Get more from your HART-based instruments with I/O interfaces that "speak the language"

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You may have upgraded your field instruments to HART some time ago, but now you can get more data from them.

Millions of traditional smart analog instruments are installed in process plants throughout the world and are working just fine. These dependable instruments, which have been counted upon for decades to keep track of temperature, pressure, level, and flow conditions, can operate reliably in rugged field conditions—making them essential to existing distributed monitoring/control strategies.

The vast majority of field devices report back to a distributed control system (DCS) or programmable logic controller (PLC) using tried-and-true analog 4-20 mA signals. These same 4-20 mA signals are also sent from the control system to operate valves and other final control elements.

However, all-digital transmitters (i.e., those that communicate using digital protocols such as FOUNDATION fieldbus and Profibus) are beginning to be applied, and delivering significant advantages—with two of the most important of these being the enhancement of process diagnostics and preventative maintenance. Despite their current higher unit cost, it is likely that all-digital transmitters and final control elements will eventually eliminate the use of analog signals for data communications and control in the majority of applications.

The question is: When?

Manufacturers will certainly consider widely applying these digital fieldbus transmitters and control devices in new plants and for major retrofits. However, even under ideal economic conditions, history proves that most existing process plants typically migrate slowly to new technologies. As evidence, consider the amount of pneumatic instrumentation still in daily use.

Given today's money-tight, manpower-short conditions, it is unreasonable to expect

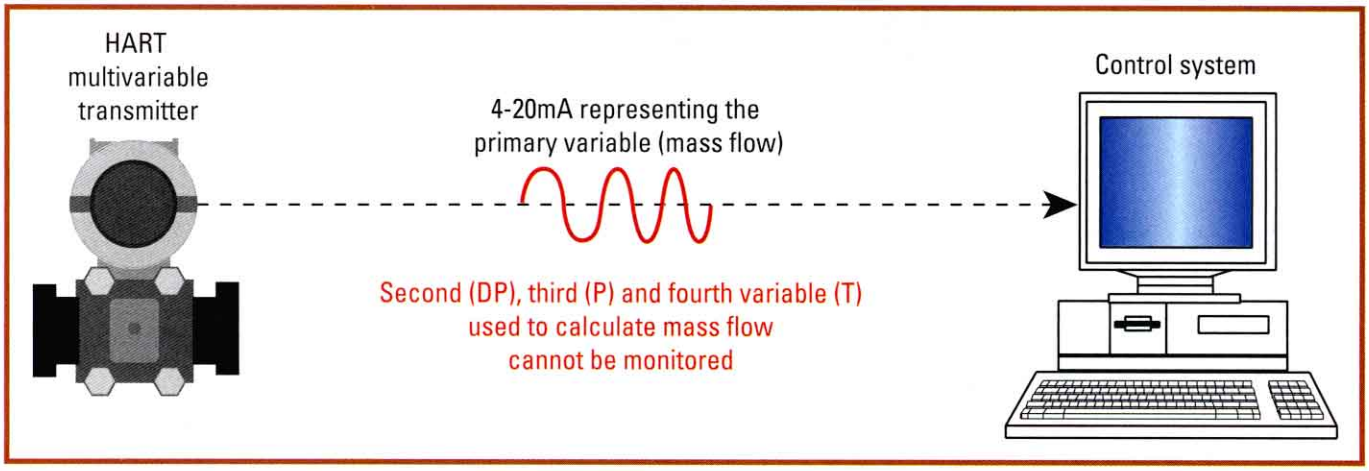

FIG. 1. While multivariable transmitters make multiple process measurements, only the Primary Variable value is available via the 4-20 mA signal.

users to spend the dollars required to implement a wholesale, field-level instrument retrofit to accommodate new digital-communicating instruments. At the same time, high risk and safety-related applications, where mistakes and instrument failures are not only expensive, but potentially dangerous, also call for a cautious approach to change.

