EPRO Gallspach GmbH

EPRO Measurement System

• Electrotechnical products for power distribution and measurement •

EPRO Measurement System -
fully automatic transformer measuring system

Basic Measurements:

- No Load Loss
- Load Loss
- Heat Run
- Induced Voltage
- Zero Sequence

All these measurements are realized for 1 Phase or 3 Phase EUT according to the latest standards, IEC-60076-1, 2, 3, 8 ANSI/IEEE C57.12.90

On demand other measurements can be integrated in the test system, as:

- Winding Resistance
- Transformer Turn Ratio
- Partial Discharge etc...

Scope

Energy and mainly the electric energy are agreed all over the world, to be the main challenge of the 21st century. The industry of electrical energy distribution has developed and produced equipment to reduce waste and improve the network reliability for many years. On the other hand, many emerging countries have to build electrical networks in a very short time, in order to sustain their economic growth.
EPRO has developed and delivered for 20 years equipment with unique accuracy and unique reliability for use in test laboratories or to be connected to the grid. Strong from this experience EPRO has developed a revolutionary measurement system, in order to help high voltage laboratories or equipment manufacturer testing their equipment.

The EPRO Measurement System was developed following one goal, integrating all the test and measurements in the laboratory or in the factory, under one system, to ease control of the Equipment Under Test (EUT) and to integrate all test result in one test report without large manpower.

EPRO designed the system using the latest technologies of electronics and the most reliable measurement techniques as EPRO did with all their measurement transformers for years. EPRO delivers the EPRO Measurement System with some basic measurements, but the system can be easily expanded, with existing equipment using the Interface Box, or with other Measurement box for developing a special measurement environment.

System Highlights

Accuracy For AC voltage and current measurement, EPRO is a synonym of accuracy. The system benefits from the high Accuracy of EPRO measurement transformers, and exhibits accuracy better than ±0.1% in case of very low power factor of 0.05.

Ease of use The EPRO Measurement System is controlled by the EPRO Measurement Center Software which takes advantage of the 2 large screens on the Desktop to bring customers all information about measurements; standards and accuracy.

Full automatic tests The Measurement box of the EPRO Measurement System are allowing the user to make full measurement without rewiring the test equipment.

Modularity The EPRO Measurement System is built to be highly modular, every measurement can be combined, using the EPRO measurement transformers with their associated Measurement box and the range of accessories supplied.

Scalability The EPRO Measurement System benefits from the large range of measurement transformers supplied by EPRO. Every measurement transformer from EPRO (even already in production for years) can be equipped with a Measurement box and connected to the EPRO Measurement Center.

Integration The EPRO Measurement Center can control and interface on demand all existing third party equipment with a communication interface in the laboratory. The EPRO Communication box makes these tailored developments easy and short.

Self-verification The EPRO Voltage and Current Measurement box can verify their calibration data, thanks to a very accurate and stable voltage source embedded in the Measurement box itself.

Easy and efficient calibration Only the Measurement box have to be calibrated in the EPRO Measurement System, their small form makes it easy to ship, and the modularity from the system makes it possible to have spare Measurement box that guarantee an uninterrupted measurement.

System Description

EPRO Measurement Desk

The **EPRO Measurement Desk** is the „brain" of the system. It runs the EPRO Measurement Center Software. This software is tailored to the application or can be delivered as a stand alone product. The Measurement Desk integrates a powerful industrial PC with the latest technologies, so that the EPRO Measurement Center can deliver the best efficiency for the measurements and to help the customer. Two large graphic displays guide the customer through the measurement setup, helping to take the right decisions about the measurement accuracy, depending on the EUT. The use of the Touchscreen makes even more natural the use of this system.

Measurement Instruments

The measurement instruments are the fundament of the EPRO measurement system. They are positioned at the place where the physical measurement must be taken.

The architecture of the EPRO measurement system, measuring directly at the measurement instrument, ensures a very high immunity to electromagnetic interferences, and provides an inexpensive wiring method through plastic optical fiber.

Scope of the measurement instruments

Voltage and current measurements

Voltage and current measurement are performed with the most accurate measurement transformer from EPRO, with their associated Measurement Box.

The Measurement Box allows the measurement of voltage or current through the entire range of the measurement transformer (5 - 200% for current and 40 - 120% for voltage transformer) without the need of rewiring or range switching.

EPRO can deliver a large range of measurement transformers; this huge range combined with the versatility of the Measurement Box makes it possible to fulfill every need of Voltage and Current for the System.

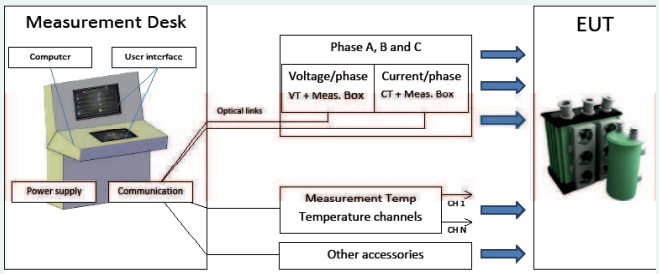
Temperature measurements

A temperature Measurement Box with the associated temperature probes , this instrument sends the temperature measurement to the Measurement Desktop.

