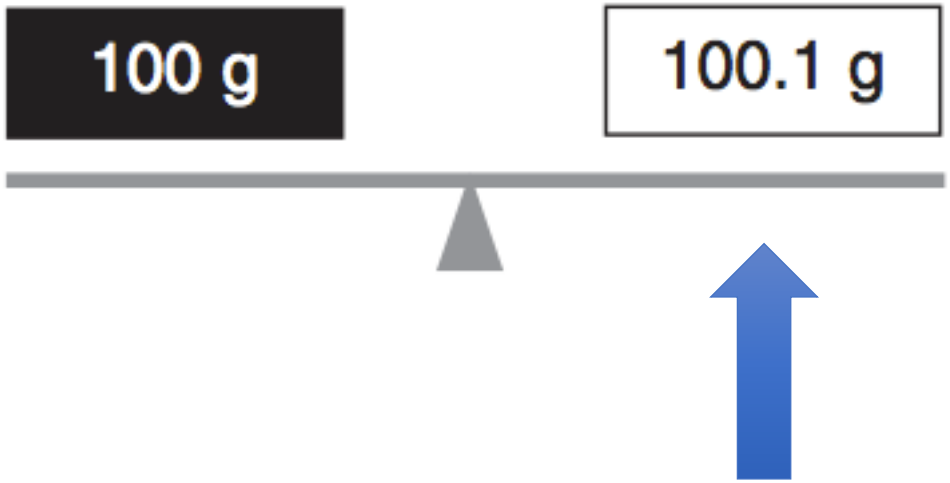
Introduction to Environmental Sensors

Sensor Definitions

- **Accuracy** – ability of a measurement to provide a result that is close as possible to the actual value
- **Precision** – amount of agreement between repeated measurements of the same quantity
- **Resolution** – the smallest increment of a measurement
- **Hysteresis** – delayed response of a measurement
- **Linearity** – the quality of delivering identical sensitivity throughout the measurement

Accuracy

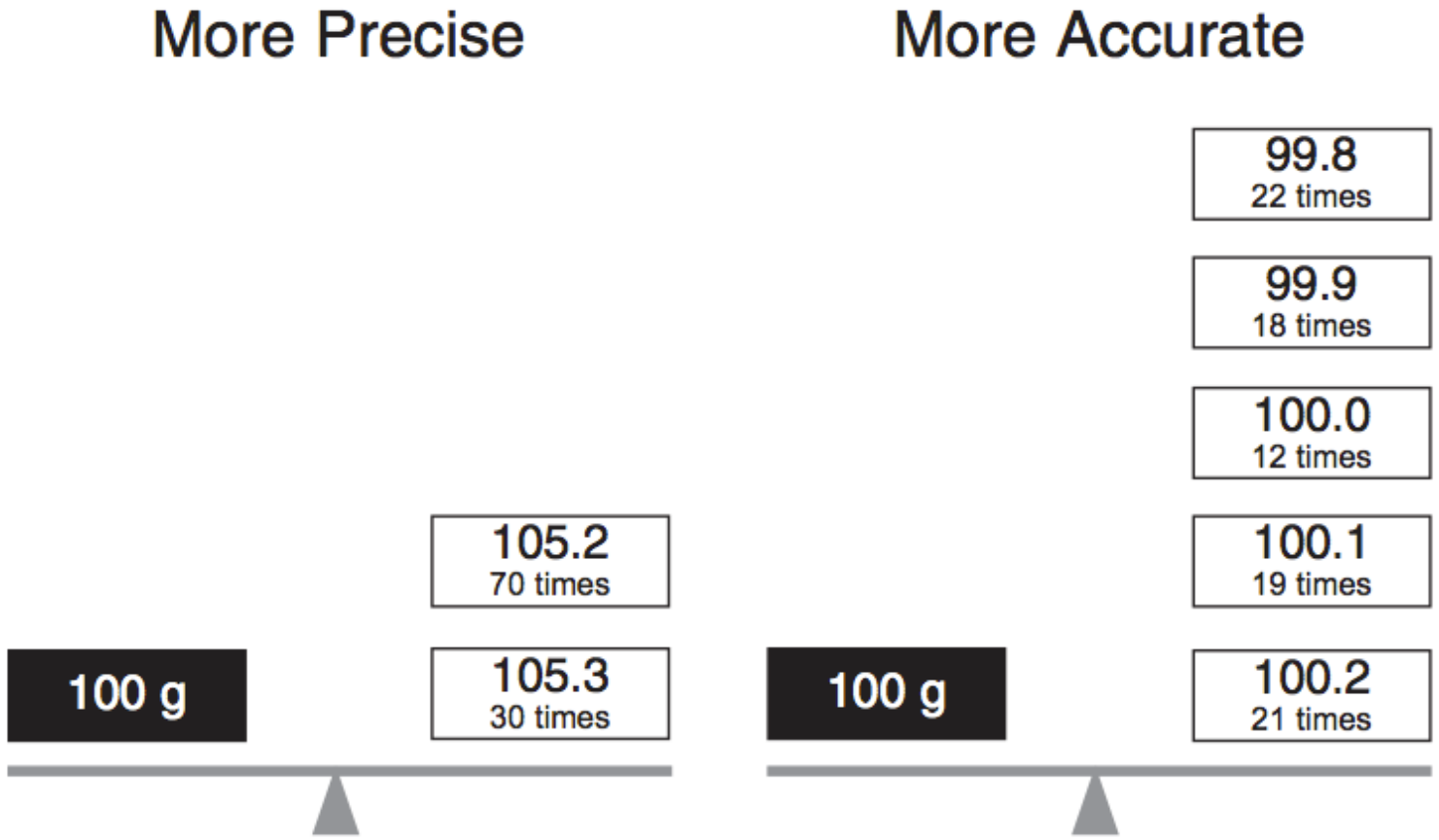
The ability of a measurement to provide a result that is close as possible to the actual value



