EVS35
OSL2022

CHECK4CHARGE

FKFS
RESEARCH IN MOTION.

In-Field High-Power EV Charging Infrastructure Testing and Maintenance

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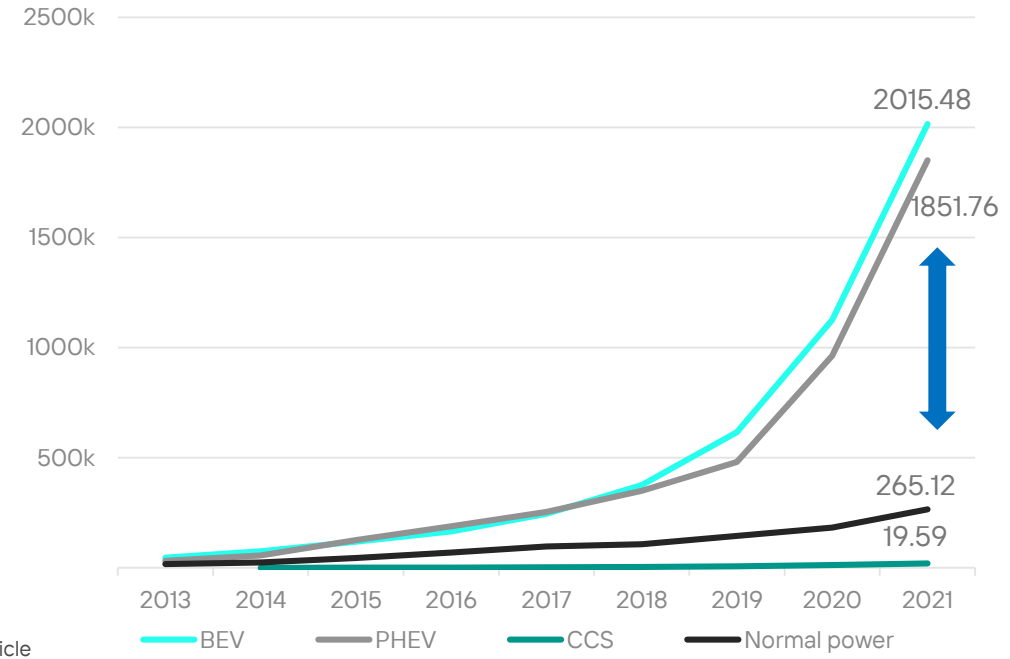
Motivation

Total Number of Passenger Cars and Recharging Points in EU

- Total amount of BEV and PHEV nearly doubled within the past years
- Charging points increasing rate around 60%

Gap between EVs and EVSEs will expand in the next years



Source: European Alternative Fuels Obervatory

EV: Electric Vehicle
EVSE: Electric Vehicle Supply Equipment
BEV: Battery Electric Vehicle
PHEV: Plug-In Hybrid Electric Vehicle
CCS: Combined Charging Station

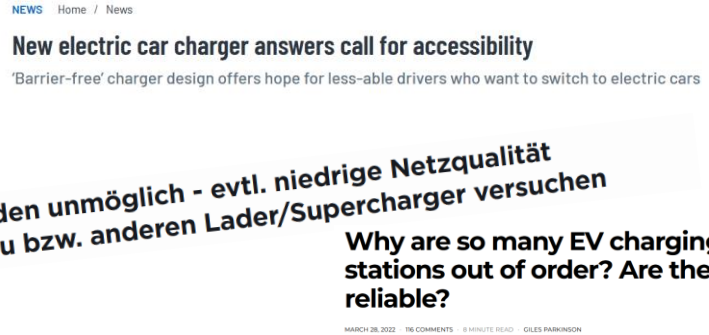
Motivation

Charging Problems

- Problems with grid quality
- Communication breaks up
- Special challenge for disabled people

