Piezo-electric

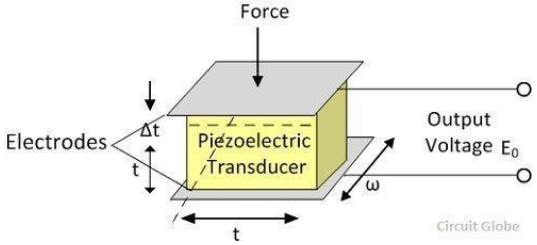
The Piezoelectric transducer is an **electroacoustic transducer** use for conversion of pressure or mechanical stress into an alternating electrical force**.** It is used for measuring the physical quantity like force, pressure, stress, etc., which is directly not possible to measure.

The piezo transducer converts the physical quantity into an electrical voltage which is easily measuredby analogue and digital meter.
The piezoelectric transducer uses the piezoelectric material which has a special property, i.e. the material induces voltage when the pressure or stress applied to it. The material which shows such property is known as the electro-resistive element.
The Quartz is the examples of the natural piezoelectric crystals.

Piezoelectric Effect

The EMF develops because of the displacement of the charges. The effect is changeable, i.e. if the varying potential applies to a piezoelectric transducer, it will change the dimension of the material or deform it. This effect is known as the piezoelectric effect.

The pressure is applied to the crystals with the help of the force summing devices for examples the stress is applied through mechanical pressure gauges and pressure sensors, etc. The deformation induces the EMF which determines the value of applied pressure.



The voltage sensitivity of the crystals is expressed by the ratio of the electric field intensity and pressure.
When the mechanical deformation occurs in the crystals, it generates charges. And this charge develops the voltages across the electrodes.
The Piezoelectric crystal is direction sensitive. The polarity of the voltage depends on the direction of the force which is either tensile or compressive. The magnitude and the polarity of the charges depend on the magnitude and the direction of the applied force.

Properties of Piezo Electric-Crystal

The following are the properties of the Piezoelectric Crystals.

1. The piezoelectric material has high stability.
2. It is available in various shapes and sizes.
3. The piezoelectric material has output insensitive to temperature and humidity.

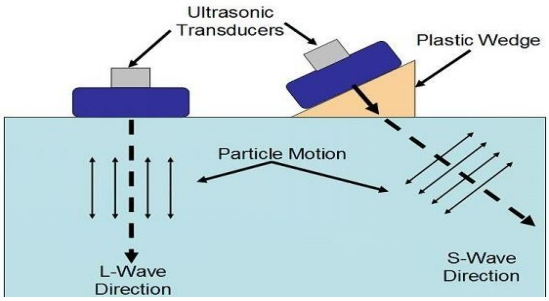
Ultrasonic transducers

- Sound that is generated above the level of human hearing range is called ultrasound. Although ultrasound typically starts at 20 MHz, most ultrasonic transducers start at 200 KHz. Ultrasound, which is similar in nature to audible sound, has far shorter wavelengths and is far more suitable to detect small flaws. These shorter wavelengths are what make ultrasound and ultrasonic transducers extremely useful for non-destructive testing and measurement of materials.

- An ultrasonic transducer itself is a device that is capable of generating and receiving ultrasonic vibrations. An ultrasonic transducer is made up of an active element, a backing, and wear plate. The active element is a piezoelectric or single crystal material which converts electrical energy to ultrasonic energy. It will also then receive back ultrasonic energy and converts it to electrical energy. The electrical energy pulse is generated from an instrument such as a flaw detector.

- The backing is most commonly a highly attenuative and very dense material and is used to control the vibration of the transducer crystal by absorbing the energy that radiates from the back face of the piezoelectric element. When the acoustic impedance of the backing material matches that of the piezoelectric crystal, the result is a highly damped transducer with excellent resolution. By varying the backing material in order to vary the difference in impedance between the backing and the piezoelectric crystal, a transducer will suffer somewhat and resolution may be much higher in signal amplitude or sensitivity.

- The main purpose of the wear plate is simply to protect the piezoelectric transducer element from the environment. Wear plates are selected to generally protect against wear and corrosion. In an immersion-type transducer, the wear plate also serves as an acoustic transformer between the piezoelectric transducer element and water, wedge or delay line.