Accuracy = 0.1 g

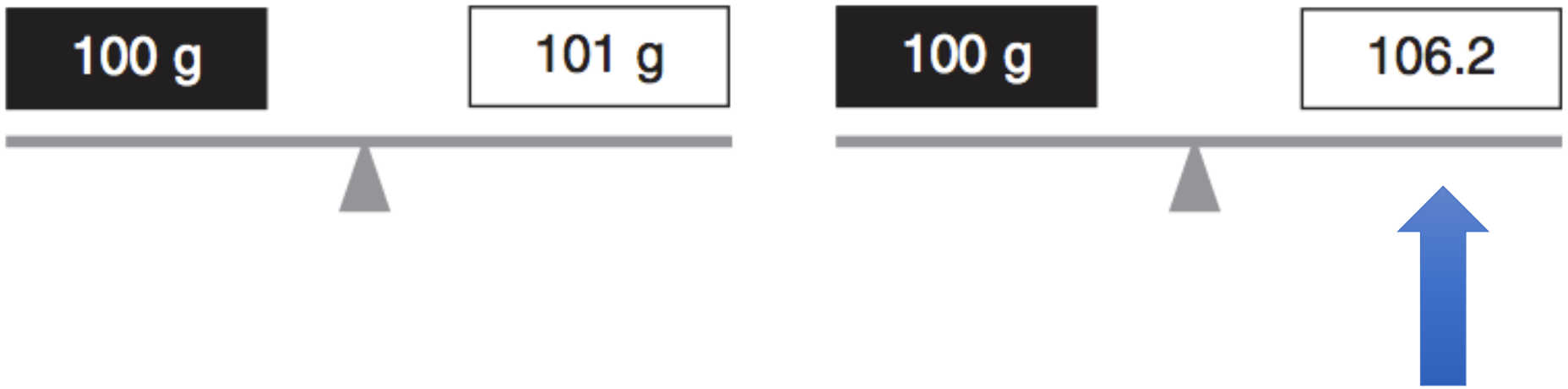
Precision (Repeatability)

