

APPLICATIONS OF THREE AXIS MAGNETIC FIELD SENSORS

SENSORS AND ACCESSORIES

Mag-03 three axis sensors

The *Mag-03* range of three axis magnetic field sensors is based on the fluxgate principle. These sensors are very accurate, have a linear response and are extremely stable. They also have a flat frequency response with a bandwidth of d.c. to 3kHz. They are suitable for measuring magnetic fields from zero to more than ten times the value of the earth's field and provide a continuous analog output.

The *Mag-03* sensors contain three orthogonal elements with integral electronics in a compact package. They require a supply of ± 12 volts and produce an analog output of ± 10 volts full scale for each axis. With a bandwidth of d.c. to 3kHz the units are suitable for a.c. and d.c. measurements. The magnetometers are available in cylindrical, square section or submersible packages and with full scale ranges from ± 70 to $\pm 1000 \mu\text{T}$. Versions are available with noise levels down to $6\text{pT}_{\text{rms}}/\sqrt{\text{Hz}}$ at 1Hz.

Mag-03PSU power supply

The *Mag-03PSU* power supply unit contains a rechargeable battery power supply for the sensor together with a filter for each output which can be configured as a low-pass or band-pass filter.

Mag-03DAM data acquisition module

The *Mag-03DAM* six channel data acquisition module with 24 bit resolution allows the data from two *Mag-03* sensors to be stored on an IBM compatible PC. The unit, which features software control and filtering, is designed for recording changes in the earth's field with the highest resolution at low data rates.

Mag-03SCU signal conditioning unit

The *Mag-03SCU* combines a power supply, signal conditioning filters and LED display for each of the three output channels. Each channel has an adjustable high and low pass filter with a variable gain and offset facility. This enables the response of the system to be set for individual requirements.

Mag-03CU calibration unit

The *Mag-03CU* calibration unit is a battery powered unit which provides a sinusoidal reference magnetic field for checking the calibration of *Mag-03* sensors which have a cylindrical enclosure.

APPLICATIONS

Medical physics

Magnetic Resonance Imaging (MRI) equipment used in medical physics requires the generation of stable magnetic fields and is therefore susceptible to interference from external fields which may result from radio frequency interference, lower frequency interference from electrically operated equipment, such as lifts within the same building, or electric trains at a considerable distance. It is standard practice to survey an area prior to installation of this sensitive equipment to record the variations in the magnetic field and select a site with the least disturbance.

Radio frequency interference can usually be sufficiently reduced by shielding but lower frequencies may be largely unaffected. A *Mag-03* sensor can be used in conjunction with a *Mag-03PSU* power supply and a digital voltmeter to provide information on the d.c. and a.c. fields in

General physics

In some applications where low energy electrons or ions are used, such as in electron microscopes and photo electron spectrometers, low magnetic fields are required and the earth's field needs to be cancelled. This is often done using pairs of Helmholtz coils to oppose the vertical and horizontal components of the environmental field. In many applications a reduction to 10% of the earth's field is sufficient and this can be achieved by applying constant currents to the coils. The *Mag-03* sensor, in conjunction with a *Mag-03*PSU and a digital voltmeter, can be used to monitor each of the three components of the field in turn while the appropriate coil currents are adjusted to achieve zero field. This technique is known as active shielding with open loop control.

The earth's magnetic field is subject to considerable variations during the course of a day and further variations will occur within a building due to its structure and to activities both inside and out. In order to achieve a very low or constant field it is necessary to apply a servo system to monitor the field continuously and vary the currents in the coils to counteract these field changes. This provides active shielding with closed loop control. A sensor from the *Mag-03* range is suitable for this application as it provides simultaneous three axis monitoring with a good frequency response.

ELF measurements

The flat frequency response of the *Mag-03* sensors over the range from d.c. to 3kHz allows measurements of the environmental ELF (10Hz to 3kHz) magnetic field to be made in three axes. Sources of magnetic fields which may be investigated include devices operating at power frequencies, which generate fields at the power frequency and its harmonics, and others which produce fields that are independent of the power frequency. Examples of the latter category include VDU terminals, electric trains (16.7Hz and 25Hz), mass transportation systems (0Hz to 3kHz depending on the characteristics of the variable speed drive) , commercial aircraft (400Hz), induction heaters (50Hz to 3kHz) and electric vehicles.

Power distribution

The *Mag-03* range is used for the measurement of phase imbalances in transmission systems and earth leakage currents around power generation and distribution facilities.

Defence

The *Mag-03* range of sensors, together with the *Mag-03*SCU signal conditioning unit, can be used in magnetic ranges to measure the magnetic signature of vessels or vehicles. The *Mag-03*RC is specifically designed for this application, having a submersible enclosure, very low drift, voltage surge protection and internal calibration test coils. The *Grad-03-12* is a three axis gradiometer for closed loop degaussing applications.

Earth's field measurements and magnetic surveys

The *Mag-03* range of sensors, combined with the *Mag-03*DAM, provides a high resolution system to measure the earth's magnetic field. It can be used as a base station during magnetic surveys, as a secondary system to monitor the performance of a magnetic observatory system or as a long baseline gradiometer. Where very low drift is a requirement, the *Mag-03*RC should be considered. The *Mag-03*MS is used as a sensor for the airframe compensation system during



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