

# Safety through digital communication technology: Flow computer trends in international gas metering and regulating stations

Accuracy and reliability have taken a quantum leap, through the use of digital communication technology in custody transfer measurement. Although conventional digital and analogue signals are still in vogue, web-enabled flow computers (volume correctors) with a completely digital approach to achieve the ultimate in system accuracy are becoming a necessity to boost financial gains for the gas operators, especially in the context of emerging large-size gas networks.

Flow computers in custody transfer measurement today provide remote control capabilities using web-enabled TCP/IP technologies for remote panel operations, configuration set-up and pass-through communication ports enabling remote meter and transmitter diagnostics. The use of digital communication technology ensures continuous monitoring of the loop integrity as well as safe permanent monitoring of the measurement system.

Only a total energy measurement system featuring online validation and system performance monitoring, based on digital communication between all components (a gas chromatograph, multi-stream flow computers, ultrasonic/turbine meters and a supervisory system), will be able to ensure crucial system accuracy and reliability. All this aims to bring out the ideally desired performance features and techniques that new flow computing devices for custody transfer should provide to satisfy the stringent demands of the gas market.

### Total digital communication

Flow computers can be used with SMART field devices. SMART transmitters guarantee that the full measurement accuracy is preserved. They benefit from the completely digital signal handling provided by HART (Highway Addressable Remote Transducer) temperature, pressure and differential pressure transmitters through proven high-speed microprocessor technology. Ambient temperature dependence of

signals is eliminated and the system performance is solely limited to the inherent accuracy of the transmitters. Over 100 manufacturers worldwide utilise the HART protocol in over 560 different products, from simple temperature transmitters to multivariable transmitters.

### Some of the benefits offered by HART:

- No calibration of 4–20 mA loops
- No error contribution of isolators or signal converters
- Flow computer calculations can be verified (and simulated) easily
- No loss in numerical accuracy
- Communication loop integrity is ensured
- Pass-through of digital communication is possible for diagnostic purposes

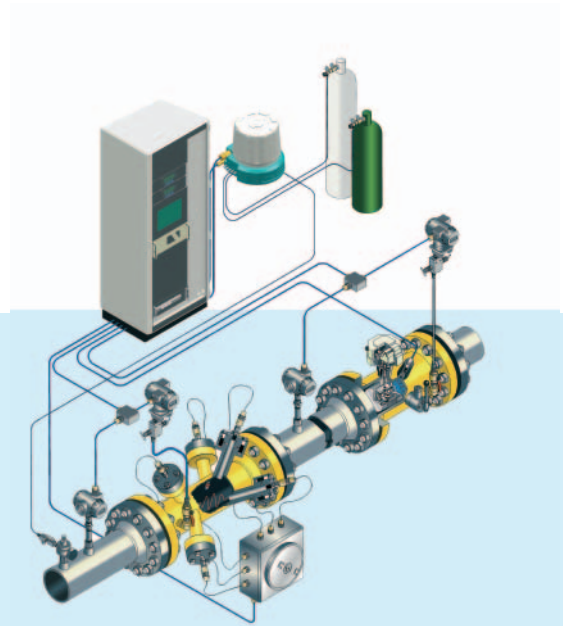


Fig. 1: A typical concept for a total energy measurement system including online diagnostics and performance monitoring

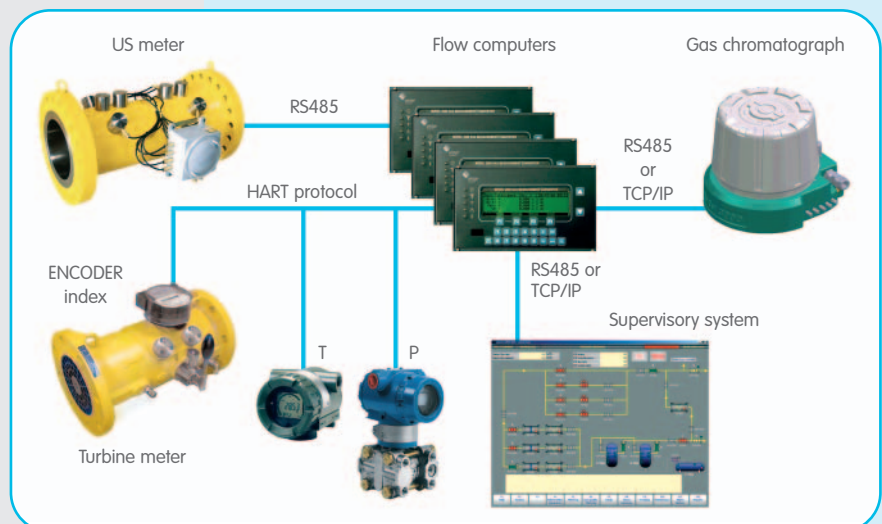


Fig. 2: Typical system configuration with total digital communication

Recommendation: Use digital communication wherever possible in your system configuration.