The amount of agreement between repeated measurements of the same quantity



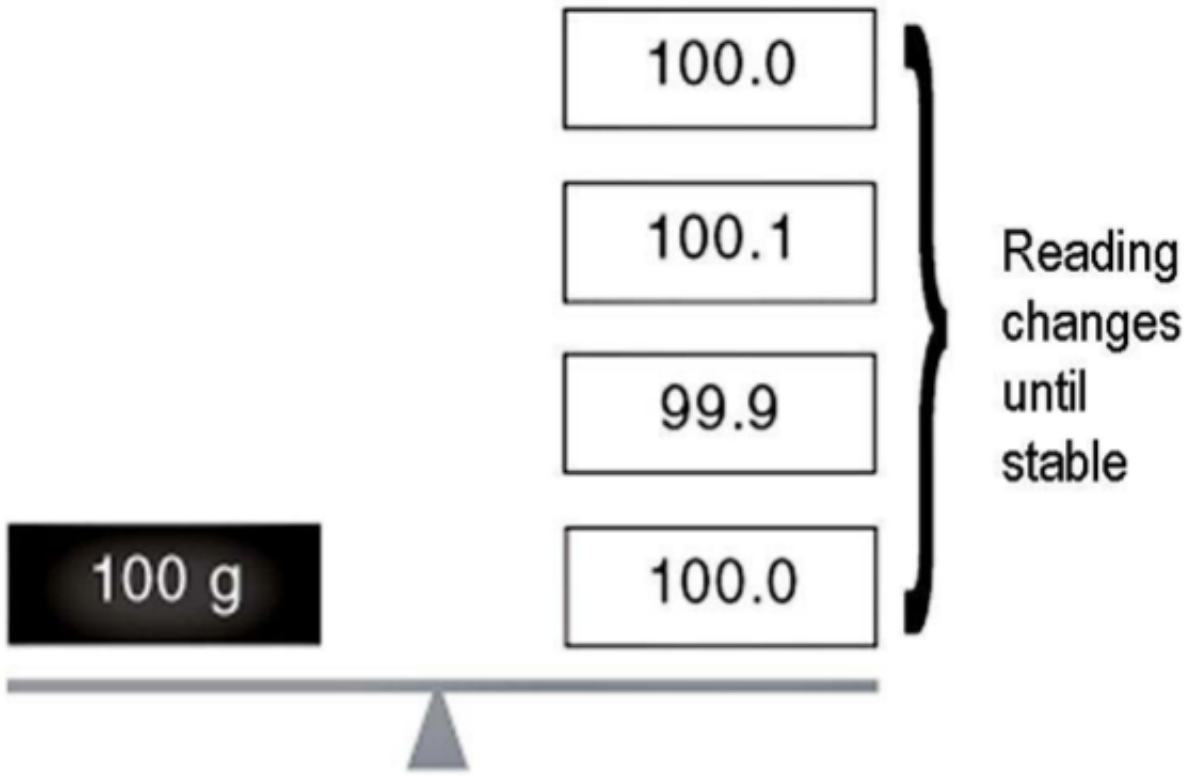
Resolution

The smallest increment of a measurement



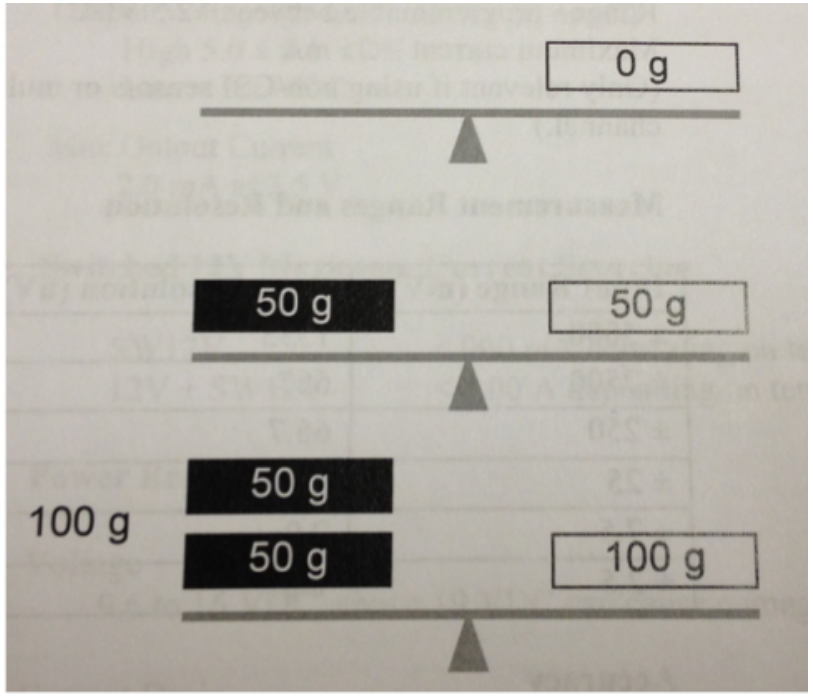
Hysteresis

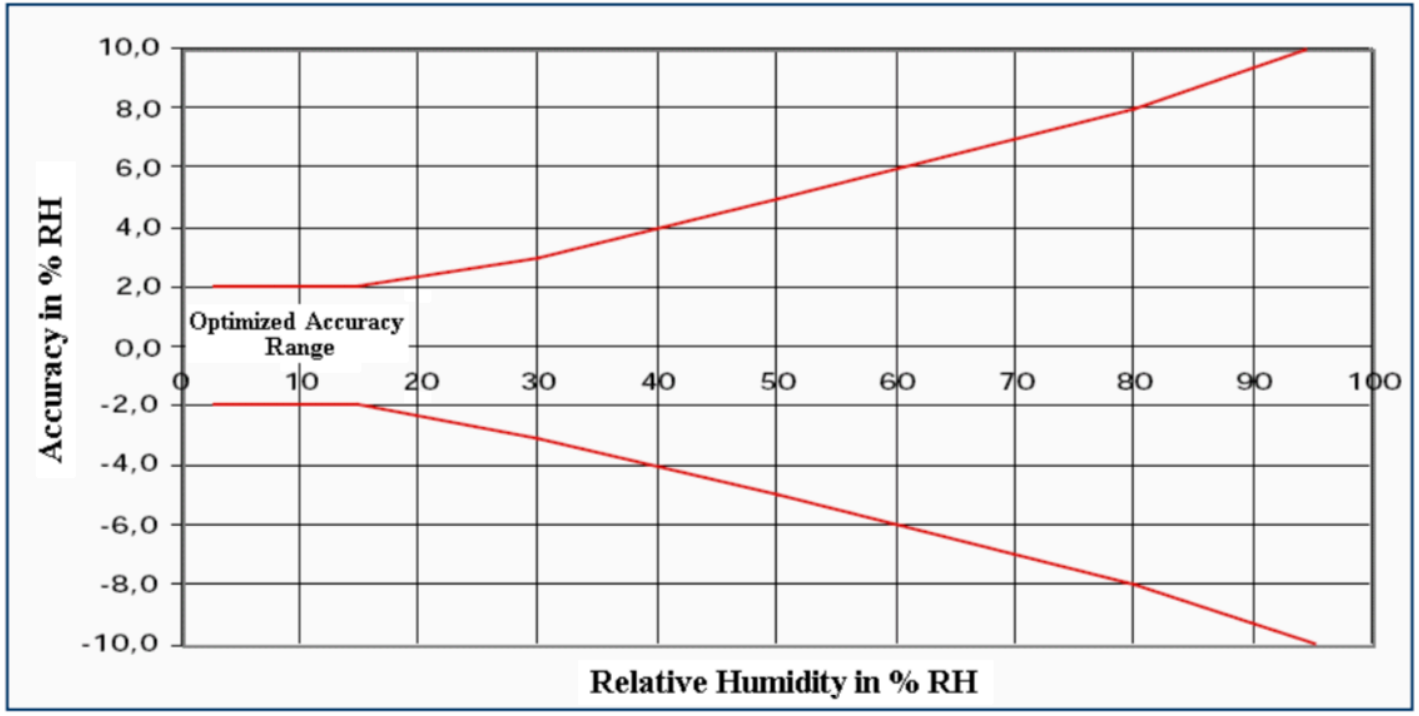
Delayed response of a measurement



Linearity (& Sensitivity)

The quality of delivering identical sensitivity throughout the measurement





