

# ***Field Devices and Wiring***

# ***Field Device and Wiring Overview***

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- The control system interfaces to the process through field devices.
- Our ability to control a process is limited to the accuracy of measurement devices and the resolution and deadband associated with actuators.
- Incorrect selection of field devices can directly impact the quality of control.
- Setup of inputs and outputs blocks in a control strategy requires some knowledge of the field devices used in the control.

# Magnetic Flow Meter



- The Rosemount 8742C Magnetic Flow meter Transmitter is a four-wire device.
- Process liquid must have a conductivity for a measurement to be made
- System accuracy is  $\pm 0.5\%$  of rated flow
- Capable of processing signals from fluids that are traveling between 0.04 and 30 ft/s
- Measurement based on voltage induced by flow of material through a magnetic field.

# Vortex Flow Measurement



- Rosemount **8800C Smart Vortex Flow meter**
- Accuracy  $\pm 0.65\%$  of rate for liquids  
 $\pm 1.35\%$  of rate for gas and steam
- 2-wire Device
- Turndown 38:1
- Measurement based on flow vortex established around a restriction in pipe

# Flow Measurement Based On Orifice Plate Restriction Using



- Flow is determined based on the **square root of the differential pressure drop** across the orifice.
- Example: Rosemount 405 Compact Orifice used with Rosemount 3051C Differential Pressure Transmitter .
- $\pm 0.5\%$  accuracy
- Turndown approximately 5:1

# Pressure Measurement



- Rosemount 3051 T Gage and Absolute Pressure Transmitter
- Rated from 0.3 to 10,000 psi
- Total Performance  $\pm 0.15$  % of span
- Rangeability 100:1
- 2-wire transmitter

# Temperature



- Rosemount 248 temperature transmitter.
- Temperature measurement is based on a measurement of change in resistance (RTD sensor) or voltage generated by dissimilar metals (thermocouple).
- RTD used in 2, 3, or 4 wire configuration. Different thermocouple wire is used for different temperature ranges e.g. ISA Type J, K, E or T wire, different mv generated.
- Sensor protected by thermowell
- Accuracy of transmitter is  $\pm 0.1\%$  but total accuracy depends on sensor element

# ***Radar Level Measurement***



- Rosemount 5400 Series Radar Level Measurement
- When a radar pulse reaches a media with a different dielectric constant, part of the energy is reflected back to the transmitter. The time difference between the transmitted and the reflected pulse is proportional to the distance, from which the level is calculated.
- 2-wire transmitter

## ***Level – Open Tank***



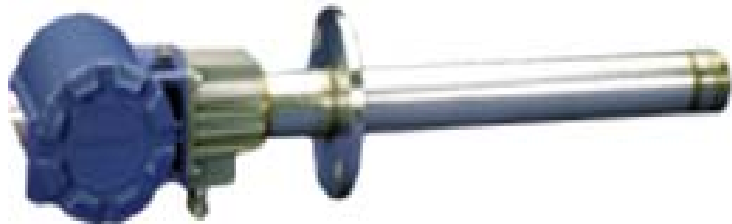
- Rosemount 3051L Liquid Level Transmitter
- Must be calibrated based on density of the liquid since level is inferred from the pressure head.

## ***Level – Closed Tank***



- Rosemount **1199 Remote Seals** used with 3051C differential pressure transmitter
- Level based on differential pressure from head space to bottom of tank.
- Must be calibrated based on density of the liquid since level is inferred from the pressure head.