**Digital communication reduces system errors**

Let us compare two flow computer systems, one using transmitters in the conventional analogue mode (4 – 20 mA) and one using the same transmitters in HART multi-drop communication mode.

The example diagram (Fig. 3) for the analogue system shows a typical configuration consisting of a pressure and temperature transmitter, intrinsically safe isolators and a flow computer. Since the process variables are transferred by analogue signals, each individual device in the chain will contribute to the overall system error: the transmitters because they convert primary process variables into analogue signals using micro-processors (and D-A converters), the isolators (DC-DC converters) and the flow computer (A-D converters). Each time a signal is converted, an error will be introduced due to linearity or ambient temperature coefficients. Even if you start with accurate transmitters, the overall worst case full-scale system error can reach  $\pm 0.4\%$ .

The example configuration diagram for the HART multi-drop system (Fig. 4) consists of exactly the same transmitters as the analogue system. Since the process variables are now transferred by the digi-

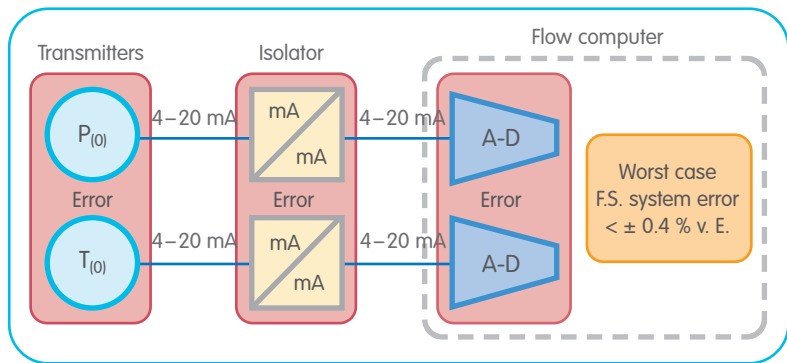


Fig. 3: Flow computer system using P&T transmitters in analogue mode

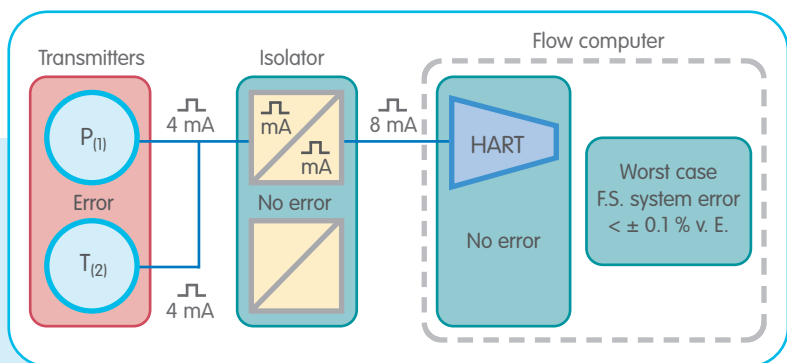


Fig. 4: Flow computer system using P&T transmitters in HART multi-drop mode

tal HART protocol, the overall worst case full-scale system error can be reduced to  $\pm 0.1\%$ . Only the conversion of the primary variables in the transmitters will contribute to the overall system error in a digital system and no conversion errors are added in the isolators or flow computer. Without spending extra money you will

benefit greatly when using HART. Given the current prices for natural gas your savings will be significant.

**Network pass-through**

Network pass-through is another unique aspect of web-enabled flow computers. It allows any remote PC or supervisory system direct access to pressure or temperature transmitters and US meters connected to the flow computer using a proprietary serial protocol. Remote serial diagnostics software can be used, since the serial RS232 port is emulated in the PC or supervisory system. Network pass-through communication is suitable for many applications. For example, to remotely read and configure HART transmitters using software packages provided by transmitter manufacturers or third parties. Similarly, US meter protocols can be used to read or diagnose ultrasonic meters remotely. At the same time, ModBus over TCP/IP communication packages are supported to retrieve online or stored (logged) data from any flow computer for storage in supervisory systems.

