TÜBİTAK

UME

PRODUCT CATALOG

April 2015

A country's path to economic strength and societal welfare is through the possession of high- quality, high value-added industrial and IT sectors that are the products of technological innovation and development combined with creative and progressive thought.

The National Metrology Institute of Turkey (UME), work on whose foundation began in 1982, was formally established as an institute tied to the Scientific and Technological Research Council of Turkey (TÜBİTAK) in 1986 for the purposes of facilitating the development of the high-technology production capacity of our country's industrial sector through building and improving the national measurement and metrology infrastructure.

TÜBİTAK UME was established to be a primary level measurement center to meet the needs of private and public sector entities in industry and other relevant areas. TÜBİTAK UME, which has strived to meet the demands of all types of industry through the supply of calibration, testing, repair/maintenance services, as well as training and consulting in the field of metrology, has also aimed at making a contribution to the development of new technologies through the adoption of the newest techniques in measurement and calibration.

About 30 years of accumulated know-how, an expert team of researchers and experienced staff, TÜBİTAK UME not only supports the productive sectors of the domestic economy but has also become a well-accepted institute in the world of metrology by becoming a leader in its region through sharing its experience and expertise with neighboring countries.

Within the framework of its duties, TÜBİTAK UME has expended considerable effort to ensure that our industrial products are competitive domestically and internationally. The institute, which has built measurement systems and devices in addition to establishing measurement reference standards, also directly transfers know-how to industrial establishments through setting up collaborative arrangements at the stage of product development.

This catalogue displays instruments, systems and machines that were developed in TÜBİTAK UME's various laboratories for use as references in measurements. We are pleased to offer these products to our customers as a solution to their measurement needs. If you want to provide the products which are in this catalogue, please contact with TÜBİTAK UME by using contact information given at www.ume.tubitak.gov.tr .

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IMPEDANCE LABORATORY

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4 DECADE CAPACITOR STANDARD

The 4 decade capacitor can be used as a working standard and is delivered with a calibration certificate that is performed at 1 kHz.

Specifications

Nominal Value	Accuracy (1 kHz)
100 pF x 10 decade	2%
1 nF x 10 decade	1%
10 nF x 10 decade	1%
100 nF x 10 decade	1%

- Voltage : 400 VAC / 50 Hz
- Stability (1 kHz) : 0.2 %/ year
- Temperature coefficient : 100 ppm / °C
- Insulation resistance : $\geq 5x10^{10}$
- Terminal : Banana connector
- Dimensions (W x H x D) : ~(300 mm x 105 mm x 180 mm)
- 4 digit resolution
- Appropriate for use with calibration instrument

Service Code : CHZ--G1KA-0300

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INDUCTIVE VOLTAGE DIVIDER

The Inductive Voltage Divider is used for calibration of AC voltage dividers, transformer standards, synchro/resolver standards, transformers, calibrators, ammeters, and voltmeters by serving as a precision AC voltage divider. It is produced as either digital or manual type. The manual type is more economical than the digital type. The inductive voltage divider is delivered with a calibration certificate that is performed in the frequency range of 55 Hz – 10 kHz.

Accessories

- Post- office / post-office coaxial cables
- Post-office / BNC coaxial cables
- Isolation transformer

Specifications

- Range : 0.0000000 –1.0000000
- Stability : 5 ppm / year
- Resolution : 0.1 ppm
- Frequency range : 50 Hz – 10 kHz
- Input impedance (1 kHz) : >40 kΩ
- Output current : 100 mA max.
- Dimensions (W x H x D) : ~(410 mm x 195 mm x 310 mm)
- Max. Input Voltage : 0.35 V / Hz, 350 V max.
- Connection terminal is post-office (BPO). Also BNC or banana types are selectable

Service Code : CHZ-G1KA-0700
CHZ-G1KA-0710

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DC RESISTANCE STANDARD

In electrical metrology, DC resistance standards are commonly used. Different types of resistance wires like manganin, isaohm or evanohm are used in the production of resistance standards. Heating treatments are applied to these standards to stabilize its resistance value. These standards are designed to serve as reference DC resistance standards or as working standards for various metrological purposes.

Resistance standards are delivered with calibration certificates.

Specifications

- Nominal values : 1 – 10 –25– 100 –1000 Ω
- Stability : 2 ppm / year
- Accuracy : 50 ppm
- Temperature Coefficient : 5 ppm / °C
- Dimensions(Diameter x Height): ~(85x140)mm
- Suitable for 4 wire measurements.
- Can be used in an oil bath filled with silicon oil.

Service Code : CHZ-G1LR-0100
CHZ-G1LR-0200
CHZ-G1LR-0300

VOLUME & SURFACE RESISTIVITY MEASUREMENT APPARAT

Resistivity value and discharge time are important parameters when defining the electrical specifications of insulation materials. This instrument is used to take surface resistivity value and discharge time measurements that are needed to define the anti-static properties of a material. Measurements are realized according to the ASTM D257-92 standard.

Specifications

- Volume resistivity range : 10^3 - 10^{15} Ωcm
- Surface resistivity range : 10^3 – 10^{15} Ω
- Sample dimensions : (6.3 -10.2) cm diameter
- Sample thickness : (0.159 – 0.635) cm
- Applied voltage : (10-1000) VDC
- Power input : N-type coaxial
- Signal output : BNC coaxial
- Dimensions (W x H x D) : ~(115 mm x 155 mm x 110mm)

Service Code : CHZ-G1LR-9900

4 TERMINAL AC RESISTANCE STANDARD

Four-terminal AC resistance standards are used for AC resistance calibration of LCR meter instruments up to 100 kHz. Four terminal AC resistances can be used as a reference standard or a working standard with metrological instruments.

The standards are delivered with a calibration certificate that is performed at 20 Hz - 100 kHz.

Nominal Value	Accuracy (DC)
1 Ω	0.02 %
10 Ω	0.01 %
100 Ω	0.005 %
1 kΩ	0.005 %
10 kΩ	0.005 %
100 kΩ	0.005 %

Calibration equipment

Open-short termination adapter is necessary for the AC resistance measurement instrument to make an accurate measurement.

Specifications

- Frequency range : ≤ 100 kHz
- Stability (DC) : 50 ppm / year
- Temperature coefficient (DC) : 2 ppm / °C
- Terminals : BNC coaxial connectors
- Dimensions (W x H x D) : ~(93 mm x 53 mm x 40 mm)
- Suitable for 4 terminal pair measurement

Open termination (≤ 100 kHz)

Short termination (≤ 100 kHz)

Service Code : CHZ-G1KA-9900

LOW VALUE DC RESISTANCE STANDARD

These standards are produced with a manganin wires, to which special heating techniques to stabilize resistance value are applied. These standards are designed for use as a reference DC resistance standard or a working standard for various metrological purposes.

Resistance standards are delivered with the calibration certificate.

Specifications

- Nominal value : 100 μΩ - 10 mΩ
- Stability : 200 ppm / year
- Accuracy : 500 ppm
- Temperature coefficients : 150 ppm / °C
- Dimensions (W x H x D) : ~(170 mm x 300 mm x 70 mm)
- Suitable for 4 wire measurement

Service Code : CHZ-G1LR-0100

STANDARD CAPACITOR

These capacitors have been designed as reference or working standards for precise measurements with their low temperature coefficient, low loss and long-term stability.

Standard capacitor is delivered with its own calibration certificate that is performed at 1 kHz.

Specifications

- Nominal Values : 10 nF – 100 nF – 1000 nF
- Stability : 100 ppm / year
- Accuracy : 200 ppm
- Dissipation Factor (1 kHz) : $< 3x10^{-4}$
- Temperature Coefficient : 50 ppm / ^{0}C
- Working Temperature : (10 – 50) ^{0}C
- Dimensions (for 100 nF) : ~(65 x 115 x 58) mm (W x H x D)
- Post-office (BPO) type connectors are used for terminations.
  Different type of connectors are selectable (eg. Banana type connectors).
- Suitable for 2 or 3 Terminal measurements

Service Code : CHZ-G1KA-0100

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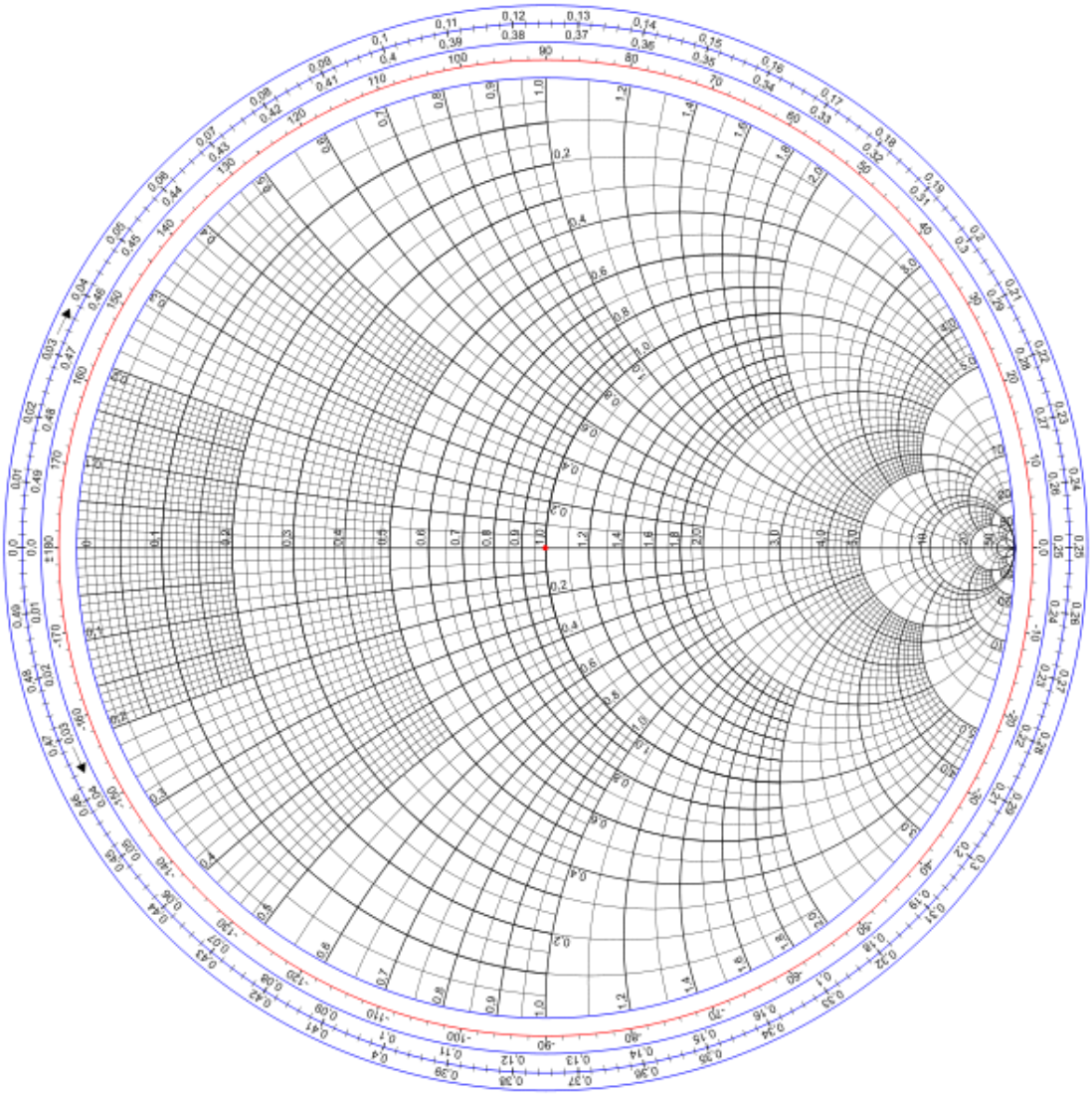


RF & MICROWAVE LABORATORY

MPS34 MICROWAVE POWER SENSOR

Diode type microwave sensor

Technical Specifications

Frequency Range	33 GHz – 36 GHz
Power Range	-10 dBm – +10 dBm
Nominal Impedance	50 Ω
Maximum SWR	1.80:1
RF Connector	2.92 mm
Maximum Power	200 mW CW
Communication	RS232
Power Supply	± 5 V DC
Dimensions	80x45x140mm

MPS34 microwave power sensor is directly connected to personal computer using RS232.
The cost of equipment is minimized due to no need power meter.
Calibration factor and linearity compensations are performed automatically.
Easy usage

Service Code : CHZ-G1MD-9900

HIGH VOLTAGE LABORATORY

100 kV DC HIGH VOLTAGE DIVIDER

The DC high voltage divider is used for calibrations with a low measurement uncertainty up to 100 kV. The divider decreases high voltages by dividing with special resistors.