These temperature tools, together with the EPRO Measurement Center, monitor the temperature of the transformer during the test, as required by the standards, and provide the temperature measurements to perform an accurate Heat Run Test. They also provide safety information during every test whether the EUT faces an overheating problem, allowing the system to automatically stop the test and warn the user.

Other instruments and accessories

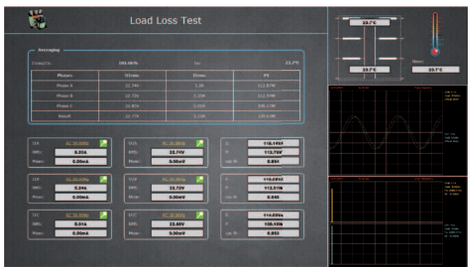
EPRO has developed a unique architecture that helps including in a short time and very efficiently, instrument from third party or existing equipment in the lab, which will be directy controlled and read back from the system through the Communication Box. Automating the high voltage source existing in the lab is usually the main target of these features.



System Description

The EPRO Measurement Center Software

The EPRO Measurement Software takes advantage of the high quality hardware configuration, the powerful embedded computer helps calculate all the measurement, but the main advantage of the EPRO Measurement Software is the use of the two large screens of the measurement desktop.
The large touchscreen is a contextual keyboard and displays at each phase of test or EUT setup only the useful keys for the user, helping the user to configure easily every type of test.



The Top screen displays during setup or test run, helpful information to the user in order to configure every step of test. The large screen displays all elements required by the standards as IEC-60076, or all elements needed to define a EUT or a Routine Test.

Productive structure

The EPRO Measurement Software is oriented on 3 different axes:

EUT Designer to define the characteristics of an EUT, like transformer type, number of windings, power rating of the transformer, tap changer

Routine Test Designer to define Routine or Type Test. Routine test links an EUT and a list of tests, speeding up the routine test of equipment in production.

Free measurement to perform measurements on any type of EUT in design phase, or in order to prepare a future Routine Test.

Fully automated Test

EPRO Measurement Software enables full automated measurement, by controlling all elements of the lab, power source, measurement devices and also include an automatic Tap Changer Controller to facilitate the test of EUT with tap changers.

Automated test report

Test results are stored in the archive of the EUT, coded by EUT Type, serial number and a date code. These results can be combined in a report at any time.

Report Designer helps the user to prepare an automated report engine. Reports are generated in pdf format, and stored on the Measurement System hard drive.
If the Measurement Center is connected to the network, these reports can be shared or backed up on another system.

Integration in the laboratory
The EPRO Measurement Software concentrates the entire customer needs in one Interface, the system can control through the EPRO Communication Box, most of existing devices with communication port. EPRO has already integrated some devices; any device can be efficiently integrated on customer demand.
The main benefit of this integration is the integration of the high voltage source. This source is completely controlled by the software. In automatic control mode, the source will be set at the nominal rating specified for the EUT. In manual mode, the software assistant will prompt the user for the needed settings, and control the user settings.

Accuracy assistant
The EPRO Measurement Software integrates an accuracy assistant that gives an assessment about the accuracy of the current measurement. Depending on the ratings of the EUT and the test setup, accuracy of the measurement will be automatically calculated and displayed on the screen.

Accuracy

Voltage and current measurements are done directly at the output of the measurement transformers, eliminating any influence from all electromagnetic interference to the measurements.

The use of the latest electronic technologies, like a 31 bit analog to digital converter for the measurements, and a 1ppm precision digital to analog converter for the reference generator, guarantees the best accuracy even at low signal level, and the best stability over time and temperature.

The Measurement Box integrates the Load of the measurement transformer to reduce the uncertainty of varying contact impedance.

The **electronic wide range amplifier** senses the signal level at the measurement transformer secondary. The wide range avoids any waste of time during the measurements to rewire the test setup, and ensures that the measurement will not be influenced by impedance varying relay contacts during range switching.

The **Temperature compensation system** monitors the transformer Load temperature and the electronic temperature at several points, to correct the measurement values depending on any temperature change.

Absolute and relative accuracy
The EPRO Measurement System and the Measurement Box have the best absolute accuracy on the market for the power measurements. Using the reference generator, the system benefits from the high accuracy of the reference generator and then reaches an unequaled relative accuracy.

The phase angle measurement accuracy is provided by the **EPRO Synchronization System** which uses the same fiber optics as the data transmission from the Measurement Box, and guarantees a synchronous time at any measuring point of the system.

Factory calibration
To provide the best accuracy, the measurement transformers are calibrated using the calibration process approved by the PTB and all certification institutes. Then, the deviation in phase and amplitude are recorded range by range in the Measurement Box.
The Measurement Box compensate in real time the amplitude and phase measurement of the transformer, depending on the signal range (% of range utilization).
Combined to an exhaustive calibration process for the Measurement Box electronic, all these calibration ensure a very accurate measurement.

