SMT1200 Instrumentation & Control

The course student learning outcomes and College Graduate Competencies

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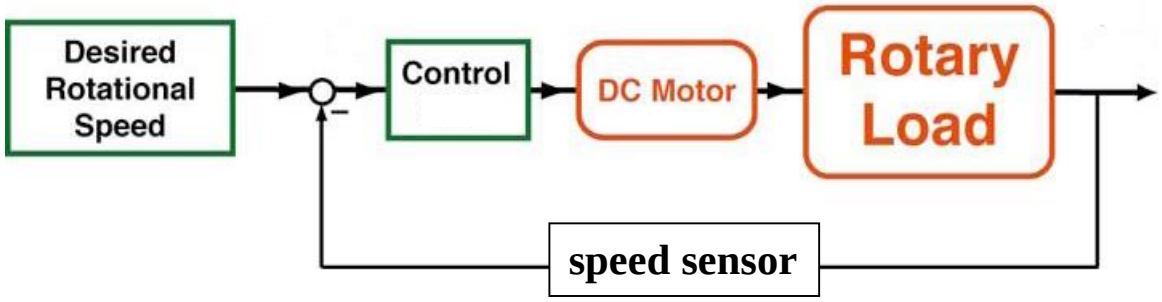
- Understand the basics of control loops;
- Understand the components in control loops;
- Understand the algorithm of PID;
- Calibration, programming and operation of instruments in automation engineering.

Control

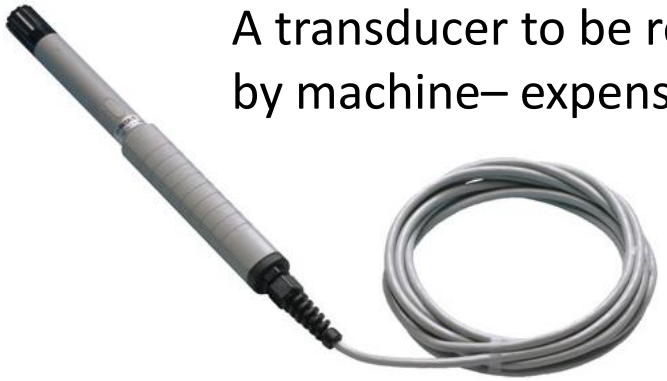
Close loop= sensor + processor + actuator

