ADVANCED INDUSTRIAL SYSTEMS, INC.

Applications Note 1403
4-20 mA Analog Transmitters, Scalers, and Splitters

Analog Transmitters are often required when using 4 – 20 mA loops. As opposed to Digital Transmitters (next month's app note), an analog transmitter provides an analog signal (normally 4 – 20 mA) for use with other instruments such as a temperature controller, indicator or PLC.

Analog Transmitters are often used to fulfill these requirements…

1. Accept a Sensor (TC, RTD, level sensor, etc.) and output a standard 4 – 20 mA signal.
2. Isolate an Input Signal to avoid ground loops, provide voltage isolation (up to 1000's of volts), and transmit it as a 4 - 20.
3. Split The Signal Into 2 Or More Separate Loops for transmission to separate parts of the plant.
4. Local Alarms, Emergency Shutdowns (pumps, tanks, heaters) etc.
5. Re-Scaling And Re-Transmission

Analog transmitters are commonly available as "Hockey Pucks" or DIN rail mounts. Not all transmitters are available in all configurations. A.I.S. has adapters to convert "Hockey Pucks" to DIN rail mount.

The most familiar transmitters are head mounted "Hockey Pucks" for TCs and RTDs. These transmitters have changed a lot since I first started using them. They used to come in, set for what you ordered. To change them, it was Soldering Iron and Xacto knife time. Modern transmitters may be easily changed in the field with programming software. Plug in your USB cable and they are easily re-scaled to change TC type or range. These transmitters are readily available in both DIN Rail and "Hockey Puck" styles.

Our **Transmitter Selection Guide** (http://www.advindsys.com/ApNotes/TransmitterSelectionGuide.pdf) can save time when selecting a transmitter.

1. Common Transmitter Inputs with 4 – 20 mA Output…

- TCs, RTDs, etc.
- Humidity, pH, Concentration (gas or liquid)
- Flow (pulses, square root extraction, etc.)
- Level
- Up/Down Totals (pulses)
- Non-Linear (such as thermistors or horizontal tanks)
- Local Alarms and Shut-downs
- Ratio (net fill, elongation, mixing ratio)
- Position
- Duty Cycle
- AC and DC Voltage and Current, True RMS AC
- Resistance.

Some sensors come with transmitters as part of the sensor. Temperature transmitters are readily available. AC current transmitters and RH (Relative Humidity) transmitters are commonly available with built-in 4 – 20 mA transmitters.

2. Isolation is a common requirement…

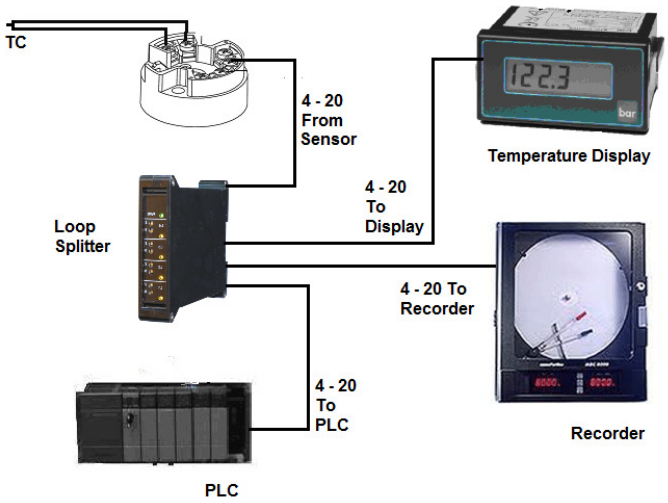
Many times measurements need to be made in an electrically hostile environment. Equipment cabinets may have high voltages. Temperatures may need to be measured in motors, in environmental chambers with high power switches and relays, on battery chains --- anywhere where the potential exists for undesirable voltages or where a remote ground may be undesirable.

