



CALIBRATION SERVICES

Accredited Calibration for EMC Laboratories



AN INTRODUCTION TO CALIBRATION

UL's Carugate Laboratory is operated with the needs of UL clients in mind. With a highly trained team of calibration specialists, dedicated laboratory space, and state-of-the-art equipment, the Carugate Laboratory facility is the ideal location for calibration services.

Information on our accredited calibration services for EMC laboratories can be found in "UL Calibration Services: Accredited Calibration for Safety and Safety/EMC Laboratories."



CALIBRATION SERVICES

The Carugate Lab is currently accredited to IECEE, ACCREDIA, OSHA, IAS and more. Proper calibration of sensitive equipment remains a critical part of staying competitive in the global market, and working with a respected, trusted partner like UL can make all the difference.

Understanding Metrological Confirmation

The term “metrological confirmation” typically includes calibration and verification, along with adjustment and/or repair that might be required for equipment found to be outside of a designated range. Equipment calibration and verification are a critical part of ensuring that your laboratory facilities continue to provide accurate results. Due to transit, installation, and the rigors of regular use, even the highest-quality equipment will need initial and routine calibration/verification.

An explanation of metrological confirmation according to the International Organization for Standardization (ISO) is as follows:

Metrological Confirmation <<ISO 10012 Par. 3.5>>

Set of operations required to ensure that measuring equipment conforms to the requirements for its intended use.

NOTE: Metrological confirmation generally includes calibration and verification, any necessary adjustment or repair, and subsequent recalibration, comparison with the metrological requirements for the intended use of the equipment, as well as any required sealing and labeling

Calibration <<ISO Guide 99 (VIM) Par. 2.39>>

Operation that, under specified conditions, in a first step, establishes a relation between the quantity values with measurement uncertainties provided by measurement standards and corresponding indications with associated measurement uncertainties and, in a second step, uses this information to establish a relation for obtaining a measurement result from an indication.

Verification <<ISO Guide 99 (VIM) Par. 2.44>>

Provision objective evidence that a given item fulfills specified requirements.

Adjustment of a Measuring System <<ISO Guide 99 (VIM) Par. 3.11>>

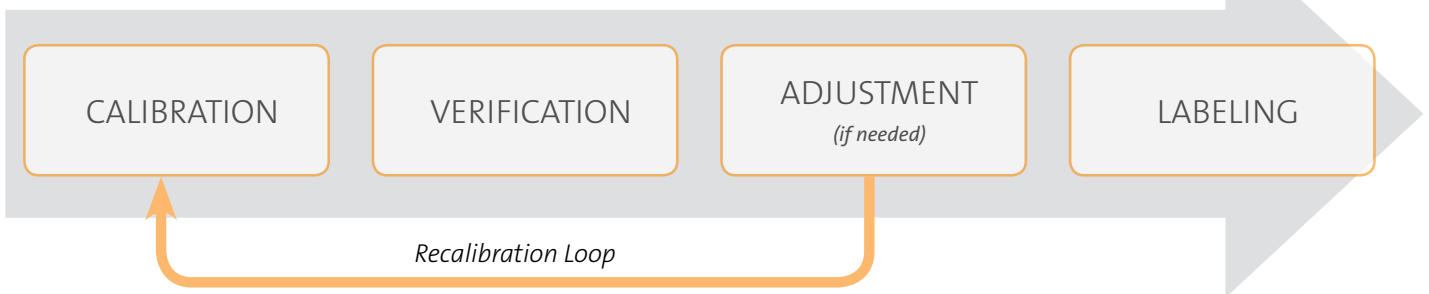
Set of operations carried out on a measuring system so that it provides prescribed indications corresponding to given values of a quantity to be measured.

As an ilac-MRA and iAS accredited laboratory, UL's Carugate Calibration Centre is equipped to conduct calibration activities in our facility or on-site in our customers' labs.



Available services include calibration, verification, adjustment and labeling. To ensure conveniences, all of our calibration services are modular, meaning you can request the complete metrological confirmation process or only a part of the confirmation process. Every complete process includes the evaluation of instrument conformity to the standard under which it will be governed. Further, our calibration experts provide advice for managing "out of specification/tolerance" measurement instruments.