Analog Sensors

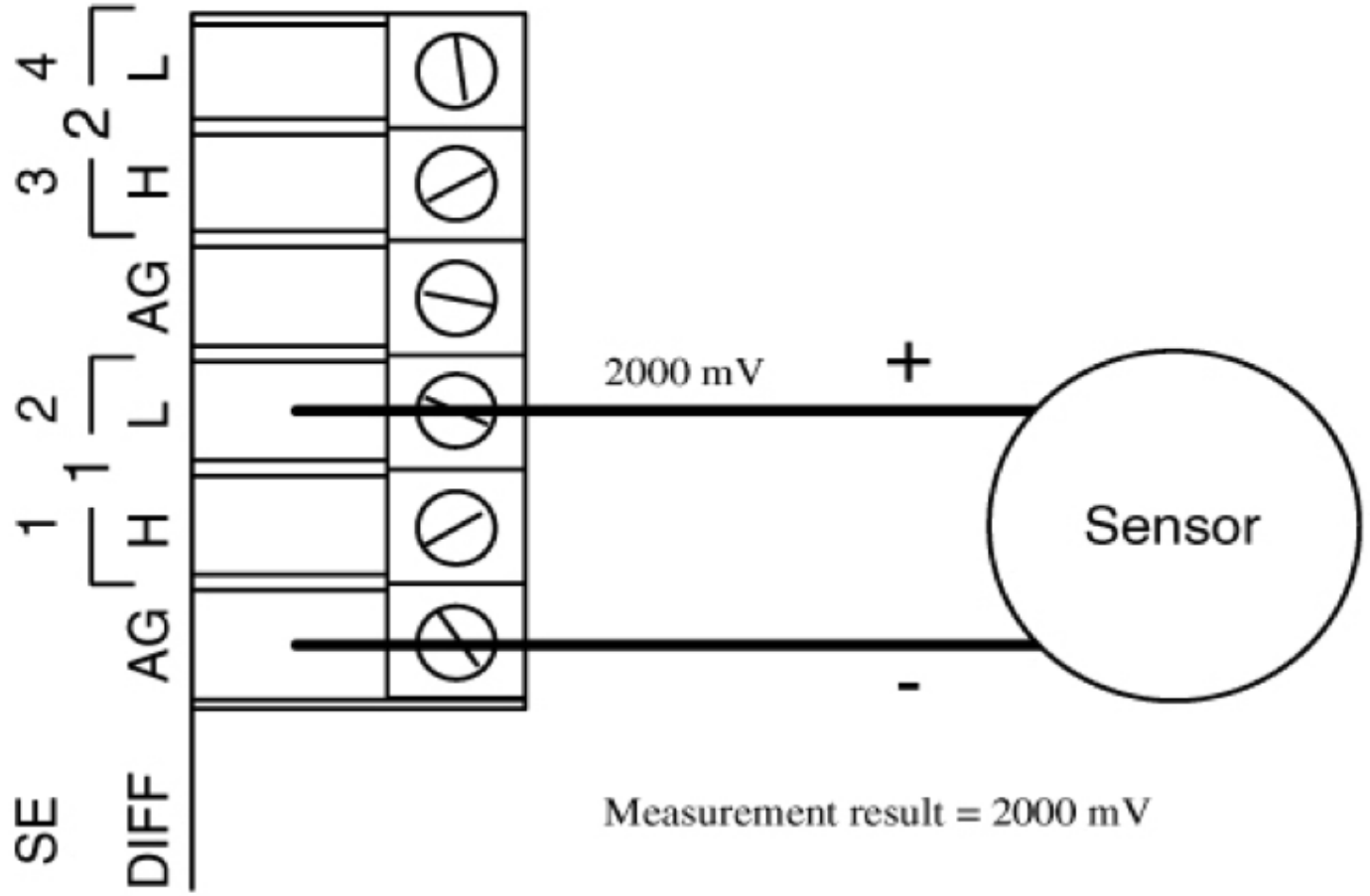
- Output continuous voltages that vary with the phenomena measured
- Connect to analog terminals
- Single Ended (SE) channels – measured with respect to ground
- Differential (DIFF) channels – measured with respect to another input channel
  - **8 Differential & 16 Single Ended Channels**

