



Report on Electricity and Magnetism Metrology Activities at the Standards and Calibration Laboratory (SCL), Hong Kong

For the 31st meeting of the CCEM, March 2019

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This report gives a brief summary on key activities in the field of electricity and magnetism at the Standards and Calibration Laboratory (SCL), Hong Kong in 2017-2019.

Quantum Metrology

- The laboratory has setup a Programmable Josephson Voltage Standard (PJVS). The system was delivered in January 2018. An onsite direct comparison was performed with a NIST transportable PJVS system in March 2018.
- The laboratory has setup a new Quantum Hall Resistance (QHR) system. The new system was delivered in October 2017.
- The laboratory is piloting an inter-laboratory comparison on 10 V and 1.018 V DC voltages with GULFMET (GULFMET.EM.BIPM-K11). The linking laboratories are BIPM and KRISS (Korea), and the participating laboratories are EMI (United Arab Emirates), SASO (Saudi Arabia) and IMBIH (Bosnia and Herzegovina). The draft A report is preparation in progress.

Direct Current

- The laboratory will upgrade the existing voltage ratio box and DCC potentiometer to an automatic potentiometer system for DC voltage dissemination.
- The laboratory will setup an ultra-low noise current amplifier system for small current calibration.
- The laboratory has developed an in-house system for the calibration of residual current device (RCD) testers.

Low Frequency

- The laboratory has upgraded the existing single junction thermal converter system to an automated multi-junction system.
- The laboratory has developed calibration service for AC electronic loads.

Power and Power Quality

- The laboratory has setup a second set of 3 phase power and energy calibration system in 2017 to support the calibration requests from the local power utility companies.
- The laboratory will develop and setup another 3 phase primary power calibration system based on digital sampling technique. The new system will use auto range current transformer and resistive voltage dividers for high precious automate calibration.

RF and microwave

- The laboratory has installed a new microcalorimeter system to upgrade the existing system for calibration service of thermistor mount power sensors up to 18 GHz with better measurement uncertainty.
- The laboratory has set up facilities for calibration of the magnetic antenna factor for loop antenna with frequency range from 1 kHz to 30 MHz.

Medical Testing Equipment

- The laboratory has been working on the calibration of medical testing equipment since 2013, as the local hospitals and medical institutes were looking for traceable calibration of their medical testing equipment. For electrical type medical testing equipment, SCL has developed calibration services for electrical safety analyzers, defibrillator analyzers and electro-cardio graph (ECG) simulators.
- The laboratory has conducted study for electro-surgical unit (ESU) analyzers.

EMC/EMI

- The laboratory has updated the calibration service for electrical fast transient/burst generator in accordance with the IEC61000-4-4 Edition 3.0 2012-04.
- The laboratory has updated the calibration service for 50 Ω /50 μ H + 5 Ω V-network Type Artificial Mains Networks (AMN)/Artificial Networks (AN) in accordance with the CISPR 16-1-2 Edition 2.1 2017-11.
- The laboratory has updated the calibration service for Voltage Dips and Short Interruptions Generator in accordance with the IEC 61000-4-11 Edition 2.0 2017-05.

Key and Supplementary Comparisons

- APMP.EM-K12 (Comparison of AC-DC Current Transfer Standards)
 - Measurement completed in April 2014. Draft A report in progress.
- APMP.EM.BIPM-K11.3 (DC Voltage, Zener diode)
 - Reviewed draft B report in January 2015. Final report was issued in June 2017.

- APMP.EM-S8 (Comparison on digital multimeter)
 - Measurement completed in February 2015.
- APMP.EM-S12 (Comparison of Standards for the Calibration of Voltage, Current and Resistance Meters)
 - SCL is the support member of this comparison.
 - Measurement completed in March 2016. Final report was issued in November 2017.
- GULFMET.EM.BIPM-K11 (Comparison on 10 V and 1.018 V DC Voltages)
 - Measurement completed in 2018.
 - Draft A report preparation in progress.
- GULFMET.EM.S1 (Comparison of Resistance Standards at 100 Ω)
 - Measurement completed in April 2017.