Specifications

Manufacturer	: TÜBİTAK UME
Type	: DC-100
Max. Voltage	: 100 kV
Max. Current	: 1 mA
High Voltage Resistor	: 100 MΩ
Low Voltage Resistor	: 10 kΩ

Service Code : CHZ-G1YG-9900

100 kV STANDARD CAPACITOR WITH SF_6 GAS INSULATION

The standard capacitor is used in capacitance bridge circuits as a reference standard for measurement of capacitance/ dissipation factor at high voltage and in the calibration of AC high voltage calibrations.

Specifications

Manufacturer	: TÜBİTAK UME
Type	: AC-100
Max. Voltage	: 100 kV
Capacitance Value	: 37 pF
Gas Insulation	: SF_6
tanδ	: $<1x10^{-5}$

Service Code : CHZ-G1YG-9900

200 kV AC HIGH VOLTAGE DIVIDER

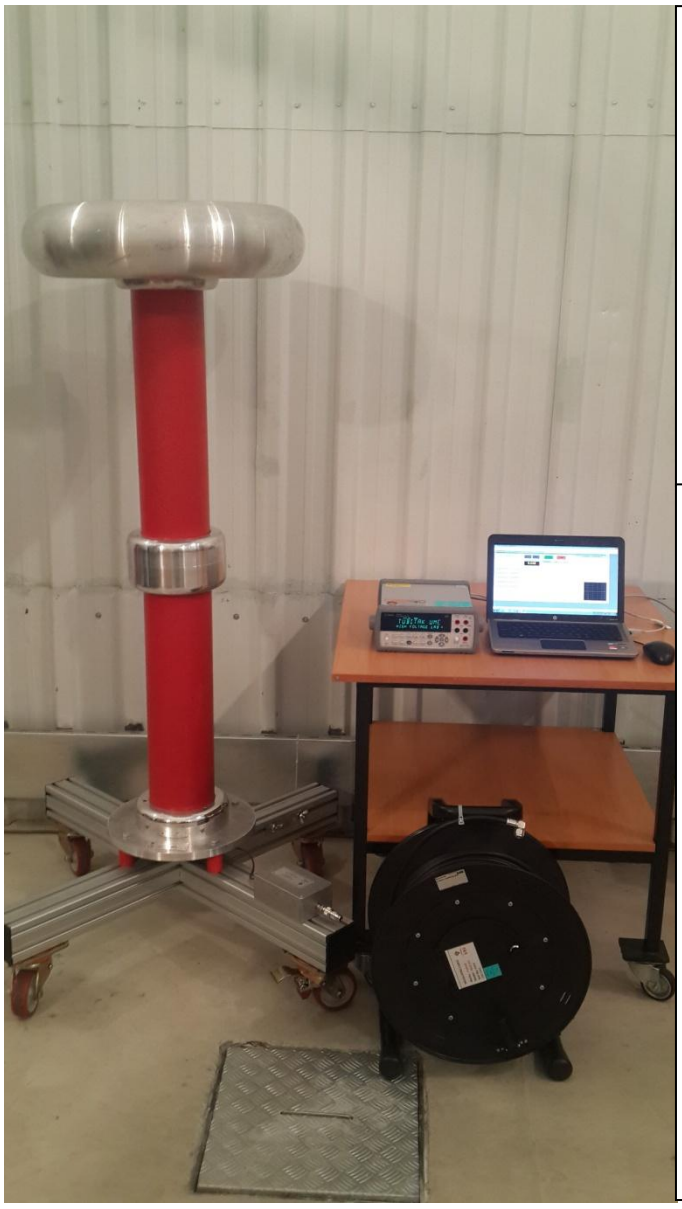
200 kV AC high voltage divider is used as a reference divider for AC high voltage calibrations and measurements with a low measurement uncertainty. The divider decreases high voltage by dividing with special capacitors and transforms the voltage down to measurable level for voltmeters and multimeters.

Specifications

Manufacturer	: TÜBİTAK UME
Type	: 200kVAC
Max. Voltage	: 200 kV
Gas Insulation	: SF_6
Pressure	: 0.5bar
Frequance	: 50-150Hz
Nominal Ratio	: 2000

Service Code : CHZ-G1YG-9900

200 kV AC HIGH VOLTAGE MEASURING SYSTEM



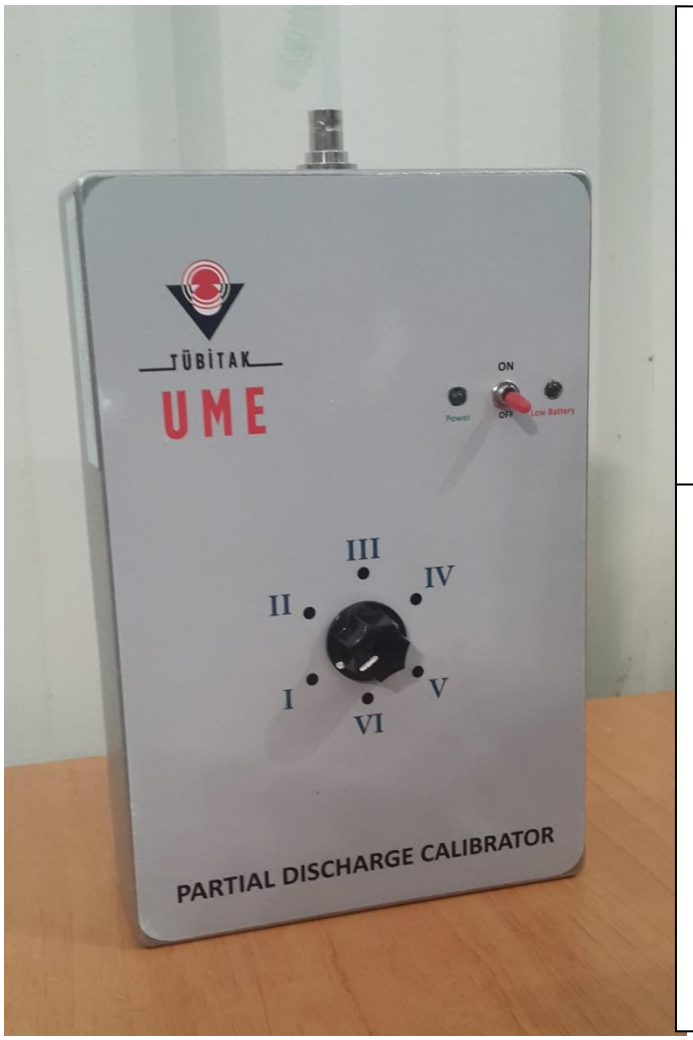
200 kV AC high voltage measuring system is used as a reference measuring system for AC high voltage calibrations and testing with a low measurement uncertainty. Measuring system, consisting of a 200kV high voltage divider, 6.5 digit multimeter, special software, computer and measuring cable.

Specifications

Manufacturer	: TÜBİTAK UME
Type	: 200kVAC
Max. Voltage	: 200 kV
Insulation	: SF6 gazı
Pressure	: 0.5bar
Frequance	: 50-150Hz
Nominal Ratio	: 2000
Multimeter	: HP34401A
Software	: ACM-Vee
Cable	: 25m

Service Code : CHZ-G1YG-9900

PARTIAL DISCHARGE (PD) CALIBRATOR



Partial discharge (PD) calibrators are used for calibration of partial discharge dedectors which measure the partial discharge of dielectric materials used in high voltage equipment.

Specifications

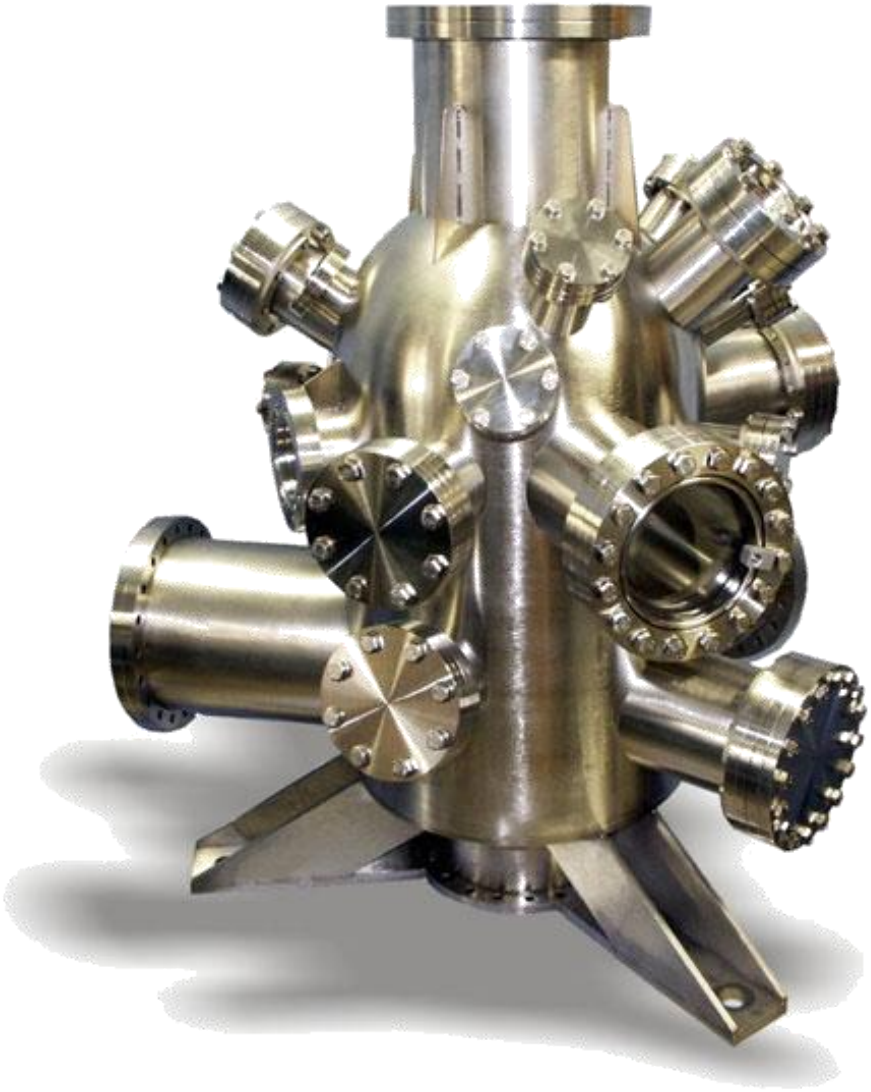
Manufacturer : TÜBİTAK UME
Type : PDC
Applying values : 5-20-50-100-200-500 pC
Frequancy : 1 kHz
Rise Time : <60ns

Service Code : CHZ-G1YG-9900

CALCULABLE IMPULSE VOLTAGE CALIBRATOR

Calculable impulse voltage calibrator used for calibration of recorder of impulse high voltage measuring system by applying reference impulse signal whose voltage and time parameters are known.	**Specifications** Manufacturer : TÜBİTAK UME Type : CRIC300 Voltage : 0-300V Time parameters : 0,84/40 µs-0,84/60 µs -1,2/50 µs 1,56/40 µs -1,56/60 µs -100/2000 µs -100/3000 µs 250/2500 µs -400/2000 µs -400/3000 µs Software : LI/SI Calibrator

Service Code : CHZ-G1YG-9900



VACUUM LABORATORY

PRIMARY MULTI–STAGE STATIC EXPANSION SYSTEM (MSSE1)
(Primary Vacuum Standard)

MSSE1 is the new primary system for generation of vacuum pressures between 9 x 10^{-4} Pa and 10^{3} Pa. It is based on the static expansion method, whereby the range is extended to lower pressures by multiple-expansions. The apparatus consist of 6 vessels. 17 PRT temperature sensors are mounted on the vessels to determine the correction due to temperature effects. The whole apparatus is built with the UHV technique and can be baked up to 400 ^{0}C.