Metrological Confirmation



The Carugate Calibration Centre can calibrate commercial and/or custom instrumentation, in a variety of quantities, in the following categories:

- **Electrical:** DMM, Power Meter, Voltage and Current Harmonics, Leakage Current Meter and Network, Current Clamp, Built-in Meter, Components
- **Thermal:** Temperature Data Logger, Thermocouple, Climatic Chamber, Climatic Environmental Unit
- **Dimensional:** Caliper, Micrometer, Tape Measure, Test Probe
- **EMC:** RF cable, Directional Coupler, ISN, LISN, Attenuator, EM Clamp, RF amplifiers, Van Veen Loop antenna, Helmholtz Coil, CDN, Burst/Surge/Ring Wave generator, Harmonics & Interharmonics analyzer and Generators, Flicker
- **Others:** Fluid Pressure Meter/Transducers, Force Meter, Torque Meter, Scale, Mass

Metrological Confirmation of equipment subjected to calibration as verification of compliance to international regulatory requirements and/or to specific standards for which the instrument is used.

Calibration allows you:

- To comply with IEC 17025 General requirements for the competence of testing and calibration laboratories
- To comply with UL's Data Acceptance Program for simplified UL Certification
- To ensure compliance of products on the basis of traceable measurements, as required by the IECCE rules and the CE Mark
- To ensure the reproducibility of the measurements during the development of standards and/or products





Current Harmonics and Inter-Harmonics Analyzer

On-site calibration of current harmonic analyzers used for current emission according to IEC/EN 61000-3-2 ($I < 16A$) and IEC/EN 61000-3-12 ($16A < I < 75A$)

Our field engineers use UL developed harmonic and inter-harmonic software and hardware during calibration. Our current inter-harmonic meter (CIHM) is a 4-channel inter-harmonic analyzer able to measure (in a time domain) up to 180 harmonic sinusoidal components overlapped to the main supply. This equipment is available for purchase or rental.

EXAMPLE REPORT

CURRENT HARMONICS - 20A Shunt 50Hz

Applied quantity			Equipment in calibration		Measurement Results	
Parameter	Value	Frequency	Range	Reading	Error	Uncertainty
Hrm 1	15,9993 A	50 Hz	20 A	16,0052 A	0,01 A	48,26 mA
Hrm 2	0,79698 A	100 Hz	20 A	0,7973 A	0,00 A	12,02 mA
Hrm 3	0,79694 A	150 Hz	20 A	0,8015 A	0,00 A	12,08 mA
Hrm 4	0,79732 A	200 Hz	20 A	0,7978 A	0,00 A	12,03 mA
Hrm 5	0,79706 A	250 Hz	20 A	0,7963 A	0,00 A	12,00 mA
Hrm 36	0,79684 A	1800 Hz	20 A	0,8072 A	0,01 A	12,17 mA
Hrm 37	0,79678 A	1850 Hz	20 A	0,8071 A	0,01 A	12,17 mA
Hrm 38	0,79686 A	1900 Hz	20 A	0,8084 A	0,01 A	12,19 mA
Hrm 39	0,79668 A	1950 Hz	20 A	0,8087 A	0,01 A	12,19 mA
Hrm 40	0,79655 A	2000 Hz	20 A	0,8075 A	0,01 A	12,17 mA

SCOPE OF ACCREDITATION

CURRENT HARMONICS - interharmonics and THD meters

Measurement Area	Range & Resolution			Calibration & Measurement Capability ¹ (CMC) (±)		Technique, Reference Standard, Equipment
	Par	IHRM Amplitude	IHRM Frequency	U1	U2	
AC Current Harmonics and Interharmonics - Measure	Fund	50mA to 0.5A	50Hz/60Hz	1.2E-02 rel	0.58 µA/I	UL International Italia CIHM IEC 61000-4-7 (Note 1, 3, 12)
		0.5A to 100A	50Hz/60Hz	2.0E-02 rel	0.58 µA/I	
	IHRM11 to IHRM2000	4.5mA to 135mA (TotRMSmax:500mA)	55Hz to 12kHz	2.0E-02 rel	0.58 µA/I	
		50mA to 1.35A (TotRMSmax:5A)	55Hz to 12kHz	2.0E-02 rel	0.58 µA/I	
		300mA to 9A (TotRMSmax:32A)	55Hz to 6kHz	2.5E-02 rel	0.58 µA/I	
		1A to 30A (TotRMSmax:100A)	6kHz to 12kHz	5.0E-02 rel	0.58 µA/I	
	THDI	Fund: 50mA to 100A	55Hz to 12kHz	2.5E-03 rel	58 µ%THD/THD	