Differential	SE
1H	1
1L	2
2H	3
2L	4

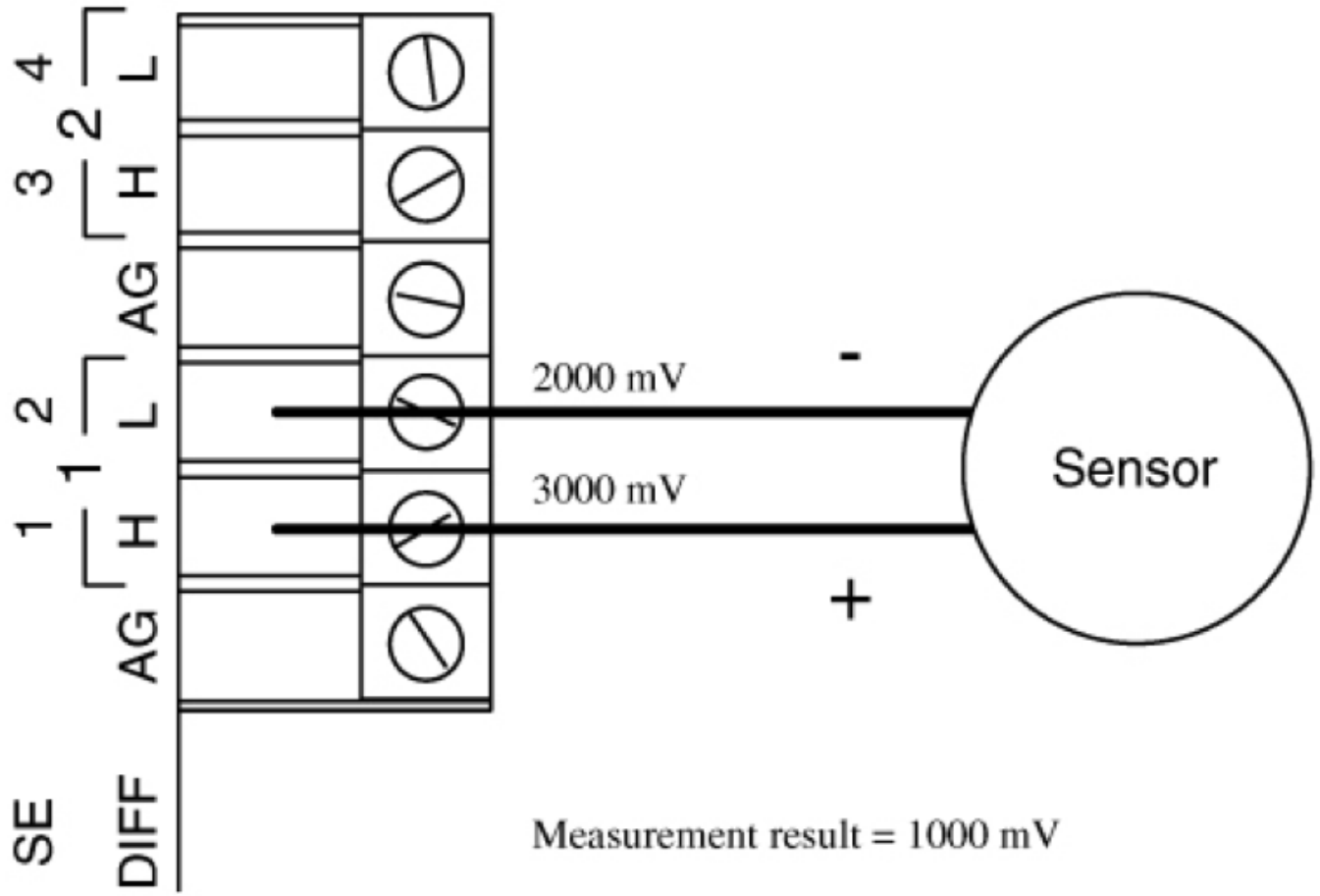
Analog Sensors

- Many analog sensors can connect to either SE or DIFF channels
- Pro of SE wiring: can connect twice as many sensors
- Con of SE wiring: data are generally noisier
- Rule of thumb: always connect sensors differentially if you have space to do so to get cleaner data

