ENCODER RESOLUTION

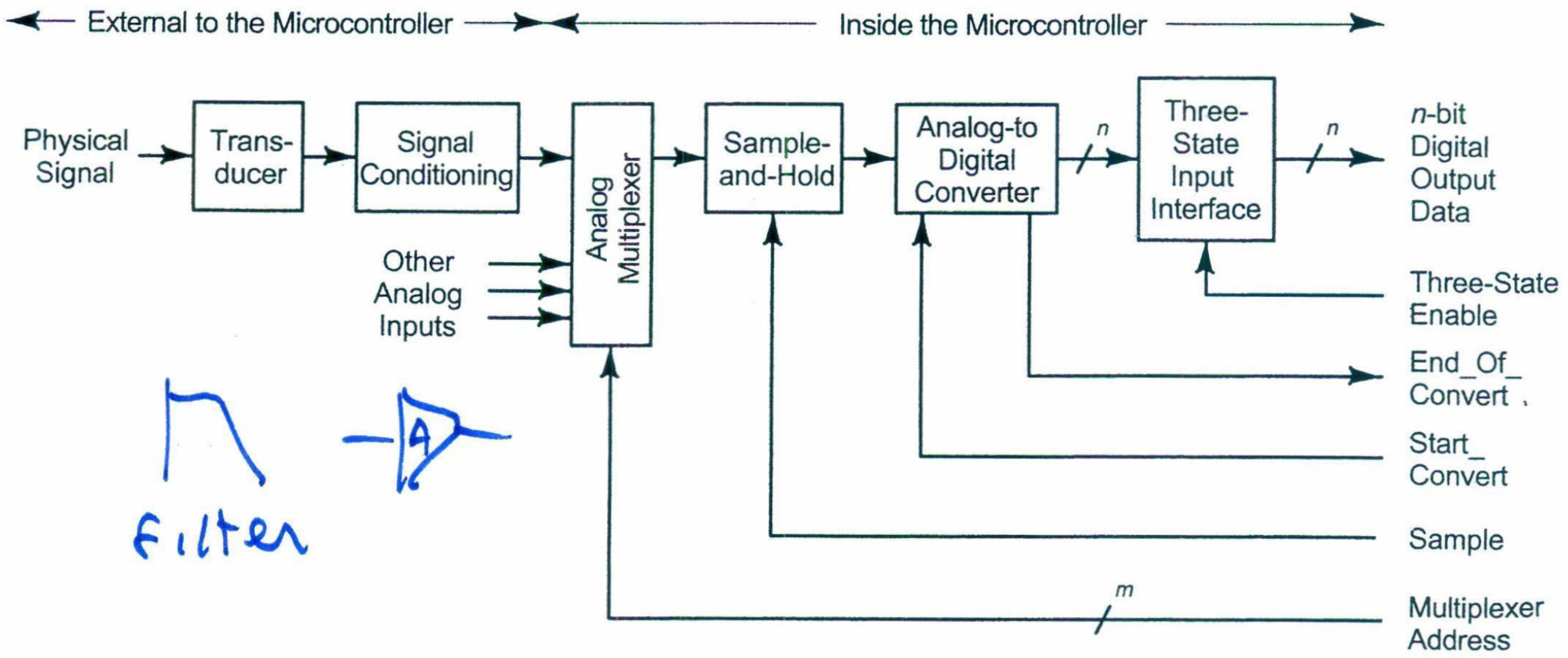


Figure 13-1 Data acquisition system.

• **Resolution:** Resolution is the minimum step size within the range of measurement of the sensor. In a wire-wound potentiometer, it will be equal to the resistance of one turn of the wire. In a digital device with *n* bits, the resolution will be

$$\text{Resolution} = \text{Full Range}/\ 2^n$$

For example, an absolute encoder with 4 bits can report positions up to $2^4 = 16$ different levels. Thus, its resolution is $360/16 = 22.5°$.

