

High-performance low-noise current sensors with 2100 V RMS isolation

Allegro MicroSystems Europe has introduced two new families of high-performance low-noise Hall-effect current sensors featuring an isolation voltage of 2100 V RMS. Each device is available in ± 5 A, ± 20 A or ± 30 A versions, with corresponding sensitivity levels of 185, 100 or 66 mV/A.

The new devices, ACS712 (bidirectional) and ACS713 (unidirectional), have been developed to address the growing demand for low-cost, high-accuracy and compact current-sensing solutions with added functionality. The chip design is based on the latest Allegro low-noise 0.65 μm BiCMOS process (DABIC6), and parameters such as quiescent output voltage, sensitivity and temperature coefficient have been optimised to minimise noise and total output error.

The new current sensors provide lower noise and higher accuracy than previous types, and also include an integrated shield which effectively attenuates high dV/dt voltage transients across the leadframe - making this solution ideal for motor control and high-side current sensing applications.

The combination of improved process performance, new design concepts and additional programming capability has resulted in a twofold reduction in noise compared with previous devices. The total output error is only 1.5% at room temperature and +4% in the industrial temperature range from -40°C to $+85^\circ\text{C}$. The ACS712 and ACS713 also incorporate a filter pin that can be used to set the -3 dB point with a capacitor, reducing the number of external components required to improve sensor resolution.

The devices feature very fast response times, with nominal rise times for the 30 A device of 5 μs at an input current of 26.5 A and 2.5 μs at 10.6 A. This represents a twofold improvement over previous devices, and makes the sensors suitable for protection and high-speed applications. In addition, a filter pin has been added to further reduce output noise and improve the low current accuracy without the attenuation effects of an external RC filter. Each of the new devices consists of a precise, low-offset, linear Hall sensor circuit with a low-noise copper conduction analogue signal path located near the surface of the die. Applied current flowing through this copper conduction path generates a magnetic field which is sensed by the integrated Hall IC and converted into a proportional voltage.

Device accuracy is optimised through the close proximity of the magnetic signal to the Hall transducer. A precise, proportional voltage is provided by the low-offset, chopper-stabilised BiCMOS Hall IC, which is programmed for accuracy after packaging. The ACS712 and ACS713 also exhibit near-zero magnetic hysteresis.

The new sensors produce an analogue signal output that varies linearly with the unidirectional or bidirectional AC or DC primary sensed current.

The output has a positive slope when an increasing current flows through the primary copper conduction path used for current sensing. The internal resistance of this conductive path is typically 1.2 milliohm, leading to very low power loss.

The thickness of the copper conductor allows survival of the device at up to five times its maximum rated current. The terminals of the conductive path are electrically isolated from the sensor leads with an isolation voltage of 2.1 kV RMS, allowing the ACS712 current sensor to be used in applications requiring electrical isolation without the use of opto-isolators or other costly isolation techniques.

The ACS712 and ACS713 are each supplied in a small, surface mount SOIC8 package. The leadframe is plated with 100% matt tin, which is compatible with standard lead (Pb) free printed circuit board assembly processes. Internally, the device is lead-free, except for flip-chip high-temperature lead-based solder balls, currently exempt from RoHS. The device is fully calibrated prior to shipment from the factory.

The Allegro ACS712 provides economical and precise solutions for AC or DC current sensing in industrial, automotive, commercial and communications systems, with the compact device package allowing for easy implementation into customers' designs. Typical applications include motor control, load detection and management, switched-mode power supplies, and over-current fault protection.