

Beamex Calibration White Paper

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Configuring and Calibrating Smart Instruments

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So called “smart” instruments are ever more popular in the process industry. The vast majority of delivered instruments today are smart instruments. These new smart instruments bring new challenges to the calibration and configuration processes. But what are these smart instruments and what is the best way to configure and calibrate them?

Beamex has recently introduced a new revolutionary tool, the Beamex MC6 –Advanced Field Communicator and Calibrator, that will help to overcome these challenges.

What is a “Smart” transmitter?

A process transmitter is a device that senses a physical parameter (pressure, temperature, etc.) and generates an output signal proportional to the measured input. The term “smart” is more of a marketing term than a technical definition. There is no standardized technical definition for what smart really means in practice.

Generally, in order for a transmitter to be called smart, it will utilize a microprocessor and should also have a digital communication protocol that can be used for reading the transmitter’s measurement values and for configuring various settings in the transmitter. A microprocessor-based smart transmitter has a memory that can perform calculations, produce diagnostics, etc. Furthermore, a modern smart transmitter typically outperforms an older type of conventional transmitter regarding measurement accuracy and stability.

In any case, for the engineers who need to configure and calibrate the transmitter, the digital communication protocol is the biggest difference compared to conventional transmitters. Engineers can no longer simply measure the output analog signal, but they need to have the possibility to communicate with the transmitter and read the digital signal. That brings a whole new challenge - how can the digital output be read?

Thinking of the opposite of a smart transmitter, i.e. a non-smart transmitter, would be a transmitter with a purely analog (or even pneumatic) output signal.

Smart transmitter protocols

There are various digital protocols that exist among transmitters considered smart. Some are proprietary protocols of a certain manufacturer, but these seem to be

fading out in popularity and favor is being given to protocols based on Open Standards because of the interoperability that they enable.

Most of the protocols are based on open standards. The most common transmitter protocol today is the HART (Highway Addressable Remote Transducer) protocol. A HART transmitter contains both a conventional analog mA signal and a digital signal superimposed on top of the analog signal. Since it also has the analog signal, it is compatible with conventional installations. Recently the HART protocol seems to be getting more boosts from the newest *WirelessHART* protocol.

The fieldbuses, such as FOUNDATION Fieldbus and Profibus, contain only a digital output, no analog signal. FOUNDATION Fieldbus and Profibus are gaining a larger foothold on the process transmitter markets.

This article will discuss “smart” transmitters, including HART, *WirelessHART*, FOUNDATION Fieldbus and Profibus PA protocols.

Configuration

One important feature of a smart transmitter is that it can be configured via the digital protocol. Configuration of a smart transmitter refers to the setting of the transmitter parameters. These parameters may include engineering unit, sensor type, etc. The configuration needs to be done via the communication protocol. So in order to do the configuration, you will need to use some form of configuration device, typically also called a communicator, to support the selected protocol.

It is crucial to remember that although a communicator can be used for configuration, it is not a reference standard and therefore cannot be used for metrological calibration. Configuring the parameters of a smart transmitter with a communicator is not in itself a metrological calibration (although it may be part of an Adjustment/Trim task) and it does not assure accuracy. For a real metrological calibration, by definition a traceable reference standard (calibrator) is always needed.

Calibration of a smart transmitter

According to international standards, calibration is a comparison of the device under test against a traceable reference instrument (calibrator) and documenting the



comparison. Although the calibration formally does not include any adjustments, potential adjustments are often included when the calibration process is performed. If the calibration is done with a documenting calibrator, it will automatically document the calibration results.

To calibrate a conventional, analog transmitter, you can generate or measure the transmitter input and at the same time measure the transmitter output. In this case calibration is quite easy and straight forward; you need a dual-function calibrator able to process transmitter input and output at the same time, or alternatively two separate single-function calibrators.

But how can a smart transmitter, with output being a digital protocol signal, be calibrated? Obviously the transmitter input still needs to be generated/measured the

same way as with a conventional transmitter, i.e. by using a calibrator. However, to see what the transmitter output is, you will need some device or software able to read and interpret the digital protocol. The calibration may, therefore, be a very challenging task; several types of devices may be needed and several people to do the job. Sometimes it is very difficult or even impossible to find a suitable device, especially a mobile one, which can read the digital output.

Wired HART (as opposed to *WirelessHART*) is a hybrid protocol that includes digital communication superimposed on a conventional analog 4-20mA output signal. The 4-20mA output signal of a wired HART transmitter is calibrated the same way as a conventional transmitter. However, to do any configuration or trimming, or to read the digital output signal (if it is used), a HART communicator is needed.

The solution

The new Beamex MC6 is a device combining a full field communicator and an extremely accurate multifunctional process calibrator. With the Beamex MC6, the smart transmitter's input can be generated/ measured at the same time as reading the digital output. The results can be automatically stored into the memory of the MC6 or uploaded to calibration software.

When it comes to configuration of the smart transmitters, the MC6 includes a full field communicator for HART, WirelessHART, FOUNDATION Fieldbus H1 and Profibus PA protocols. All required electronics are built-in, including power supply and required impedances for the protocols.

The Beamex MC6 can be used both as a communicator for the configuration and as a calibrator for the calibration of smart instruments with the supported protocols. The MC6 supports all of the protocol commands according to the transmitter's Device Description file. Any additional communicator is therefore not needed.

There are some other "smart" process calibrators on the market with limited support for different protocols, typically only for one protocol (mostly HART) and offering very limited support. In practice, a separate communicator is needed in any case.

About Beamex MC6

Beamex[®] MC6 is an advanced, high-accuracy field calibrator and communicator. It offers calibration capabilities for pressure, temperature and various electrical signals. The MC6 also contains a full fieldbus communicator for HART, FOUNDATION Fieldbus and Profibus PA instruments.

The usability and ease-of-use are among the main features of the MC6. It has a large 5.7" color touch-screen with a multilingual user interface. The robust IP65-rated dust- and water-proof casing, ergonomic design and light weight make it an ideal measurement device for field use in various industries, such as the pharmaceutical, energy, oil and gas, food and beverage, service as well as the petrochemical and chemical industries.

The MC6 is one device with five different operational modes, which means that it is fast and easy to use, and you can carry less equipment in the field. The operation modes are: Meter, Calibrator, Documenting Calibrator, Data Logger and Fieldbus Communicator. In addition, the MC6

communicates with Beamex[®] CMX Calibration Software, enabling fully automated and paperless calibration and documentation.

In conclusion, the MC6 is more than a calibrator.



WHY CALIBRATE?

■ A modern transmitter is advertised as being smart and extremely accurate and sometimes sales people tell you they don't need to be calibrated at all because they are so "smart". So why would you calibrate them?

First of all, the output protocol of a transmitter does not change the fundamental need for calibration. There are numerous reasons to calibrate instruments initially and periodically. A short summary of the main reasons include;

- Even the best instruments and sensors drift over time, especially when used in demanding process conditions.
- Regulatory requirements, such as quality systems, safety systems, environmental systems, standards, etc.
- Economical reasons – any measurement having direct economical effect.
- Safety reasons- employee safety as well as customer/patient safety.
- To achieve high and consistent product quality and to optimize processes.
- Environmental reasons.