

## Smart stuff

A new breed of transmitters can help optimize maintenance and operations by putting the user in control

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Today's smart transmitters incorporate powerful features that increase functionality, speed installation, sharpen measurement accuracy, trim maintenance costs and provide a wealth of valuable process diagnostic information. Offered by dozens of manufacturers worldwide, smart instruments are available to measure every major process variable, and can pay off in both small and large applications.

### Universal plant standards

The textbook definition of a smart transmitter is an instrument that incorporates a microprocessor. The processor (at the very least) allows the instrument to accommodate all common inputs within a specific category. A smart temperature transmitter, for example, is expected to handle a host of resistance temperature devices (RTDs) (2-, 3-, and 4-wire; Pt, Cu, and Ni) and thermocouple types (J, K, E, T, R, S, N, B). This includes the full temperature range, or specific segments of a range, within the capabilities of each sensor type. The idea here is to reduce the number of transmitter models you must specify and inventory as spares. Basically, one "size" fits all.

The smartest smart temperature transmitters feature programming options that go far beyond relatively common universal input capabilities. The arrival of simple, yet highly functional, Windows-based configuration software allows faster setup, with more precise settings than is possible with a hand-held smart transmitter communicator.

Instead of scrolling through lengthy configuration branches (as is necessary with hand-

held devices), setup choices—such as input type and range, output zero and span, output damping, upscale/downscale drive and display parameters—can be viewed easily and selected in a minute or two with a few clicks of a mouse. With another click, the parameters can be downloaded to the transmitter. Another significant advantage of the PC over a hand-held is that once developed, a PC configuration can be stored to disk and downloaded to multiple transmitters. The more transmitters with the same or similar setup, the more time you save.

### Extreme accuracy

Fierce competition has led to the development of instruments with accuracy ratings that were unheard of just a few years ago. Smart temperature transmitters routinely deliver 16-bit input resolution, some deliver 18-bit, and transmitters with 20-bit input accuracy are

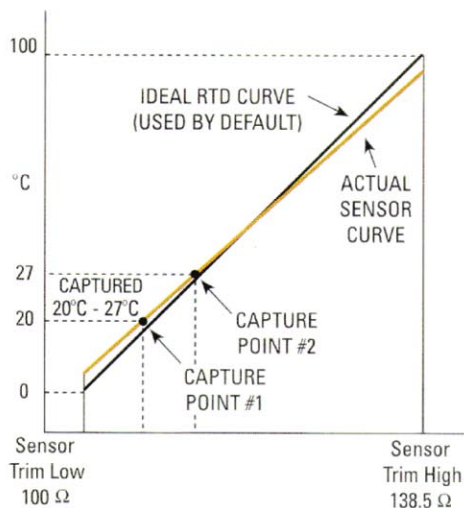


Figure 1. A smart transmitter can be set to measure the segment most critical to the process.

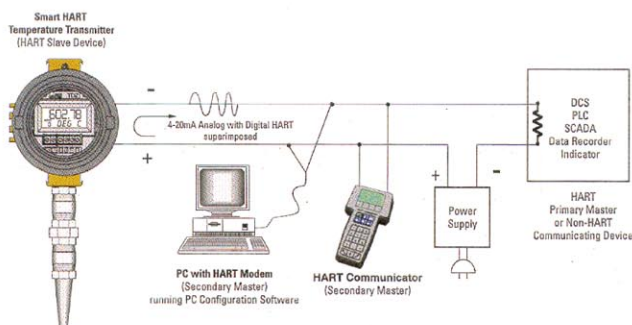


Figure 2. From any point on the 4-20 mA loop, you can view, test and change smart transmitter parameters.

now hitting the market. This translates into phenomenal accuracy possibilities. For example, with a 1,000-ohm RTD, a smart transmitter offering 20-bit input resolution produces an input measurement error of only  $\pm 0.001^\circ\text{C}$ .

PC programming advancements also allow sensor input trimming techniques that greatly enhance the measurement accuracy of transmitter and sensor combinations. This is a very hot subject, and engineers are striving for the tight tolerances needed to squeeze every dollar out of a finicky process.

Sensor-to-transmitter trimming, a calibration technique offered by leading smart transmitter manufacturers, essentially eliminates measurement errors that temperature sensors introduce. Sensors, even precision ones, can vary in measurement accuracy. To adjust for this, the transmitter and sensor are calibrated as a unit.

The process is simple. The temperature sensor is immersed in stabilized temperature baths representing the upper and lower range values. Using its smart electronics, the transmitter takes a "snapshot" of the lower, and

then upper, reference points derived from the sensor, and stores them in non-volatile memory. The transmitter then continuously uses the data points to compensate for deviations between a sensor's stated linearization curve and its actual measurement.

Another smart transmitter input trimming technique involves setting the transmitter to respond to specific sensor curve segments. The smart transmitter is trimmed with two data points within the input span. This allows monitoring of a complete process range, while placing measurement emphasis on a specific segment of the range most critical to the process (Figure 1).