BENEFITS

- No equipment removal or disconnection required
- No risk of equipment damage during transportation
- Minimal interruption of client lab activities

APPLICABLE STANDARDS

- IEC61000-4-7



EQUIPMENT/SOFTWARE FEATURES

- Quick test setup and execution
- Easy collection, monitoring, management and exporting of data

EQUIPMENT/SOFTWARE SPECIFICATIONS

- 50 kS/s/ch simultaneous input
- Built-in antialiasing filters
- 4 different measurement range
- USB Connection



Harmonics and Inter-harmonics Services

Unique in-house or on-site calibration services for harmonics and inter-harmonics according to IEC 61000-4-7

Equipment Type	Range	Accredited	In-House	On-Site
Voltage Harmonics and Inter-Harmonics and THD Meter/Generator (According IEC61000-3-2 and IEC61000-3-12)	Fundamental: 30V to 290V@50/60Hz Harmonics and Inter-Harmonics: 0,3V to 60V@55Hz±12kHz THD: 0 to 100%	X	X	X
Current Harmonics and Inter-Harmonics and THD Meter/Generator (According IEC61000-3-2 and IEC61000-3-12)	Fundamental: 80mA to 90A@50/60Hz Harmonics and Inter-Harmonics: 5mA to 30A@55Hz±12kHz THD: 0 to 100%	X	X	X

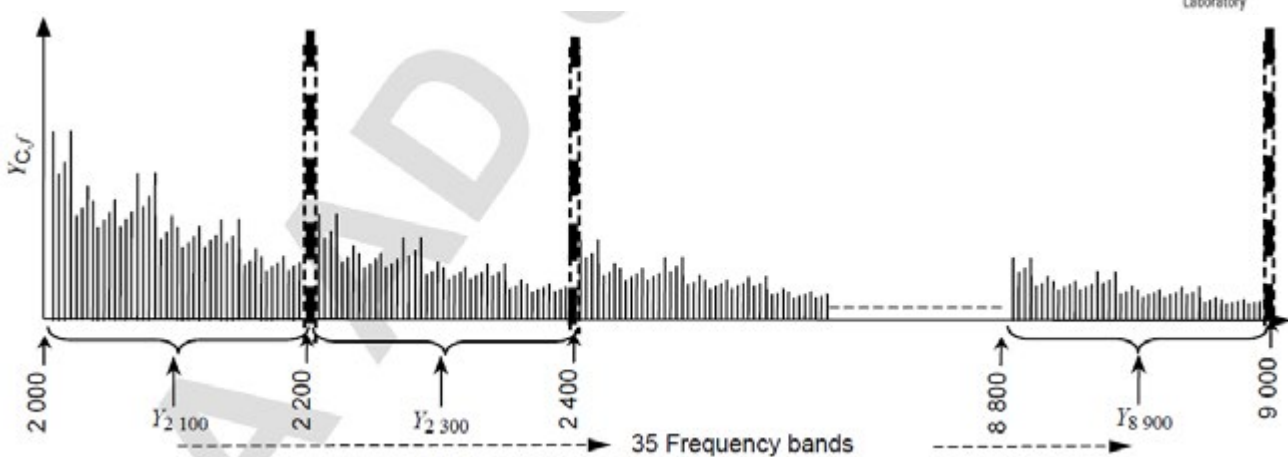
Components in signals (currents or voltages) with frequencies ranging from the 40th harmonic (approximately 2 kHz) to just below the upper limit of the low frequency range (9 kHz) are due to several phenomena:

- Pulse-width modulated control of power supplies at the mains side connection (synchronous or asynchronous with the frequency of the mains supply), for example as used in (active) power factor correction systems
- Emissions, such as mains signalling
- Feed-through from the load side or generator side of power converters to the mains system side
- Oscillations due to commutation notches

These components can be single frequency or broadband and the measurement of these components does not require a high resolution in the frequency domain. Instead, it is customary to group the energy of the signal to be analyzed into predefined frequency bands, as shown below:

