

EURAMET Supplementary comparison of JV Current shunts for AC-DC Current transfer Standards

EURAMET.EM-S39

Technical Protocol

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Scope

Justervesenet (JV) has produced a set of Current Shunts to be used as Current Transfer Standards with nominal values ranging from 30 mA to 20 A. The Current Shunts were developed as part of the EMRP project “Power & Energy” in which one set of shunts would be made available for comparisons between NMIs. The Shunts have been designed for operation together with 90 Ω planar multi-junction thermal converters, where a nominal current input will produce a voltage drop of about 1 V across the shunt.

The procedures outlined in this document should allow for a clear and unequivocal comparison of the measurement results. The protocol was prepared following the CCEM guidelines for planning, organizing, conducting and reporting key, supplementary and pilot comparisons.

Definition of Measurand

Ac-dc current transfer difference is defined as

$$\delta = \frac{I_{ac} - I_{dc}}{I_{dc}},$$

where I_{ac} is the rms ac current, and I_{dc} is a dc current which, when reversed, produces the same mean output response as the rms ac current. Differences are expressed in $\mu A/A$, and a positive sign signifies that more ac than dc current was required for the same output response.

Travelling Standards

The traveling standards consist of 8 JV AC-DC current shunts with nominal operating current values of 30 mA, 100mA, 300 mA, 1 A, 3 A, 5 A, 10 A and 20A. The shunts have been produced at NOTE NORGE AS located at Kjeller, Norway, based on a design made by JV.



Figure 1: The current shunts viewed from the output side.

The 20 A shunt has UHF connectors, while all the others have N connectors.

Measuring Conditions

- If the ac-dc difference of the connected thermal converters is *not* known, the contribution of the thermal converters must be eliminated by switching the positions of them and averaging the results.
- The results must *either* be averaged from measurements of the shunt in both “Lo” and “Hi” position, *or* if it is to be measured only in the “Lo” position, the asymmetry of the setup must be accounted for in the uncertainty budget.
- At least 1 hour should be allowed for stabilization after the first application of current, and sufficient delay time should be used between successive applications of alternating and direct current.
- Recommended ambient conditions are $23\pm 1^{\circ}\text{C}$ and a relative humidity of $45\pm 5\%$.

Measurement Scheme

The ac-dc difference of each Shunt should be measured at its nominal current and the following frequencies:

10Hz, 20Hz, 55Hz, 110Hz, 400Hz, 1kHz, 5kHz, 10kHz, 20kHz, 50kHz and 100kHz.

In addition the 5 A and 20 A Shunts will be measured at 3A and 10 A, respectively.

Measurement Report

The participants should submit a printed and signed report by e-mail within 3 weeks after completing the measurements. The report should contain the following:

- Description of the measurements and the setup.
- Ambient conditions of the measurements.
- Measurement results.
- A statement of traceability.
- A detailed uncertainty analysis and an uncertainty budget in accordance with the ISO Guide to the Expression of Uncertainty in Measurements should be reported.

Transportation

The transportation is on each laboratory's own responsibility and cost. It is important that the package is shipped together with documentation stating that the Shunts are "**Temporarily Exported**". For customs purposes and/or transport insurance, the value of the set of Shunts is 15100 EUR.

Each participating laboratory covers the cost of the measurement, transportation and customs clearance as well as for any damage that may occur within its country.

Participants

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