Isolated Shunt Modules Challenge Hall Sensors In High-Power Current Sensing Applications

Riedon's SSA Smart Shunt series modules offer designers a new option for high-power current-sensing applications requiring 1% or higher accuracy (i.e. error ≤ 1%). These current sensing modules combine the advantages of conventional passive shunt resistors with those of the more expensive and bulky closed-loop Hall Effect current sensors. Each module features a built-in precision amplifier, reinforced electrical isolation (up to 1500 Vdc), and what the company describes as industry-leading levels of stability and accuracy (Fig. 1).

SSA Smart Shunt units exhibit ±0.1% sensing accuracy and ±0.1% linearity over their entire current range, with far less susceptibility to temperature drift than Hall sensors. The need for routine calibration can therefore be eliminated. They also have a rapid response time of less than 1.5 µs.

With an amplified analog output and integrated protection, these current sensors can be placed on either the high or low side of a circuit, enabling easy integration. Their temperature range spans -40°C to 125°C. Riedon plans to offer a digital output as well, through I^2C, RS-232, Modbus and CAN interfaces. However, as Phil Ebbert, VP engineering at Riedon notes, the majority of applications for this type of current sensor such as motors for example, are requiring an analog signal as supplied by this SSA Smart Shunt.

The robustness of SSA Smart Shunt modules makes them suitable for use in high-power (100-A to 1000-A) implementations, where harsh conditions may need to be dealt with—such as elevated temperature levels, heavy vibrations and electromagnetic interference (EMI). Key examples include electric vehicle (EV) and hybrid-electric vehicle (HEV) traction inverters, ac-dc converters, uninterruptible power supplies, renewable energy generation sites and smart grid infrastructure.

"SSA Smart Shunt signifies a major step forward in shunt-based current sensing," explains Ebbert. "Until now, despite clear drawbacks, such as the impact of electromagnetic fields and temperature fluctuations on their accuracy, Hall Effect sensors have proved preferable in more challenging current measuring applications, as they are non-intrusive, possess intrinsic electrical isolation and support higher voltages. Conversely, the non-isolated nature of standard shunt resistors has held back their widespread deployment, even though they offer more accurate and operationally stable parameters."

"By integrating isolation amplifiers, SSA Smart Shunt modules deliver superior accuracy and stability," Ebbert concludes. "This opens up new current sensing opportunities, providing engineers with a compact and cost-effective alternative to specifying Hall devices."

THE SSA offers advantages versus a standalone shunt sensor and versus a Hall Effect sensor. Unlike a shunt resistor alone, the SSA module provides isolation, better tolerance (0.1%), amplified output and differential output. When compared with a Hall Effect sensor, the SSA module is 50% smaller, 5X more accurate, much more stable and costs a third less than Hall sensors at current levels of 500 A and higher. Some other differences are highlighted in Fig. 2. Fig. 3 offers a more detailed comparison of these devices with respect to weight, accuracy and stability.

At the heart of SSA Smart Sensor module is a precision, reinforced isolated amplifier, which integrates much (but not all) of the circuitry required to interface the shunt resistor to an ADC. However, by packaging this amplifier IC with its external circuitry and the shunt resistor, and testing and qualifying the module as a functionally complete current sensor, Riedon has provided more of a plug-and-play solution.

Riedon's SSA Smart Shunt modules are now available exclusively via Digi-Key.

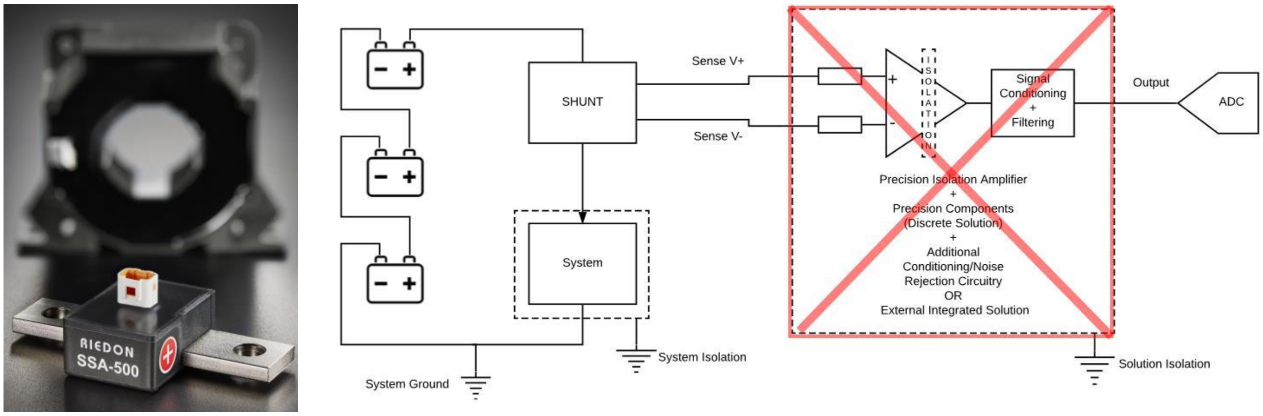

Fig. 1. The SSA Smart Shunt current-sensing module, pictured in the foreground on the left, combines a shunt resistor with a precision isolation amplifier and signal conditioning circuitry as suggested by the diagram on the right. These functions are crossed out to signify that the SSA module eliminates the need for external, discrete components to implement these functions, which condition the shunt resistor signal for use by the ADC. In the photo on the left, the SSA module is shown with a Hall effect sensor in the background to illustrate the size reduction it affords versus the Hall sensor.