# ***Analyzer Transmitter – Gas***



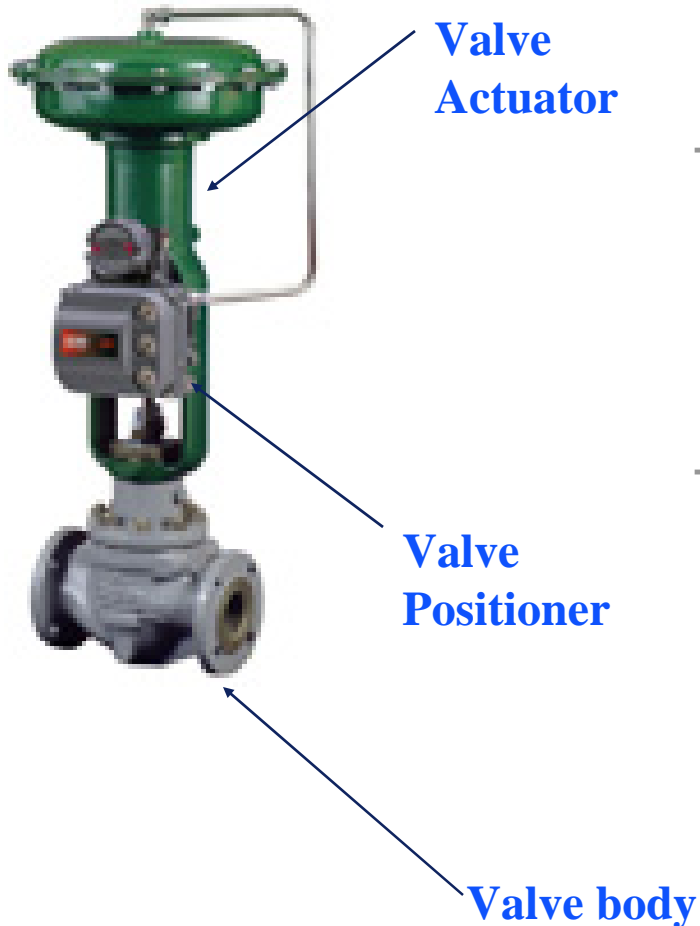
- **Rosemount In Situ Flu Gas Oxygen Transmitter**
- Accuracy  $\pm .75\%$  of reading or  $.05\%$  O<sub>2</sub>
- Measurement based on voltage generated by *zirconium oxide Cell*.
- Optional autocalibration, input to control system to indicate calibration is in progress.

# Analytical Transmitters - Liquid



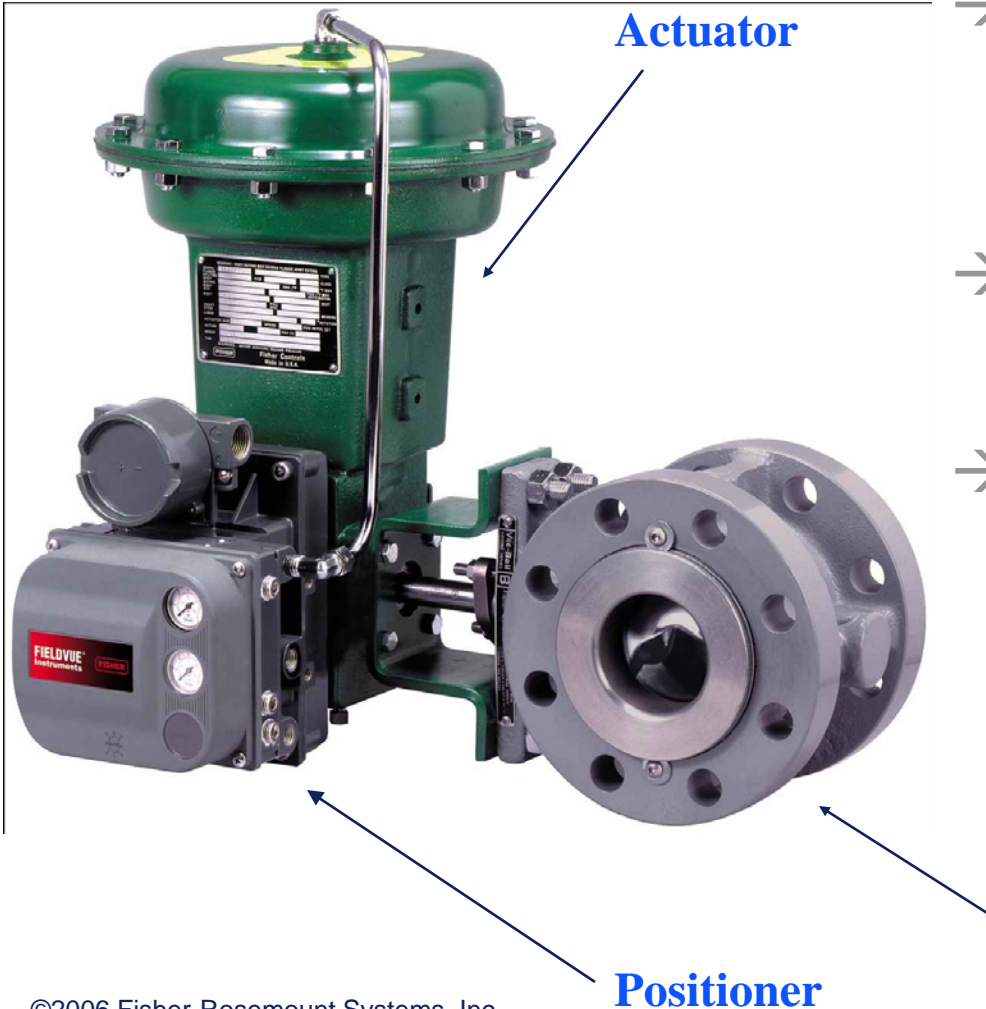
- **Rosemount MODEL 5081-P  
pH/ORP TRANSMITTER**
- **TWO-WIRE  
TRANSMITTERS**
- **Wide variety of sensors  
may be used based on pH  
or ORP application  
requirements**
- **pH Range: 0 to 14**
- **Accuracy:  $\pm 0.01$  pH**

