Engineering Measurements

Chapter three

Transducers

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Transducers

Types

- A large number of devices transform values of physical variables into equivalent electrical signals. Such devices are called *transducers.*
- The process of converting physical property into electrical signal depends on phenomenon. For example, if a heat is transferred in small wire, a voltage difference will be created.
- The transducers can be classified as:

1. resistive
2. capacitive
3. Piso-electric
4. Photovoltaic
5. electromagnetic

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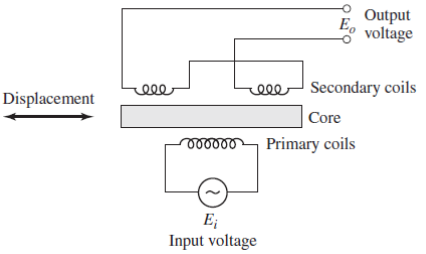
The Differential Transformer (LVDT)

- An alternating input voltage is impressed in the center coil, and the output voltage from the two end coils depends on the magnetic coupling between the core and the coils.
- This coupling, in turn, is dependent on the position of the core.
- Thus, the output voltage of the device is an indication of the displacement of the core



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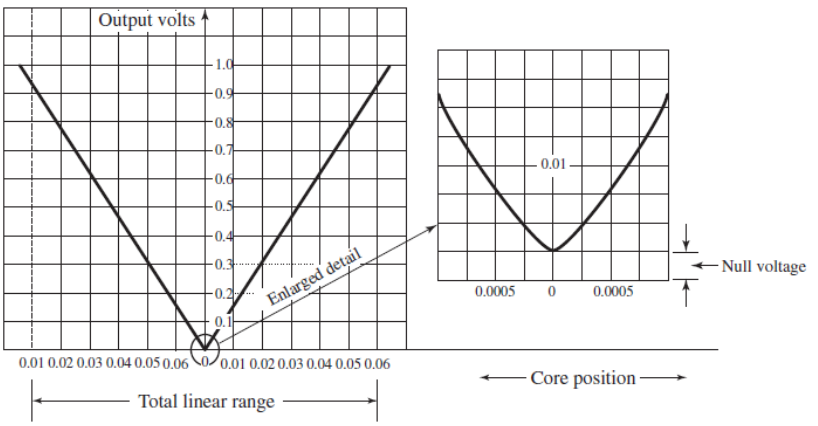
The Differential Transformer (LVDT)



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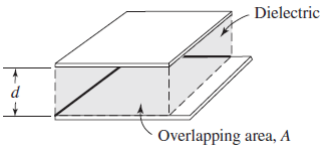
Capacitive Transducers



$$C = 0.225\epsilon\frac{A}{d}$$

where d = distance between the plates, in or cm
A = overlapping area, in^2 or cm^2
ϵ = dielectric constant ($\epsilon = 1$ for air; $\epsilon = 3$ for plastics)

$$Z = \frac{1}{2\pi fC}$$

where Z = impedance, Ω
f = frequency, Hz
C = capacitance, F

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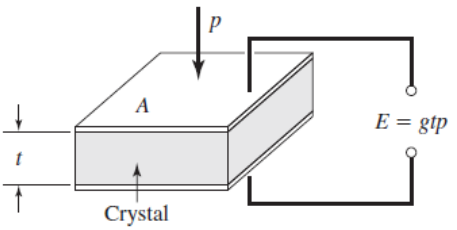
Piezoelectric Transducers

➢**A piezoelectric crystal is placed between two plate electrodes. When a force is applied to the plates, a stress will be produced in the crystal and a corresponding deformation. With certain crystals this deformation will produce a potential difference at the surface of the crystal, and the effect is called the *piezoelectric effect***



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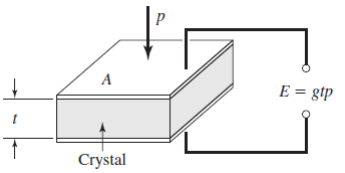
Piezoelectric Transducers

➢**The charge induced in the crystals (Q) is related to the force (F) by:**

Q=F.d ; d is the piezoelectric constant

The output voltage of the crystal is given by:

$$E = gtp$$



Where :

g is voltage sensitivity

p is the impressed pressure in N/m2

t is the crystal thickness in meters

The voltage sensitivity (g)is given as: g=d/ε.