The expanded relative uncertainties of this new standard is from 2.1 x 10^{-3} to 9.5 x 10^{-4}.

TÜBİTAK UME Primary Vacuum Standard (MSSE1)

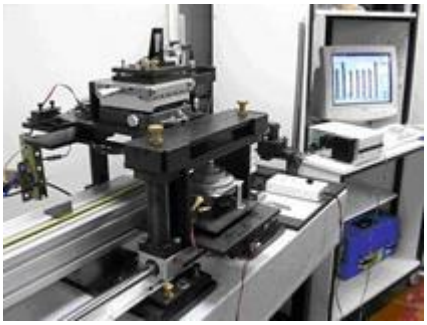
The system was used in two EUROMET projects in 2001 and 2002, and values obtained using this standard show good agreement within EUROMET

Service Code : CHZ-G2VK-9900

DIMENSIONAL LABORATORY

5m BENCH
TAPE AND RULE MEASUREMENT SYSTEM

The 5m Bench designed and constructed by TÜBİTAK UME's Dimensional Lab is used for the calibration of line standards such as measuring tapes and rules. The calibration or verification of such standards can be carried out in order to check whether they comply with the classes given in OIML standards and in 73/362/EEC directives or with the user specifications using the 5m Bench.



5m Bench tape and rule measurement system

- The stability of the 5 m bench system supported on 3 marble blocks interconnected to each other with steel frame is provided by its solid design and construction. 2 off centreless ground steel rods (rails) used for guiding of the carriage are kinematically located on a heavy marble construction.
- Heidenhain linear steel encoder integrated to the system is used as a reference measurements system as well as laser interferometer which can be used optionally.
- Motorised carriage which employs a camera for probing of the scales on the tapes, can be moved along the rails by the operator using the joystick. The tape scale can be observed on the computer screen by the operator and positioning can be performed according to required target point. The tape can be stretched out using the special tensioning system.
- The distance between target points is measured with the reference measurement system and delivered to computer. Special compensation software written by TÜBİTAK UME is employed for correction of the measurement system according to its calibration certificate. The operator can perform test and evaluation using the user friendly 5m bench software.
- 5 m tapes can be measured in one set-up and longer ones in multiple setups. Measurement uncertainty is U = (50+5.L) μm , L: meter, k = 2.

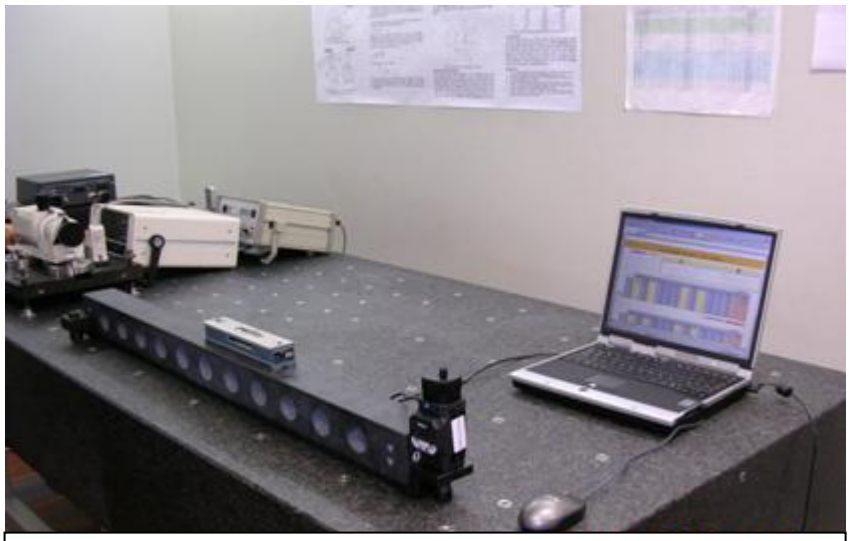
Interlaboratory Comparisons

We participated in Euromet supplementary comparisons for evaluation of the 5m bench system by performing measurements on 10m steel tape. The results are satisfactory and given in "EUROMET.L- S17- Length intervals on a steel tape" (http://kcdb.bipm.org/appendixB/KCDB_ApB_search.asp)

Service Code : CHZ-G2B0-9900

1 METER SMALL ANGLE GENERATOR

The Sin Bar, which is also known as small angle generator, is used for calibration of small angle measurement devices. Small angles in the range of ±1000 arc seconds can be generated with a resolution of 0.001 mm/m (0.20 arc seconds) with the 1 meter sin bar designed and madeby TÜBİTAK UME.



TÜBİTAK UME – 1 Meter Small Angle Generator

- The 1m Sin Bar generates small angles by trigonometric calculation of length measurements. Reference angles are generated by movement of digital micrometer fixed on one end of the 1m granite bar.
- The (70x75) mm cross section granite bar has a (70x1000) mm reference surface, the flatness of which is 1 μm. It employs three feed ended with spheres for tilting purpose and the bar is placed on a surface plate during use.
- It is mainly used for calibration of all types of spirit levels. The angular scales of spirit levels are compared with the generated reference angles and evaluated by the TÜBİTAK UME Sin Bar software.

Interlaboratory Comparisons

There is no organised comparison for such instruments at the EURAMET and CCL level.

Service Code : CHZ-G2B0-9900

FORCE LABORATORY

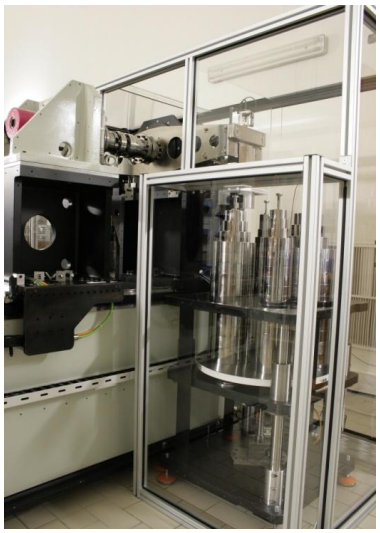
1 kN·m PRIMARY TORQUE CALIBRATION MACHINE WITH LEVER AND DEADWEIGHT

The machine is designed for static calibration of torque measuring devices (such as torque transfer standards, torque transducers, e.g.) with high accuracy. It is mainly used for calibration of transducers with capacity of 100N.m, 200N.m, 500N.m and 1000 N.m. The machine can provide torque measuring devices calibration according to the national and international torque calibration standards. Especially suitable for primary level torque calibrations.

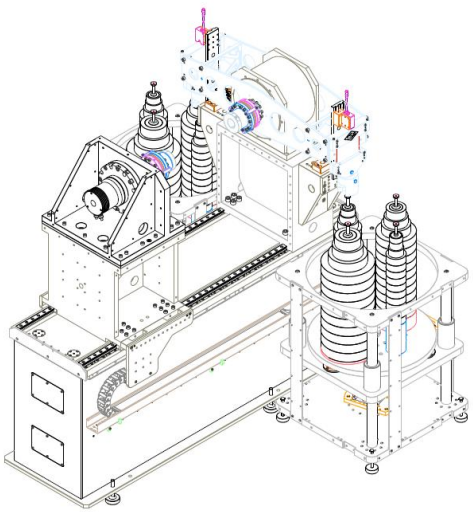
Realization of Torque unit is based on the definition of torque and directly traceable to the mass and length units. It is performed by a lever arm and dead weights system. The lever arm is symmetric and supported by an air bearing. Dead weights, which are under the influence of local gravity and buoyancy of air, can be freely hanged on the lever arm ends to be able to create right and left hand torques. The control of the machine is through a user friendly software interface.

Technical Specifications

Working principal	:	Mass-Lever System
Working ranges		(2 – 1100) N·m
Measuring uncertainty	:	$\leq 1x10^{-4}$
Torque arm		500 mm, symmetric double arms
Force	:	Generated by dead weights
Mass sets		(2 x 4) sets x 13 steps
Force hanging type		Elastic foil
Bearing type	:	Air bearings
Working direction	:	Clockwise and counterclockwise
Working position	:	Horizontal
Control	:	PLC control with user interface
Test space (HxWxD)	:	~(500x500x600) mm
Dimensions (HxWxD)	:	~(2000x2000x2000) mm



1000 N.m Primary Torque Calibration Machine with Lever and Deadweight, TSE



Schematic view of 1000 N.m Primary Torque Calibration Machine with Lever and Deadweight, TSE

Service Code : CHZ-G2KV-9900

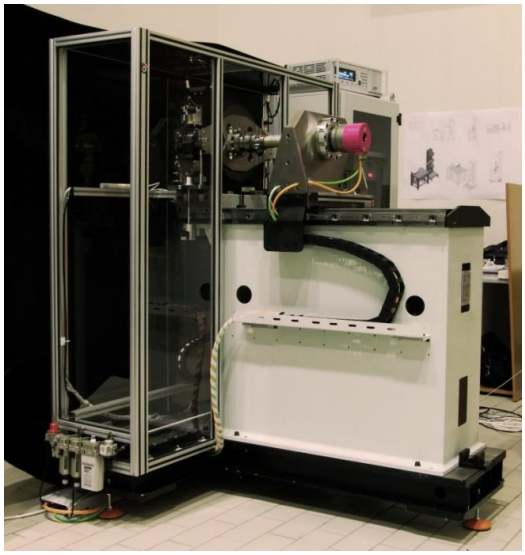
50 N·m PRIMARY TORQUE CALIBRATION MACHINE WITH LEVER AND DEADWEIGHT

The machine is designed for static calibration of torque measuring devices (such as torque transfer standards, torque transducers, e.g.) with high accuracy. It is mainly used for calibration of transducers with capacity of 10 N.m, 20 N.m, and 50 N.m. The machine can provide torque measuring devices calibration according to the national and international torque calibration standards. Especially suitable for primary level torque calibrations.

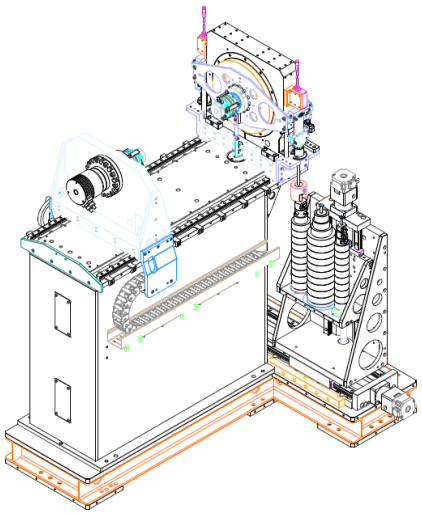
Realization of Torque unit is based on the definition of torque and directly traceable to the mass and length units. It is performed by a lever arm and dead weights system. The lever arm is symmetric and supported by an air bearing. Dead weights, which are under the influence of local gravity and buoyancy of air, can be freely hanged on the lever arm ends to be able to create right and left hand torques. The control of the machine is through a user friendly software interface.

