



IECEE OD-5013

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

Leakage (Touch) Current Measurement Instruments





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FOREWORD

Document Owner

CTL WG 1 “Metrology and Accuracy/Uncertainty”

History of changes

Revision Date	Brief summary of changes
2018-06-03	<p>Changes are editorial: restructure to new IECEE OD template, number paragraphs per new OD template guidance, adjust document to align with new version of IEC 60990.</p> <p>IEC 60990:2016 has changed “perception-reaction” to “startle-reaction” - Section 6, par 2: change “For the perception/reaction...” to “For the startle-reaction”, added paragraph numbers to section 6</p> <p>Change all “60990:1999” references to “60990” The most-recent version is the applicable edition.</p> <p>Section 6, par 2: change “table L2” to “K1”</p> <p>Section 6, par 3: change “L2” to “K2”</p> <p>Paragraphs 6.1.5 and 6.1.6, changed “ma” to “mA”</p> <p>Paragraph 10.1, changed ISO/IEC 17025:2005 par 5.4.6.2 reference to ISO/IEC 17205:2017 par 7.6.3</p>

Effective date	Next maintenance due date
2019-06-30	2021-06-30

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	Methods of measurement of touch current and protective conductor current
ISO/IEC 17025:2017	General requirements for the competence of testing and calibration laboratories
IEC Guide 115	Application of uncertainty of measurement to conformity assessment activities in the electrotechnical sector
IECEE OD-5014	Instrument Accuracy Limits

4 Definitions

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

None	
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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

6.1 Precautions in arranging for calibration services are advisable.

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

6.1.2 The calibration should include verification of the input impedance to IEC 60990 over the required frequency range of 20 Hz to 1 MHz. For the startle-reaction network, table K1 of IEC 60990 applies.

6.1.3 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 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 (measurement indication unit) is another name for the weighted milli-amperes measured at the output of the leakage (touch) current networks. For the startle-reaction network, table K2 of IEC 60990 applies.

6.1.4 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.

6.1.5 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.

6.1.6 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

7.1 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

8.1 "House-Made" Instruments:

8.1.1 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 in a box. Some of these networks have been shown by calibration to meet the requirements of IEC 60990, while others have not met the requirements. The networks that do not comply with the requirements usually exceed the allowable tolerances at frequencies of 100 kHz to 1 MHz.

8.1.2 Some design considerations that need to be made are:

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

8.1.2.2 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.

8.1.2.3 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. manufacturer to get the desired results.

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

8.1.2.5 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.

8.1.2.6 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.

8.1.2.7 Shielded connection between the network box and the leakage (touch) current switching circuits, for example IEC 60990 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

- 9.1 There are a number of commercially available integral leakage (touch) current instruments - instruments that combine both the leakage (touch) current networks and a meter. Some of these instruments have been shown by calibration to meet the requirements of IEC 60990, while other instruments have not. As with the network boxes, instruments that do not comply with the requirements usually exceed the tolerance limits at frequencies of 100 kHz to 1 MHz.
- 9.2 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 over the full frequency range of 20 Hz to 1 MHz before buying.

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

- 10.1 ISO/IEC 17025 clause 7.6.3 gives direction. If there is no tolerance specified in the test standard or other agreed upon requirement such as IECEE OD-5014, 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.
- 10.2 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.
- 10.3 An alternative is to use the accuracy method described in IEC Guide 115 and the application of a desired accuracy specification for the leakage (touch) current networks and instruments.

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