### Long-term stability

The advanced components and self-calibration techniques used in smart transmitters result in amazingly little drift. The time and resulting cost advantages are obvious. If you are currently on a one-year calibration schedule, you can go to two or three and, with some smart transmitters, to even five years between calibrations with as little as 0.18 percent of span drift over this extended period.

### Remote access is key

By far, the top reason smart transmitters are selected is because their digital communication capabilities allow them to be configured and tested over the signal wires. In the middle of winter, the last thing you want to do is trudge up a wind-blown tower toting test equipment. Even on a good day, why climb at all?

Smart transmitters allow you to check the status, or make complete configuration changes, from your control room or any other convenient termination point (Figure 2). Recent estimates from the Hart Communication Foundation, Austin, Texas, indicate that commissioning a smart transmitter results in an average 77 percent time savings over traditional techniques.

Remote access is also a big advantage in hazardous area installations. The transmitter can be tested and calibrated remotely. Because you don't have to access the transmitter's enclosure, you don't have to decommission explosion-proof areas for routine calibrations.

### Fault diagnostics

Because smart transmitters use powerful microprocessors and digital communications, they can provide valuable self and process diagnostic information that can speed troubleshooting and maintenance. This may include fault information on itself (such as a software or hardware problem), and the input.

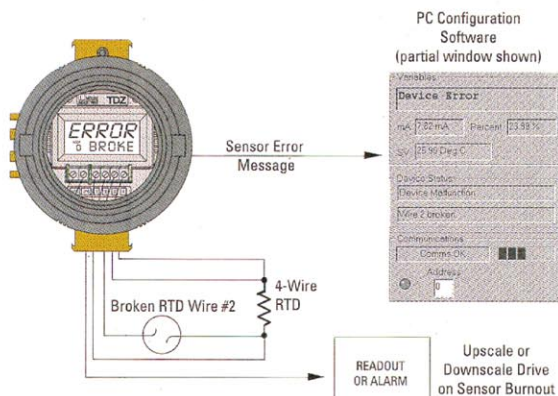


Figure 3. Advanced sensor diagnostics save troubleshooting time.



For example, in the case of input failure, a smart temperature transmitter would not only let you know about RTD burnout, but available information may extend to exactly which RTD wire has failed or come loose from its connection (Figure 3).

### HART protocol

While a number of smart field transmitter digital communication protocols have emerged, the HART (Highway Addressable Remote Transducer) protocol are some of the most widely used.

The HART protocol uses the frequency shift keying (FSK) principle derived from the Bell 202 communication standard. This method calls for a digital signal made up of sine waves of two frequencies—1,200 Hz and 2,200 Hz—to be superimposed onto analog (4–20 mA) loop wiring. The 1,200 Hz frequency signal represents bit one, while 2,200 Hz represents bit zero. The analog signal is not affected by its presence because the average value of the frequency signal is always zero.

This very simple technique results in HART's ability to simultaneously communicate analog and digital signals on the same twisted wire pair. HART provides a "bridge" between in-place analog systems and the advantages of digital communications. You get two-way communications, yet you can use your in-place twisted pair 4–20 mA wiring and analog-based receiving devices.

While smart HART transmitters are capable of being incorporated into all-digital, multidrop networks (Figure 4), they are used almost exclusively in point-to-point schemes such as regular analog transmitters. The HART digital signal, moving at a sluggish 1,200-baud communication rate, is considered too slow to use as a standard for plant-wide monitoring and control applications.

### True field transmitter networked systems

Users are just now migrating to true field transmitter digital networked systems. The major advantage (but certainly not the only one) is one that users in the distributed input/output arena have enjoyed for years: decreased wiring and installation costs.

Major smart transmitter manufacturers are now investing in fieldbus-based smart transmitters, and users are starting to consider these transmitters for new construction and major upgrades. While a worldwide consensus is not likely to be reached on one fieldbus standard, Foundation Fieldbus, Profibus, and industri-

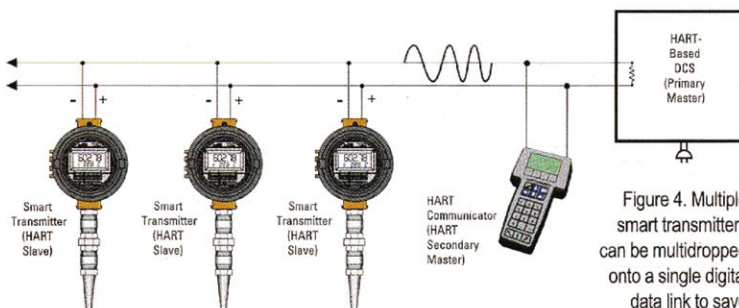



Figure 4. Multiple smart transmitters can be multidropped onto a single digital data link to save wiring costs.

al Ethernet TCP/IP appear to be the architectures most smart transmitter manufacturers will pursue.

As comfort levels increase with proven performance and demonstrated paybacks, all-digital smart transmitter strategies will certainly surpass the tried and true 4–20 mA analog standard, just as 4–20 mA replaced its predecessor, 3–15 psig pneumatic technology. 

*Figures courtesy of Moore Industries-International, Inc.*

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