# Regulating Valve – Sliding Stem



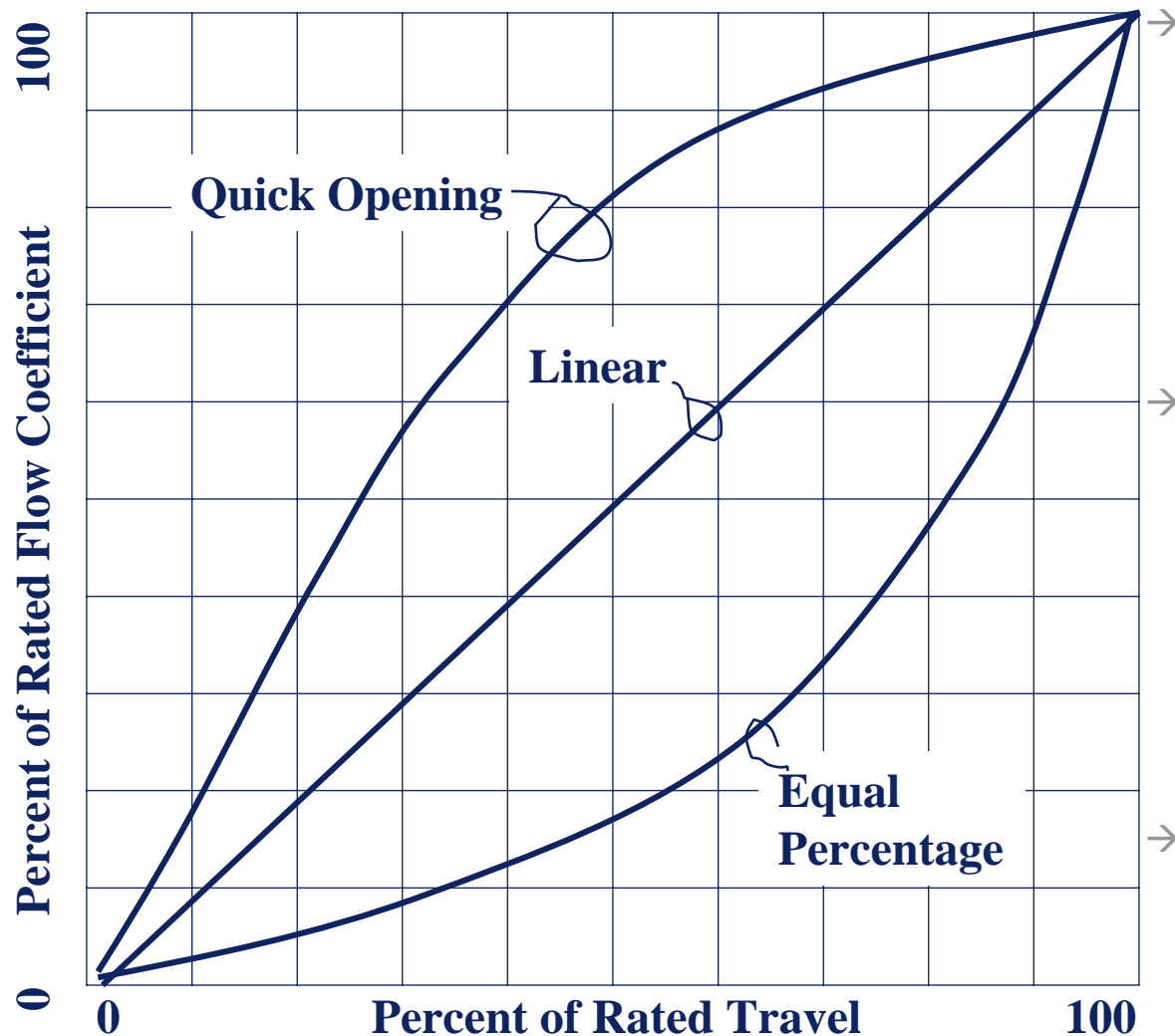
- Fisher Controls sliding stem valve
- May be used with pneumatic or digital positioner (e.g. DVC5000) or electro-pneumatic transducers
- Variety of construction material depending on application i.e. gas or liquid application, temperature, pressure