Technical Specifications

Working principal	:	Mass-Lever System
Working ranges		(0,2 -50) N·m
Measuring uncertainty	:	$\leq 1x10^{-4}$
Torque arm		250 mm, symmetric double arms
Force	:	Generated by dead weights
Mass sets		3 sets x 13 steps
Force hanging type		Elastic foil
Bearing type	:	Air bearings
Working direction	:	Clockwise and counterclockwise
Working position	:	Horizontal
Control	:	PLC control with user interface
Test space (HxWxD)	:	~(500x500x600) mm
Dimensions (HxWxD)	:	~(1500x1500x1500) mm



50 N.m Primary Torque Calibration Machine with Lever and Deadweight



Schematic view of 50 N.m Primary Torque Calibration Machine with Lever and Deadweight

Service Code : CHZ-G2KV-9900

TÜBİTAK
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1 kN·m TORQUE CALIBRATION MACHINE WITH REFERENCE TORQUE TRANSDUCERS

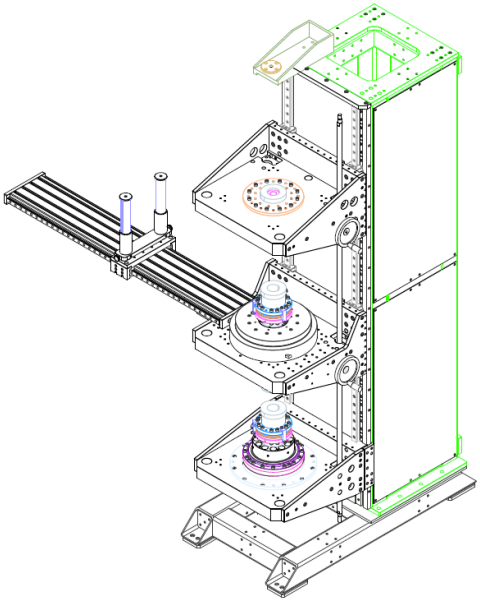
It can be used as a secondary level torque calibration machine. It is designed for static calibration of torque hand tools (acording to the ISO 6789) and torque wrenches with high accuracy (reference torque wrenches) and it is also possible to calibrate torque transducers with that machine. Especially suitable for secondary level torque calibrations. The machine can provide calibration according to the national and international torque calibration standards.

Torque values are generated over reference torque transducers by means of a servo motor. For the calibration of rorque wrenches, there is a torque arm with air bearing. Depend on the reference torque transducer working ranges can be changed. The control of the machine is through a user friendly software interface.

Technical Specifications

Working principal	:	With reference torque transducers
Capacities of Reference Torque Transducers	:	200 N.m, 1000 N.m (Standard) 100 N.m, 500 N.m (Optional)
Measuring uncertainty	:	Between 0,05 % and 0,1 % of applied torque (depending on reference torque transducer)
Working direction	:	Clockwise and counterclockwise
Working position	:	Vertical
Bearing type	:	Air bearing
Control	:	With user interface
Test space (HxWxD)	:	~1000x500x500 mm
Dimensions (HxWxD)	:	~22000x600x1100 mm

1 kN.m Torque Calibration Machine with Reference Torque Transducers.



Schematic view of 1 kN.m Torque Calibration Machine with Reference Torque

Service Code : CHZ-G2KV-9900

TÜBİTAK
UME

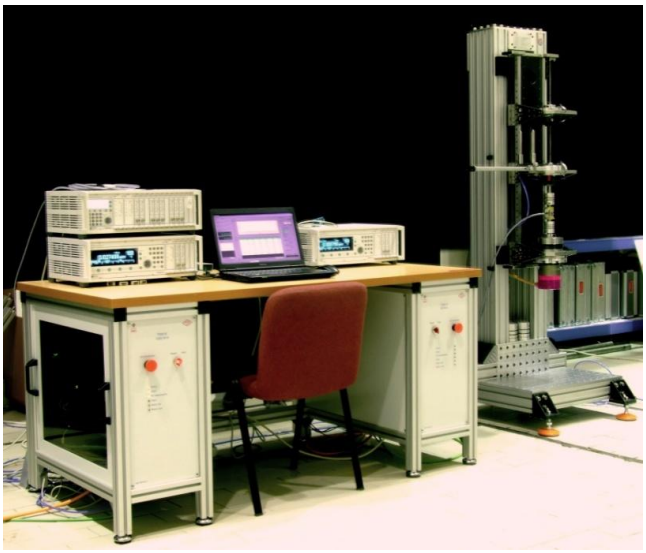
50 N·m TORQUE CALIBRATION MACHINE WITH REFERENCE TORQUE TRANSDUCERS

It can be used as a secondary level torque calibration machine. It is designed for static calibration of torque hand tools (acording to the ISO 6789) and torque wrenches with high accuracy (reference torque wrenches) and it is also possible to calibrate torque transducers with that machine. Especially suitable for secondary level torque calibrations. The machine can provide calibration according to the national and international torque calibration standards.

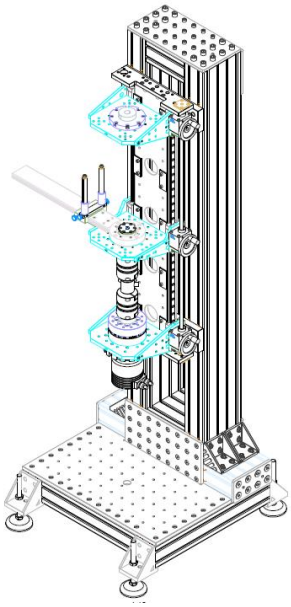
Torque values are generated over reference torque transducers by means of a servo motor. For the calibration of torque wrenches, there is a torque arm with air bearing. Depend on the reference torque transducer working ranges can be changed. The control of the machine is through a user friendly software interface.

Technical Specifications

Working principal	:	With reference torque transducers
Capacities of Reference Torque Transducers	:	10 N.m, 50 N.m (Standard) 5 N.m, 20 N.m (Optional)
Measuring uncertainty	:	Between 0,05 % and 0,1 % of applied torque (depending on reference torque transducer)
Working direction	:	Clockwise and counterclockwise
Working position	:	Vertical
Bearing type	:	Air bearing
Control	:	With user interface
Test space (HxWxD)	:	~(500x200x200) mm
Dimensions (HxWxD)	:	~(2000x700x700) mm



50 N.m Torque Calibration Machine with Reference Torque Transducers, TSE



Schematic view of 50 N.m Torque Calibration Machine with Reference Torque

Service Code : CHZ-G2KV-9900

TÜBİTAK

UME

200 N, 1 kN, 10 kN and 100 kN CAPACITY DEAD WEIGHT FORCE CALIBRATION MACHINE

The machines are used for the calibration of force measuring instruments-FMI (force transducers, load cells, proving rings, dynamometers and etc.), which are widely used in industry. In this system, 2 N - 100 kN capacity dead weight force calibrations are established for the calibration of FMI. This system can be programmed according to the capacities of the calibrated FMI for automatic calibration by the computer controlled force calibration machine. At the same time, this machine can be controlled manually by using the push buttons.

Specifications

- Structure of system : Dead weights are established in mass stack which is calibrated in Newton unit
- Force appl. Direction : Tension and compression
- Measuring range : 200 N, 1 kN, 10 kN and 100 kN capacity force measuring instruments can be calibrated with this system with 10 % increment in 10 steps.
- Rel. Meas. Uncertainty : 2×10^{-5}
- Traceability : TÜBİTAK UME

Service Code : CHZ-G2KV-9900

EXTENSOMETER CALIBRATION SYSTEM

In order to determination of mechanical properties of the materials (modulus of elasticity, Poisson ratio, ultimate, rupture and yielding stress and etc),force and elongation measuring systems are used in material testing machines. Strain or elongations of the material under load is measured by extensometers. Force measuring system calibration is not sufficient for the determination of mechanical proporties of the materials. Extensometer should also be calibrated by reference system. A new extensometer calibration system is designed and manufactured at TÜBİTAK UME for the calibration of extensometers which are used in material testing machines.

Specifications

- Structure of system : Digital and precise length measuring system installed the system body
- Movement system : Manually activated fine threaded screw mechanism
- Measuring range : (0-100) mm
- Rel. Meas. Uncertainty : 0.1 μm
- Traceability : TÜBİTAK UME (via laser interferometer)

Service Code : CHZ-G2KV-9900

TIME FREQUENCY and WAVELENGTH LABORATORY

THE STANDARD AT 780 nm AND 852 nm WAVELENGTHS

This standard is realized by locking of external cavity diode lasers (ECDL) to the D_2 energy transitions of Rb atoms (780 nm) and Cs atoms (852 nm). The external cavity diode laser (ECDL) was used, which included the anti-reflection coated diode laser AC-SDL-5410 (spectra diode laser) as an active element with a nominal wavelength 850 nm. The external cavity was formed by the high reflection faces of the diode laser and diffraction grating (1200 lines/mm) mounted in the Littrow configuration on the piezo transducer PZT. The diffraction grating allowed detuning of the laser wavelength to the Cs D_2 line. By changing of diode laser's current with a rate of 1 GHz/mA, the temperature with a rate of 0.3 nm/C, the angle between diode laser and diffraction grating and also the length of external cavity (0-0.5 μ m); the frequency of ECDL is adjusted to the energy transitions of Rb or Cs atoms. Fine-tuning was realized by the change of the length of the external cavity by using adjustable PZT voltage. Using the selective external resonator helps to reduce the diode laser's spectral band (10-100 MHz) by an amount of $(\ell / L)^2$; where, ℓ is the length of the diode laser resonator, L is the length of the external resonator.

The experimental setup for locking of portable ECDL to the D_2 energy transition of Rb atoms (λ=780 nm)

The ECDL laser beam passes through the glass cell in which there exists Rb or Cs gases, and then it is reflected back by using a mirror and detected by photo-detector. The laser frequency is locked to the energy transition of atoms by using an electronic servo system. The stability of laser frequency, when the frequency is not locked to the energy transition of atoms, changes between $4x10^{-10}$ –$7x10^{-9}$ in the mean time interval of 1-100 s.

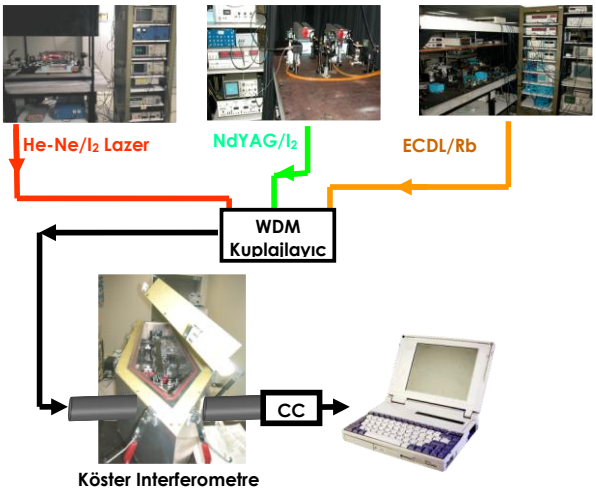
After the locking process of the lasers to the energy transition of the atoms, it is measured that the frequency stability values change in the range of 1x10-12 - 5x10-13. Besides, laser frequency drifts during stabilization on atomic transition was measured to be less than $\pm$ 200 kHz.

These lasers are employed as length standards or for realization of new Cs fountain frequency standards.

Service Code : CHZ-G1ZF-9900

KOSTER INTERFEROMETER FOR LONG GAUGE BLOCK LENGTH MEASUREMENTS

The Koster interferometer is used for long gauge block length measurements with an accuracy of 10^{-9}. The interferometer was designed and made by TÜBİTAK UME. The wavelength standards (HeNe/I_2, Nd:YAG/I_2 ve ECDL/Rb) and Köster interferometer are illustrated in the figure below.



The Gauge Block Length Measurement System with Köster Interferometers and Laser Wavelength Standards

The length of the blocks is measured in terms of the wavelength emitted by the wavelength standards. They can then be used to calibrate the lengths of other standards through comparison, i.e. micrometer, or can be used to verify the performance of length measurements (CMM-Coordinate Measuring Machine).

The Köster interferometer can measure the length of 1000 mm blocks with an uncertainty less than 100 nm. The refractive index of the air inside the interferometer can be calculated using the temperature, humidity and pressure values in a semi empiric way with the Edlen formula. The uncertainty value in the refractive index is in the range of 3.3x10-8. Furthermore, the temperature control and stabilization is achieved by circulating water through the copper pipes placed over the inner surface of the main body and the cover.