Publications

- [1] S. L. Yang, H. S. Lam and M. N. Ng, "Calibration of Electrocardiograph (ECG) Simulators," NCSLI Measure J. Meas. Sci, 2017.
- [2] S. L. Yang, Y. K. Yan and H. M. Chan, "Calibration of Programmable Loads," NCSLI 2017 Conf. Proc., August 2017.
- [3] H. W. Lai, Michael W. K. Chow and K. Y. Chan, "Calibration of Electrostatic Discharge (ESD) Generator in accordance with IEC61000-4-2: 2008," NCSLI 2017 Conf. Proc., August 2017.
- [4] Steven Yang, Brenda Lam and Chris M. N. Ng, "Calibration of Electrocardiographic (ECG) Simulators," NCSL International measure: The Journal of Measurement Science, Vol. 12 (1), pp. 46 to 53, March 2018.
- [5] S. L. Yang, H. S. Lam and M. N. Ng, "Digital Sampling Technique in the Calibration of Medical Testing Equipment with Arbitrary Waveforms," IEEE MEMEA 2018 Conf. Digest, June 2018.
- [6] H. W. Lai, C. M. Tsui, and H. W. Li, "Calculation of Voltage Reflection Coefficients of Coaxial Airlines and Evaluation of Their Measurement Uncertainties at SCL," CPEM 2018 Conf. Digest, July 2018.
- [7] C. M. Tsui, H. W. Lai and H. W. Li, "Calibration of AMN/LISN at SCL," CPEM 2018 Conf. Digest, July 2018.
- [8] S. L. Yang, Stephane Solve, Regis Chayramy, H. S. Lam and Y. N. Yip, "Determination of Pressure Coefficients for the Transport Standards of GULFMET DC Voltage Inter-laboratory Comparison," CPEM 2018 Conf. Digest, July 2018.
- [9] S. L. Yang, K. H. Chan, H. S. Lam and Y. C. Lee, "Improvement of an Automated AC/DC Voltage Transfer Calibration System at the Standards and Calibration Laboratory," CPEM 2018 Conf. Digest, July 2018.

- [10]C. M. Tsui, Aaron Y. K. Yan and H. W. Lai, "Speeding up Monte Carlo Computations by Parallel Processing Using GPU for Uncertainty Evaluation in Accordance with GUM Supplement 2," NCSLI 2018 Conf. Proc., August 2018.
- [11]H. W. Lai, C. M. Tsui and H. W. Li, "Computer Aided Verification of Voltage Dips and Short Interruptions Generators for Electromagnetic Compatibility Immunity Test in Accordance with IEC 61000-4-11: 2004 + AMD: 2017," NCSLI 2018 Conf. Proc., August 2018.
- [12]S. L. Yang, H. S. Lam and Y. N. Yip, "Arbitrary Power Waveforms Measurement for Electrosurgical Unit Analyzers," NCSLI 2018 Conf. Proc., August 2018.

International Technical Activities

- SCL Participated in the BIPM Capacity Building and Knowledge Transfer Program (CBKT) in the electricity area from January to March 2017.
- SCL staff has supported GULFMET on 81 CMC reviews of EM entries in May 2018.

Peer Reviews

The laboratory has completed peer reviews for direct current, low frequency and radio frequency areas and transition to the latest version of ISO/IEC 17025:2017 led by the Hong Kong Accreditation Service (HKAS).

<u>Areas</u>	<u>Assessors</u>	<u>Date</u>
Direct current, low frequency and high voltage	Dr Murray EARLY (NIST, USA)	10-13 December 2018
Magnetism	Dr Qing HE (NIM, CHINA)	11 December 2018
Radio frequency	Prof Xiaohai CUI (NIM, CHINA)	17-18 January 2019

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