➡ 5 – 20%*of all charging stations in EU are not intact

*Source:
Stern.de



Agenda

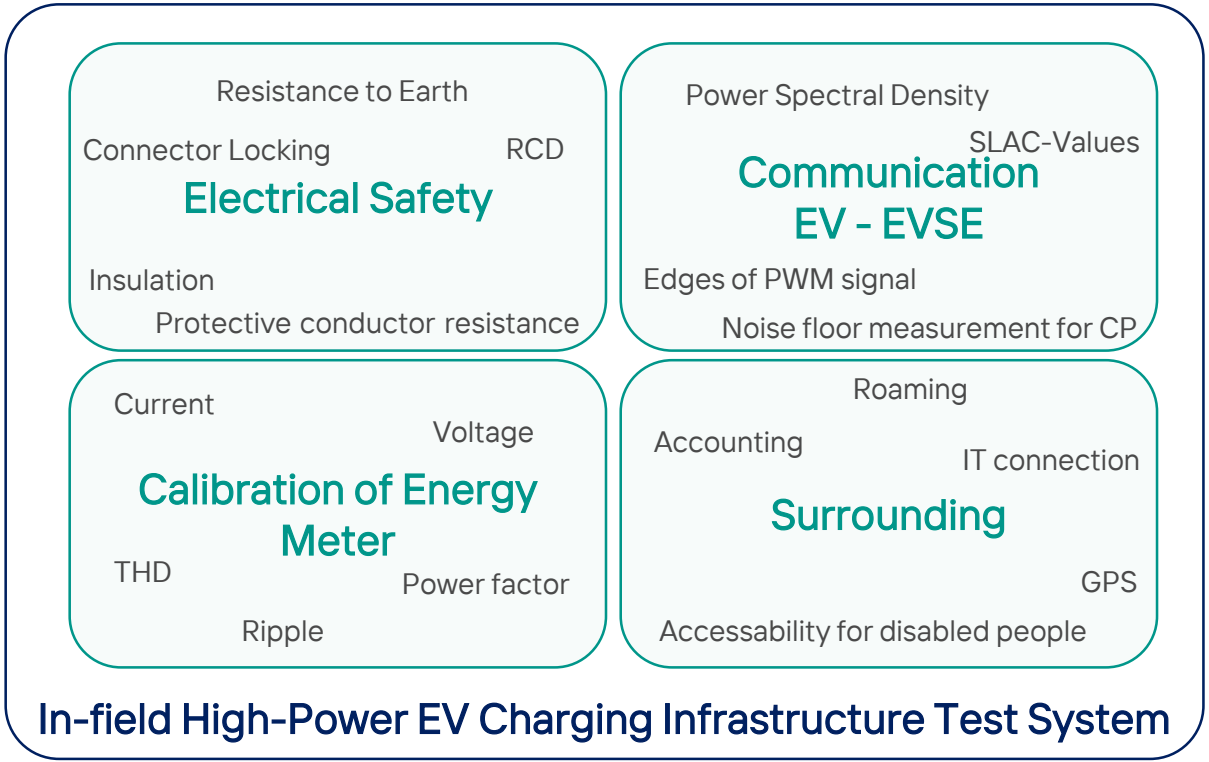
Subline

1. Concept
   - Investigation Fields
   - System Overview
   - Test Setups
2. Measurement results
   - Charging Power and Total Harmonic Distortion
   - Edge steepness at different charging stations
3. Summary and Outlook

