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| Title of REPORT | On-site comparison of Quantum Hall Effect resistance standards of the PTB and the BIPM: Ongoing key comparison BIPM.EM‑K12 |
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| FIELD | **Electricity and Magnetism** |
| COMPARISON TYPE | **KEY COMPARISON** |
| COMPARISON identifier | *BIPM.EM-K12* |
| APPROVING BODY | CCEM |
| final report URL | **TO BE COMPLETED BY THE KCDB OFFICE** |

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| ABSTRACT | The ongoing on-site comparison BIPM.EM-K12 is part of the BIPM program implemented to verify the international coherence of the primary resistance standards. It allows National Metrology Institutes (NMIs) to validate their implementations of the Quantum Hall Effect (QHE) for dc resistance traceability by comparison to the reference maintained at the BIPM.  The realization of the ohm from the QHE-based standard of the NMIs at 100 Ω is compared with that realized by the BIPM from its own transportable quantum Hall resistance standard (QHRS). This comparison is usually completed by scaling measurements from 100 Ω to 1 Ω and 10 kΩ through the measurement of the resistance ratios 100 Ω/1 Ω and 10 kΩ/100 Ω, respectively.  In May 2025, a new BIPM.EM-K12 on-site comparison was carried out at the Physikalisch-Technische Bundesanstalt (PTB). It was the third time the PTB participated in this comparison program (previous comparisons in 1996 and 2013).  Measurements of the 100 Ω transfer standard in terms of the ohm realized from the QHE-based standards of the PTB and the BIPM agreed to 4 parts in 1010 with a relative combined standard uncertainty *u*c = 21 × 10−10. Measurements of 10 kΩ/100 Ω and 100 Ω/1 Ω ratios agreed to 7 parts in 1010 with *u*c = 21 × 10−10 and to 7 parts in 1010 with *u*c = 24 × 10−10, respectively.  The above result for the comparison of the 100 Ω transfer standard was obtained when both the BIPM and the PTB used a GaAs-based QHRS. For the first time in this key comparison program, the 100 Ω comparison was repeated using the same GaAs-based QHRS for the BIPM and a graphene-based QHRS for the PTB. These additional comparative measurements also gave excellent results and confirmed the equivalence between the two types of QHRS. This confirms the possibility of using a graphene-based QHRS as a primary standard for realizing the ohm under relaxed experimental conditions (typically 5 T and 4.2 K). |
| KEY WORDS FOR SEARCH  separated by ; | Quantum Hall effect; Quantum Hall resistance standard; Graphene; Key comparison; International comparison; Resistance standard; Resistance ratio |

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