Applications of Ultrasonic Transducer

1. Ranging and Navigating
2. Diagnosis
3. Therapy and surgery
4. Doppler Effect
5. Medical imaging techniques

Temperature measurement

A Thermometer is a device that measures temperature or temperature gradient.

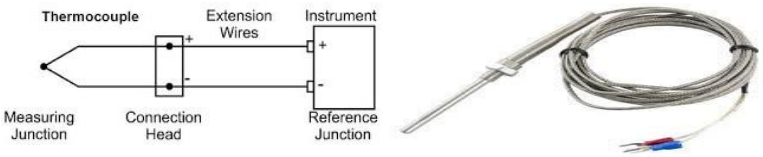
Thermometers can be divided into two groups according to the level of knowledge about the physical basis of the underlying thermodynamic laws and quantities.

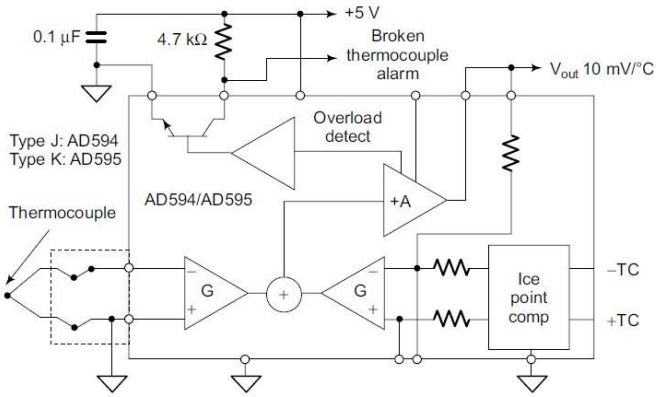
1. Primary thermometers; the measured property of matter is known so well that temperature can be calculated without any unknown quantities. Examples of these are thermometers based on the equation of state of a gas, on the velocity of sound in a gas, on the thermal noise, voltage or current of an electrical resistor, and on the angular anisotropy of gamma ray emission of certain radioactive nuclei in a magnetic field.

2. Secondary thermometers are most widely used because of their convenience. Also, they are often much more sensitive than primary ones. For secondary thermometers knowledge of the measured property is not sufficient to allow direct calculation of temperature. They have to be calibrated against a primary thermometer at least at one temperature or at a number of fixed temperatures. Such fixed points, for example, triple points and superconducting transitions, occur reproducibly at the same temperature.

Thermocouple

A **Thermocouple** is a sensor for measuring temperature. This sensor consists of two dissimilar metal wires, joined at one end, and connected to a thermocouple thermometer or other thermocouple-capable device at the other end. When properly configured, thermocouples can provide temperature measurements over wide range of temperatures.





Thermocouple amplifiers with cold junction compensation

Thermistors

Thermistors are the oxides of certain metals like manganese, cobalt and nickel which have largenegative temperature coefficient of resistance, i.e. resistance of the thermistor shows a fall withincrease in temperature

Thermistors when used for measuring temperature have many advantages over thermocouplesand resistance thermometers.

The large change in resistance with temperature means that a comparatively simplebridge circuit is sufficient.

Infrared thermometers

Measure temperature using blackbody radiation (generally infrared) emitted from objects. They are sometimes called laser thermometers if a laser is used to help aim the thermometer, or non-contact thermometers to describe the device's ability to measure temperature from a distance. By knowing the

amount of infrared energy emitted by the object and its emissivity, the object's temperature can be determined. The most basic design consists of a lens to focus the infrared energy on to a detector, which converts the energy to an electrical signal that can be displayed in units of temperature after being compensated for ambient temperature variation. This configuration facilitates temperature measurement from a distance without contact with the object to be measured

Liquid crystal thermometer

A **liquid crystal** thermometer or plastic strip thermometer is a type of thermometer that contains heat- sensitive (thermochromic) liquid crystals in a plastic strip that change colour to indicate different temperatures. Liquid crystals possess the mechanical properties of a liquid, but have the optical properties of a single crystal. Temperature changes can affect the colour of a liquid crystal, which makes them useful for temperature measurement.