speed control



Sensors & Transmitters

Honeywell pressure transducer



A transducer to be read by machine– expensive

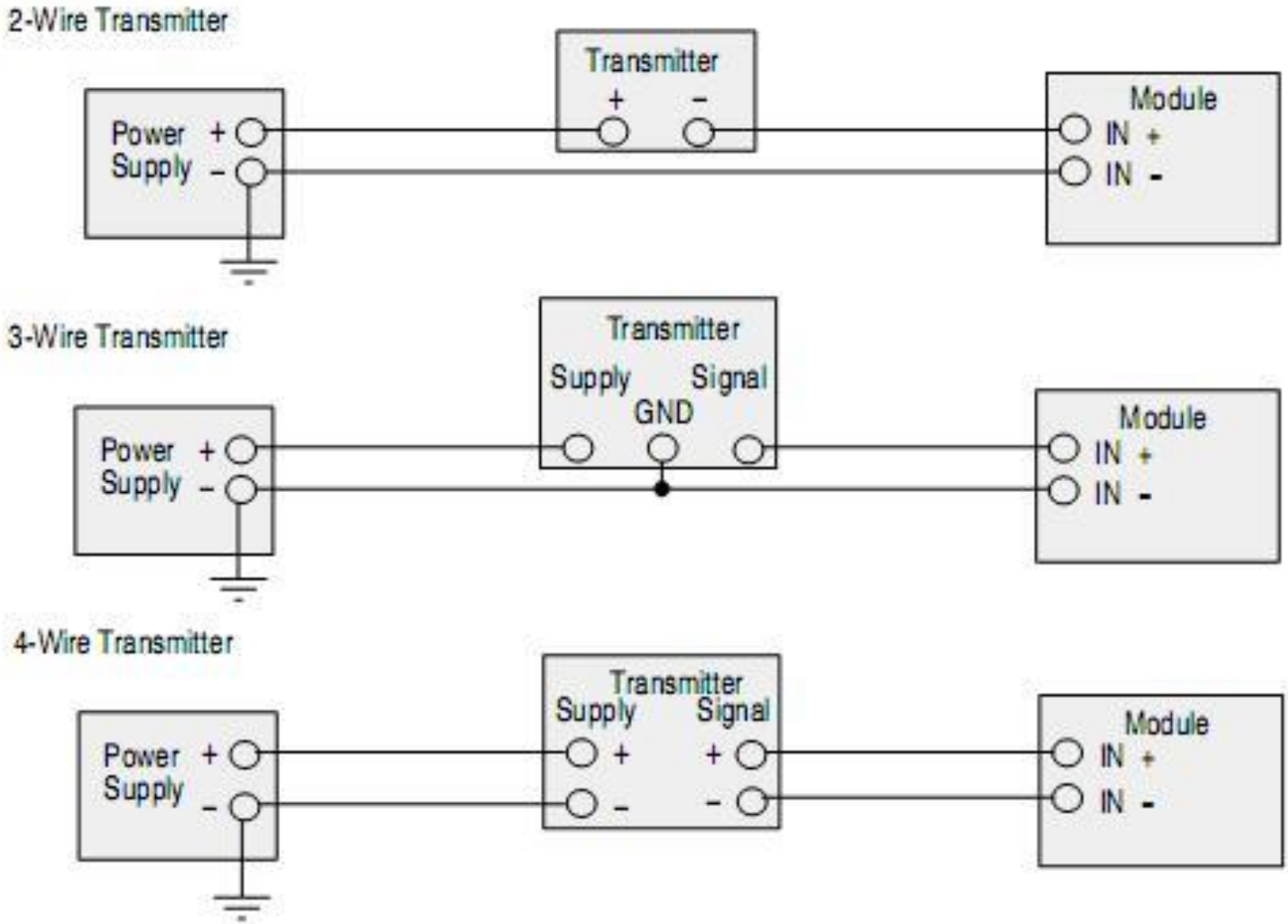
Vaisala Temperature & Humidity Transducer

A sensor to be read by human- cheap

Thermometer in thermowell

http://www.instrumentationtoolbox.com/2011/03/how-to-calibrate-your-dp-transmitter.html#axzz3IuQhN4da
http://www.instrumentationtoolbox.com/2013/05/how-to-calibrate-smart-transmitters.html#axzz3IuQhN4da

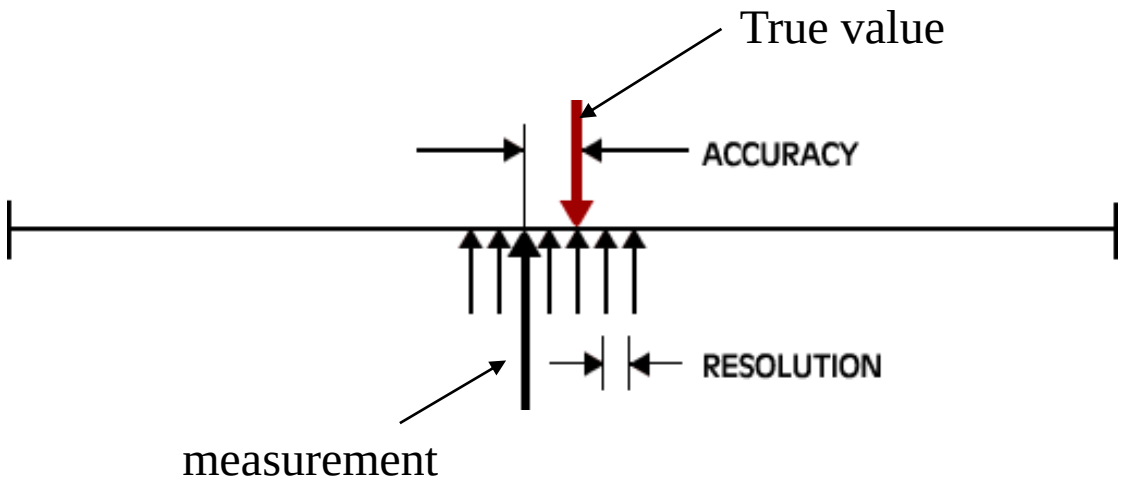
Wiring Schematics for 2, 3, and 4-Wire Analog Input Devices