# Regulating Valve – Rotary Valve



- Fisher Controls V150 Vee-Ball Control Valve
- Flanged valve in sizes from 1-20”.
- Pneumatic or digital positioner (e.g. DVC5000) or electro-pneumatic transducers may be used with valve.

# Valve Characteristic



→ The choice of characteristic has a considerable influence on the achievable control response and control stability.

→ Liquid flow Coefficient,  $C_v$ , is the number of U.S. gallons of water at 60 degrees F that will flow through a valve in one minute at a pressure drop of 1 PSI.

→ Gas and steam flow capacity are defined by coefficients  $C_g$  and  $C_s$

## Valve Actuation - Electro-Pneumatic Transducer (I/P)



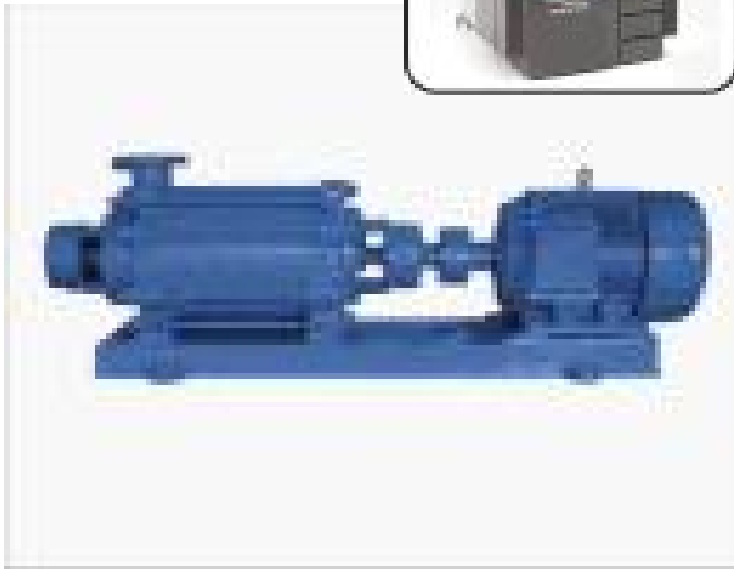
- Air to the valve actuator may be provided directly (no positioner) by Electro-Pneumatic Transducers e.g. Fisher Controls Type 546 or i2P-100
- 4-20ma input is used to provide 3-15 psi or 6-30 psi output to actuator
- **Supply pressure** 5 psi higher than upper range limit of output signal, maximum of 50 psig.

# Damper Drives



- Often used to regulate air flow in large ducts through the regulation of a damper e.g. air flow to a boiler.
- Linkage can introduce deadband in adjustment of damper.