Analog Sensor wired to SE Channel #2

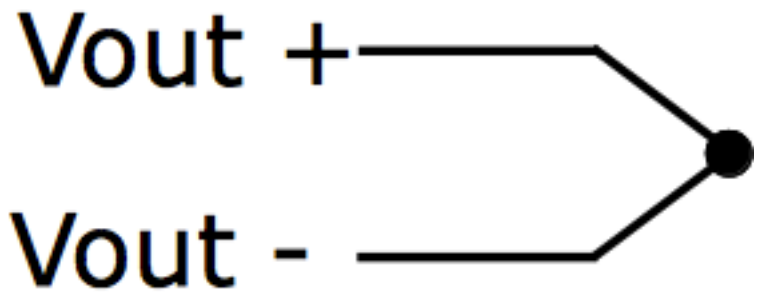


Analog Sensor wired to DIFF Channel #1



2-wire Voltage Sensor

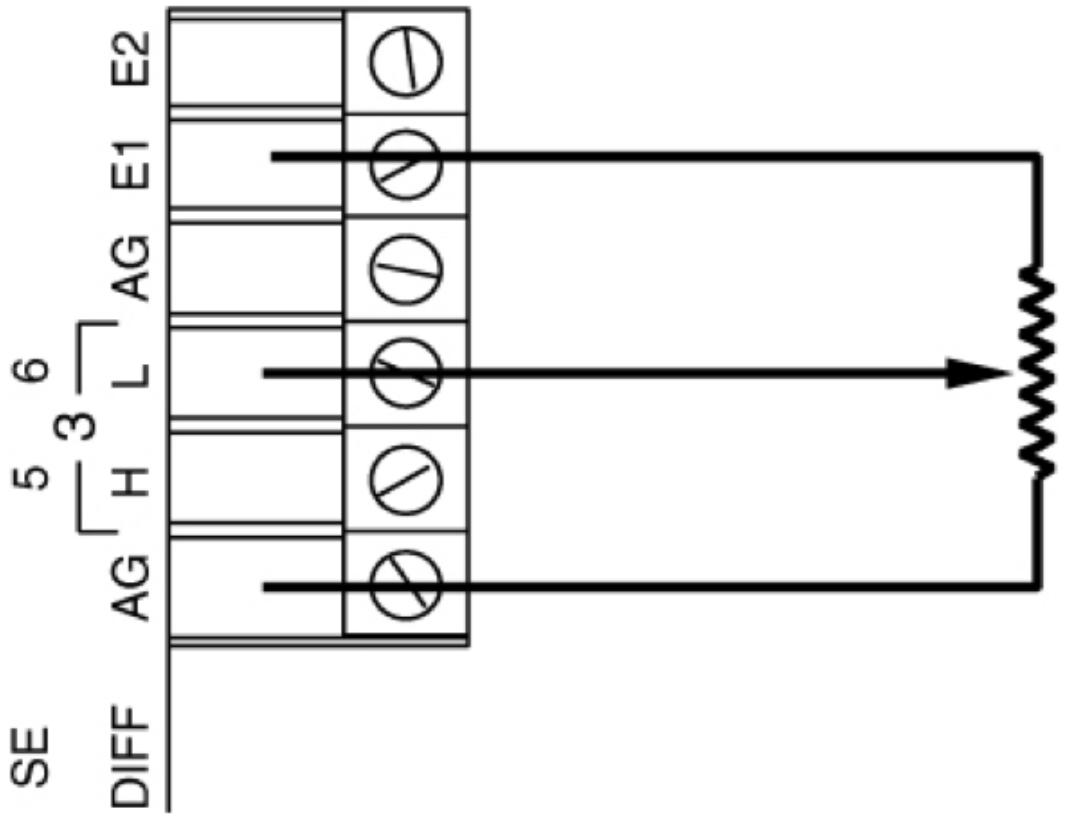
- Can be single ended or differential
- E.g., a thermocouple



Bridge (Resistance) Sensors

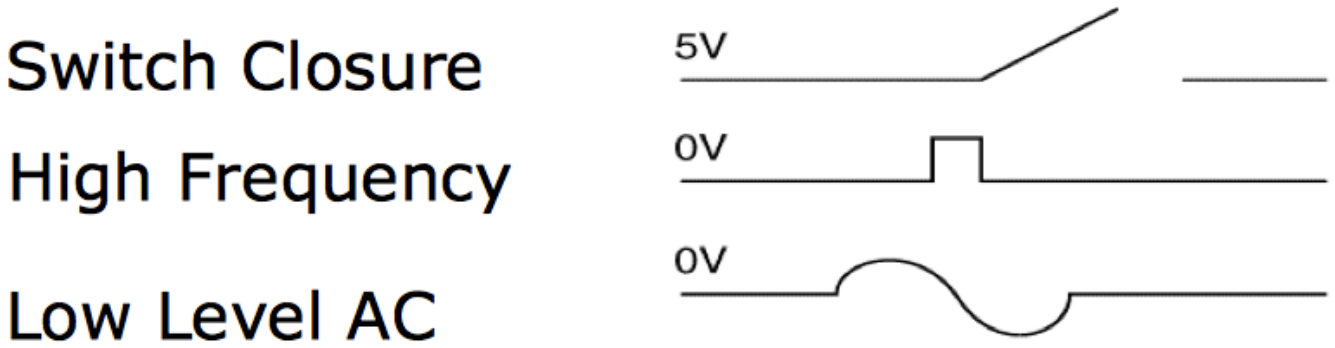
- Change resistance with respect to environmental change
  - E.g., a thermistor
- Datalogger provides precise excitation voltage via the Excitation terminals (*labeled EX1-3 or VX1-3 depending on your datalogger model*)
- Sensors are measured on analog terminals