Concept

Concept

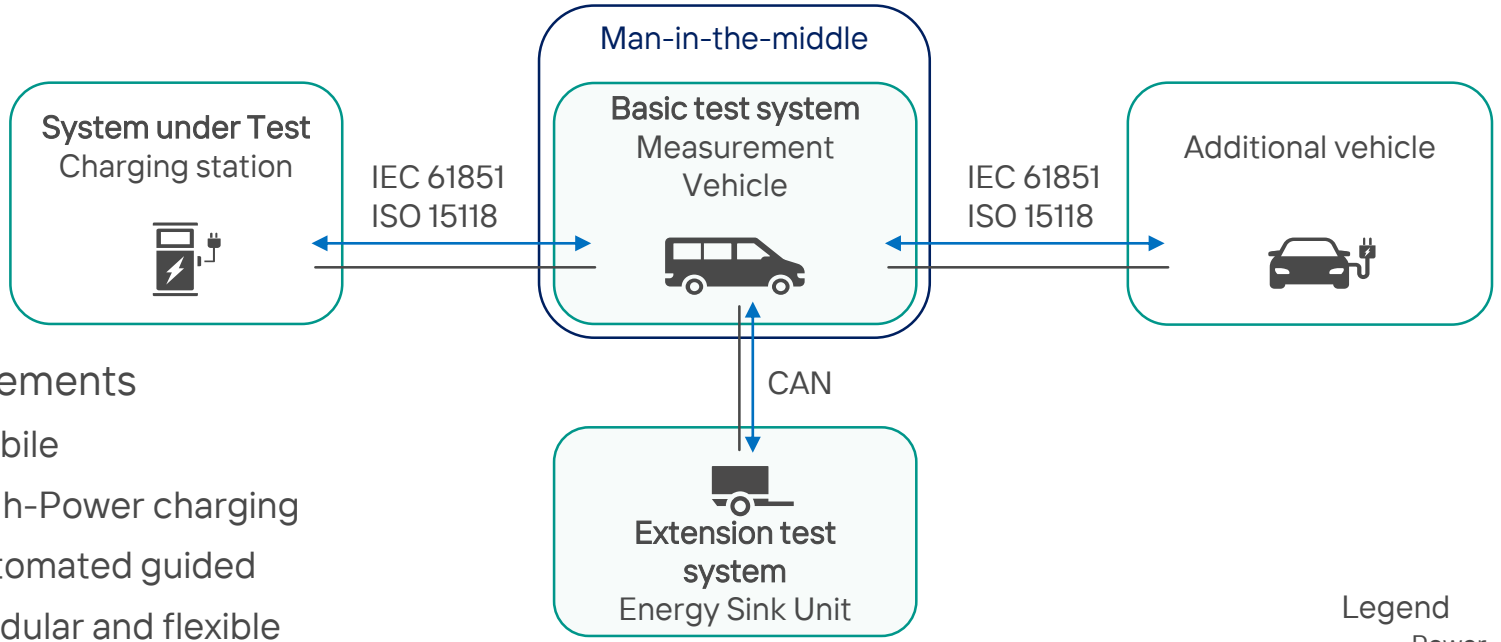
Investigation Fields



RCD: Residual Current Device
PWM: Pulse Width Modulation
CP: Communication Pilot
SLAC: Signal Level Attenuation Characterization
THD: Total Harmonic Distortion
GPS: Global Positioning System

Concept

System Overview



Requirements

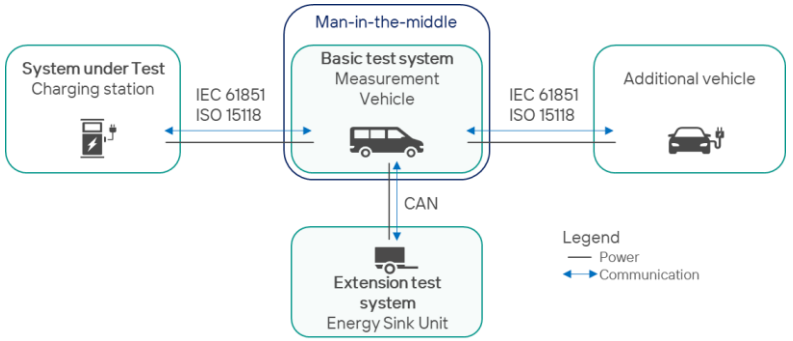
- Mobile
- High-Power charging
- Automated guided
- Modular and flexible
- Environment friendly

Concept

Test Setups

Primary Setups

- Man-in-middle tests with different additional vehicles
- Testing with storing energy



Extensional Tests

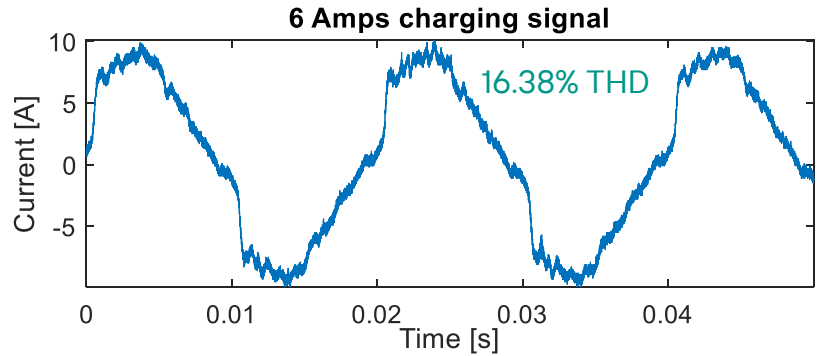
- Check bidirectional energy flow of charging points
- Investigate charging stations with occupied multiple
- Testing system limits

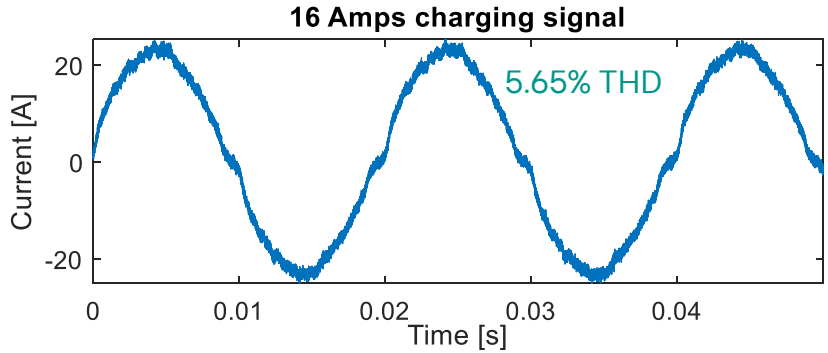
Measurement results

Measurement Results

Charging Power and Total Harmonic Distortion (THD)

- Distortion is within the limited range of $< 20\%$ (IEEE Std. 519)
- THD decreases with higher charging currents
- Important for AC charging