FREQUENCY BANDS

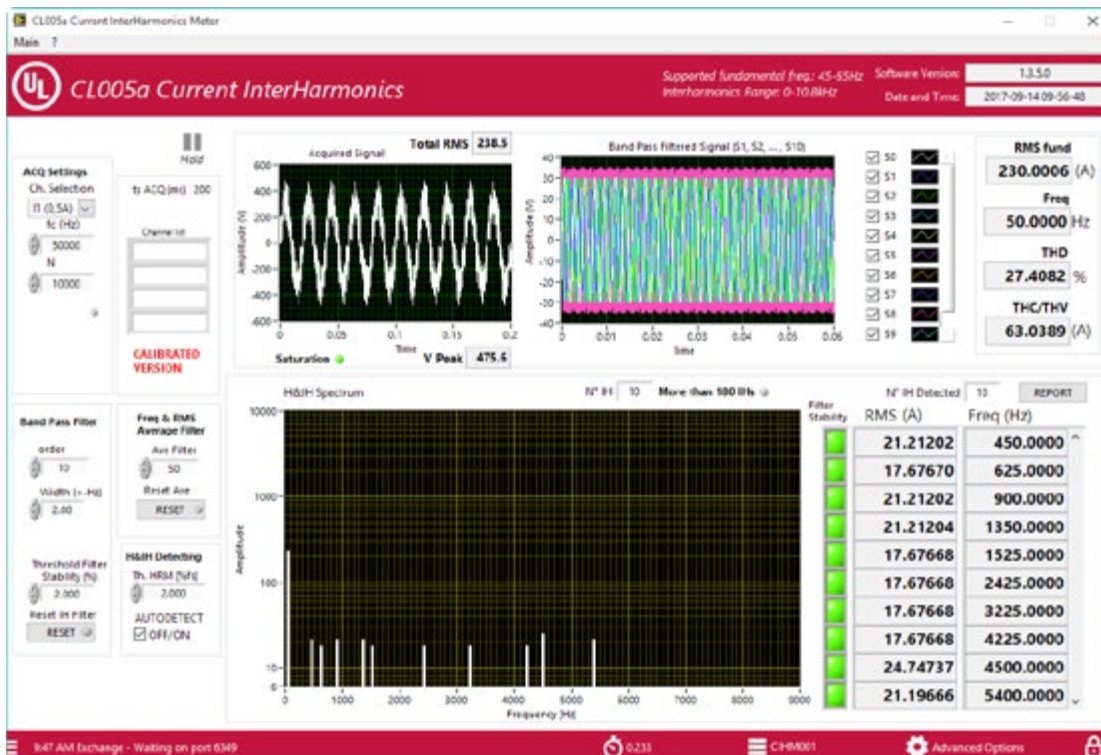
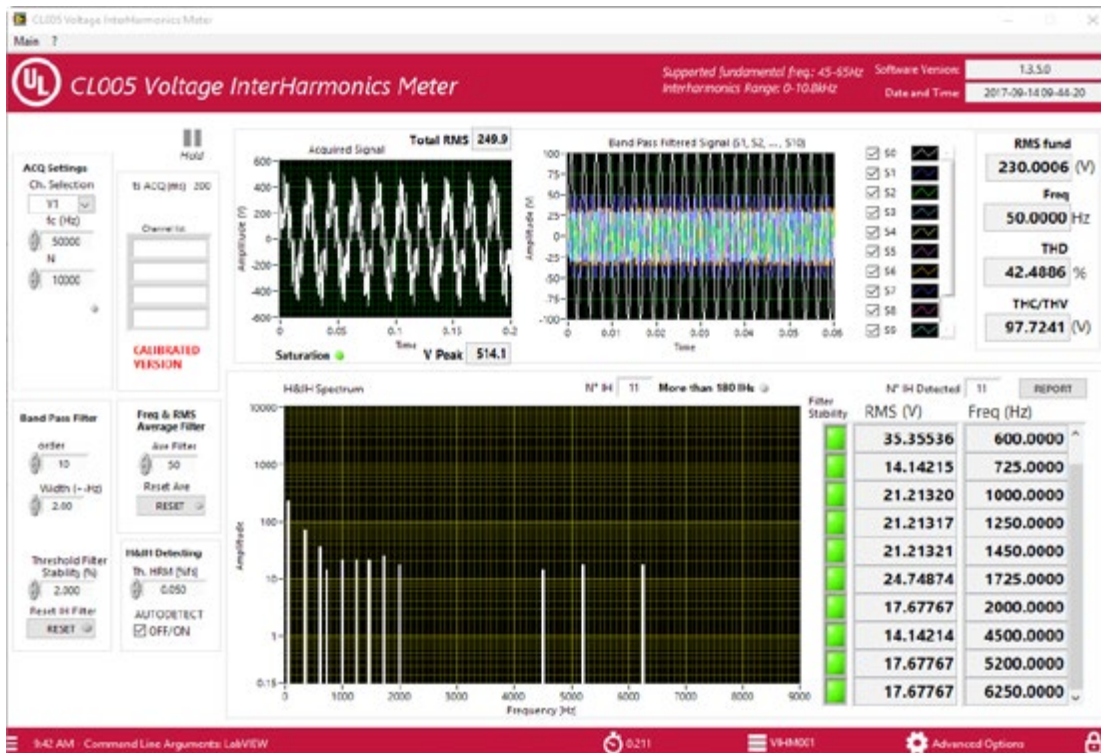
Range: Above the 40th harmonic order for 50 Hz power system up to 9 kHz.