Potentiometer from Wind Vane wired to Excitation Channel #1

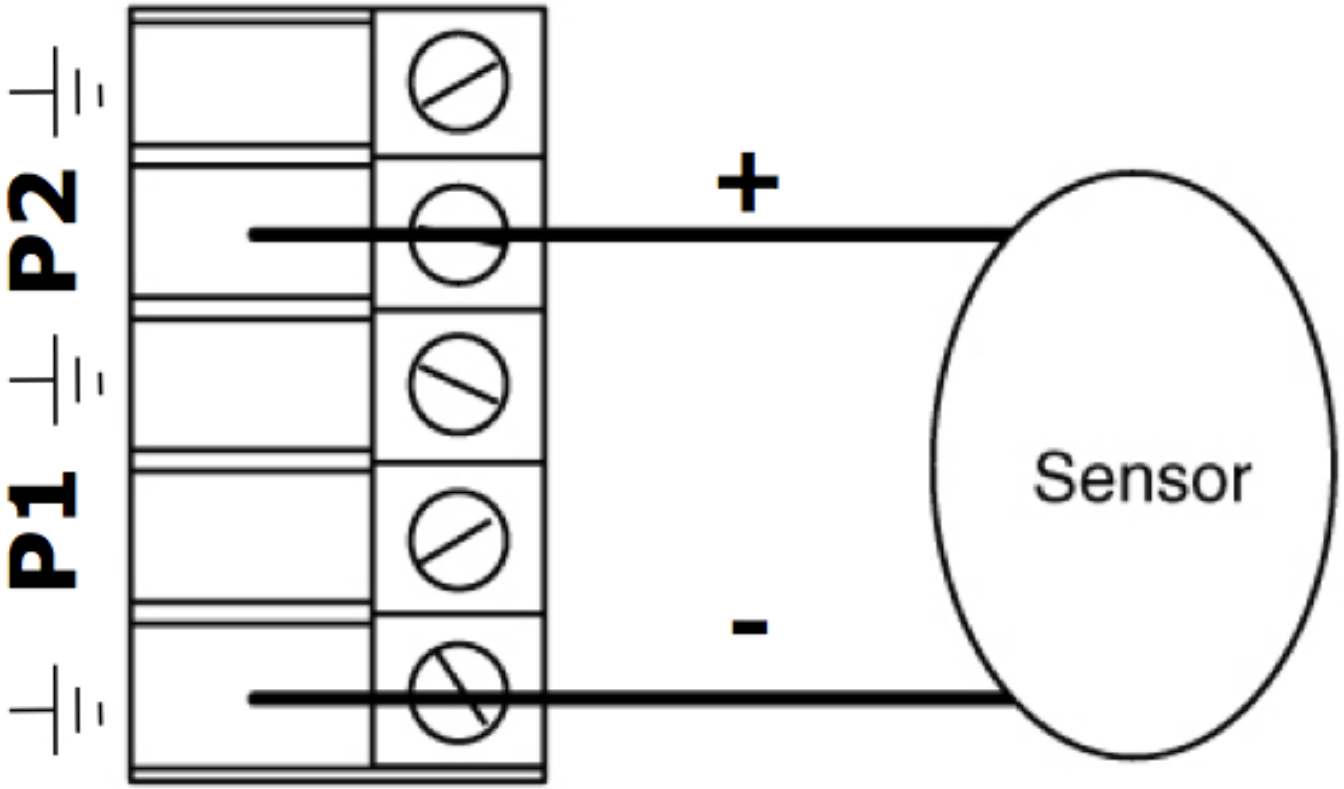


Pulse Sensors

- Connected to a Pulse terminal (*P1, P2*)
- Datalogger can measure switch closures, AC signals, or digital pulses (0-5v)