When the temperature value is set to 20 ^{0}C and after the system reaches temperature stabilization, the temperature variation is in the range of 2 mK as measured using 10 thermistors placed in different places inside the interferometer. Additionally, no drift occurs in the temperature values for 2 hours.

Service Code : CHZ-G1ZF-9900

TÜBİTAK
UME

DOPPLER SPEED MEASUREMENT RADAR CALIBRATOR SYSTEM

It is projected for the calibration of speed measurement accuracy and measurement of power density of doppler radars. PC controlled Calibrator System with a capacity of hardcopy measurement results includes speed and power measurement unit, radar and radar antenna sockets and uninterrupted power source as in a 19 inch rack system. Up to customer request, only PC controlled speed and power measurement unit with a capacity of hardcopy measurement results is satisfied.

General Specifications

- Operated Voltage : 200 - 240 V_{AC}
- Operated Frequency : (49 – 51) Hz
- Operated Temperature : 15 °C – 35 °C
- Operated Humidity : (50 ±20) %
- Produced Year : 2009
- Measurement Area : Stationary Speed Measurement Radars
- Current/Voltage Protection: Line Filter

Technical Specifications

- Radar Frequency : Ka Band* (33.0 GHz – 36.0 GHz)
- Speed Reading Interval : 20 km/h - 250 km/h
- Speed Reading Accuracy : 0.2 km/h
- Speed Step Increasing : 1 km/h
- Display : LCD

Radar frequency can be extended to 24.0 GHz – 36.0 GHz frequency band

Standards

1. 89/336/EC EMC Directive:
   - •EN 55022:2006
   - •EN 61000-4-2:1995+A1:1998+A2:2001
   - •EN 61000-4-3:2006
   - •EN 61000-4-4:2004
   - •EN 61000-4-5:2006
   - •EN 61000-4-6:1996+A1:2001
   - •EN 61000-4-11:2004
   - •EN61000-3-2:2000+A2:2005
   - •EN61000-3-3:1995+A1:2001+A2:2006

2. Coverage of MIL-STD-810F Standard; Temperature, humidity and vibration tests for equipments operated at laboratory conditions.

Service Code : CHZ-G1ZF-9900

TÜBİTAK
UME

TIME DISSEMINATION SYSTEM
(With Rb Frequency Standard and GPS)

Designed for time dissemination over Local Area Network (LAN), Wide Area Network (WAN), and Internet. There are three time servers over the system to distribute time: All of them are at Stratum 1 level.

GPS disciplined Rb oscillator which is calibrated by UME is used as time standard for servers. 10 MHz output of Rb oscillator can be used for applications requiring high stable oscillators. System is mounted in a 19 inch cabinet with an internal UPS for uninterrupted operation.

General Specifications

· Power Supply	: 200 - 240 V_{AC}
· Operating Frequency	: (49 – 51) Hz
· Operating Temperature	: 15 °C - 35 °C
· Operating Humidity	: (50 ± 20) %
· Production Year	: 2010
· Current/Voltage Protection	: Line Filter
· Dimensions	: 600 mm(W) x 800 mm(L) x 1150 mm(H)
· Weight	: 150 kg

Compatibility to Standards

1. EMC Directive 89/336/EC:
   - •EN 61326-1:2006
   - •EN 61326-2-1:2006
2. Humidity and temperature tests in accordance with EN 61010-1:Mart 2001 Standard
3. Vibration Test

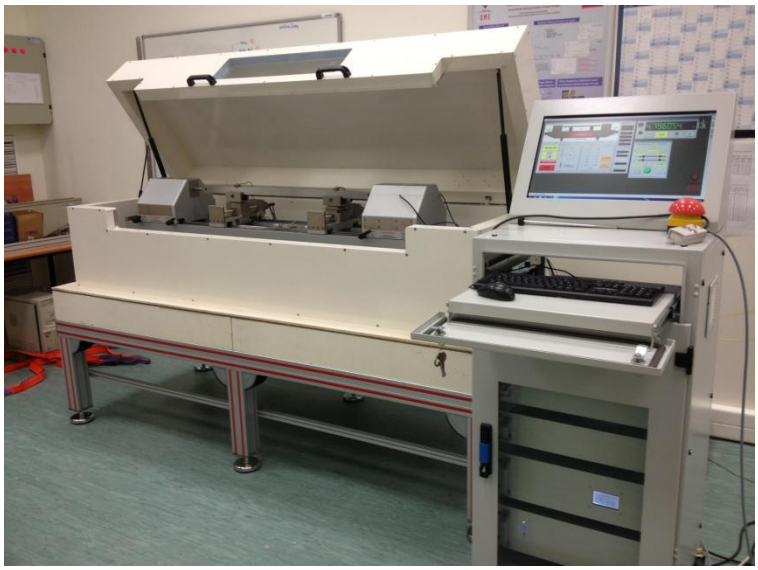
Technical Specifications

- IPv4 or IPv6 based time distribution over LAN, WAN, and/or Internet
- 2 NTP servers which are at Stratum 1 level and accept 1pps sync reference over LAN are allocated for time distribution (Accuracy < 5 ms)
- 1 NTP server is allocated for time distribution over Internet or WAN at Stratum 1 level (Accuracy < 50 ms)
- Rb Frequency Standard which accepts GPS syc reference (It also has 10 MHz and 1 pps outputs)
- Internal UPS for uninterrupted operation
- Integrated system in a 19 inch cabinet

Service Code : CHZ-G1ZF-9900

LONG GAUGE BLOCK COMPARATOR

Long Gauge Block Comparator is a Secondary Level Measurement system based on “Mechanical Comparison”. In this method, the test block and referans block are placed parallelly in the system and their lengths are compared.
The comparator is placed in a surrounding temperature controlled cabin to mininize the temperature effects and to reduce the mesurement uncertainty. During the gauge block measurement, the temperature data of the test and reference blocks are taken continously and the length corrections to the blocks are applied according to the temperature values.

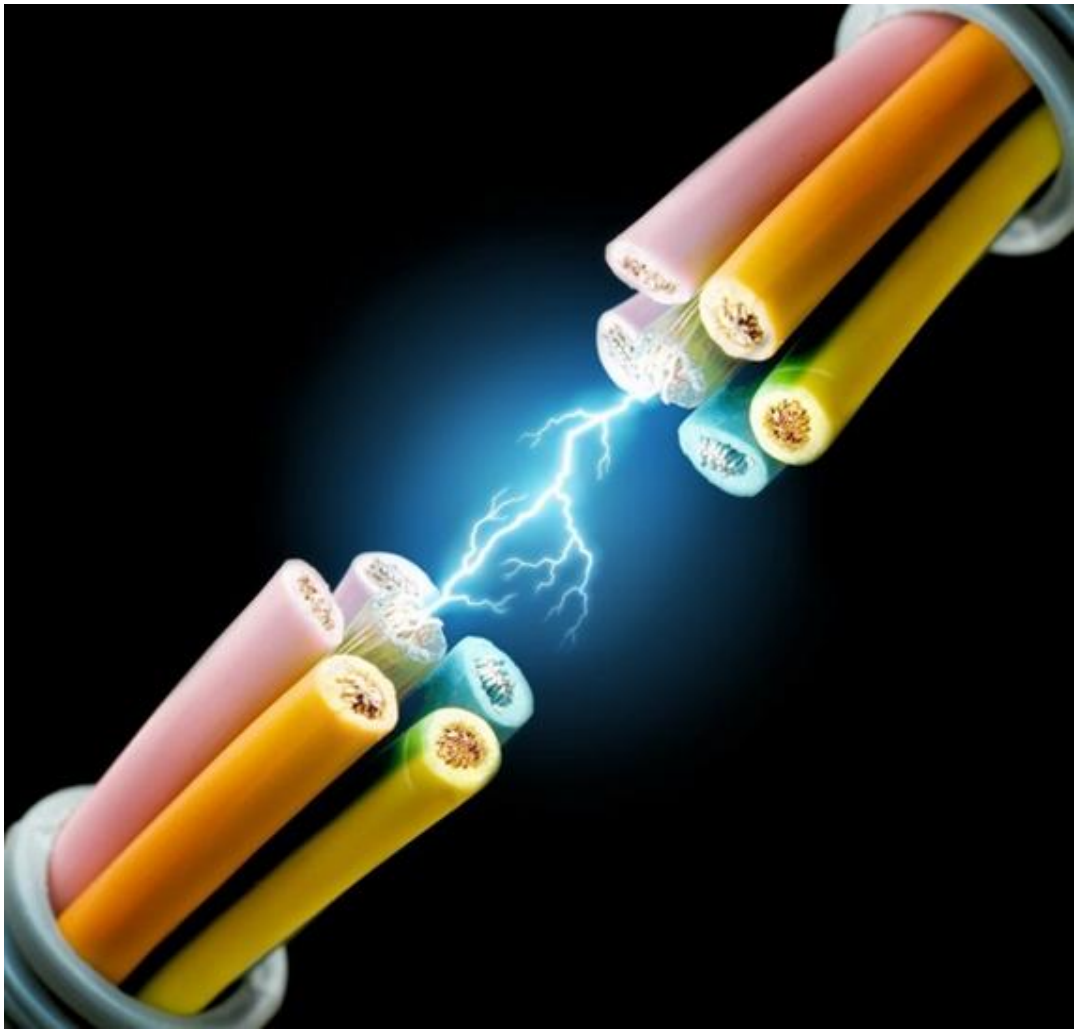


In the system, the remote controlled motors are commanded and by this way automatic transitions between blocks are realized by using prepared hardware and software. The length of the gauge blocks are measured in 1 nm resolution by receiving and analyzing of data from high precise displacement probe (1 nm resolution) and from temperature measurement system of the blocks.
The expanded uncertainty value is given U= [72 + (0.2 x L)] nanometer (“L” in milimeters) (k=2).
Additionally, all of the electronic controlling equipments and computer are placed and presented in a closed cabin.

General Specifications:

- 125 mm – 1000 mm rectangular and square gauge blocks
- Measurement results in inch or metric units (metric-metric, inch-inch, metric-inch)
- Horizontal placement of the gauge blocks in the comparator, ISO 3650 standards
- Temperature controlled cabin

Service Code : CHZ-G1ZF-9900



VOLTAGE LABORATORY

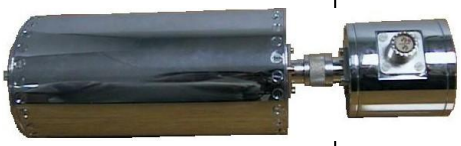
THERMAL VOLTAGE CONVERTER/ THERMAL CURRENT CONVERTER AND AC/DC CURRENT SHUNT STANDARDS

Thermal converters are widely used in calibration laboratories for highly accurate AC Voltage and AC Current measurement due to their long stability, large bandwidth and low calibration uncertainty. Despite new electronic devices that have appeared recently, thermal converters are still at the top of the traceability chain in most of the national institutes and high level laboratories.

TÜBİTAK UME, with its experience and knowledge, can respond to a customer's special requirements for thermal voltage converter/ thermal current converter standards and AC-DC Current Shunts.

