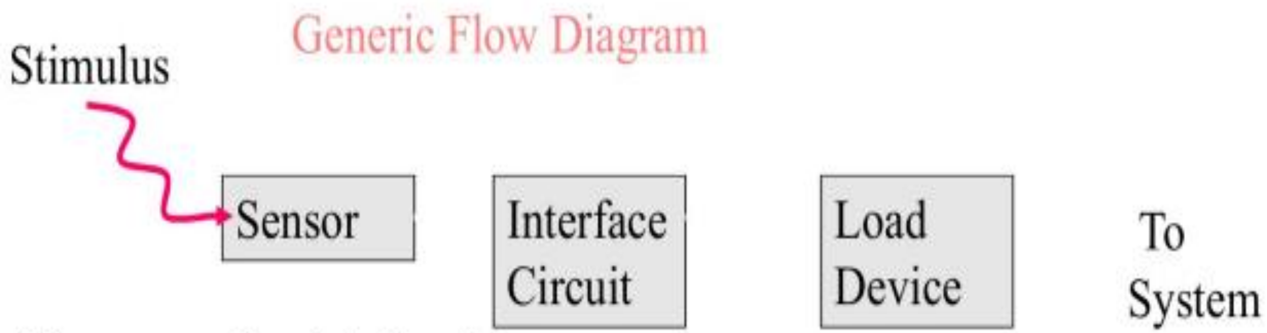
Why need interface

Sensor electronics can limit the performance, cost and range of application of the sensor.



Why we need an Interface?

Sensor's output electrical signals are normally

1. **Very week:** For example passive sensors like piezoelectric, thermoelectric etc. produce signals of the order of milli Volts=10^{-3}V or pico ampere=10^{-12}ampere. While data acquisition systems like analog/digital converter, frequency modulator or other systems need input of the order of Volts or milliampere (mA).

So signal must be amplified.

Why we need an Interface? continued

2.Lots of noise: interference noise, inherent noise.
There are various sources of noise which are difficult to avoid. Thermal noise, white noise, shot noise.

Noise must be filtered or reduced.

3.Undesirable components.

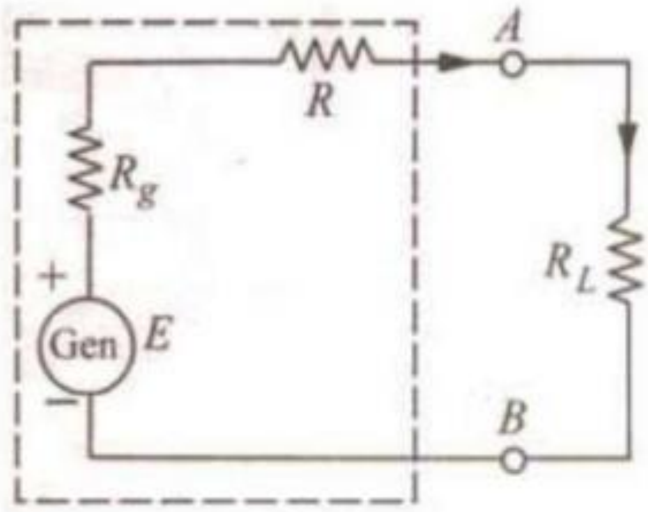
They must be removed.

4. Output signal is not in a compatible format according to the requirements of the data acquisition systems.

Output must be generated in a right format

Maximum Power Theorem
as applied to DC Circuits

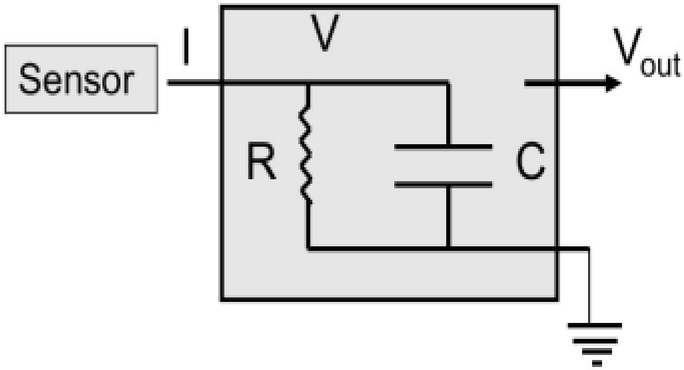
- *A resistive load will abstract maximum power from a network when the load resistance is equal to the resistance of the network as viewed from the output terminals, with all energy sources removed leaving behind their internal resistances*
- Let $R_i = R_g + R$ = internal resistance of the network as viewed from *A* and *B*.