Accuracy: Accuracy is defined as how close the output of the sensor is to the expected value. If for a given input, the output is expected to be a certain value, the accuracy is related to how close the sensor's output is to this value.

A2D & ENCODERS

ERRORS

KLAFTER P238 – 242

A2D CONVERTER –

ACCURACY $\approx \frac{1}{2^m}$ for m-bits

10 bits $\frac{1}{1024} \times 100 \doteq 0.1\%$

IN EXAMPLE 4.5.1 HE USES 13 BITS

WOULD USE 14-bits

$2^{14} = 16384$ about 0.0061%

For 10V Full scale $\Delta V \approx 610\,\mu V$.

ENCODER ACCURACY

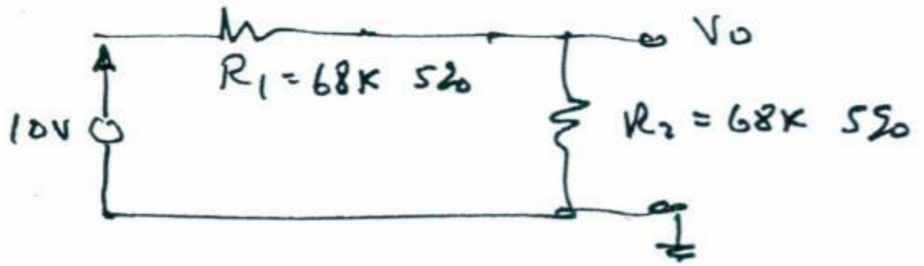
200 lines or counts / revolution

$\Delta\theta = \frac{360^\circ}{200} \doteq 1.8^\circ$ measure as θ_1

$\frac{\theta_2}{\theta_1} = \frac{1}{50}$ so $\Delta\theta_2 = \frac{1}{50}\Delta\theta_1 = \frac{1.8^\circ}{50} = 0.036^\circ$

Use Gears

(1) Tolerance



$$V_{OUT} = V_{IN} \frac{R_2}{R_1 + R_2}$$

(1) If $R_1 = R_2 = 68K$ $\quad V_0 = 5.00$ volts

(2) Let $R_1 = 68K(.95) = 64.6K$

$R_2 = 68K(1.05) = 71.4K$

Thus if $R_2 = 68K \pm 5\%$, low voltage out

$$V_0 = 10 \times \frac{64.6}{64.6 + 71.4} = 4.75 \text{ volts}$$

If $R_2 = 71.4$; $R_1 = 64.6$, high voltage out

$$V_0 = 10 \times \frac{71.4}{R_1 + R_2} = 5.25 \text{ volts}$$

YOU COULD MEASURE EACH RESISTOR AND SELECT THE BEST –
OR DESIGN A FEEDBACK SCHEME TO REDUCE THE EFFECT OF THE VARIABILITY.

https://electronics.stackexchange.com/questions/98357/is-the-error-in-a-5-resistor-consistent-across-measurements

> What I'm really saying is that if a given resistor is "off" by 3.5% I don't really care... as long as it's **always** off by the same 3.5%. But if from one measurement (voltage? current?) to another it might be +2% one time and -3% another time, then I need to get higher quality components ?

The answer to your questions is mostly covered in the data sheets. A 5% tolerance resistor will also have a specification for temperature drift, "load life" (drift with time under certain environmental conditions) and so on. It's possible to make a 1% resistor that is just as crappy as a 5% resistor in stability, it's just trimmed closer to begin with (and at a certain temperature). Calibration can reduce the initial inaccuracy, but it won't reduce the other kinds of drift. The drift will determine whether you can make a 0.1% circuit with 1% resistors or a 0.5% circuit with 5% resistors.

Temperature Coefficient	1 Ω ≤ R ≤ 10 Ω	±200 ppm/°C
	10 Ω < R ≤ 10 MΩ	±100 ppm/°C
	10 MΩ < R ≤ 22 MΩ	±200 ppm/°C