Thermal Voltage Converter Specifications

Type	: Single-Junction	
Voltage	: Single point (0.5 V, 1 V, 2 V, 3 V, 5V, 10 V, 20 V, 30 V, 50 V, 100 V)	
Frequency	: 10 Hz – 100 MHz	
Input Connector	: N or GR (Optional)	
Output Connector	: Twin	
Input Impedance	: 200 Ω/V	
Nominal Output	: 7 mV	
AC-DC differences	: 10 Hz to 50 kHz	< 25 μV/V
	50 kHz to 1 MHz	< 200 μV/V
	1 MHz to 100 MHz	< 1.5 %
Delivery time	: 3 Months	



Thermal Current Converter Specifications

Type	: Single - Junction	
Current Range	: Single point (2 mA, 5 mA, 10 mA)	
Frequency	: 10 Hz - 100 kHz	
Input Connector	: Banana or UHF (Optional)	
Output Connector	: Twin	
Nominal Output	: 7 mV	
AC-DC differences	: 10 Hz to 20 kHz	< 50 μA/A
	20 kHz to 100 kHz	< 200 μA/A
Delivery time	: 3 Months	

AC/DC Current Shunt Specification

Type	: Sqüirel Cage or Coaxial Foil	
Current	: Any current on request between 10 mA – 100A	
Frequency	: 10 Hz – 100 kHz	
Input Connector	: N, UHF, LC (Optional)	
Output Connector	: N	
AC-DC Difference	: 10 Hz - 20 kHz	< 30 μΩ/Ω
	100 kHz	< 200 μΩ/Ω
Delivery Time	: 6 Months	

Service Code: CHZ-G1LV-0101, CHZ-G1LV-0102 CHZ-G1LV-0103

LOW VOLTAGE DIVIDER

Low Voltage Divider (UME - LVD1000) is a low thermal voltage divider designed for use in calibration of voltmeters at DC voltages lower than 100 mV. The divider construction is optimized for low thermal voltage drift, low voltage dependence and low noise.

INPUT VOLTAGE: 50 V Max.

CONNECTORS:

INPUT : 5 way binding posts (Input, Sense and case ground)

OUTPUT :3 WAY binding posts

Posts are optimised for low thermal drift

DIMENSIONS: (90 x 65 x 145) mm (W x H x D)

WEIGHT : 2 kg

CALIBRATION REQUIREMENTS:

Period : Max. 1 hour before its usage

Required References:

DC Voltage Meter

Calibrated at 100 mV DC, for 10^2:1 ;

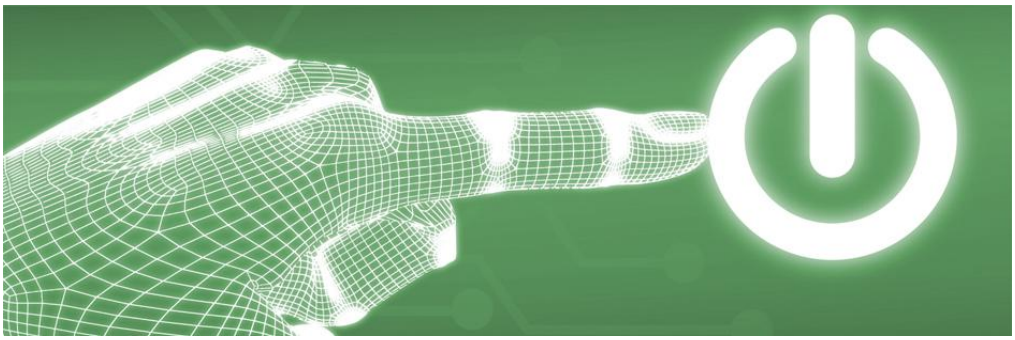
Calibrated at 10 mV DC for 10^3:1

Voltage Source

Calibrated at 10 V DC

DIVIDER RATIO	OPERATING RANGE	RESISTANCE			THERMAL DRIFT	STABILITY	POWER COEFFICIENT / VOLTAGE DEPENDENCE	OUTPUT NOISE (p – p)
		INPUT	OUTPUT	INSULATION				
10^3:1 (1000 V/V)	20 V / 20 mV 1 V / 1 mV	10 kΩ	10 Ω	> 1 GΩ	< 10 nV/(h/°C)	<4 ppm/h	< 6 ppm	< 10 nV @100 s
10^2:1 (100 V/V)	20 V /200 mV 0.1 V / 1 mV	10 kΩ	100 Ω			<1 ppm/h	< 3 ppm@(V_{in}<10 V) < 6 ppm@(V_{in}>10 V)	< 20 nV @100 s

Service Code: CHZ-G1LV-0104



POWER AND ENERGY LABORATORY

AC POWER MEASUREMENT SYSTEM (Digital Sampling Wattmeter)

AC Power Measurement System has been developed at TUBITAK UME to fulfill the growth in demand for traceable calibrations of power and energy meters with lower uncertainties. It is based on digital sampling technique, and has been designed and evaluated as a measuring standard for active, reactive and apparent power for power frequencies.

The power measurement system consists of two digital sampling voltmeters (DVMs), a computer controlled phase-locking device, a precision voltage transformer, an electronically compensated current transformer with a temperature controlled AC shunt resistor.

The data from both DVMs is transferred to the PC via IEEE488, and analyzed by means of discrete integration. All available calculated results are displayed during the measurements.

All of the components and devices of the system together with the software were developed at UME except for the DVMs.

Areas

- AC Voltage Measurements
- AC Current Measurements
- Phase Angle Measurements
- Active, Reactive and Apparent Power Measurements
- Active, Reactive Energy Measurements
- Harmonics Measurements (DFT & FFT)

Other applications

- AC Resistor/Shunt Measurements
- Current/Voltage Transformer Test Set (Bridge) Calibrations
- Current/Voltage Transformer Standard Burden Calibrations

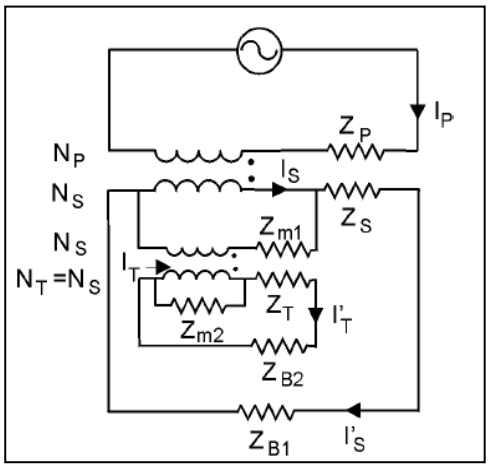
Technical Specifications

- Voltage : 60 V - 480 V
- Current : 0.05 A - 10 A
- Phase Angle : $\pm 180°$
- Best Measuring Uncertainty : 20 ppm (μW/VA)

Service Code: CHZ-G1PE-9900

STANDARD CURRENT TRANSFORMER (ACCURACY < %0.01)

A two stage passive compensated technology is used in the design of standard current transformer. The standard current transformer is basically a four wire transformer with three windings and two magnetic cores. The primary and secondary windings link both cores, but the tertiary winding only links core 2. The second stage consisting of core 2 and the tertiary winding, senses the ampere-turn difference of the first stage and under the proper conditions produces a tertiary current that is very nearly equal to it.



Therefore, the sum of the secondary and tertiary winding currents is very nearly equal to the ideal secondary current. For the second stage to produce an accurate correction however, the two stages must have separate burdens, or the common burden must be very small. The equivalent circuit of figure illustrates the case in which there are two separate burdens, designated Z_{B1} and Z_{B2}. Note that the equivalent circuit is simply the equivalent circuit of a simple current transformer with separate burdens transformer (stage 2) embedded in the equivalent circuit of another simple current transformer (stage 1), and the primary current of stage 2 is the magnetizing current of stage 1. A solution of the network equations for the equivalent circuit gives the expression for the transformer ratio, defined as the ratio of the primary current to the sum of the actual secondary and tertiary currents.

Therefore, the ratio error is approximately equal to minus the product of the ratio errors of the individual stages.

Technical Specifications

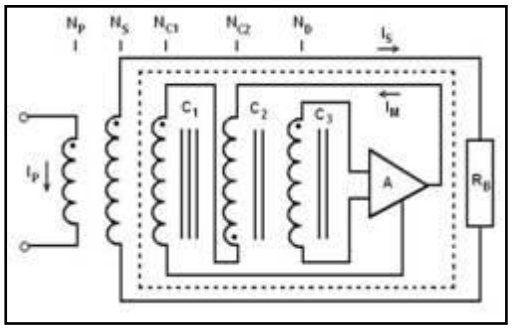
- Current Ratios : 5 A:5A - 1000 A:5 A
- Operating Ranges : 1 % - 200 %
- Frequency : 50 Hz - 60 Hz
- Accuracy : < 0.01 % for ratio
  < 0.01 crad for phase
- Burden : up to 0.5 Ω
- Electronically Compensated

Service Code: CHZ-G1PE-0100

TÜBİTAK
UME

ELECTRONICALLY COMPENSATED CURRENT TRANSFORMER

The compensated current comparator is a well-known high accurate ratio standard. Construction of a hollow toroid core prevents almost all external unwanted electromagnetic fields to reach the detector core so that the detector can sense the unbalanced currents almost without error. Because of this physical advantage, current comparator based ratio standards have been used in a wide application range.



Several techniques have been developed to achieve error-free current transformations. Recently, the introduction of electronic circuitry is preferred because of its simplicity and success in compensation. Use of electronic circuitry within the current comparator structure showed that one could design a current transformer with errors not more than few ppms.

A new compensation technique for laboratory type current comparators has been developed at UME. Similar to others, it has a detector core C_3, a detection winding N_D, a hollow toroid core C_1 surrounding the detector core, a primary winding N_P and a secondary winding N_S. Then, two additional windings N_{C1}, N_{C2} with the same number of windings are wound to inside and outside of the hollow toroid core, and connected each other in series but inversely. Here, C_2 represents a thick magnetic shield surrounding the detector core and winding. The dashed line shown in the figure represents a thick copper shield to prevent N_{C1} from the stray fields of primary and secondary currents.

The electronic circuitry is designed as a transconductance amplifier which amplifies the voltage obtained from the detector winding and converts it into a current. And, it forces this current to the inner and outer compensation windings not only for compensating the secondary current but also for zeroing the detection voltage, automatically.

Technical Specifications

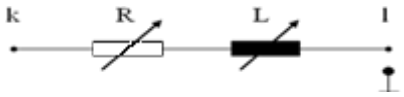
- Current Ratios : 5 A:5A - 1000 A:5 A
- Operating Ranges : 1 % - 200 %
- Frequency : 50 Hz - 60 Hz
- Accuracy : < 0.0005 % for ratio
  < 0.0005 crad for phase
- Burden : up to 0.5 Ω
- Electronically Compensated

Service Code: CHZ-G1PE-0200

STANDARD CURRENT TRANSFORMER BURDEN SET (IEC/ANSI)

According to the international standards, the ratio and phase angle error of a current transformer under test should be measured by connecting the external standard current burden in series to the secondary terminal of the current transformer since these errors of the current transformer vary with the burden value.

The standard current burden consists of a serial connection of the resistor and the inductor, expressed as follows:



$$Z_B = R_B + jX_B$$

The standard current burden is usually expressed in volt-amperes (VA) at a specified power factor and frequency.

Standard current burden sets have been developed for accuracy testing of the instrument current transformers according to the IEC 60044-1 (2003) and ANSI/IEEE C57.13-2008 as follows:

Technical Specifications (IEC 60044-1)

Nominal current (I_N) : 1 A and 5 A
Frequency : 50 Hz
Limit of Error : 3 %
Range in step : 1 ... 200 % I_N
Burden Steps($\cos\varphi$ = 1.0) : 1-1.25-1.5-2-2.5-3.75 VA
($\cos\varphi$ = 0.8): 5-6.25-7.5-10-11.25-15-20-25-30-45-60 VA

Technical Specifications (ANSI/IEEE C57.13)

Nominal current (I_N) : 5 A
Frequency : 60 Hz
Limit of Error : 3 %
Range in step : 1 ... 200 % I_N
Burden Steps($\cos\varphi$ = 0.9): 2.5–5–12.5–22.5-45 VA
($\cos\varphi$ = 0.5): 25–50–100–200 VA

Service Code: CHZ-G1PE-0300

STANDARD VOLTAGE TRANSFORMER BURDEN SET (IEC/ANSI)

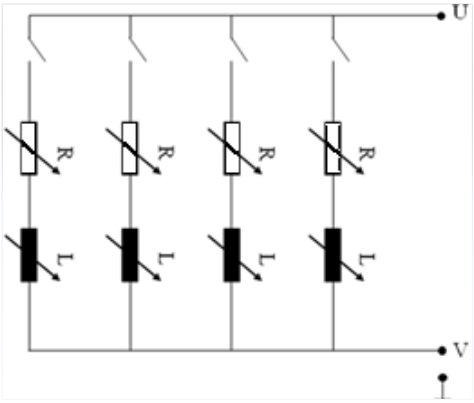
According to the international standards, the ratio and phase angle error of a voltage transformer under test should be measured by connecting the external standard voltage burden in parallel to the secondary terminal of the voltage transformer since these errors of the voltage transformer vary with the burden value.