EXAMPLES OF APPLICABLE STANDARDS

- VDE-AR-N 4105 (Germany, LV)
- FGW_Part3 (Germany, MV)
- CEI 0-16 (Italy, MV)
- IEC 61400-21 (Wind turbines)
- SAGC (South Africa)





CALIBRATION SERVICES **EMC**



Power Supply Services

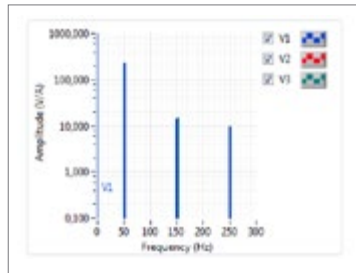
On-site validation and calibration of power supplies and related analysis equipment

Our field engineers use UL developed 3-channel IEC 61000-4-13 analyzer software and hardware for on-site validation. This equipment is available for purchase or rental.

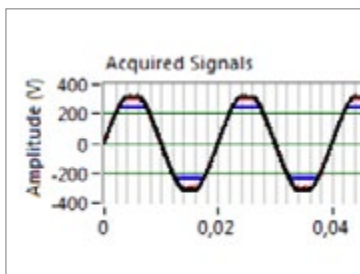
UL's complete validation assesses compliance with the standard of performance for the power supply generator by validating:

Mode	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
Mode Frequency	50.0000	200.0000	250.0000	200.0000	150.0000	100.0000	50.0000	50.0000	50.0000	50.0000
Mode Amp	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Mode Phase	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mode Q	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Mode R	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Mode S	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Mode T	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Mode U	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Mode V	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Mode W	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Mode X	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Mode Y	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Mode Z	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

