INTRODUCTION TO TRANSDUCERS

In general terms, the transduction process involves the transformation of one form of energy into another form. This process consists of sensing with specificity the input energy from the measurand by means of a “sensing element” and then transforming it into another form by a “transduction element.”

The sensor-transduction element combination shown in Fig. 5.1 will henceforth be referred to as the “transducer.” Measurand relates to the quantity, property, or state that the transducer seeks to translate into an electrical output.

As an example, consider a “walkie-talkie” intercom set where the loudspeaker also functions as a microphone. At the input end, the loudspeaker functions as an acousto electric transducer and at the output end as an electro acoustic transducer. Moreover, in the reverse direction, the functions of the loudspeakers are interchanged, and for this reason we say that the loud-speaker is a bidirectional transducer and the transduction process is reversible.

Another example of reversible transduction is seen in piezoelectric materials; when an electric voltage is applied to the faces of a piezoelectric substrate, it produces a change in its physical dimensions; and conversely, when the material is physically deformed, an electric charge is generated on these faces.

In this transducer, the sensing and transduction functions cannot be separated as easily, and it represents a good example of a practical transducer used in the field of nondestructive testing (NDT) of materials and in medical ultrasound imaging of body tissues and organs. This is a bidirectional transducer, but most practical transducers are not bidirectional.

Transducers may be classified as self-generating or externally powered.

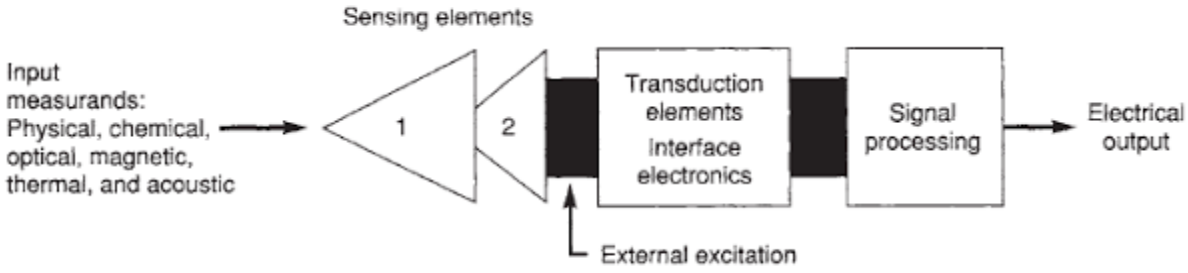

Fig 5.1. Sensor-Transduction Element Combination

Self Generating Transducer:

Self-generating transducers develop their own voltage or current and in the process absorb all the energy needed from the measurand. Externally powered transducers, as the name implies, must have power supplied from an external source, though they may absorb some energy from the measurand. The Hall effect transducer and integrated-circuit temperature transducer are examples of externally powered transducers, whereas the loudspeaker and the piezoelectric substrate are self-generating transducers.

Transduction Mechanisms and Measurands

The operation of a transducer is tightly coupled to one or more electrical phenomena or electrical effects. These effects are listed below. Some relate to more advanced concepts for transducers that are leaving the research and development laboratories and making an entry into the commercial world. In addition, the most useful and important measurands are also listed.

Transduction mechanisms

(i)Capacitive
(ii)Inductive and electromagnetic
(iii)Resistive and thermoresistive
(iv)Piezoresistive effect
(v)Hall effect
(vi)Lateral effect
(vii)Extrinsic
(viii) interferometric
(ix) evanescent effects in optical fibers
(x) Magnetoresistive effect
(xi)Piezoelectric effect
(xii)Tunneling effect.
(xiii)Thermoelectric effects (Seebeck andPeltier)
(xiv)lonization effects
(xv)Photoelectric effect

(xvi)Photoresistive effect

(xvii)Photovoltaic effect

(xviii)Acoustooptic effect

(xix)Fluorescence and fluorescence quenching effect

(xx)Field effect

(xxi)Doppler effect

Measurands

(i)Displacement

(ii)Position

(iii)Velocity

(iv)Acceleration

(v)Force and load

(vi)Strain

(vii)Rotation and encoding

(viii)Vibrations

(ix)Flow

(x)Temperature

(xi)Pressure

(xii)Vacuum

(xiii)Relative humidity

Source: http://mediatoget.blogspot.in/2012/05/introduction-to-transducers.html