The standard voltage burden consists of a parallel connection of the resistor and the inductor serial combinations.

The standard voltage burden is usually expressed in volt-amperes (VA) at a specified power factor and frequency.

Standard voltage burden sets have been developed for accuracy testing of the instrument voltage transformers according to IEC 60044-2 (2003) and ANSI/IEEE C57.13-2008 as follows.

Technical Specifications (IEC 60044-2)



Nominal voltage (U_N)	:	100 V, 100/√3 V, 110 V, 110/3 V
Frequency	:	50 Hz
Limit of Error	:	3 %
Range in step	:	40 ... 120 % U_N
Burden Steps($\cos\varphi$ = 0.8)	:	1.25...225 VA in stages of 1.25 VA

Technical Specifications (ANSI/IEEE C57.13)

Nominal voltage (U_N)	:	120/3 V, 120/√3 V
Frequency	:	60 Hz
Limit of Error	:	3 %
Range in step	:	40 ... 120 % U_N
Burden Steps($\cos\varphi$ = 0.1)	:	12 VA (W)
($\cos\varphi$ = 0.7)	:	25 VA (X)
($\cos\varphi$ = 0.2)	:	35 VA (M)
($\cos\varphi$ = 0.85)	:	75 VA (Y)
($\cos\varphi$ = 0.85)	:	200 VA (Z)
($\cos\varphi$ = 0.85)	:	400 VA (ZZ)

Service Code: CHZ-G1PE-0400

AC CURRENT SHUNT (SQUIRREL CAGE)

Coaxial shunts for precision current measurements at power frequencies are built by UME using a squirrel-cage design developed by the Mendelejev Institute.

Their extremely symmetrical design and the use of discrete resistors are their typical properties. The purpose of the design is to minimize the mutual inductance between the output of the shunt and the current path leading to the resistors and also external current loops.

Double-sided copper-clad boards which are normally used for printed circuits boards are used for building the current paths and the side walls. They are arranged so that the currents on each side of the boards are equal in magnitude and of opposite direction. As the boards are thin, the current loop areas are small and thereby the magnetic fields caused by these loops inside the shunt are also small. The cylindrical symmetry further minimizes these magnetic fields. The influence from magnetic fields caused by external current loops is minimized by the cylindrical symmetric design and the sheet-metal housing.

It also enables the type of current paths used in this design by which the resistors are placed far from the possible unsymmetries at the current input, thereby decreasing the mutual inductance even more.

Technical Specifications

- Operating Current : 1 A, 2 A, 5A or any other
- Frequency : 50 Hz - 60 Hz
- Inductance : < 1 nH
- Excellent Stability (Low Temperature Coefficient)
- Metal case

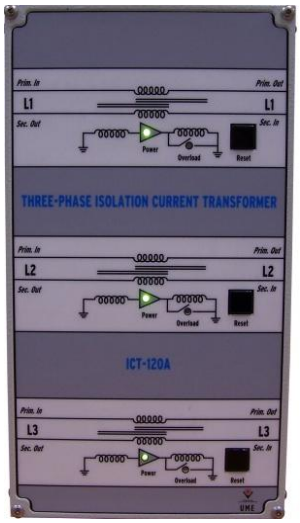
Service Code: CHZ-G1PE-0500

THREE PHASE ELECTRONICALLY COMPENSATED ISOLATION CURRENT TRANSFORMER FOR ELECTRICITY METERS

Electricity meters with interconnected current and voltage circuits are increasingly preferred by the electricity meter manufacturers for lowering the manufacturing costs and to prevent their misuse for fraud.

Meter manufacturers and operators used to test such meters by directly disconnecting the voltage and current terminals just before the tests and then connecting them together inside the meter. However, the only testing method for the meters which do not allow opening the links will be separating the applied voltage and currents outside of each meter by introducing isolation voltage and current transformers. Simply, an isolation voltage transformer for each single-phase electricity meter and a three-phase isolation current transformer for each of three-phase meter.

These transformers should have amplitude and phase errors small enough as not to introduce significant additional errors. The electronically compensated three-phase isolation current transformers developed by TUBITAK UME are operated well in a large operating range within the desired 0.05% error condition which is ten times better than the accuracy class of any meter.



Technical Specifications

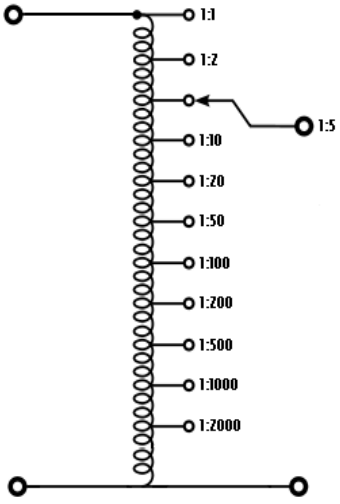
- Operating Current : 0.1 A - 120 A
- Frequency : 50 Hz - 60 Hz
- Accuracy : < 0.05 %
- Ratio : 1:1
- Electronically compensated
- Grounded and electrically shielded case design
- Overload protection and LED warning indicator, power indicator, RESET push button
- ±15V DC source with short circuit protection

Service Code: CHZ-G1PE-0600

TRANSFORMER TURN RATIO CALIBRATOR

Several test sets are on the market in order to determine the turn ratio of transformers, especially the voltage transformers. A reference voltage divider has been developed by TÜBİTAK UME for the control and calibration of such laboratory type or mobile transformer turn ratio test sets.

The reference voltage divider called as "Transformer Turn Ratio Calibrator" has multiple ratio taps between 1:1 and 1:2000. It operates at mains frequencies and offers convenient operating voltage for all transformer turn ratio test sets through its high input impedance.



The equivalent circuit model of TTR Calibrator.

Technical Specifications

- Exciting Voltage : 150 V (max)
- Operating Frequency : 50 Hz, 60 Hz
- Input Impedance : >300 kΩ @ 150 V
- Accuracy : 0.5 %
- Turns Ratio Steps : 1:1, 1:2, 1:5, 1:10, 1:20, 1:50, 1:100; 1:200, 1:500, 1:1000, 1:2000

Service Code: CHZ-G1PE-0700

CALIBRATION/TEST SYSTEM FOR ROGOSWKI TYPE AND LPCT TYPE CURRENT TRANSFORMERS (Reference Rogowski Current Sensor and V/I Converter)

Electricity meters with interconnected current and voltage circuits are increasingly preferred by the electricity meter manufacturers for lowering the manufacturing costs and to prevent their misuse for fraud.

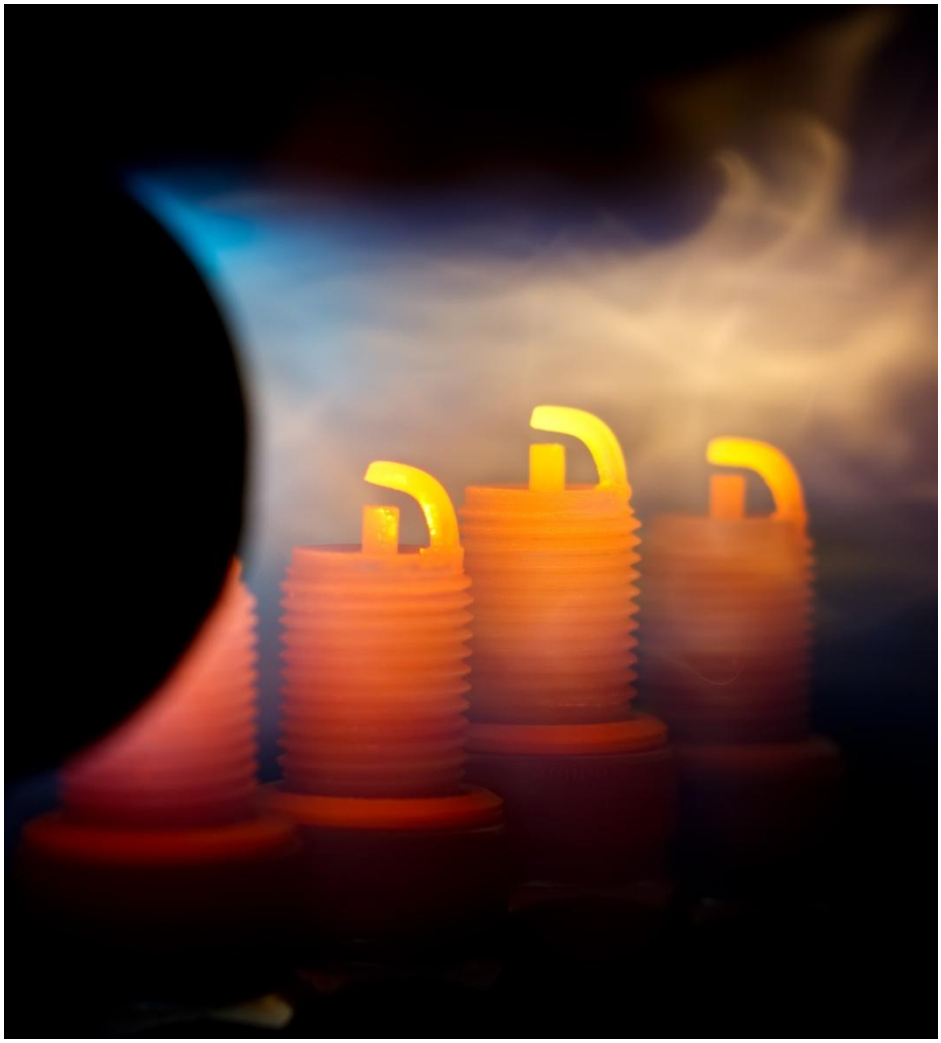
Meter manufacturers and operators used to test such meters by directly disconnecting the voltage and current terminals just before the tests and then connecting them together inside the meter. However, the only testing method for the meters which do not allow opening the links will be separating the applied voltage and currents outside of each meter by introducing isolation voltage and current transformers. Simply, an isolation voltage transformer for each single-phase electricity meter and a three-phase isolation current transformer for each of three-phase meter.

These transformers should have amplitude and phase errors small enough as not to introduce significant additional errors. The electronically compensated three-phase isolation current transformers developed by TUBITAK UME are operated well in a large operating range within the desired 0.05% error condition which is ten times better than the accuracy class of any mete

Technical Specifications

- Operating Current : 0.1 A - 120 A
- Frequency : 50 Hz - 60 Hz
- Accuracy : < 0.05 %
- Ratio : 1:1
- Electronically compensated
- Grounded and electrically shielded case design
- Overload protection and LED warning indicator, power indicator, RESET push button
- ±15V DC source with short circuit protection

Service Code: CHZ-G1PE-0800

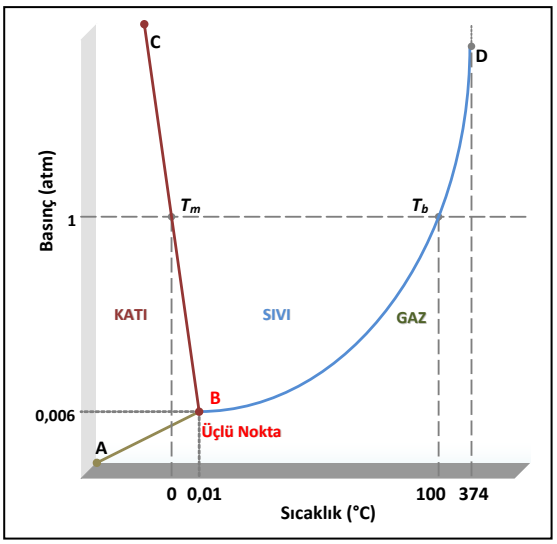


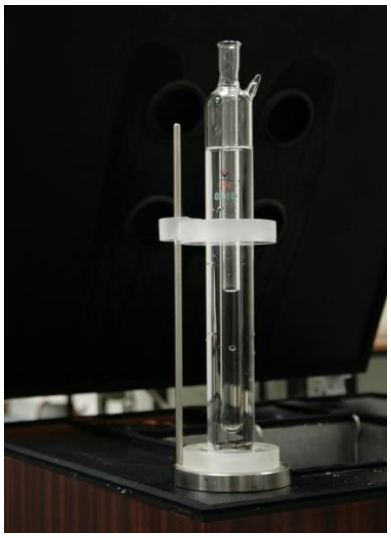
TEMPERATURE LABORATORY

TRIPLE POINT of WATER CELL

(Temperature Standard)

The temperature of the triple point of water is the temperature of water, ice and vapor in thermal equilibrium. It is the fundamental definition of the fixed point of the International Temperature Scale of 1990 (ITS-90) and the one defining fixed point of the Kelvin thermodynamic temperature scale. This temperature has been assigned a value of 0.01°C on the ITS-90 and a value of 273.16 K on the Kelvin thermodynamic scale.