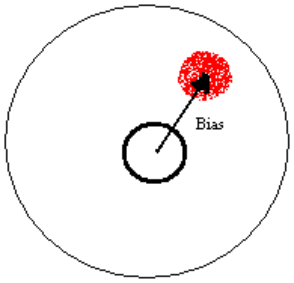
Specifications of Sensor

- **Accuracy:** error between the result of a measurement and the true value being measured.
- **Resolution:** the smallest increment of measure that a device can make.
- **Sensitivity**: the ratio between the change in the output signal to a small change in input physical signal. Slope of the input-output fit line.
- **Repeatability/Precision**: the ability of the sensor to output the same value for the same input over a number of trials

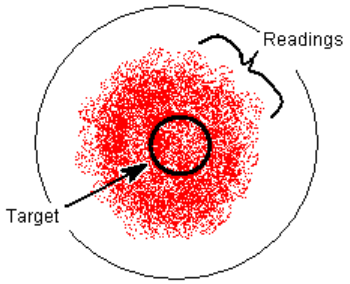
Accuracy vs. Resolution



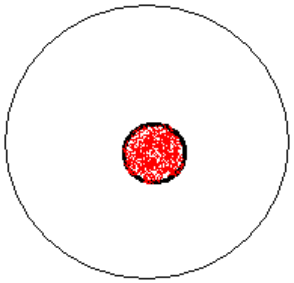
Accuracy vs. Precision



Precision without accuracy



Accuracy without precision



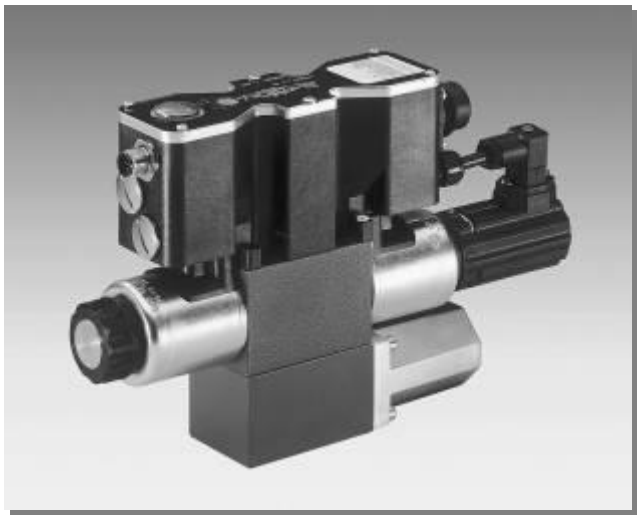
Precision and accuracy

Actuators

Variable frequency drive (VFD)
The higher the output frequency, the higher the motor speed.

Hydraulic Proportional Valve

- In a hydraulic system, proportional control allows an actuator or control valve to operate at any value between 0 and 100%.
- The proportional valve is an electrical solenoid valve with a more precise spool and more powerful coil.
  - Since the voltage or current must be varied, an electronic amplifier is used between the valve and the PLC.



Proportional valve

Amplifier

HYDRAULIC PROPORTIONAL CONTROL

Typical voltage/current signals for proportional hydraulic valves.

TABLE 5-2 Proportional Voltage and Current Signals

Percent	Volts	Milliamps
100	10	20.0
90	9	18.4
80	8	16.8
70	7	15.2
60	6	13.6
50	5	12.0
40	4	10.4
30	3	8.8
20	2	7.2
10	1	5.6
0	0	4.0

https://www.youtube.com/watch?v=sFqFrmMJ-sg
https://www.youtube.com/watch?v=fv6dLTEvl74
https://youtu.be/MF8lmQTkMyE