

Magnetometer Encyclopedia Article

Magnetometer

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Magnetometer

A magnetometer measures the strength and direction of a magnetic field. The first magnetometers were mechanical devices that had a spring-loaded magnet which moved in relation to an external magnetic field. The greater the movement, the greater the magnetic field. Modern electronics have made this design obsolete, and today there are three basic designs of magnetometers: the Hall effect, fluxgate, and proton.

The principle governing the Hall effect magnetometer dates back to 1879. In that year Edwin Herbert Hall (1855-1938) discovered that an electric current flowing through a conductor in the presence of a magnetic field produced an electric potential that was perpendicular to both the current and the field. The strength of the potential was directly related to the strength of the magnetic field and created a transverse current in the conductor.

In 1966 it was discovered that the Hall effect influenced the electrons located at the interface between a semiconductor and an insulator and resulted in a voltage, the magnitude of which is a measure of the magnetic field strength. The Hall effect magnetometer is very well-suited for measuring strong magnetic fields.

The fluxgate magnetometer depends on two easily magnetized cores. Each core has an internal and external winding. When alternating current (AC) is applied the primary winding becomes magnetized and induces a current in the secondary winding. If an external magnetic field is present, the primary core becomes more magnetized. Because the outputs of both cores reinforce each other, the signal is doubled for the external field and appears as an AC voltage at twice the original frequency.

The proton magnetometer is the most accurate. It depends on a material which is rich in protons, such as paraffin or water. A coil magnetizes the paraffin to align the protons. When the coil is switched off the protons begin to return to their original random orientation. When this happens, they generate a voltage in a sensor, and the speed at which the orientation decays is a measurement of the external magnetic field. Because the rate of decay can be very accurately measured, the strength of the magnetic field can be precisely determined. Its main disadvantage is the inability to measure rapidly-changing fields.