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IECEE
OPERATIONAL DOCUMENT

IEC System of Conformity Assessment Schemes for Electrotechnical Equipment and Components (IECEE System)

Committee of Testing Laboratories (CTL)

Leakage (Touch) Current Measurement Instruments

IECEE OD-5013:2015(EN)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE ZZ

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Background

The CTL decided in 2014 to convert the CTL Operational Procedure (OP) into the IECEE Operational Document (OD) structure. The content of the former OP's has not been changed. Editorial adjustments have been made where necessary. The forms have been separated into independent documents for better handling.

A transfer table which CTL/OP has been transferred into which OD is given in OD 5000.

1 Purpose

The purpose of this document is to give advice regarding the selection and calibration of leakage (touch) current meters and circuits.

2 Scope

Applicable for all laboratories within the IECEE CB Scheme.

3 Normative References

The following publication contain provisions which, through reference in this text, constitute modification or additions of this Operational Document.

IEC 60990:1999	Methods of measurement of touch current and protective conductor current
IEC 17025	Conformity assessment -- Vocabulary related to competence of persons used for certification of persons
IEC Guide 115	Application of uncertainty of measurement to conformity assessment activities in the electrotechnical sector
CTL/DSH 251	Measurement accuracy

4 Definitions

For the purpose of this publication, the definitions of *IECEE Definitions* apply with the following additions:

None	

5 Abbreviations

CTL	IECEE Committee of Testing Laboratories
CTL/ETF	CTL Expert Task Force
CTL/WG	CTL Working Group

6 Calibration of Leakage (Touch) Current Measurement Instruments

Precautions in arranging for calibration services are advisable.

1. The request for calibration should clearly require that the calibration laboratory establish conformance with IEC 60990:1999. While the main interest in the study was the perception/reaction network, figure 4 of IEC 60990:1999, some standards utilize other networks as well.

2. The calibration should include verification of the input impedance to IEC 60990:1999 over the required frequency range of 20 Hz to 1 MHz. For the perception/reaction network, table L2 of IEC 60990:1999 applies.

3. Leakage (touch) current instruments with integral meters giving readings in milli-amperes or MIUs are verified against the calibration curves and tables in IEC 60990:1999 for transfer impedance. The output voltage figures in the tables and curves are divided by 500 to get milli-amperes or MIUs. The term MIU (**m**easurement **i**ndication **u**nit) is another name for the weighted milli-amperes measured at the output of the leakage (touch) current networks. For the perception/reaction network, table L2 of IEC 60990:1999 applies.

4. Some leakage (touch) current instruments have, in addition to a built-in meter, output terminals for use in measuring voltage U2 shown in the diagrams for touch current networks with an external voltmeter. The built-in meter and output terminals both need to be calibrated.

5. Because of the high attenuation provided by the touch current networks at the higher frequencies, the limited sensitivity and resolution of meters on the touch current instruments, and the restrictions on input current (usually limited to 100 mA to protect internal components), it may be impractical to calibrate the touch current instruments throughout the frequency range on all scales. Care needs to be taken to come to an agreement with the calibration laboratory on the procedure used to provide an acceptable calibration.

On some instruments, calibration on one scale may partially represent other scales. For example calibration at the high frequencies on a 0-0.3 mA scale may make it unnecessary to calibrate at those frequencies on higher scales, such as 0-10 mA, where it is not possible to drive the input at a high enough current at the higher frequencies to get a reading on the scale. On other instruments, calibration on one scale may not represent other scales.

7 Peak and True RMS Touch Current

When measuring the output voltage of touch current measurement networks the voltmeter needs to be able to measure both true RMS and peak voltages throughout the frequency range of 20 Hz to at least 1 MHz, have an input impedance of at least 1 MOhm and an input capacitance no greater than 200 pF. These specifications are considerably better than the specifications of the usual voltmeter commonly found in the product safety testing laboratory. Accordingly, laboratory procedures for touch current measurement need to require the use of voltmeters with the proper specifications. Additionally, the voltmeters used need to be calibrated for measuring both true RMS and peak voltages at least over the frequency range of 20 Hz to 1 MHz, and have the input impedance verified.

8 Leakage (Touch) Current Measurement Instruments

"House-Made" Instruments:

A number of laboratories have made their own leakage (touch) current measurement networks in a box. Also, there are a number of commercially-made leakage (touch) current networks.

Some design considerations that need to be made are:

1. Resistors and capacitors used need to have a tolerance of +/- 1.0 % or individually selected for correct value by measurement.

2. The types of resistors used (e.g. carbon composition, thin film, cermet or metal oxide) need to be of the type with low parasitic inductance and capacitance. Resistors may need to be selected not only by type but also manufacturer to get the desired results.

3. The types of capacitors used (e.g. mica, glass, ceramic) need to be of the type with low parasitic inductance and low resistive leakage. The type and construction affect the high frequency performance. Capacitors may need to be selected not only by type but also manufacturer to get the desired results. Due to the tolerance on capacitance, capacitors may need to be individually selected for correct value.

4. Physical layout of the network components is a concern at the higher frequencies. The physical layout needs to minimize parasitic inductance and capacitance.

5. Consideration needs to be given to shielding the network in the box to prevent reception of electromagnetic radiation within the test area so as not to affect the readings obtained.

6. Shielded connection of the voltage output of the box to a voltmeter, such as by coaxial cable and BNC connectors, is advisable to prevent reception of electro-magnetic radiation present within the test area.

7. Shielded connection between the network box and the leakage (touch) current switching circuits, for example IEC 60990:1999 figure 6 should be considered to prevent reception of electro-magnetic radiation within the test area. Where direct coaxial connection with BNC connectors is not practical, use of a shielded, un-attenuated test probe such as is often used with an oscilloscope should be considered.

9 Availability of Commercially Made Integral Leakage (Touch) Current Instruments

There are a number of commercially available integral leakage (touch) current instruments - instruments that combine both the leakage (touch) current networks and a meter.

When purchasing commercially-made integral leakage (touch) current instruments, it would be prudent to obtain a calibration certificate and report with data for the instrument from an accredited calibration laboratory demonstrating conformance with IEC 60990:1999 over the full frequency range of 20 Hz to 1 MHz before buying.

10 Accuracy Specification for Leakage (Touch) Current Measurement Instruments and Networks

IEC 17025 clause 5.4.6.2 gives direction. If there is no tolerance specified in the test standard or other agreed upon requirement such as CTL DSH-251(suffix), then the laboratory is obligated to determine uncertainty associated with the leakage (touch) current measurement and if it has a material effect on the test results.

Calculation of the uncertainties for the networks and integral leakage (touch) current instruments is not simple and straight forward due to the non-linear performance curve given by IEC 60990:1999.

An alternative is to use the accuracy method described in IEC Guide 115 and the application of an applicable accuracy specification for the leakage (touch) current networks and instruments.

INTERNATIONAL ELECTROTECHNICAL COMMISSION

3, rue de Varembé
PO Box 131
CH-1211 Geneva 20
Switzerland

Tel: + 41 22 919 02 11
info@iec.ch
www.iec.ch

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IECEE Secretariat c/o IEC
3, rue de Varembé
PO Box 131
CH-1211 Geneva 20
Switzerland

Tel: + 41 22 919 02 11
secretariat@iecee.org
www.iecee.org