Measurement Characteristics of Different Integrated Three-Dimensional Magnetic Field Sensors

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Abstract

Datasheets of different commercially available integrated sensors for vector measurements of magnetic fields provide typical specifications, such as measurement range, sampling rate, resolution, and noise. Other characteristics of interest, such as linearity, cross-sensitivity, remanent magnetization, and drifts over temperature, are mostly missing. This letter presents testing results of those characteristics of integrated three-dimensional (3-D) sensors working with different sensor principles and technologies in a reproducible measuring process. The sensors are exposed to temperatures from -20 degC to 80 degC and are cycled in hysteresis loops in fields up to 2.5 mT. For applying high-accuracy magnetic fields, a calibrated 3-D Helmholtz coil setup is used. Commercially available integrated 3-D magnetic field sensors are put in operation on a printed circuit board using nonmagnetic passive components. All sensors are configured for best measurement accuracy according to their data-sheets. The results show that sensors based on anisotropic magnetoresistance have high accuracy and low offsets yet also a high degree of nonlinearity. Hall-based sensors show good linearity but also high cross-sensitivity. A magnetic remanence appears for Hall-based sensors with integrated magnetic concentrators as well as for sensors using anisotropic magnetoresistance. Nearly all sensors show remaining drifts over temperature regarding offset and sensitivity up to several percentages.

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