies for their conformance to IEC 61508 safety standards. Approval certificates are awarded when an audited device has met manufacturer design process requirements of an identified Safety Integrity Level (SIL 1 through SIL 4).

SIL capable STZ dual input Smart HART temperature transmitter.

You need a complete FMEDA (failure modes, effects and diagnostic analysis) report to support your SIF (stress intensity factor) calculations. When a third-party certified instrument is used in a Safety Instrumented System (SIS) a certificate of IEC 61508 compliance for specified SIL capability is provided, and is backed by all the necessary documentation.

SIL certified temperature transmitters typically have all the same capability as outlined above for the smart transmitter. It's also important to permit the user to configure the temperature transmitters HART communications to "Read Only" which prevents accidental configuration changes that would compromise the safety function of the device.

Moore Industries
www.miinet.com

New 4-channel oscilloscope series

The MSO8000 Series of digital oscilloscopes combines sampling of 10GSa/sec and memory depth of 500Mpts with a modern, flexible user interface enabled by Rigol's new UltraVision II architecture and Phoenix chipset. Three models are available with input bandwidths from 600 MHz to 2GHz, each with four analog channels. An optional 16-channel logic analyzer interface provides digital debug capabilities with the addition of 16 channel probes and software. Features include a 10.1" 1024 x 600 capacitive multi-touch colour LCD screen with 256-level intensity grading and a waveform refresh rate of up to 600,000wfm/sec.

Saelig
www.saelig.com

Valve position sensor for oil and gas applications

Designed for use in the oil and gas industry, the F31K2 is a flexible, ruggedized and weatherproof valve position sensor. Features include an extended temperature range along with numerous options for electrical connections. Direct-mount valve position sensors minimize space requirements, maintain assured sensing distance and offer simple, reliable monitoring. Optimized for outdoor use, the F31K2's housing materials provide high UV protection and are resistant to extreme temperatures and corrosion. The modular housing is made of a ruggedized, translucent plastic. LEDs that indicate the power supply, sensor, and valve conditions are integrated into the encapsulated sensor module.

Pepperl+Fuchs
www.pepperl-fuchs.com

HD thermal camera with viewfinder

The T1020 uses the power of FLIR Vision Processing to deliver detailed, smooth pictures with minimal image noise. FLIR Vision Processing combines HD resolution, MSX, and UltraMax image enhancement with FLIR's adaptive filtering algorithms to produce thermal images with up to 3.1 million pixels. The T1020 detects temperature differences down to <20 mK, for clear, low-noise images. It includes a 120° rotating optical block and bright, high-resolution LCD viewfinder, putting any target within comfortable viewing range.

FLIR Systems
www.flir.ca