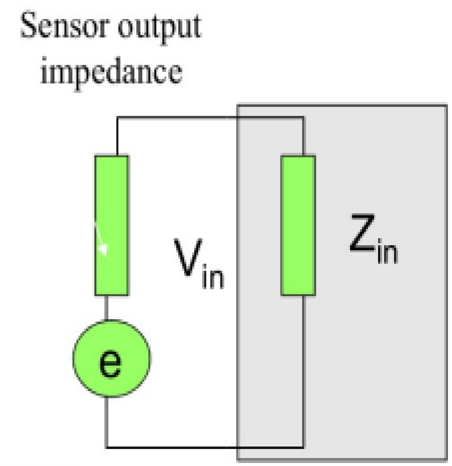


According to this theorem, *RL* will abstract maximum power from the network when $R_L = R_i$

Interface circuit's parameters:

These parameters help us to know how accurately the signal will be processed by the interface.





$$Z = \frac{V}{I}$$

If the effective impedance of the an interface appears a parallel combination of a capacitor, C, and a resistance R , then

$$Z = \frac{R}{1 + j\omega RC}$$

Frequency Response of the sensor interface

The frequency response and phase lag of the sensor interface system depends on the nature of Z_{out} and Z_{in}.

$$Z_{in} = \frac{R}{1 + j\omega RC}$$

$$V = E\frac{Z_{in}}{Z_{in} + Z_{out}} = \frac{E}{1 + \frac{Z_{out}}{Z_{in}}}$$

$$= E\frac{1}{1 + \frac{R_{out}}{R}(1 + i\omega RC)} = \frac{E}{1 + \frac{R_{out}}{R} + i\omega R_{out}C}$$

$$= \frac{E}{(1 + \frac{Rout}{R})[1 + \frac{i\omega R_{out}C}{1 + \frac{R_{out}}{R}}]}$$

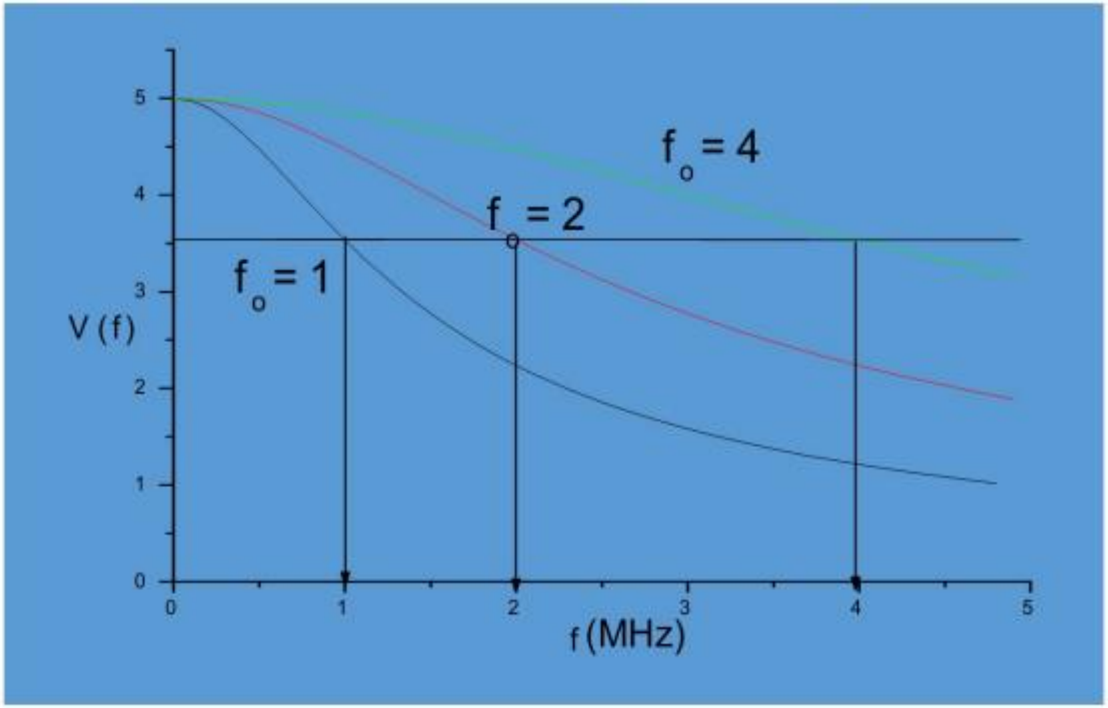
Real value of the voltage across the interface

$$V = \frac{E}{1 + \frac{Rout}{R}} \cdot \frac{1}{\sqrt{1 + \frac{(\omega R_{out}C)^2}{(1 + \frac{Rout}{R})^2}}}$$

Frequency dependent behavior

The corner frequency $f_c = \frac{1}{2\pi R_{out} C}$

$\frac{R_{out}}{R} << 1$ We get output voltage $V = \frac{E}{\sqrt{1 + \frac{f^2}{fc^2}}}$




Thank you