

3.3 HALL EFFECT

Hall effect is a process in which a transverse electric field is developed in a solid material when the material carrying an electric current is placed in a magnetic field that is perpendicular to the current.

Principle of Hall effect

The principle of the Hall effect states that when a current-carrying conductor or a semiconductor is introduced to a perpendicular magnetic field, a voltage can be measured at the right angle to the current path. This effect of obtaining a measurable voltage is known as the Hall effect.

Theory

When a conductive plate is connected to a circuit with a battery, then a current starts flowing. The charge carriers will follow a linear path from one end of the plate to the other end. The motion of charge carriers results in the production of magnetic fields. When a magnet is placed near the plate, the magnetic field of the charge carriers is distorted. This upsets the straight flow of the charge carriers. The force which upsets the direction of flow of charge carriers is known as Lorentz force.

Due to the distortion in the magnetic field of the charge carriers, the negatively charged electrons will be deflected to one side of the plate and positively charged holes to the other side. A potential difference, known as the Hall voltage will be generated between both sides of the plate which can be measured using a metre.

The Hall voltage represented as V_H is given by the formula:

I is the current flowing through the sensor

B is the magnetic field strength

q is the charge

n is the number of charge carriers per unit volume

d is the thickness of the sensor.

Hall Coefficient

The Hall coefficient R_H is mathematically expressed as

Where j is the current density of the carrier electron, E_y is the induced electric field and B is the magnetic strength. The hall coefficient is positive if the number of positive charges is more than the negative charges. Similarly, it is negative when electrons are more than holes.

Applications of Hall Effect

Hall effect principle is employed in the following cases:

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- Magnetic field sensing equipment
 - For the measurement of direct current, Hall effect Tong Tester is used.
 - It is used in phase angle measurement
 - Proximity detectors
 - Hall effect Sensors and Probes
 - Linear or Angular displacement transducers
 - For detecting wheel speed and accordingly assist the anti-lock braking system.