# Motor Variable Speed Drive



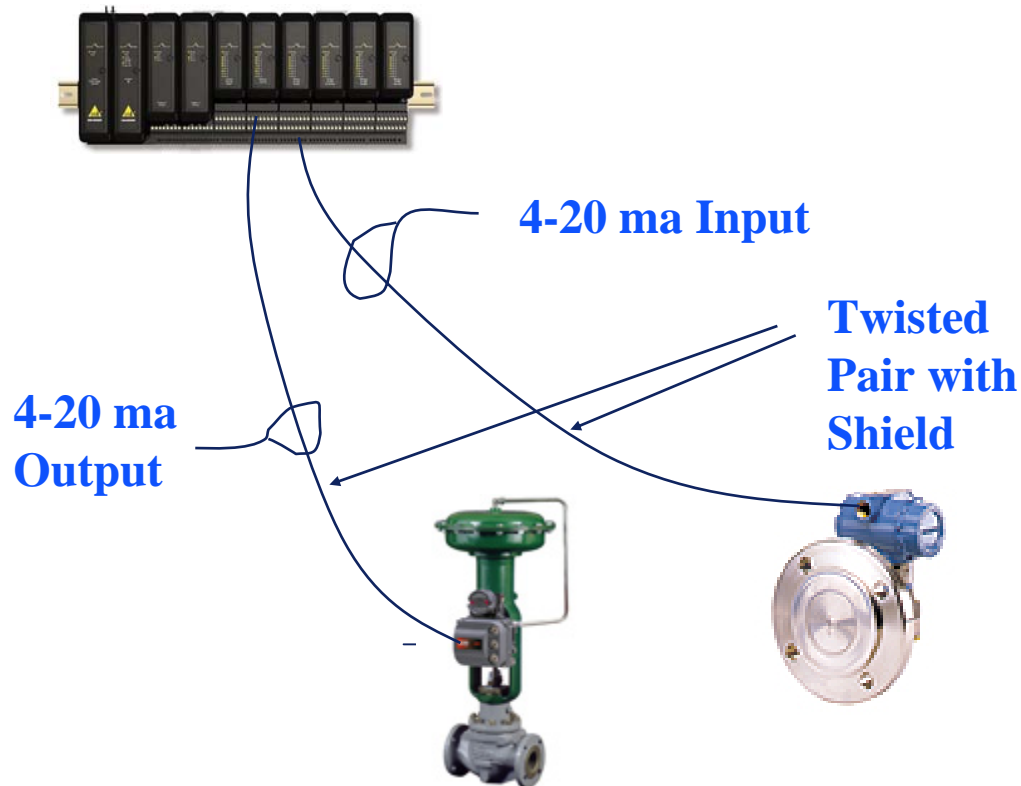
- On flow application, a variable speed motor may be adjust flow through a pump.
- More efficient that throttling flow with a regulating valve after a constant speed pump.
- More costly to install, requires blocking valve to block flow when motor is off.

# Blocking Valves



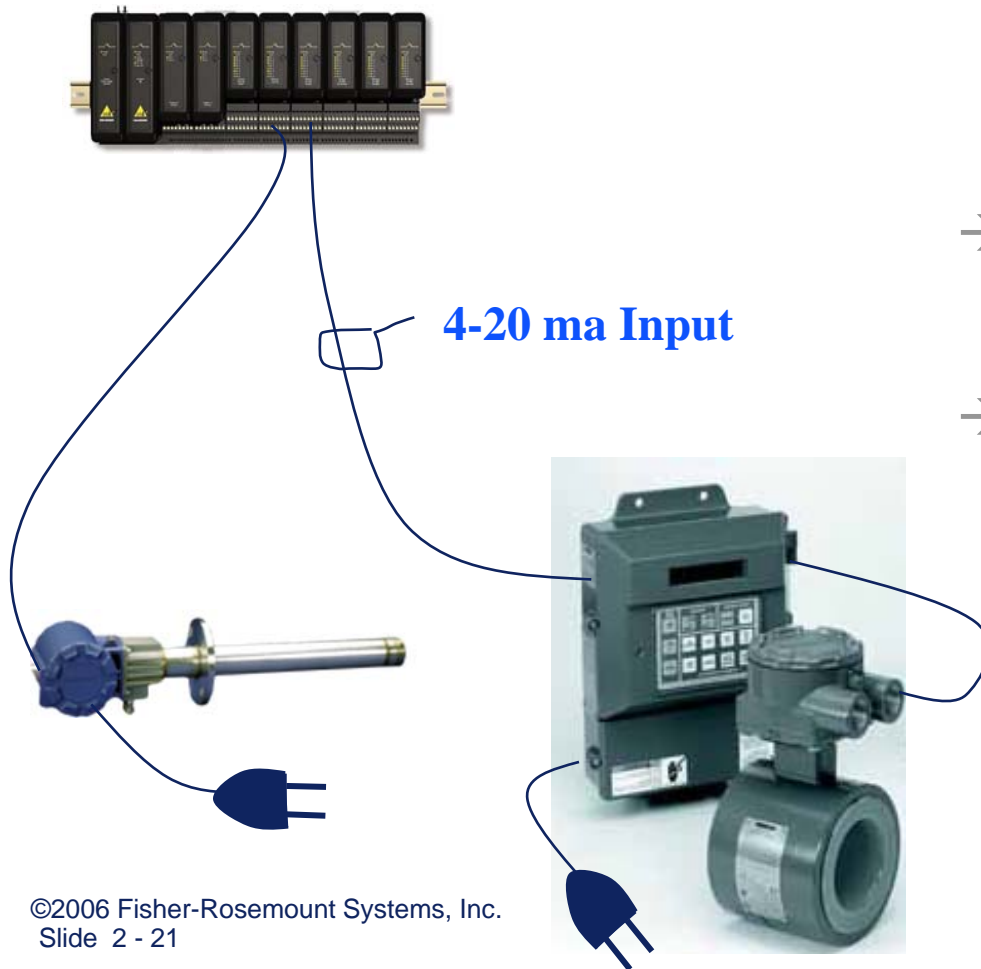
- Used to block or bypass process normal flow path when equipment is not in use.
- Valves may be manually adjusted or automatically set through motorized or pneumatic actuator.
- Blocking valves are not designed for continuous regulation of flow and are equipped with on-off actuators.

