Technical Article

Delivering accurate current sensing for safer solar energy systems and EV chargers

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Our society relies on the electric grid every day, so monitoring and maintaining the grid is vital in order to ensure day-to-day reliability. The everyday supply and demand from the grid is changing as more people transition from nonrenewable to renewable energy sources, so we must manage its evolving needs.

Isolated current sensing, often made possible through Hall-based or shunt-based sensing, helps manage the electrical grid by enabling safe and accurate measurement of the current supplied to or drawn from the grid. In electric vehicle (EV) charging and solar systems, for example, isolation is necessary to protect low-voltage circuitry controls from high-voltage transients.

Figure 1 shows current sensing in EV charging and solar applications. In these applications, current sensing also plays an important role in efficiency, metrology, and control of power gates. In this article, we'll discuss how to deliver accurate, safe current sensing in EV chargers and solar energy systems.

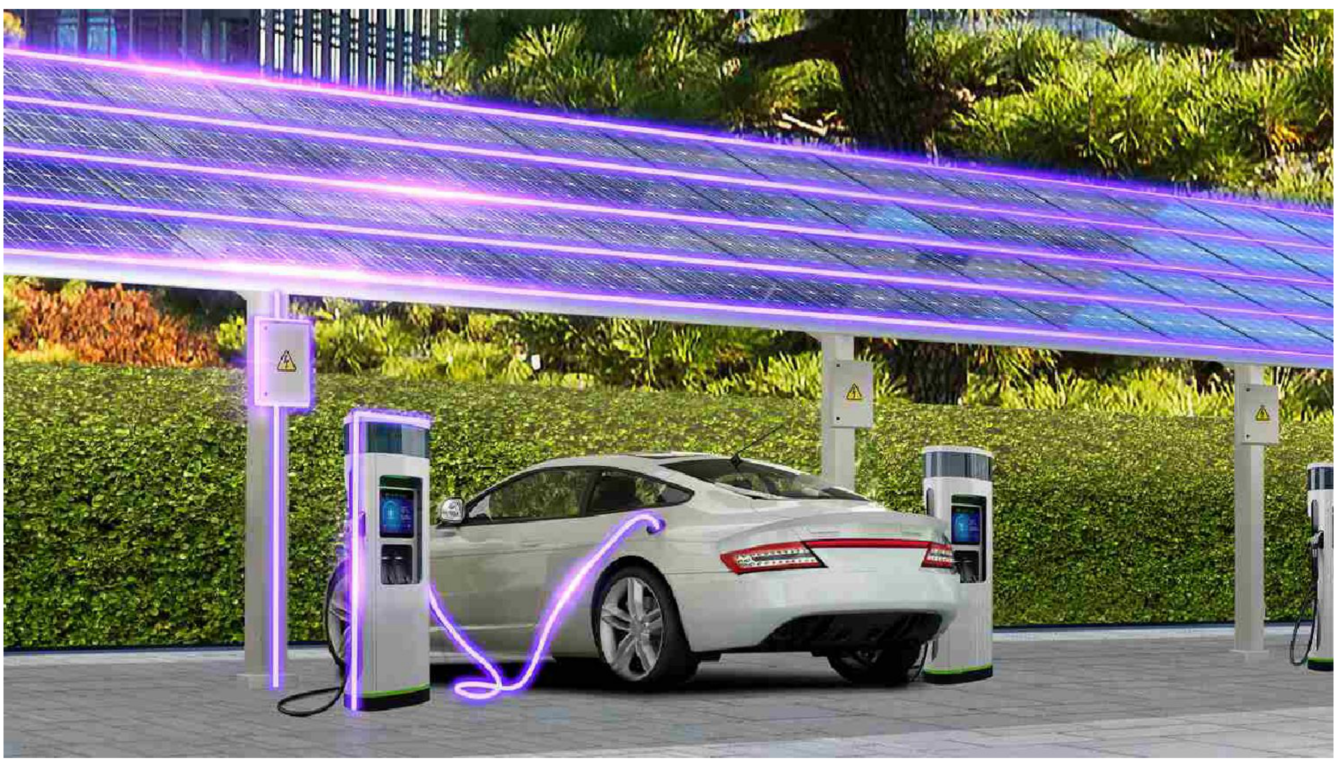

Figure 1. Example of current in EV charging and solar

Efficiency and power conversion in EV charging and solar applications

DC fast chargers and solar inverters share similar main power conversion building blocks. A DC fast charger converts AC power from the grid to DC power to charge an EV's battery. A solar panel converts DC power to AC power, connecting and delivering power to the grid.

In EV charging, a basic DC fast charger connects to the grid at what is known as the "common-coupling point." An electromagnetic interference filter that prevents noise from the following power factor correction stage from coupling back to the grid immediately follows the common-coupling point, maintaining measurement accuracy. This accuracy enables efficiency in the AC to DC conversion.

Solar panels connect to the grid similarly to EV chargers. A solar panel produces a DC voltage that fluctuates depending on the access the panel has to the sun and the amount of UV rays it receives. The solar inverter then converts DC power to AC power, which can be integrated back to the AC electric grid at the point of common coupling. Here, the isolated current measurement must be accurate so that the output power from the solar inverter matches the grid.

Metrology

Accurate current measurements are necessary for accurate metering and billing. At the point of common coupling, metrology may use current sensing to track how much energy a DC fast charger draws. Tracking the health of a DC fast charger can help identify maintenance needs, as well as determine proper billing for end users.

For solar panels, metrology standards monitor the common coupling point to return renewable energy to the grid. High accuracy over lifetime is required to track minor changes in current draw over time, so designers often prefer to use an isolated shunt-based current sensor, like AMC131M03, because the accuracy of open-loop technologies may drift over time, and shunt-based has no lifetime drift. Shunt-based current sensing technologies help prevent performance from degrading over a system's lifetime.

Accurate control of power gates

Hall-based current sensing is another form of isolated current sensing. Hall-based current sensing can sense the currents used to control the precise switching of power gates in the power conversion stages. In the power conversion stages, 10-bit accuracy is often acceptable, as the magnitude of the current is large and accuracy over the full range is not needed; therefore, Hall-based technologies such as the TMCS1126 current sensor are popular given their ease of use and low cost.

At the output of a DC fast charger, the connection to the vehicle often features shunt-based current measurement; high accuracy is a priority in order to ensure that the vehicle battery charges safely. Alternatively, at the input of a solar inverter, precise shunt-based current sensing with the AMC3302 isolated amplifier is often used in the mass power point transfer algorithm to achieve maximum power production.

Conclusion

Current sensing provides important protections that can not only move the future of renewable energy forward, but also enable the proper and safe management of our grid. The rise of electric vehicles and renewable energy will prompt additional investment into DC fast charging stations and solar panels. In both EV charging and solar applications, shunt and Hall-based isolated current sensing are essential to ensure safe, high-efficiency operation.

Additional resources

- See design resources for metrology.
- See the technical article, "Simplifying High-Voltage Sensing With Hall-Effect Current Sensors".

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