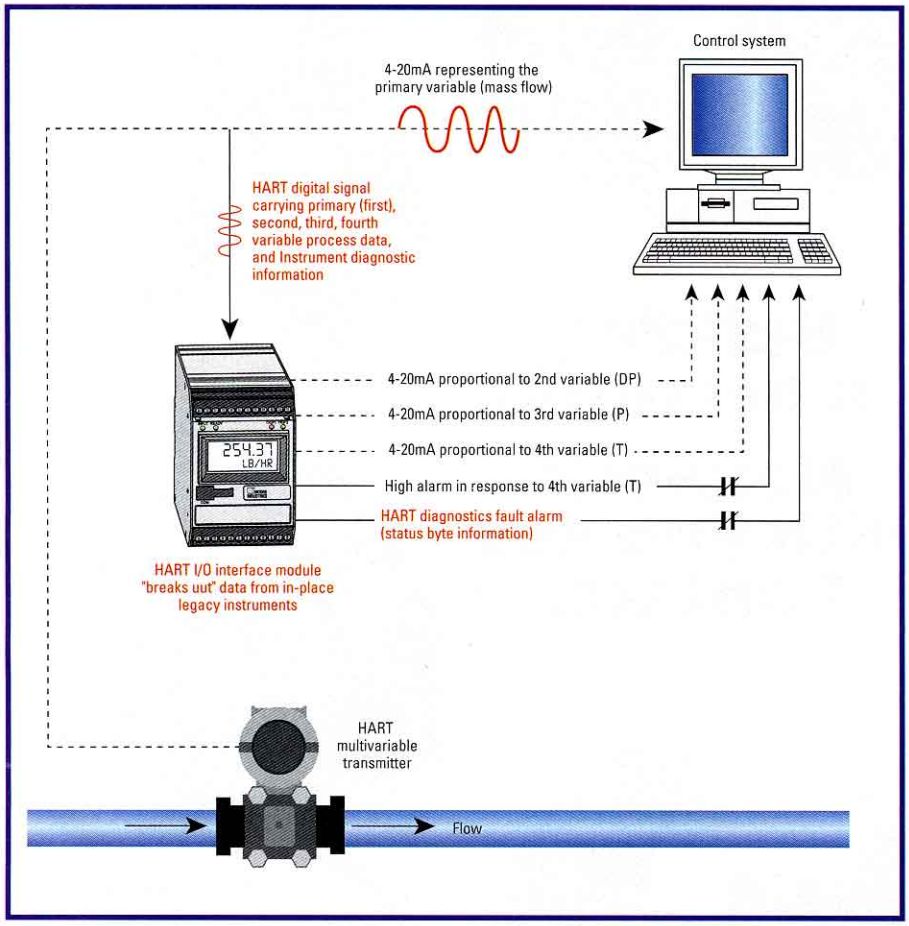

FIG. 2. I/O interface modules "break out" valuable process and diagnostic information from multivariable smart analog transmitters.

FIG. 3: The HIM HART I/O Interface Module from Moore Industries works with HART-based transmitters.

I/O interfaces unlock hidden secrets

Without the luxuries of all-digital instrumentation working in combination with the newest control systems, users are discovering ways to extract additional information from in-place instruments, and to deliver it to their existing control systems. Their goals are to achieve similar process improvements and diagnostic capabilities at much lower costs.

One way to accomplish this is to use HART I/O interface modules to "unlock the hidden secrets" of in-place smart HART® transmitters. According to the HART Communication Foundation, HART transmitters are by far the most widely used smart instruments, with an installed base in the millions. More than two-thirds of all smart instruments shipping today communicate using the HART protocol. These devices are available from numerous suppliers, to handle nearly every process measurement.

Even though the HART protocol supports multidrop digital networking, it is rarely used for control applications due to its speed restrictions. Most use HART devices in the analog 4-20 mA mode, and only use the protocol's superimposed digital capabilities for remote configuration and occasional analysis and loop checks. This is accomplished when a technician hooks up to the loop using a handheld HART Communicator.