# Field Wiring – 2-Wire Devices



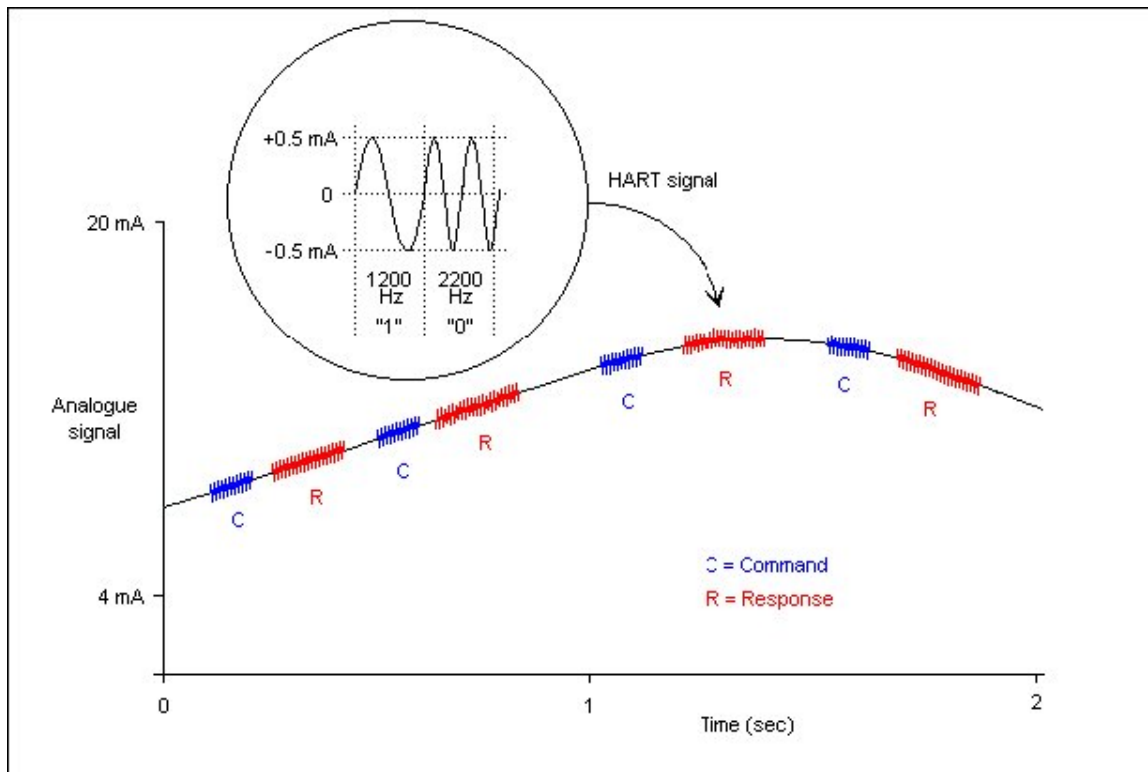
- Power for the device is supplied by the twisted pair.
- Transmitters modulate current proportional to measurement
- Current to valve is modulated by controller to imply target percent open. Based on actuator, I/P or positioner setup, valve may open or close with increasing current