An isolating transmitter provides an electrical isolation to avoid damage to other equipment or personal. With a 4 – 20 mA isolator, above ground measurements such as battery chains or motor windings are easily made. If you have grounded TCs, an isolated transmitter is usually necessary.

Isolators are often used to minimize "ground noise" in larger installations. Isolators may be used to split or extend 4 – 20 mA loops. It is important to know whether the isolator is powered from the input loop or the output loop. If it is a TC, RTD or other simple device it is usually powered from the output loop. It may also use its own power source.

3. Loop Splitters…

4 – 20 mA Loop Splitters split the signal into 2 or more separate loops, for transmission to separate parts of the plant or separate instruments. The major advantage of a loop splitter is that failure of one of the output loops does not affect the other. Thus if you disconnect an instrument or have a wiring failure, the other loops will continue to operate as if nothing happened. If you are doing critical alarming this is a necessity. Placing instruments in series leaves you with a single loop failure causing the entire system to fail if any instrument or signal cable is disconnected. You can also use a loop isolator to provide a remote output.



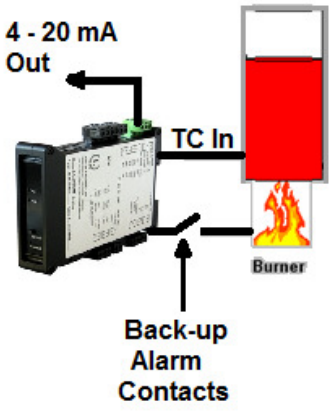
The splitter used in the illustration is locally powered. It also includes a loop power supply.

Input powered signal splitters require a compliance voltage high enough to provide power to all of the output loops. Add together the 20 mA output voltages required for each output loop. Raise it 3 – 5 volts at minimum. This is the minimum voltage that must be available at the transmitter input for proper operation. Note: Voltage = 20 mA x loop resistance in Kohms.

4. Local Alarms, Emergency Shutdowns (pumps, tanks, heaters) etc...

It is often desirable to have local indication of an alarm, or back-up shutdown for pumps, heaters etc. Intelligent transmitters provide this capability.

In addition to transmitting the signal to the control or monitoring system, built in alarms with contact closures provide a local shut down if a tank gets too full, or a heater over-heats. This can also provide cost savings as additional wiring is not required from the main control system for the back-up alarms.



5. Re-Scaling and Re-Transmission…

Before the advent of microprocessor instruments, it was not uncommon to need accommodation for instruments, controllers, and recorders all with different input scaling. Transmitters were often used to provide these re-scaled values. If a recorder was scaled 0 – 300° and the controller was scaled 0 - 250°, a re-scaling transmitter is used to scale one 4 – 20 signal into the other. This is rarely a problem anymore as most microprocessor instruments have programmable scaling. It still occurs from time to time, especially in retrofits.

Retransmission is also required on occasion. If you need a remote readout of a value in the instrument cabinet, you may want to use an isolator to retransmit the value to the remote display. This avoids the possibility that a failure in the remote area will shut down your system on the floor.

Conclusion…

4- 20 mA transmitters are still very popular. They make installation and maintenance easier. The provide isolation and scaling. Loop splitters and isolators keep systems isolated while providing data to multiple systems.

4 – 20 mA transmitters provide linearization for non-linear signals such as thermistors and horizontal tanks. Local alarms provide an additional level of safety and notification at a low cost.

Rescaling and re-transmission are easily achieved.

Our **Transmitter Selection Guide** (http://www.advindsys.com/ApNotes/TransmitterSelectionGuide.pdf) can save time when selecting a transmitter. Feel free to give us a call if we can help you. Note that pricing is approximate and may change due to features, price changes or configurations.

Hint: Be sure to keep a record of how your transmitters are configured. A card near the transmitter installation and in the instrument shop is recommended.

A sticker on the transmitter itself will save you time when the transmitter is pulled for repair or recalibration. It will help the person in the instrument shop know exactly what it is and how it is calibrated.

No one wants be called at home at 2:00 am because the new instrument person did not know how a signal was scaled.