Phase Diagram and Triple Point of Water Cell

TPW cell is the main temperature fixed point for the measurements of primary level resistance thermometers. The reproducibility of the cells was found to be ± 0.0001 K so that they can be employed for the determination of the stability of the thermometers.

Comparison Results

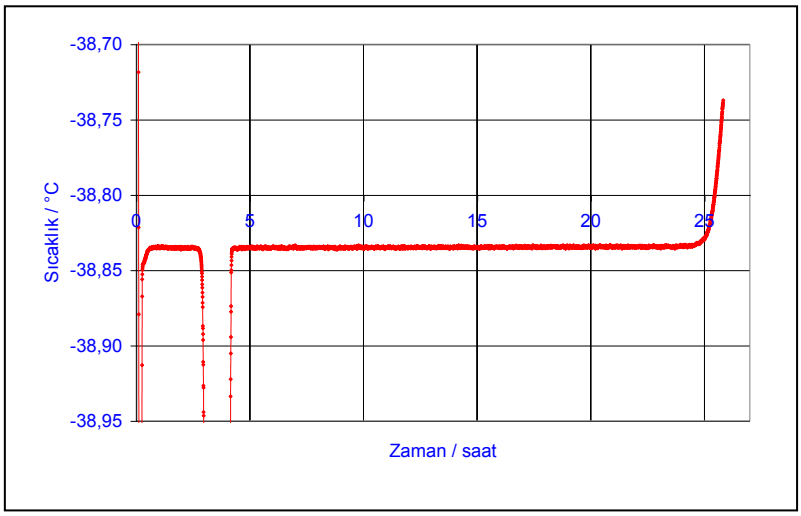
Comparison Name	Cell	Year	Difference(mK)
CCT-K7	UME 92	2002-2003	0,055
EUROMET Project 549	UME 4 UME 61	2001	0,035 0,036
BIPM Study	UME 52	2000	0,040
EUROMET Project 278	UME 4 UME 6 UME 13	1997	0,090 0,081 0,080

Service Code: CHZ-G1KS-0210

FIXED POINT CELLS

Fixed Points are the primary level temperature standards according to International Temperature Scale of 1990. Fixed Point cells contain high purity metals and the phase transition of these metals enables us to carry out high accuracy temperature calibrations. Contact thermometry part of the scale requires the measurements at Mercury Triple Point, Gallium melting point, Indium freezing point, Tin freezing point, Zinc freezing point, Aluminum freezing point and Silver freezing point. All these reference fixed point cells are produced by TÜBİTAK UME Temperature Group Laboratories with the highest accuracy.

Mercury Fixed Point



Phase Transition of a Fixed Point

Fixed point cells manufactured by TÜBİTAK UME with associated uncertainties

Fixed Point Cell	Temperature /°C	Uncertainty
Mercury Fixed Point	-38.8344	0.65 mK
Gallium Fixed Point	29.7646	0.55 mK
Indium Fixed Point	156.5985	1.70 mK
Tin Fixed Point	231.928	1.20 mK
Zinc Fixed Point	419.527	1.55 mK
Aluminum Fixed Point	660.323	8.0 mK
Silver Fixed Point	961.78	15.0 mK

Service Code : CHZ-G3KS-350, CHZ-G3KS-400, CHZ-G3KS-450, CHZ-G3KS-500, CHZ-G3KS-550

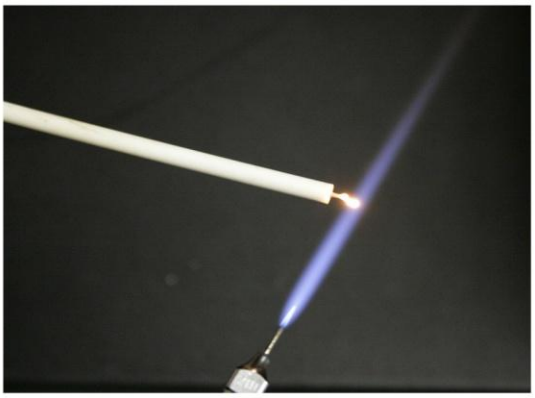
REFERENCE THERMOCOUPLES

Type R, S, Pt/Pd and Au/Pt

R and S type thermocouples are widely used for contact temperature measurement in temperature range from 0 °C up to 1400 °C due to their easy handling, resistivity to mechanical and thermal shocks within wide temperature range and their high stability. The lower drift and higher stability at high temperatures of the platinum based thermocouples than the base metal thermocouples (type K, J, N, E, T...) are main reasons why platinum based thermocouples are recommended for use as the reference thermometer.

In order to improve the quality of temperature measurements in the temperature range from 800 °C to 1500 °C, new kind of thermocouples have been developed using thermoelements of the pure platinum and palladium. These thermocouples have shown better characteristics than the standard platinum-thermocouples B, R and S types due to the structure of noble metal thermoelements. Pt/Pd thermocouples are recommended for use as the reference thermometer in the high temperature range.
For the temperature range from 0 °C to 1000 °C the Au/Pt type thermocouples are recommended as reference thermocouples.

Reference thermocouples are delivered with calibration certificates.



Reference Thermocouple

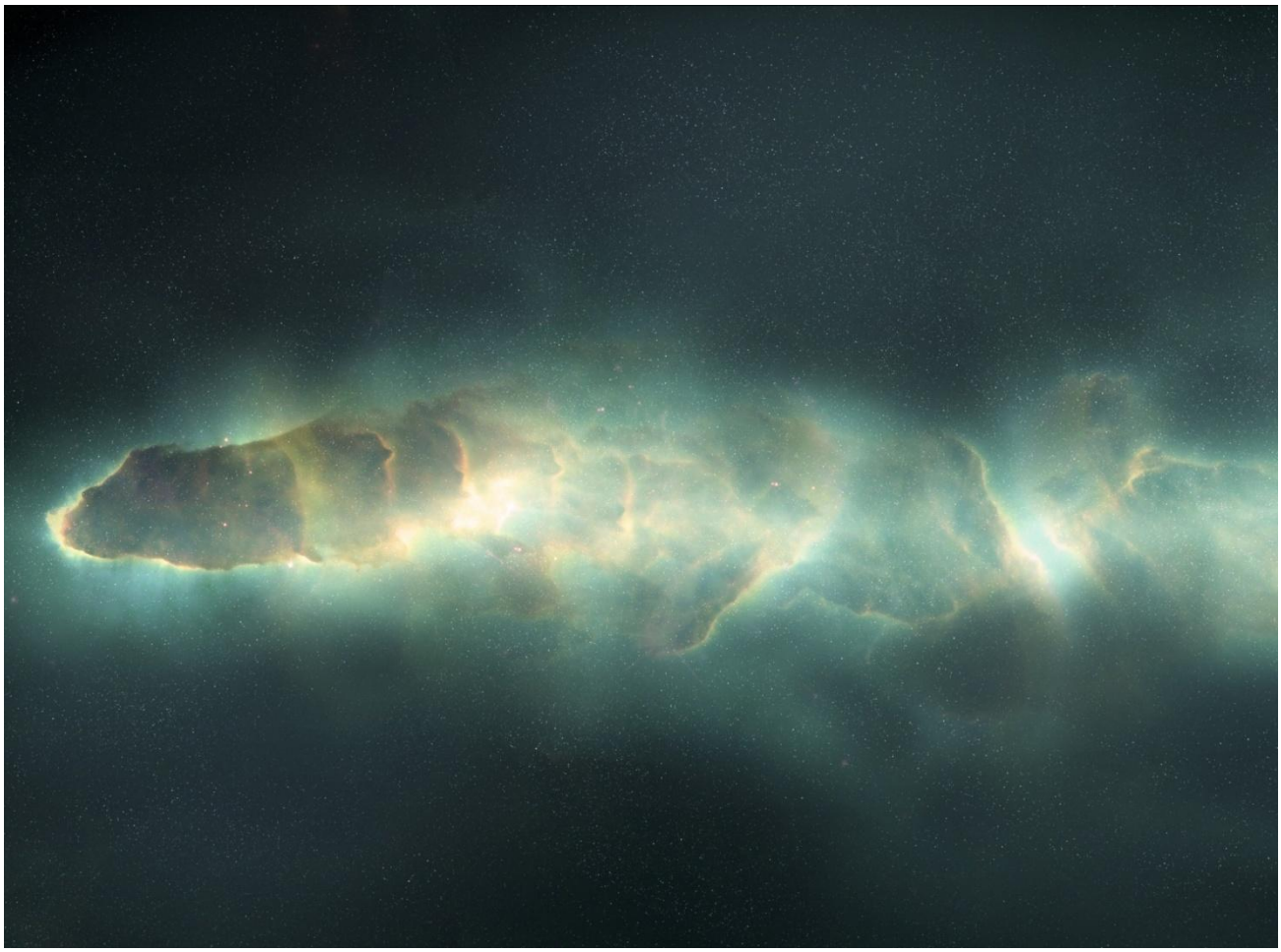
Reference thermocouples manufactured by TÜBİTAK UME

Reference Thermocouple	Temperature Range
Type Au / Pt	0 °C / 1000 °C
Type R and S	0 °C / 1400 °C
Type Pt / Pd	800 °C / 1500 °C

Specifications

- The purity of platinum thermo element : % 99.999
- The purity of gold thermo element : % 99.999
- The purity of palladium thermo element : % 99.97
- The diameter thermo elements : 0.5 mm
- Dimensions : ~(Dia, Length, 7 x 600)mm
- Dimensions : ~(Dia, Length, 7 x 750)mm
- Sheaths : Alumina ceramics
- The Cold Junction Compensation can be made on request.

Service Code: CHZ-G3KS-110, CHZ-G3KS-120



GAS METROLOGY LABORATORY

GAS STANDARDS

Carbon dioxide in Nitrogen Gas Mixture:

This standard serves as reference gas mixture to provide traceable and accurate gas measurements in the field of air quality monitoring.

Description:

The reference gas mixture being certified reference material contains carbon dioxide (CO_2) in nitrogen (N_2). The mixture is prepared gravimetrically according to "ISO 6142:2001 Gas Analysis – Preparation of calibration gas mixtures – Gravimetric Method" and certified according to ISO 6143:2001 "Gas analysis - Comparison methods for determining and checking the composition of calibration gas mixtures". The range of molar fraction is 0.01 % to 20 % . Gas mixtures are produced in 5 liter (water volume) aluminum cylinders at a pressure of approximately 110 bar. Cylinders are specially coated and the valve connection type is DIN 477 No. 1

Specifications

Component	CAS No.	Amount fraction	Unit
Carbon dioxide	124-38-9	0,0001 – 0,2	mol/mol
Nitrogen	7727-37-9	Balance	mol/mol

Intended Use:

The product is used for calibration and verification of gas analyzers, chromatographs and other gas measurement systems.

Service Code: CRM-G3GA-1101

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