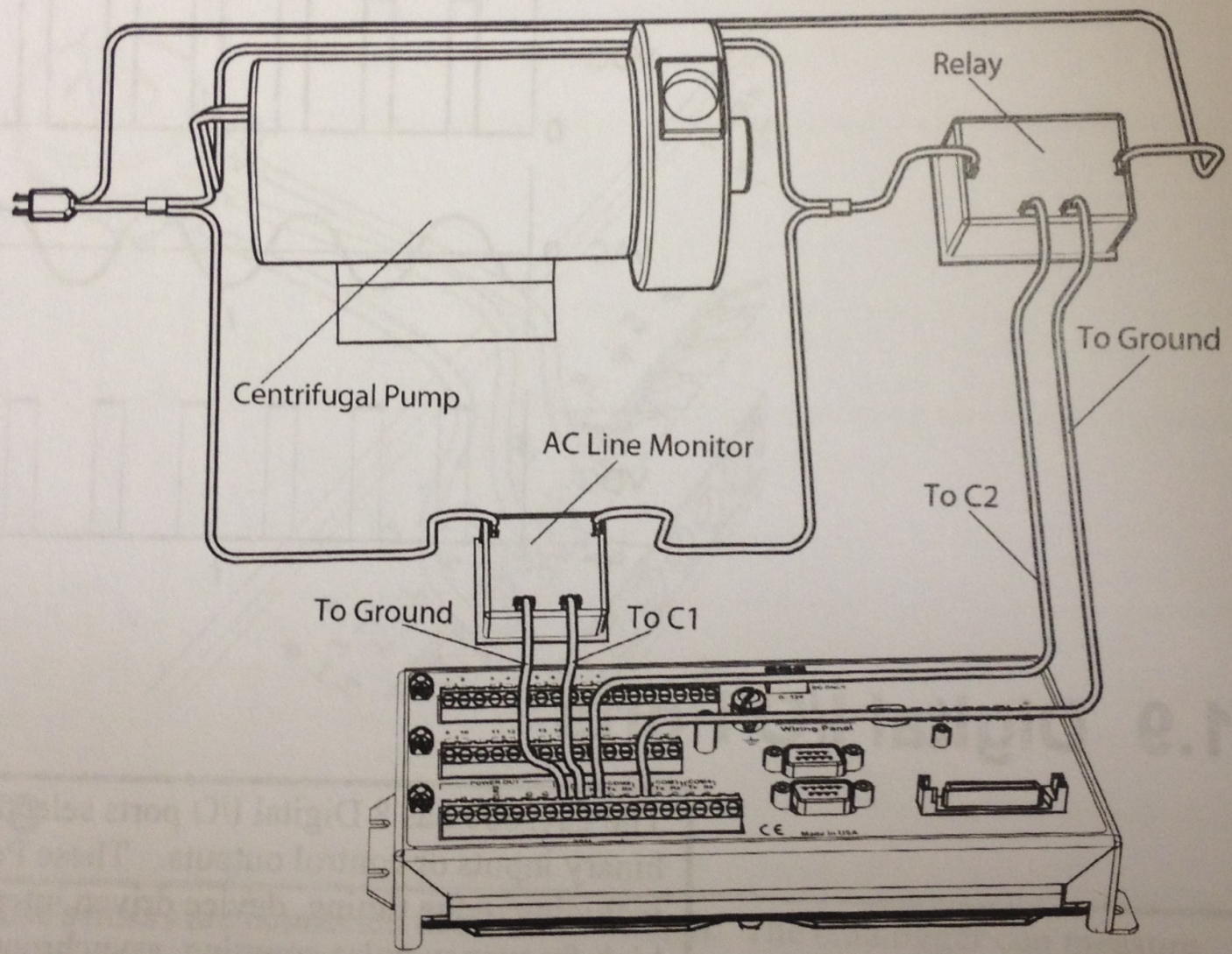
Anemometer wired to Pulse Channel #2



Digital I/O Ports

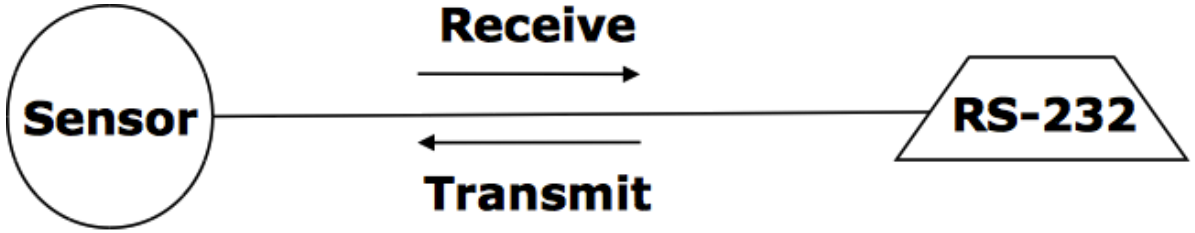
- CR1000 has 8 Digital I/O ports (*C1-C8*)
- High = 5v; Low = 0v
- Programmed as binary **inputs** or control **outputs**
- Used for:
  - Relays
  - Pulse Counting
  - Asynchronous communications
  - SDI-12 communications
  - SDM communications, etc..

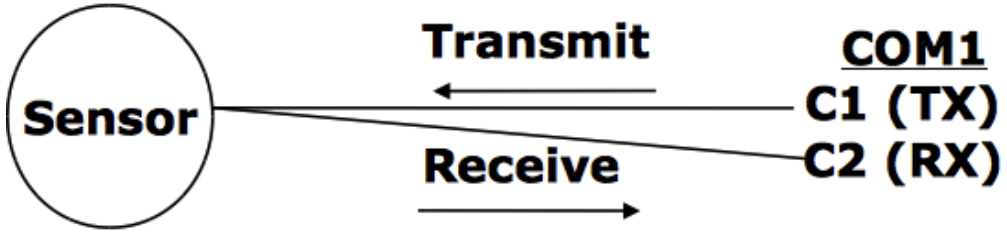
Digital I/O Ports Used to Control/Monitor Pump



RS-232 Sensors

Connect to RS-232 terminal or Digital I/O ports





SDI-12 Sensors

- **S**erial **D**igital **I**nterface at **12**00 Baud
- Asynchronous serial communications protocol
- Each sensor identified by unique address
- E.g., YSI multiparameter sondes

Group Discussion: Campbell Scientific vs. Other Vendors vs. Arduino