COTEVOS

Analysis of the Needs for Interlaboratory Comparison Tests for Accepted Standards and Results of these Tests

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Abstract

An analysis of the actual and future most accepted standards for the communication between EV and EVSE is presented. A first approach to the interlaboratory comparison tests is proposed and their results presented.

Interlaboratory comparison tests were proposed in COTEVOS as a first step to set parameters to build an adequate test infrastructure able to assess compatibility and interoperability of vehicle charging systems. Although there are other standards in development which deal with higher layers of communication like the ISO/IEC 15118-1 and the ISO/IEC 15118-2, these are still not widely implemented on neither EV nor EVSE devices. Therefore, the goal is to focus on implemented standards, where IEC 61851-1 is the key reference looking at a basic communication between EV and EVSE.

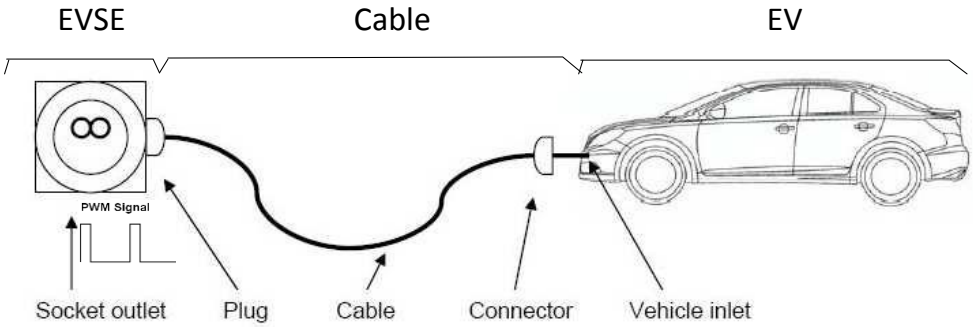

Figure 1 Physical components of the charging system

The comparison tests have been selected with the additional objective to identifying possible gaps in the standard as well as possible room to improvement the capabilities of the different laboratories. The tests should evaluate connection devices and PWM signals (See figure 1), since they represent the first level of contact between EV and EVSE. Without a proper identification of connection devices, the charging process will fail or might even endanger the users or the machines. A wrong or inaccurate PWM signal might lead to errors during charging process. These errors can be caused by the EVSE, EV or the charging cable.

For the performed tests the DUT have been examined as a black box where only the external behavior of the device is analyzed. Primarily the specific features of the devices are tested like acceptance of the out- and inlets and accordance with the specifications. To evaluate the conformance with the IEC 61851 Standard following aspects are tested: response to the charging states, duty cycle, rise time and voltage levels of the resulting PWM.

A total of 10 test cases have been implemented and carried out by 5 European test institutions on 6 EVs and 6 EVSEs, two connection devices and one additional device used to simulate different cable ratings as well as simulating different EV-states and allowing the acquisition of the resulting PWM signal. These are representative of commercially available equipment in Europe. The tests have the objective of assessing connectivity of the plugs, identification of current rates of the cables, and characteristics of the PWM signals like voltage levels, duty cycle and rise time.

The results showed that only a few devices were out of the maximum permitted values, but if it is taken into account that the sample of equipment tested is relative small, these results would become more significant if the tests were expanded to more devices. It was also noted that many of the measured values fall near to the allowed limits, which arises the question of what would happen if other components and properties of the cables were taken to the limits of tolerances. A proposal has been made in this regard for future work.

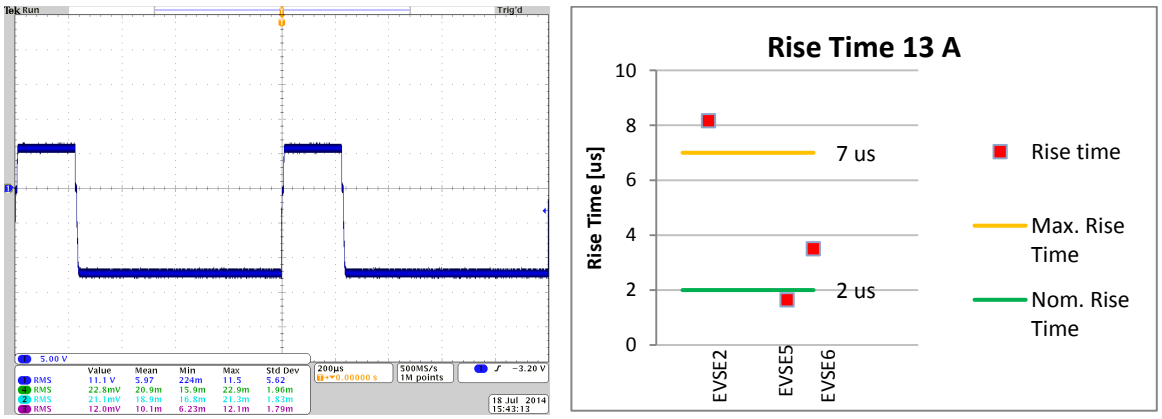

Figure 2 Measurement of an EVSE during round robin tests (13 Amp, state C),
a) Screenshot of the resulting PWM signal,
b) Evaluation and comparison of the rise time

As example, figure 2 shows the results of the measurement of an EVSE during charging process at current rate of 13 Amp. The positive and negative voltage levels of the PWM signal are within the tolerances defined in the IEC 61851 standard. The rise time of EVSE5 and EVSE6 falls close to the nominal value while the rise time of EVSE2 is above the maximum allowed limit of 7 µs.

By successfully executing this series of tests, important experience regarding interlaboratory tests with different testing institutions was gathered. Most institutions are specialized on different aspects or components of smart charging systems and this document shows the different capabilities used to perform the tests. This practical exercise has come up, as expected, with relevant information in order to define some necessary upgrades of the capabilities, which is being addressed in WP3. On the other hand, these outcomes will help make progress towards the definition of testing procedures and round robin tests.