

Tamura Flux-Gate Current Sensors

Today's power electronics applications demand a very high level of accuracy and systems stability to insure optimization of energy usage. Precise system control through stable and accurate feedback is critical to optimized system performance.

Current sensors are used in myriad power electronic applications to provide the critical feedback required for safe, efficient, and optimal operation of electrical energy conversion systems.

The key performance metrics for current measurement sensors are accuracy, response time, and thermal stability, with emphasis on cost, quality, reliability and physical size.

The predominant current sensor technology for isolated AC and DC current measurement is based on the Hall effect, and there are two main types: Open Loop and Closed Loop.

Recently an alternate closed loop current sensor based on the flux-gate principle has gained increasing application in control of power electronic systems. As with Hall effect closed loop sensors, flux gate current sensors use a magnetic core, secondary or compensation winding, and, a transducer. See Figure 1, below.

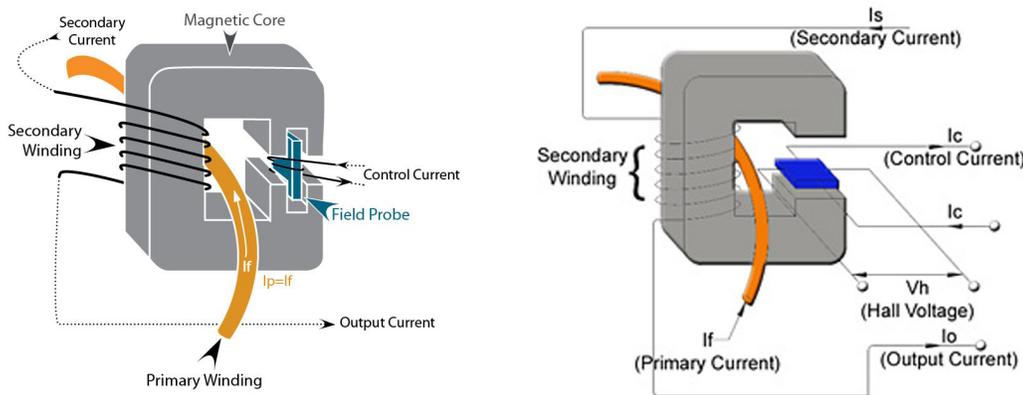


Figure 1

However unlike Hall effect current sensors, Flux-gate current sensors use a magnetic field probe as the transducer or sensing element. The magnetic field probe is inserted in a magnetic circuit formed by a high permeability tape-wound core material with a compensation winding to form the basic sensor configuration. An ASIC for control and signal conditioning completes the sensor module.

The Flux-gate sensor is fundamentally a servo-mechanism. Initially a periodic excitation current is applied to the magnetic field probe creating a homeostatic operating condition. When a conductor carrying DC or low frequency AC current is passed through the sensor module the current in the conductor induces a magnetic flux in the magnetic circuit. The induced magnetic flux in the magnetic circuit causes a shift in the output of the magnetic field probe. The control electronics detects the deviation from the probes initial state. The resultant change in the magnetic probe output signal is delivered to an operational amplifier which drives a current through the compensation winding to bring the magnetic flux in the core to zero and return the magnetic field probe to the initial condition.

The Flux-gate sensor incorporates a high-precision shunt resistor in the compensation circuit; the voltage drop across the

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Tamura Flux-Gate Current Sensors (cont.)

shunt resistor is applied to a differential op-amp which generates an analog output voltage connected to an internal voltage reference and proportional to the detected primary current.

For high frequency applications, the compensation winding of the Flux-gate current sensor operates as a current transformer.

Tamura Corporation’s new ASIC-based F-Series Flux-gate current sensors are available in three industry-standard pin configurations. The F-Series key performance parameters are summarized in Table 1, below.

Part Number	Rated Current (If)	Accuracy %	Gain	Gain Drift	Offset Drift	Response Time	Temp Range
F01P SERIES	6A – 15A -25A – 50A	< 1.7 max	625 mV / If	< 40 ppm/K	< 15 ppm/K	0.3μsec	-40C ~ 105C
F02P SERIES	6A – 15A -25A – 50A	< 1.7 max	625 mV / If	< 40 ppm/K	< 15 ppm/K	0.3μsec	-40C ~ 105C
F03P SERIES	6A – 15A -25A – 50A	< 1.7 max	625 mV / If	< 40 ppm/K	< 15 ppm/K	0.3μsec	-40C ~ 105C

Table 1

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