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On-board Charger for Worldwide Use

More than 80 % of all charging points in Germany are AC charging stations and are listed as standard charging stations in the Federal Network Agency's register. The On-board Charger (OBC) is therefore a particular focus for passenger car manufacturers, as the OBC must ensure interoperability with all AC charging points, not just in one country, but worldwide. New OBC functions such as bidirectional charging and greater integration with new technologies that offer more power with less weight are also complicating matters. Another trend must be mentioned: merging the OBC with other power electronics assemblies for example DC/DC converter, booster, and heater. Such an integrated system further increases the verification effort.

Interoperability tests are therefore used to thoroughly test newly developed OBCs before they go into series production. For this purpose, a measurement system that quickly scans the electrical currents and voltages of up to three AC phases must be inserted into the charging cable between the charging point and the vehicle in a way that meets high voltage safety requirements. Real-time analyses are carried out with a connected measurement computer, which evaluates and displays the signals of the charging process. The real-time analyses are crucial, as they are used to evaluate critical events in the case of a problem, but also to provide evidence. On the one hand, the analyses must be used to determine the grid quality during the charging process. There are criteria for grid quality in accordance with European and international standards. Depending on the grid quality, the grid robustness of the OBC can then be evaluated. On the other hand, the electric vehicle itself represents a load in the power grid and acts as an interference transmitter with grid feedback effects.

As an efficient solution, CSM offers customized, high-voltage safe measurement cases with integrated fast current and voltage measurement technology, to which charging cables and measurement computers can be connected. The sampling rate should generally not be less than 1 MSa/s to analyze problems with fast switching processes (interruption of charging or high inrush currents) or transient over voltages. With the harmonic analysis, the active power of the individual harmonics up to the 40th order must be considered for the power quality. At the charging point, parts of the harmonics of charging points connected in parallel are superimposed. Classical Fourier analysis is also necessary to examine spectra, for example to reveal which intermediate harmonics are present in the system.

The performance of such a measurement case for interoperability tests is particularly needed when the grid quality in a country fluctuates greatly or the expansion of charging stations reaches the load limit of the power grid.