What many engineers don't realize is that HART instruments communicate valuable process and diagnostic information that can be accessed and used on a continuous basis. For example, multivariable mass flow transmitters sense three process variables (differential pressure, pressure, and temperature). Using these measurements, they perform a calculation to derive mass flow. The mass flow information is transmitted as a 4-20 mA signal to the control system *(Fig. 1)*.

Unfortunately, in this scenario there is no way to monitor continuously the nonprimary variables used to calculate mass flow. Monitoring nonprimary variables may be desirable if one or more of the variables is especially important to the quality or safety of the process. In addition, valuable loop and transmitter diagnostic information, also available in the HART data string, can only be accessed and acted upon if a technician hooks up to the loop using a HART Communicator. This usually happens after an unwanted situation occurs, which has possibly triggered a costly nuisance shutdown, or even led to a dangerous condition.

"Listen in" on the process loop

HART I/O interface modules, connected transparently across the multivariable transmitter's 4-20 mA loop wires, can extract additional process and diagnostic information. Using the HART digital data that "rides" on the 4-20 mA signal, the interface "breaks out" digital repre-

sentations of the nonprimary process values, and converts them to proportional analog signals that represent any combination of the legacy instrument's primary (for sending to an alternate or safety system), second, third, or fourth variables.

In the multivariable flow transmitter application shown in Fig. 2, the I/O interface extracts and transmits to the control system isolated 4-20 mA values proportional to any selected variable. This includes the mass flowmeter's nonprimary variables: differential pressure (DP), pressure (P), and temperature (T). Since a high temperature condition in this process poses a safety concern, the I/O interface could also be programmed with a high temperature setpoint. When the setpoint is exceeded, an alarm trip (contact closure) output is sent to the control system to warn of potential trouble.

The I/O interface, by reading HART diagnostic information, can also detect when the process instrument is not behaving properly. When undesirable diagnostic conditions are sensed, the interface sends alarm (contact closure) signals to the control system or to a safety shutdown system. To help reduce disruptive nuisance shutdowns, the signals can be used to help distinguish between noncritical instrument faults and actual critical conditions. This includes use of the HART protocol's status bits to indicate unwanted conditions such as:

- Primary variable out of limits,
- Nonprimary variable out of limits,
- Primary variable analog output out of limits,
- Primary variable analog output fixed,
- Cold start,
- Field device malfunction,
- More diagnostic information available.

The proportional 4-20 mA and alarm trip signals produced by the I/O interface can be readily accepted by the in-place control system, such as a DCS or PLC with standard analog and relay input cards. No special or additional interface devices or control system software are required.

Monitoring in-place smart valves

The desire to perform predictive maintenance is growing. The ability to find a troubled device, so it can be fixed before it becomes a problem, is offered by some of the newest all-digital monitoring/control strategies. But what if a new strategy, with all of the bells and whistles, is financially out of reach?

HART I/O interface modules, connected across a smart valves positioner's 4-20 mA signal wires, can be used to "listen in" on loop diagnostic information available in the HART digital data string. The diagnostic data can be used to warn of trouble when a valve exhibits excess sticking caused by friction, which can adversely disrupt loop dynamics.

When adverse conditions are sensed, the interface can be set up to send alarm trip signals either to the primary control system, or to an annunciator or similar warning scheme. In addition to friction, other parameters that can be monitored by I/O interfaces include valve stem position, low actuator pressure (indicates that the filter may be clogged), and positioner temperature.

Keep what you have!

HART I/O interface modules *(Fig. 3)* allow you to leave trusted (and paid for) legacy field instruments in place, yet still realize many of the benefits provided by newer all-digital strategies. Until the day comes when you can install an all-digital dream system, look to I/O interface modules to increase the amount and quality of process and diagnostic information.

About the author

Joseph Hage, vice president of engineering for Moore Industries-International, Inc., directs new product development for the North Hills, California-based supplier of industrial signal interface instruments. For over 10 years, his speciality has been developing smart interfaces designed to bridge the gap between analog and digital technologies. ◆

For more information...

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