

Current Sensing Measures Up in Today's Cutting-Edge Systems

Sponsored by Texas Instruments: Current-sensing solutions, buoyed by components like Hall-effect sensors, can offer the monitoring reliability and accuracy needed for applications ranging from EVs to robotics.

As demand soars for electric vehicles and EV charging stations, renewable energy, and robotics, precise measurement solutions have become more important than ever. Few of the innovations you hear about, however, would be possible if current-sensing technology wasn't reliable, accurate, and easy to design with.

The first thing to know is that, as the name implies, current sensors monitor a vital parameter—current—in an electrical system, which allows the system to operate as efficiently as possible. Many applications today require measuring the flow of current through a specific component or load of the system. Being able to measure that flow is either used to improve efficiency or it's fundamental for the proper operation of the equipment. A sampling of such applications would have to include precision motor control, high-efficiency DC-DC converters, and battery chargers.

When choosing a current-sensing solution, design engineers must weigh the tradeoffs of cost, size, accuracy, and speed. Moreover, based on Ohm's Law, with higher system voltages, the amount of current that's delivered to a load can

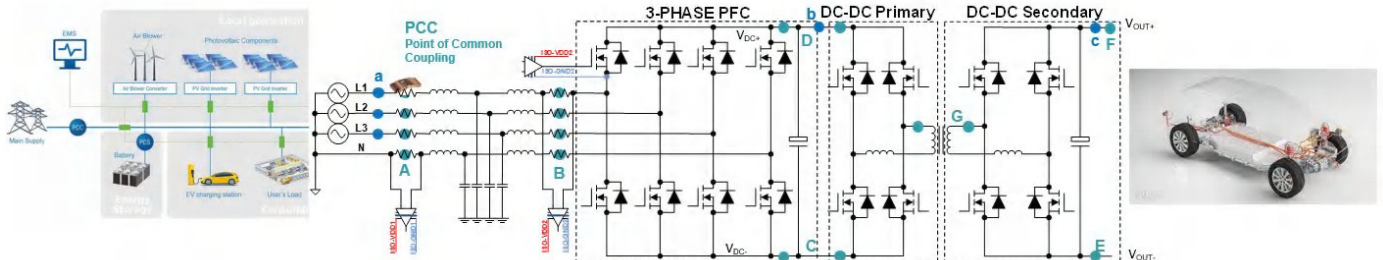
be decreased to create an equivalent amount of power.

On that front, whether your current-sensing solution is being used to detect an overcurrent fault, improve system efficiency, or provide closed-loop feedback, Texas Instruments' portfolio of products helps deliver high accuracy for a range of common-mode voltages and temperatures—without sacrificing system size, complexity, or cost.

Trends in Current Sensing

[The latest advances in sensing technologies from TI can help you design products for a wide range of applications:](#)

- *Sensor ICs for electric vehicles and EV charging stations:* Sensor ICs, and especially current sensors, are crucial to the shift from combustion engines to electric drivetrains (Fig. 1).
- *Sensor ICs for modern data centers:* Isolated amplifiers and Hall-effect sensors are enabling higher power densities in server power-supply units (PSUs) for data centers, helping maintain energy efficiency by optimizing data-center operations. Precision, isolated current-sensing ICs can help server PSUs meet the >96% system



1. The diagram illustrates current sensing points of an EV charging system.



2. TI's lowest-drift isolated Hall-effect current sensor reduces design complexity in high-voltage systems.

efficiency threshold required by the 80 Plus Titanium standard.

- *Sensor ICs for energy management:* Electricity meters are vital to efficient power distribution, helping reliably determine a building's overall energy consumption.
- *Sensor ICs for robotics and ADAS (for industrial and automotive applications):* For autonomous robotic systems to be successful, they must be able to interact and coexist with humans and other robots. This is made possible through vision, radar, and LiDAR sensing.

The current-sensing arena is [experiencing certain trends taking shape](#), including the need to downsize. As systems are required to fit in smaller spaces, there's a concomitant need to reduce the size of the components, or, alternately, to increase the number of features per unit.

Smaller current-sensing devices allow designers to increase the amount of monitoring throughout or to reduce the system's overall size. Leveraging small ICs or highly featured chips can pave the way to more compact systems, resulting in more powerful and capable end products such as personal electronics, onboard chargers, and collaborative robotic motor-driven systems. Many consumer products such as smartphones are already size-constrained and each new generation requires a constant reduction in size as well as increased feature sets.

Hall-Effect Current Sensors

Hall-effect sensors are an effective means to measure current, as there's no power loss associated with the measurement. But while the need for highly accurate current measurements in systems such as EV chargers and solar inverters is growing, Hall-effect current sensors are sometimes overlooked because of their high drift over the part's lifetime.

With the launch of TI's TMCS1123, though, engineers can specify a Hall-effect current sensor with a maximum

sensitivity error of $\pm 0.75\%$ with 50 ppm/ $^{\circ}\text{C}$ drift over temperature and $\pm 0.5\%$ drift over its lifetime (Fig. 2). Low-drift technology makes possible low-current measurement.

The TMCS1123 also features a high reinforced isolation working voltage of 1,100 V DC. Thanks to their high accuracy and low propagation delay, designers can now use Hall-effect sensors in high-voltage systems where they couldn't before—and that opens the door to reducing system cost and size.

TI's new EZShunt portfolio of current-sensing solutions simplifies designs by removing the need for an external shunt resistor. The family provides a fully integrated current-sensing solution that fits within the footprint of a 1206 shunt resistor, offering the value of a discrete solution with the simplicity of a single chip.

At this point we'll forgive you if you're overwhelmed by the number of options for designing accurate current-sensing circuits targeted at cost-optimized applications. To help in this journey, the [Simplifying Current Sensing](#) eBook addresses specific use cases as well as focuses on identifying a circuit/function problem statement, providing an outline of any challenges associated with that function.

Conclusion

From low-current sensing to high-voltage sensing, TI's portfolio enables fast detection and accurate measurement for a wide range of methods and applications.

With a better understanding of the trends discussed and the ICs that help support them, you can meet your specific design challenges by monitoring current measurements to ensure that the system is operating safely, reliably, and efficiently.