# Field Wiring – 4-wire Transmitter



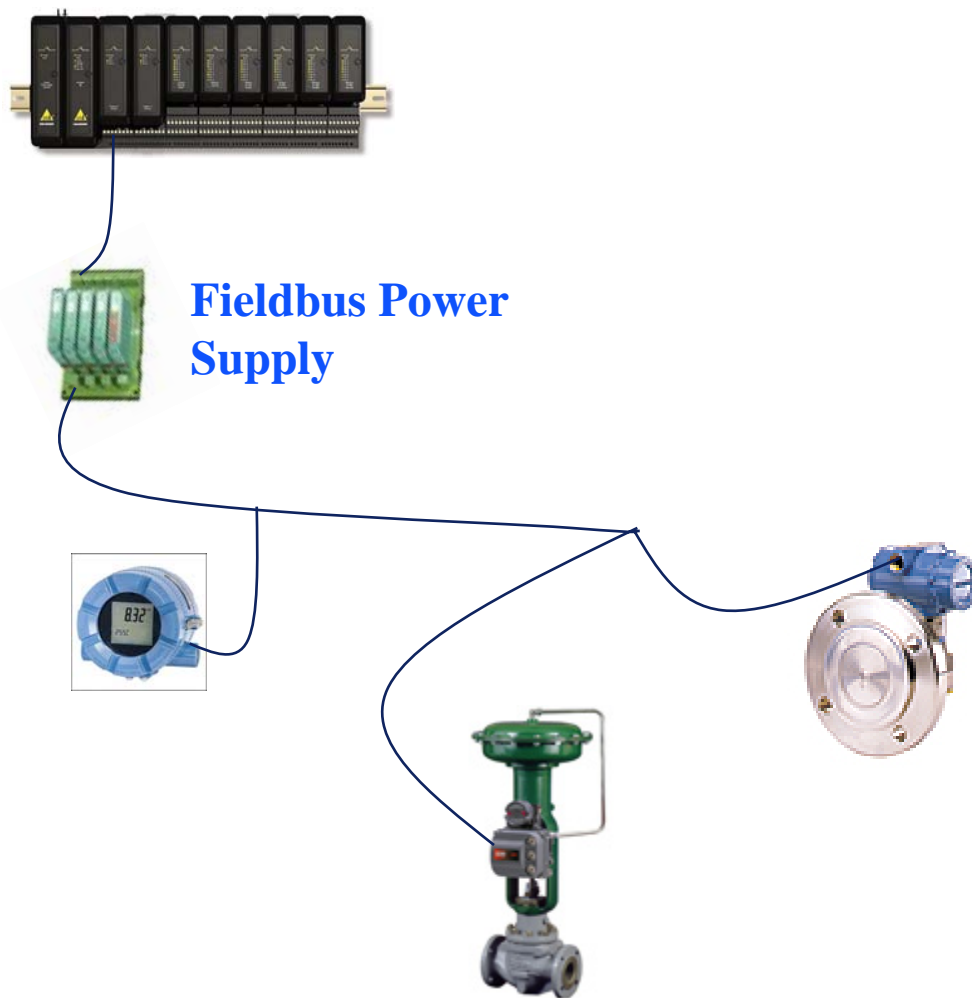
- Analyzers and some types of flow and level transmitters are 4-wire devices
- Auxiliary power is required e.g. 110vac
- Input to the controller should be electrically isolated from the device power and grounding .

# Field Wiring – HART Devices



- HART Protocol supports two way digital communications for process measurement and control devices
- Allows remote process variable interrogation, parameter setting and diagnostics.
- Communication signal is superimposed on top of the 4-20ma signal from 2-wire or 4-wire transmitters
- Digital or analog value may be used for measurement and control

# Field Wiring – Foundation Fieldbus Devices



- Devices may be **multi-dropped from a single twisted pair**
- **All values accessed by digital communication**
- Devices may be powered from the segment or locally powered (similar to traditional 2-wire and 4-wire devices)
- Special power supply and terminators required for each segment
- Measurement, calculations and control may be moved to the fieldbus device