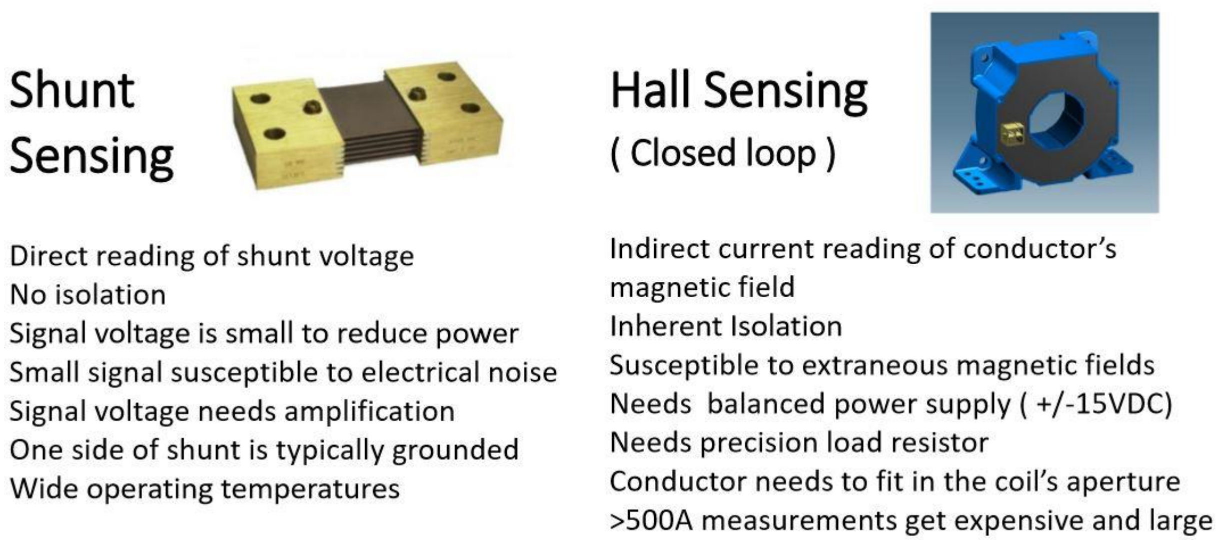

Fig. 2. Comparing a conventional shunt-resistor current sensor with a Hall Effect current sensor. The SSA Smart Sensor adds signal conditional circuitry and isolation to a shunt resistor so that it offers the benefits of both sensing methods without drawbacks such as the large size and high cost of the Hall sensor.

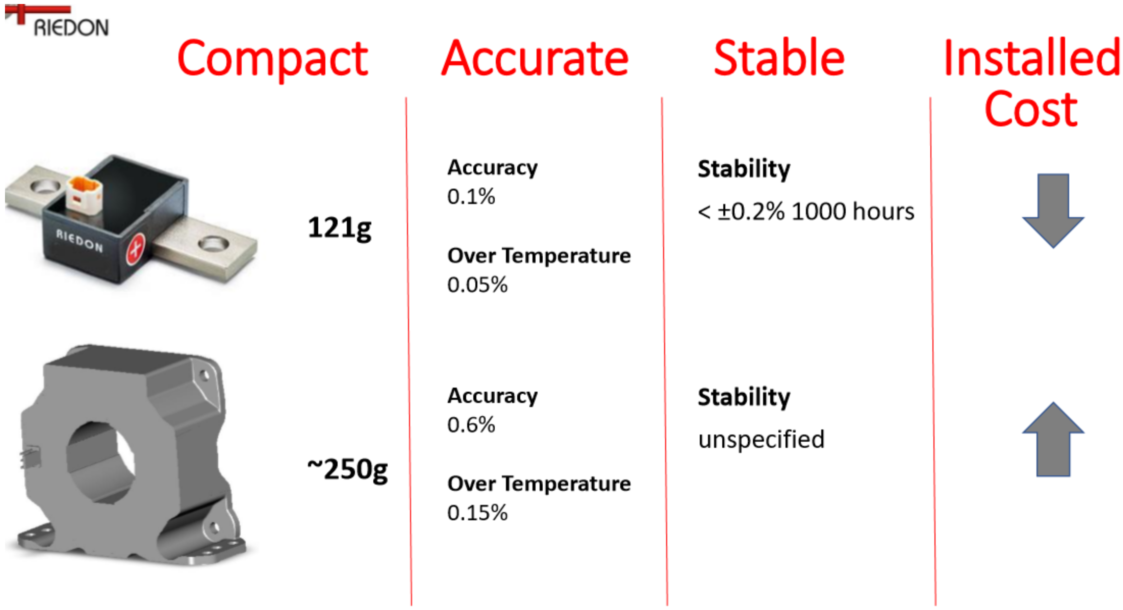

Fig. 3. The SSA Smart Sensor module outperforms Hall Effect current sensors by weight, electrical accuracy and stability as detailed here. This chart compares a 500-A SSA module versus a comparable Hall Effect sensor. According to Riedon, the cost of an SSA module is in the $40 to $60 range versus $150 for a comparable Hall sensor. The stability issue also factors into device cost. According to Ebbert, the SSA module only needs to be calibrated once at the time of installation, while Hall Effect current sensors require calibration annually. The SSA also has a wider operating temperature range, operating up to 125°C versus 85°C for the Hall sensor.