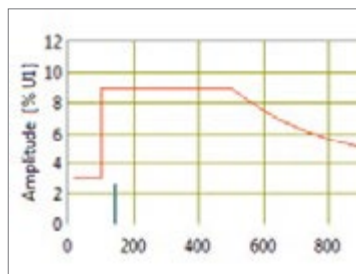
Voltage generator distortion



Over swing



Flat curve



Meister Curve

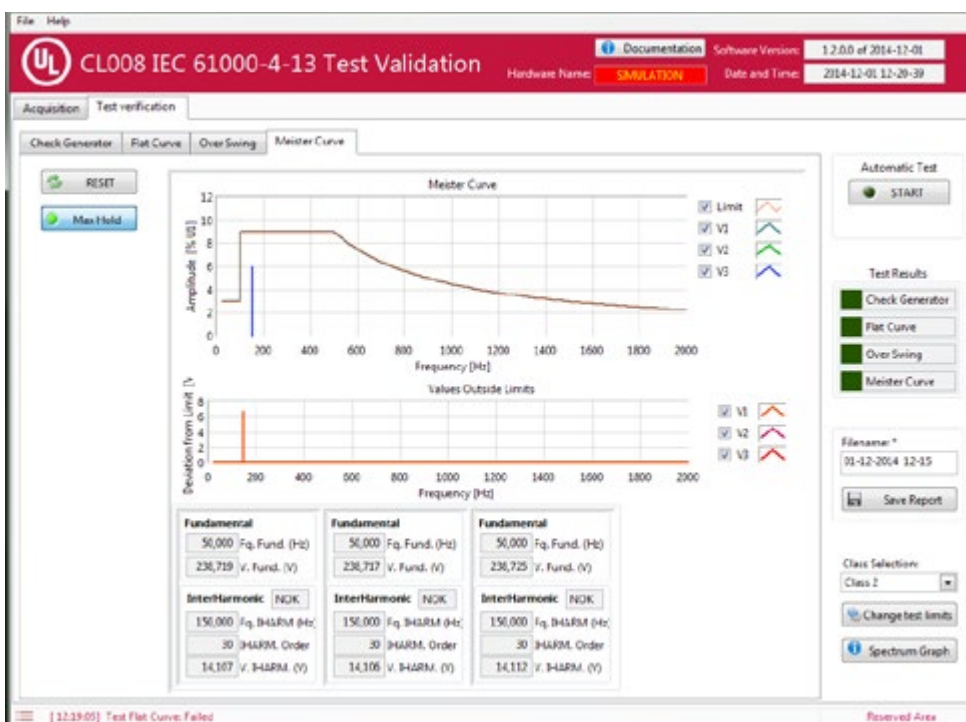
In addition, UL's field engineers can conduct on-site calibration of oscilloscopes and harmonic analyzers. This complete validation assesses compliance with the standard of performance for the power supply generator.

BENEFITS

- No equipment removal or disconnection required
- No risk of equipment damage during transportation
- Minimal interruption of client lab activities

APPLICABLE STANDARDS

- IEC 61000-4-13



Complete Calibration and Validation Training

Full training services to educate your entire laboratory team

1. SELECTION AND MANAGEMENT OF EQUIPMENT FOR SAFETY TESTING

- Categories of equipment used in certification safety laboratories
- Critical equipment specification
- Selection guidelines related to:
 - Interconnectivity (connection to automatic data acquisition, network)
 - Standards requirements (values and range)
 - Product to test (Frequency range, etc)
 - Accuracy (according to standards and/or IEC60335-1 former CTL DSH251, reading or range accuracy)
 - Safety issues
 - Calibration intervals
- Ordinary maintenance (IEC17025) and maintenance procedures
- Selection analysis
- Management of equipment according to IEC17025: Overload, repair and calibration (periodic and before out of service)

2. CALIBRATION PROCEDURE FOR SAFETY TESTING

- General requirements for internal calibration (IEC17025)
- Content of calibration procedure
- Recognized calibration guidelines
- Validation of calibration method
- Validation of auxiliary equipment or setup
- Examples of the calibration procedure: temperature, active power, etc

3. CALIBRATION PROCEDURE FOR EMC AND IMMUNITY TESTING

- Calibration procedure for emission
- Validation of auxiliary equipment or setup
- Examples of the calibration procedure: RF Amplifiers, Harmonics and Flickers, etc

4. TOUCH CURRENT TEST METHOD AND SETUP

- Requirements according IEC 60990
- Measurement methods for touch current and protective conductor current
- Body effect
- Annex B: use of the conductive plane
- Figures 3, 4, and 5 of IEC60990
- Setup and Calibration Issues

5. INTERACTION WITH A CALIBRATION CENTRE

- Calibration requests according to equipment usage
- Correct range, offset, and number of calibration points
- Request for accuracy verification (metrological confirmation according to equipment specification)
- Management of adjustment, out of tolerance report
- Acceptance of the calibration certificate/report
- Selection of the critical parameters for drift analysis (calibration interval)
- Common calibration centre mistakes (reports, calibration methods, standard procedures)

6. CALIBRATION AND MEASUREMENT UNCERTAINTY FOR SAFETY TESTING

- Type A and Type B uncertainties
- Basic statistical elements: Mean, standard deviation, distribution, etc
- General contributors to measurement uncertainty and the source of uncertainty
- Direct and derived measurement
- Quantities statistically independent or correlated
- Declaration of measurement uncertainty (repeatability and reproducibility)
- Examples of measurement uncertainty calculation for direct measure (active power) and derived measurement (temperature of winding)

7. METROLOGICAL CONFIRMATION FOR SAFETY TESTING

- Basic definitions
- Standard requirements concerning accuracy
- IEC 60730-1 : range or reading accuracy
- Impact of the range or reading accuracy
- Definition of internal measurement uncertainty

