Real Time System

Third Level

Sensors and Transducers

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Goals
Up-on completing this lecture, the student should be able to:

1- Identify the difference between sensor and transducer.
2- Comprehend set transducer c/c.

Sensor:-

- A **sensor** is a device that detects and responds to some type of input from the physical environment. The specific input could be light, heat, motion, moisture, pressure, or any one of a great number of other environmental phenomena. The output is generally an electrical signal that is converted to human-readable.
- The sensor senses a physical quantity and converts it into an electrical signal.
- A sensor is a device that receives a stimulus and responds with an electrical signal.
- A device which provides a usable output in response to a specified measured; a sensor acquires a physical quantity and converts it into a signal suitable for processing (e.g. optical, electrical, mechanical), nowadays common sensors convert measurement of physical phenomena into an electrical signal.

What are some quantities that can be sensed?

- Motion, position, displacement.
- Velocity and acceleration.
- Force, strain.
- Pressure.
- Flow.
- Sound.
- Moisture.
- Light.
- Radiation.
- Temperature.
- Chemical presence.

The Response is an Electrical Signal (Voltage, Current).

Sensors are omnipresent. They embedded in our bodies, automobiles, airplanes, cellular telephones, radios, chemical plants, industrial plants and countless other applications.

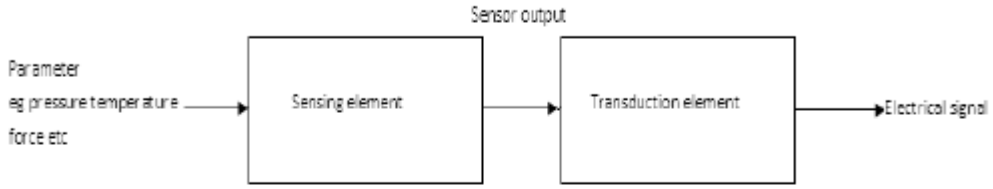
Transducers:

- A transducer is a device that converts one form of energy to another.
- A transducer is a device which transforms a physical quantity (i.e. temperature, sound or light) into another physical quantity or signal (i.e. voltage, current, capacity…).

- Energy forms can be mechanical, visual, aural, electrical, thermal, chemical, etc.

Block Diagram of Transducers:

- Transducer contains two parts that are closely related to each other, the sensing element and transduction element.
- The sensing element is called as the sensor.
- The transduction element converts the sensor output to suitable energy form.



Characteristics of Transducers:

- Ruggedness.
- Linearity.
- Repeatability.
- Accuracy.
- High stability and reliability.
- Speed of response.
- Sensitivity.
- Small size.

Classification of transducers:

1. Based on principle of transduction.
   - Thermo electric.
   - Magneto resistive.
   - Electro kinetic.
   - Optical.
2. Active & passive.
3. Analog & digital.
4. Inverse transducer.

Analog transducer: Convert I/P quantity into an analog O/P.

Digital transducer: Converts I/P into an electrical O/P in the form of pulses.

Inverse transducer: Converts electrical signal to physical.

Active transducers:

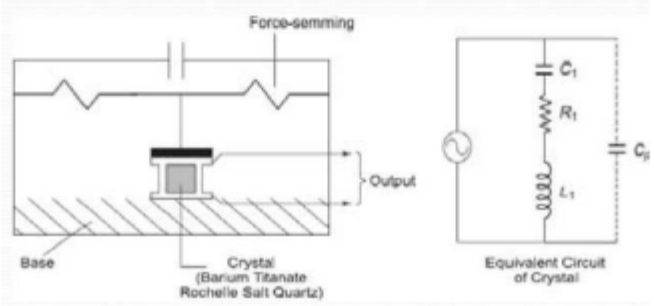
- These transducers do not need any external source of power for their operation. Therefore they are also called as self-generating type transducers.
- The active transducers are self-generating devices which operate under the energy conversion principle.
- As the output of active transducers we get an equivalent electrical output signal e.g. temperature or strain to electric potential, without any external source of energy being used.
- E.g. Piezoelectric used for acceleration measurement.

Passive Transducers:

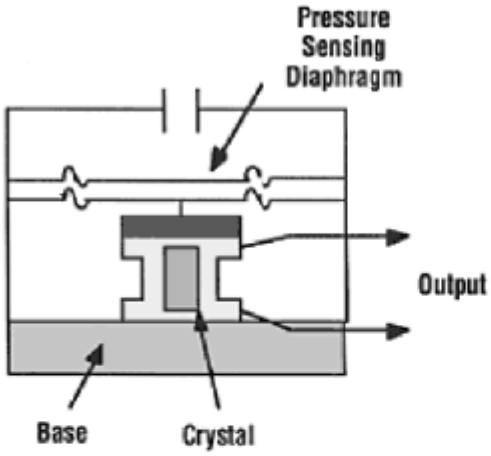
- These transducers need external source of power for their operation. So they are not self-generating type transducers.
- A DC power supply or an audio frequency generator is used as an external power source.
- These transducers produce the output signal in the form of variation in resistance, capacitance, inductance or some other electrical parameter in response to the quantity to be measured.
- E.g. Resistive, inductive, capacitive without power they will not work.

Piezoelectric Transducer:

- Piezoelectric transducer consists of a crystal material such as Quartz, Rochelle salt and Barium titanate which produces an emf (electromotive force) when they are placed under stress.
- Since the transducer has a very good high frequency (HF) response, its principal use is in HF accelerometers.



- When pressure is applied, the pressure sensing diaphragm will sense and pressure will be transferred to top of a crystal.
- The crystal will produce emf proportional to the magnitude of the applied pressure.



Advantage: Needs no external power source, self-generating.

Disadvantage: Cannot measure static condition since it is a dynamic responding sensor.

Application: HF accelerometers.

Important parameters of a transducer:

• Static response: how does it respond to slowly variable signals.

• Dynamic response: how does it respond to quickly variable signals.

• Environmental factors: how these factors are affecting transducer performance.

• Reliability.

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What is the Difference Between Sensor and Transducer?

- A transducer is a device that converts a signal from one physical form to a corresponding signal having a different physical form. Therefore, it is an energy converter. This means that the input signal always has energy or power.
- Since there are six different kinds of signals [mechanical, thermal, magnetic, electric, chemical and radiation], any device converting signals of one kind to signals of a different kind is a transducer.