EMPIR Call 2016 – Energy, Environment, Normative and Research Potential

Selected Research Topic number: **SRT-g05**
Version: 1.0

Title: Metrology for inductive charging of electric vehicles

Abstract

Manufacturers of electric vehicles (EVs) are developing inductive charging technology based on resonant coupling. This technology offers many advantages that will make electric vehicles more attractive than traditional fossil fuel vehicles. This SRT outlines the metrology support necessary for this technology to be accepted e.g. accurately measuring the efficiency of the wireless power transfer and the actual transferred power to the vehicle, measuring human exposure for compliance with safety standards and measurements necessary to improve the designs of high-efficiency couplers for inductive charging of EVs.

Keywords

Efficiency, EVs (electric vehicles), FEV (full electric vehicle), human exposure, PHEV (plug-in hybrid electric vehicle), power measurements, traceability, wireless power transfer (WPT), zero emissions.

Background to the Metrological Challenges

The current state of the art for EVs uses conductive charging technology. However, many manufacturers are developing inductive charging, which is based on static or dynamic resonant wireless power transfer (WPT). This has many advantages such as allowing vehicle charging to be done while the vehicle is moving, with the driver in the vehicle and the use of smaller batteries.

Measuring the power transmitted to the vehicle requires dedicated measurement techniques including calibration and characterisation of the transducers. Payment systems will need to ensure consumer confidence – do they pay for the transmitted or received energy? As energy losses can occur in several stages of the transmission chain, many parameters can affect both the measurements and the system efficiency.

Finally, the safety of both humans and animals that could be in close proximity to the charging pads, needs to be considered. Any foreign ferrites in the electromagnetic field produced by the coupled coils could lead to low efficiency power transfer and unintended heating of both the object and the charging system.

Objectives

Proposers should address the objectives stated below, which are based on the PRT submissions. Proposers may identify amendments to the objectives or choose to address a subset of them in order to maximise the overall impact, or address budgetary or scientific / technical constraints, but the reasons for this should be clearly stated in the protocol.

The JRP shall focus on the traceable measurement and characterisation of the efficiency of wireless power transfer.

The specific objectives are

1. To develop and characterise a power measurement unit for static wireless power transfer for the on-board measurement with a relative uncertainty in the dc circuit of 10^{-3}, the frequencies of the ac transmission being up to 100 kHz and powers up to 200 kW.
2. To develop methods to determine the efficiency of a static wireless power transfer system with a relative uncertainty of 10^{-3} and taking the relevant parameters, particularly airgap and misalignment between the coupled, coils into account.
3. To define the requirements for a power measurement unit for dynamic wireless power transfer, identify the relevant parameters (traffic conditions, speed, vehicle dimensions, power

EURAMET MSU, Hampton Road, Teddington, Middlesex, TW11 0LW, UK
Phone: +44 20 8943 6666 Email: msu@npl.co.uk
msu.euramet.org

The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States

converter state, coil configurations etc) and estimate their effect on the measurement of the power transferred to the vehicle and on the system efficiency.

4. To set up dedicated traceable measurement systems and to develop measurement protocols for the assessment of the human exposure to the electromagnetic fields generated by these technologies, in static and dynamic conditions, taking the compliance with the limits indicated by the guidelines of the international commission on non-ionizing radiation protection into account.

5. To facilitate the take up of the technology and measurement infrastructure developed in the project by the measurement supply chain (accredited laboratories) and end users (automotive industry) and to provide metrology input and pre-normative research to the evolution of relevant international standards.

These objectives will require large-scale approaches that are beyond the capabilities of single National Metrology Institutes and Designated Institutes. To enhance the impact of the research, the involvement of the appropriate user community such as industry, standardisation and regulatory bodies is strongly recommended, both prior to and during methodology development.

Proposers should establish the current state of the art, and explain how their proposed research goes beyond this.

EURAMET expects the average EU Contribution for the selected JRPs in this TP to be 2.0 M€, and has defined an upper limit of 2.3 M€ for this project.

EURAMET also expects the EU Contribution to the external funded partners to not exceed 35 % of the total EU Contribution to the project.

Any industrial partners that will receive significant benefit from the results of the proposed project are expected to be unfunded partners.

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the “end user” community, describing how the project partners will engage with relevant communities during the project to facilitate knowledge transfer and accelerate the uptake of project outputs. Evidence of support from the “end user” community (e.g. letters of support) is also encouraged.

You should detail how your JRP results are going to:

- Address the SRT objectives and deliver solutions to the documented needs,
- Feed into the development of urgent documentary standards through appropriate standards bodies,
- Transfer knowledge to the automotive sector.

You should detail other impacts of your proposed JRP as specified in the document “Guide 4: Writing Joint Research Projects (JRPs)”

You should also detail how your approach to realising the objectives will further the aim of EMPIR to develop a coherent approach at the European level in the field of metrology and include the best available contributions from across the metrology community. Specifically the opportunities for:

- improvement of the efficiency of use of available resources to better meet metrological needs and to assure the traceability of national standards
- the metrology capacity of EURAMET Member States whose metrology programmes are at an early stage of development to be increased
- organisations other than NMIs and DIs to be involved in the work

Time-scale

The project should be of up to 3 years duration.

Additional information

The following Standardisation requests from the EC may be relevant:

M/468 Standardisation Mandate addressed to CEN and CENELEC and ETSI concerning the charging of electric vehicles
M/533 Standardisation Request addressed to the European Standardisation Organisations, to draft European standards for alternative fuels infrastructure