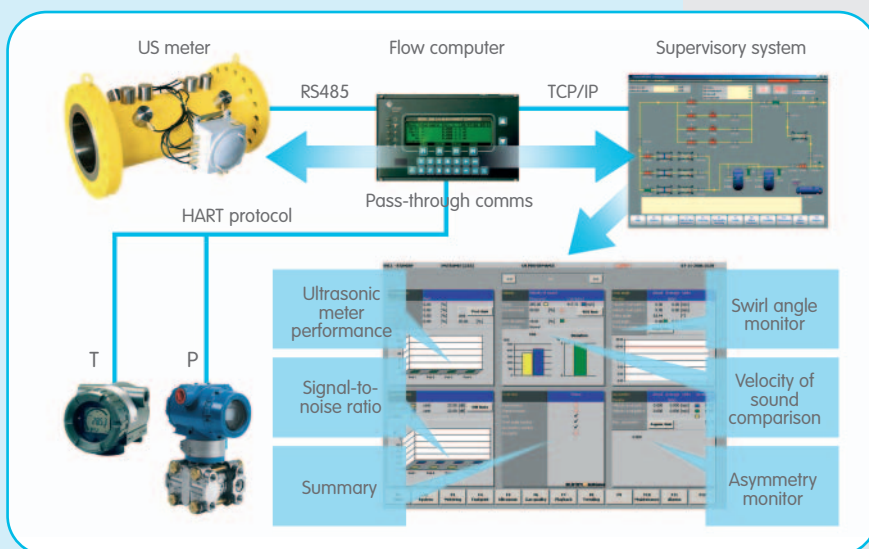
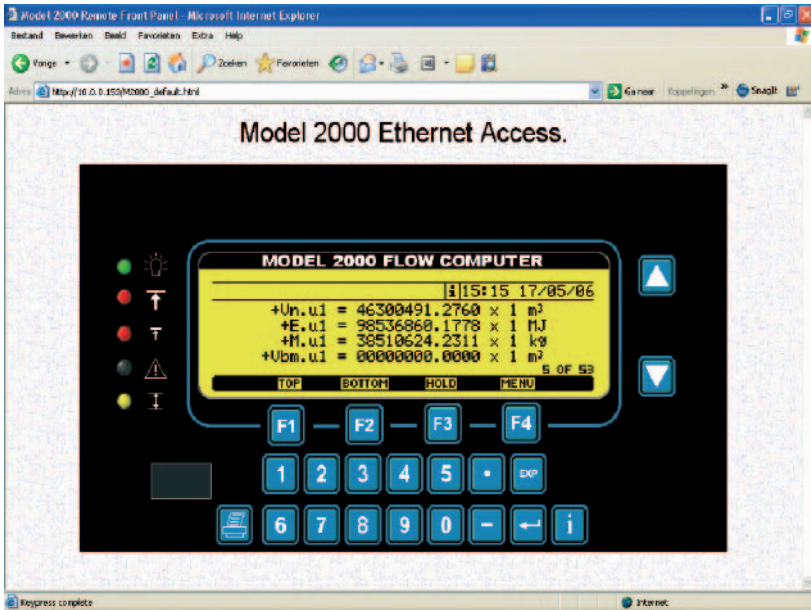


Fig. 5: Network pass-through communication used for online US meter diagnostics

### Remote front panel access

A unique feature of modern web-enabled flow computers is the support for remote front panel operations. Access is provided by selecting the IP address of the device using a standard web browser (Explorer). On connection, a JAVA applet will be started automatically and a virtual flow computer front panel will pop up. The PC mouse (or keyboard) is then used to activate any of the flow computer keyboard buttons. All local keyboard and front panel functions are supported remotely (including Alarm-log access and edit functions). The remote front panel assists remote maintenance. Any local operator can be guided through the various menus from remote (and vice versa).



Example of flow computer remote front panel access via Ethernet

A supervisory system requires an initial investment, but surely improves your return on investment:

- **Operational costs:** You get production figures in the format you want and in the system you want.
- **Maintenance costs:** A supervisory system will continuously check your system performance online and will tell you what to do and when. Maintaining more systems with the same staff will reduce maintenance costs dramatically.
- **Costs for mis-measurement:** The supervisory system will monitor the performance, accuracy and uncertainty of your metering solution. The metering system will warrant the correctness of your metering data online.