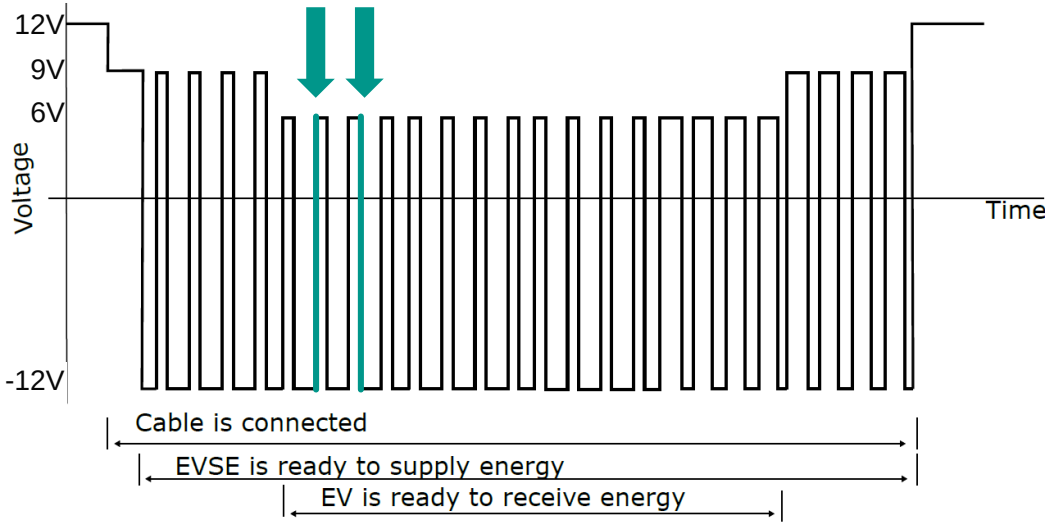




Measurement Results

PWM signal according to IEC 61851

	Rise time (10-90%)	Fall time (10-90%)
IEC 61851-1	≤ 2 µs	≤ 2 µs

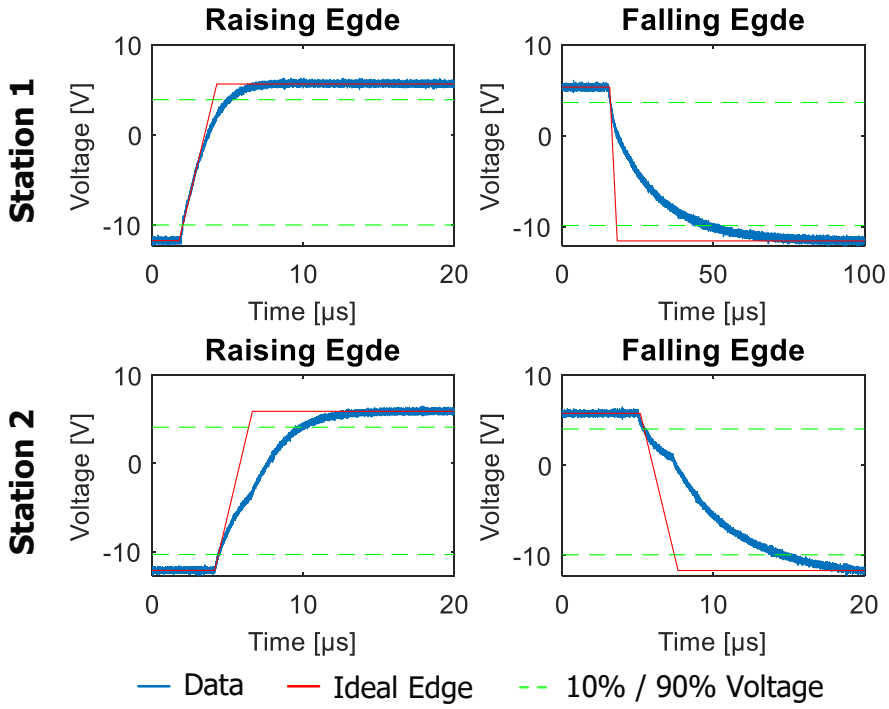


Measurement Results

Edge steepness at different charging stations

	Rise time (10-90%)	Fall time (10-90%)
IEC 61851-1	≤ 2 µs	≤ 2 µs
Station 1 (Home made)	2.5 µs	31.7 µs
Station 2 (Commercial)	5.6 µs	9.0 µs

- Currently EVs are very tolerant against the IEC 61851-1
- Degradation might be detected by long raising and falling edges



Summary and Outlook

Summary and Outlook

- High power charging test system for in field measurements
- Charging process can be affected by many reasons
- Only an overview of charging stations will allow a detailed evaluation
- This might also give possibilities in predicting aging of components
- Modular set up of test system offers also high flexibility to new requirements

- Setting up test sequences
- Building up measurement vehicle

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