8. METROLOGICAL CONFIRMATION FOR EMC TESTING

- Basic definitions
- Standard requirements concerning accuracy
- IEC 60730-1 : range or reading accuracy
- Impact of the range or reading accuracy
- Definition of internal measurement uncertainty

9. MODULATION OF CALIBRATION INTERVAL

- Reference standards
- Manufacturer suggestion (specification)
- Evidence of stability in critical parameters
- Risks of traceback

10. SAFETY RULES FOR EQUIPMENT USED IN SAFETY TESTING

- Technical documentation related to equipment
- Specification, maintenance and safety sections
- Differences between danger and risk
- Equipment classification based on risk
- Specific risks connected to mechanical, electrical and thermal equipment

11. POWER QUALITY FOR TESTING LABORATORY

- IEC 61010 requirements
- Selection of the measurement points
- Equipment and accuracy
- Algorithm to calculate harmonics and inter-harmonics (2-9kHz)
- Voltage and current harmonics
- Equipment available on the market
- Measurement issues with equipment that is not IEC 61010-4-7 compliant
- Calibration certificates issued by UL Carugate Calibration Centre
- Measurement uncertainty

12. ISO/IEC 17025

- 5.2 Personnel: Training, qualification, maintenance
- 5.3 Laboratory Accommodation & Environment Conditions
- 5.4.7 Uncertainty of Measurement
- 5.5 Measurement & Test Equipment: suitability and management
- 5.6 Traceability of Measurements: Calibration
- 5.9 Assuring Quality of Test Results



About the Carugate Laboratory

UL's Carugate Laboratory, established in 1984 as a private company, has been part of the UL family since 2003. The lab covers approximately 1700 square meters spread over two buildings. A large team of on-site engineers and technicians is dedicated to various different sectors: electrical safety, electromagnetic compatibility, performance, metrological confirmation (calibration) services and automation services.

The Carugate Lab has been operating for about 30 years in the electrical sector. We are currently accredited to IECEE, ACCREDIA, OSHA, IAS and more.



THIS LOCATION PROVIDES TESTING AND CERTIFICATION SERVICES IN THE FOLLOWING AREAS:

INTERNATIONAL MARKET ACCESS Thanks to the above mentioned accreditations, this laboratory is able to issue test reports and certificates under the IECEE CB scheme (HOUS and CONT) and ILAC-ACCREDIA reports recognized within the European Accreditation and worldwide.

INVERTER: Thanks to more than 10 years of experience and continuous updating of the scope of accreditations, Carugate Laboratory is now able to test and certify high power photovoltaic inverters, wind inverters and other types of inverters in accordance with low Voltage and EMC European Directives. We can also carry out these tests at customers' premises. The lab is also specialized and accredited for the tests required by several countries in Europe, Asia and Australia according to international, European and local standards and rules.

EMC: Testing for the following areas: household appliances, lighting, medical and hi-tech equipment, laboratory instrumentation, ISM (industrial, scientific and medical) and standards for commercial and industrial environments with the possibility of issuing CE reports, CB reports under the IECEE scheme (EMC) and ILAC - ACCREDIA reports recognized within the European Accreditation.

PERFORMANCE AND SPECIAL TESTS: measurement of human exposure to vibration (hand/arm or whole body transmitted) and special tests (thermal, acoustic, EMC, dimensional, safety, etc.); custom specifications required by clients.

TESTS ACCORDING TO UL STANDARDS: to obtain UL and cUL mark (USA and Canada) for most product categories. For more detail see the Laboratory Capabilities Catalog and the Laboratory Services Catalog

CALIBRATION SERVICES: along with standard calibration offerings, UL Italy Calibration Center can assist you with calibration services tailored to your specific needs.

AUTOMATION SERVICES: Project management, design, fabrication, programming, installation, projects start-up, operating support.

Information on our accredited calibration services for safety laboratories can be found in "UL Calibration Services: Accredited Calibration for Safety Laboratories."

UL International Italia S.r.l.
Via Delle Industrie 1
20061 Carugate (MI) - Italia
Tel: +39 02 92 52 64 27

Laboratory Manager
Eng. Dario Rivoltella
Tel: +39 02 92526427
Dario.Rivoltella@ul.com

ITALY.UL.COM