Combined features of modern flow computers and supervisory systems are:

- Velocity of sound comparison (comparing measured VOS and theoretical VOS)
- Comparison of measurement principles (e.g. comparing turbine with ultrasonic meters)
- Historical mean deviation check (signaling sudden changes in deviations)
- Truth tables (combining several checks to pinpoint the source of measurement errors)

### Basic concept for online performance monitoring

Why do you need a supervisory system? A modern supervisory system presents functions for process visualisation of your metering & control solution including reporting and billing. It increases the efficiency, and offers performance monitoring to ensure optimum metering accuracy and validation of your metering solution.

Consider the main cost drivers in the life cycle of a metering solution:

- **Initial investment:** Procuring a metering system requires an initial investment.
- **Operational costs:** What costs are involved in getting the metering data and for completing the trading process?
- **Maintenance costs:** Metering systems require maintenance to ensure reliable & accurate operation for years.

- **Costs for mis-measurement:** What are the cost implications if a metering system is not measuring correctly due to for example incorrect transmitter calibration?

### Flexible web-enabled communication with supervisory, SCADA or DCS systems

As a system component, web-enabled flow computers/station controllers should support a wide range of communication facilities to communicate with supervisory,

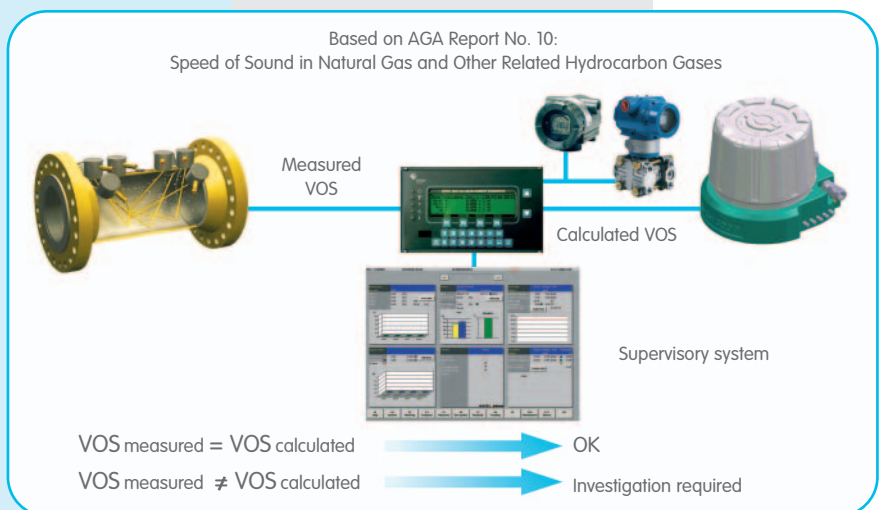


Fig. 6: Typical system configuration for the comparison of VOS

SCADA or DCS systems. Serial and Ethernet ports allow full remote configuration as well as data collection. Protocols like ModBus ASCII, ModBus RTU and ModBus over TCP/IP are supported as standard in modern flow computers.

Many specific protocols have been embedded to facilitate communication with digital process instruments of leading manufacturers, such as gas chromatographs and ultrasonic meters. High-speed serial RS232/RS485 communication ports are provided for data communication to a wide range of system devices or printers. All ports are programmable for the hardware mode of operation (RS232/RS485), baud rate, parity, start and stop bits and hand-shaking protocols.

Multiple (PC) servers are allowed to access metering data from multiple flow computers in a web-based network using standard routers or switches. The Ethernet package data transfer is far more versatile than any other communication protocol. It allows data communication from any device to any other device (no dedicated master/slave) using unique IP addressing techniques and supports modern communication networks like GPRS, ADSL, fibre-optics, etc.

### Typical Ethernet advantages

- Fast communication, worldwide
- Very good error recovery
- Multiple protocol support
- ModBus over TCP/IP
- Multiple PCs – multiple FCs
- Multiple protocol sessions per FC
- Remote front panel operations

- Network pass-through capabilities
- Emulated RS232 ports
- Remote meter/transmitter diagnostics
- Remote FC configuration & set-up

Modern supervisory systems are designed specifically for gas and liquid applications where accurate calculations, data processing and reporting are of the utmost importance. Such applications include gas & liquid metering stations, calibration installations, telemetry, remote metering, billing and pipeline monitoring systems. Complete turn-key solutions include meters, skids, gas chromatograph/analyser housings, flow computers, station controllers, control cabinets and supervisory systems which are widely used in many on- and offshore applications for instance.