Self-verification
The Measurement Box integrates on board a Reference Generator. This generator, based on a 1ppm Digital to Analog Converter is calibrated and the reference values are stored in the Measurement Box Memory during factory calibration. This source level is compared to the factory calibration values before measurement and guarantee that the Measurement Box and the EPRO Measurement System output always the best accuracy.

As described in the standards, the accuracy of measurement is of first importance for the voltage and current, but the most important factor for power measurement is the phase angle or power factor measurement.

The measured power losses are expressed as
$P = U * I * \cos\phi$

For the composite relative error the formula gives:

$$\frac{\partial P}{P} = \frac{\partial U}{U} + \frac{\partial I}{I} - \frac{\sin\phi}{\cos\phi} \times \partial\phi$$

Modified, this equation shows that when the phase angle is small due to the inductive nature of the equipment under test, the power measurement error, which varies with the inverse of the power factor, will increase.

Example of accuracy limits

Data provided for measurement transformer rated load 2 VA and accuracy of ±0.0005% and ±0.5 min. These data are guaranteed for any measurement transformer with this accuracy, delivered by EPRO.

Voltage measurement

Range of Utilization	Accuracy *
40 to 120% of Un	0.02%

Current measurement

Range of Utilization	Accuracy *
1 to 40% of In	0.05%
40 to 200% of In	0.02%

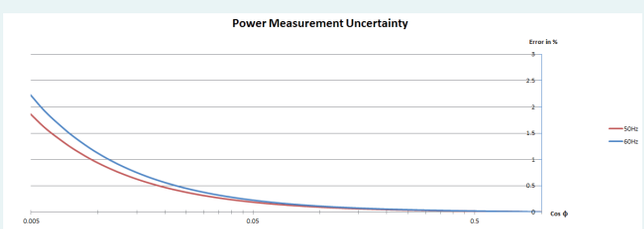
Phase angle measurement

Frequency (reference)	Accuracy *
50 Hz	< 0.4 min
60 Hz	< 0.5 min

Power measurement

Power factor	Accuracy *
CosΦ = 1 ; 40% < I < 200% of range	0.05%
CosΦ = 0.05 ; 40% < I < 200% of range	0.16%
CosΦ = 0.05 ; 40% < I < 200% of range	0.62%

Details of the power measurement are given as a graphical display for the 50Hz and 60 Hz usual frequencies, and current between 40% and 200% of In at the measurement transformer.



Temperature measurement

Temperature range	Accuracy *
0 to 100°C	0.3°C
>100°C	1°C

*„Preliminary values subject to change, please contact EPRO for the latest information."

Products for EPRO Measurement System

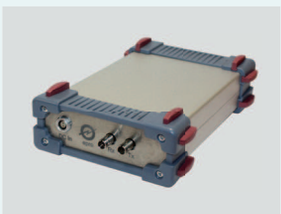
The EPRO Measurement System for a 3 Phase EUT measurement is basically composed of following equipment:

- 3 Voltage transformers NVDD or other type with their Measurement Box (depending on application rating)
- 3 Current transformers NCD or other type with their Measurement Box (depending on application rating)
- EPRO Measurement Desk running the EPRO Measurement Center Software
  - EPRO Measurement Software full version and access to the software update
  - Power Rack (option internal or external) for Measurement Box and Messtemp power supply
  - Power cables to the Measurement Box and Messtemp
- Cabling and optical fibers for connections between Measurement Box and Measurement Desk
- EPRO Temperature Measurement Box with 5 supplied temperature probes

On demand for the integration of the laboratory equipment, the following equipment can be supplied with the system:

EPRO Measurement Box
For customer already having an EPRO measurement transformer, a Measurement Box with the corresponding Load can be supplied and connected to the system

EPRO Temperature Measurement Box
To add more temperature channels, additional Temperature Measurement Box can be ordered with probes, even after delivery of the system. This box will be automatically recognized by the system.



EPRO Communication Box
Every measurement instrument in the laboratory can be integrated in the EPRO Measurement System, using EPRO Communication Box.

Measurement Box Battery Pack
This battery pack replaces the power supply connection for the Measurement Box. This battery pack can be connected to any Measurement Box, temperature Measurement Box, communication box, …

Mobility

The EPRO Measurement System can be delivered as a mobile Test System, together with the mobile range of EPRO Measurement transformers.

Contact our representative to define your mobility needs, the system can be fully tailored on your needs, to be mounted in a truck, or deployed on the field.

Further products from EPRO

- cast resin insulators
- Feed-in transformers
- Toroidal transformers
- Test bay equipment
- Calibration service
- Optimization, service and repair

Certificates and approvals

ISO 9001 Quality Management System
EN ISO/ IEC 17025 Conformation of Accreditation
GOST Pattern Approval Certificate of Measuring Instruments
PTB On-site verification of the accuracy of a current and voltage measuring system of an accredited calibration laboratory

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