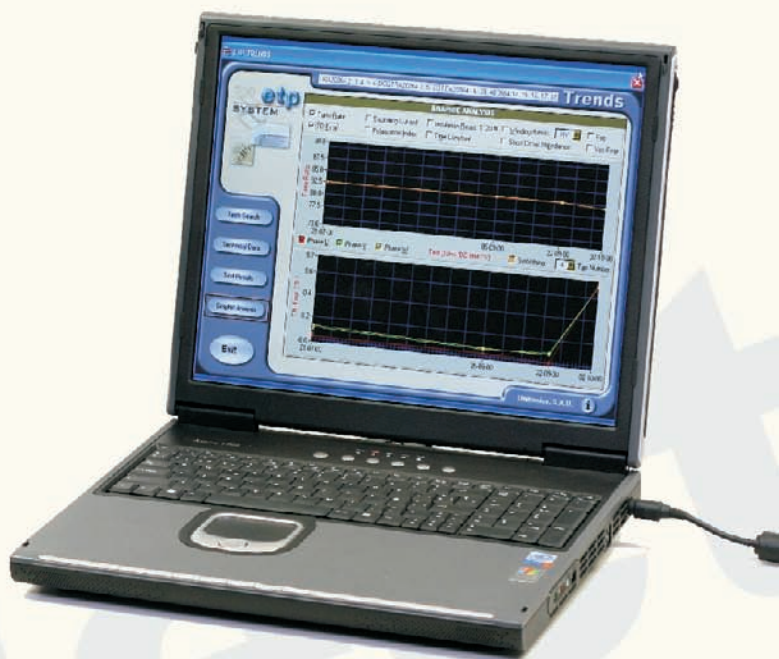


Evaluation of Power Transformers



ETP System

Reduce your operation costs thanks to Predictive Maintenance



“Be ahead of problems is solve them”

The off-line predictive maintenance

The predictive and condition based maintenance is nowadays accepted as the most efficient solution to guarantee the proper operation of the critical assets. In both electrical power generation, T & D and industry, power transformers are essential and require a right maintenance policy. For this, it's absolutely necessary to have right, precise and reliable information regarding their condition.

Due to the high cost of the on-line monitoring systems and the need of performing scheduled shutdowns for other different reasons as mechanical revisions, the off-line tests are a simple and cheap way to obtain this necessary information.

Evaluation of the Transformer: the ETP tests

As the time to have a machine available and accessible is always limited, it's essential that the performed tests bring the maximum information in a minimum of time. Furthermore, the simplicity in making a diagnostic is essential to simplify the quick decision making process. The **ETP system** has been developed based in 2 main axes:

- ✓ **Maximum information in minimum of time.**
- ✓ **Simplicity in performing and evaluating the results.**

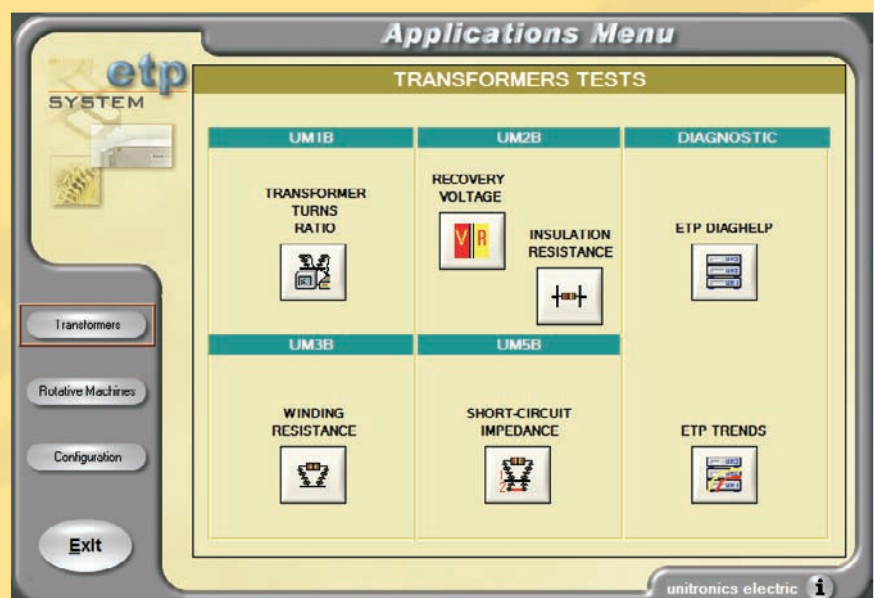
The **unitronics electric ETP test set** performs a simple, fully automatic and guided test by mean of its control software. This way allows eliminating the human error and guarantees the repeatability of the measurements.

The analysis performed from the same software allows analyzing the results in a quick and visual way, helping the diagnostic of the tested transformers.

What's ETP system?

ETP is composed of 4 independent measurement units that share unique software for controlling and analysing. Even if all the measurement units are not necessary to perform the tests on a power transformer, the more tests are performed, the more reliable and precise the diagnostic will be.

Thanks to its database, technical data of the transformer is available from every single unit at any time, allowing significant time saving in performing and analysing the tests.



What does the ETP calculate?

The diagnostic through the **ETP tests** is done by mean of the relation between the results of the different tests performed:

- Turns Ratio Meter:** three-phase measurement of the turns ratio and the excitation current in every position of the tap changer. Results are compared with the theoretical values and the error is shown graphically.
- Recovery Voltage Meter:** evaluation of the solid and liquid insulation condition through electrical measurements.
- Winding Resistance Meter:** three-phase measurement of the resistance values in every winding and for every position of the tap changer.
- Short-circuit Impedance Meter:** evaluation at low voltage of the short-circuit impedance and voltage.

By mean of these tests, we can evaluate the condition of the different circuits that a transformer is composed of, detecting the potential failure mechanism:

- Electrical Circuit:** checking the continuity of the windings, the connections and the tap changer.
- Geometrical Circuit:** checking the symmetry between the columns of the core, between the windings and the core and between these and the enclosure of the transformer.
- Magnetic Circuit:** checking the condition of the magnetic core.
- Dielectric Circuit:** checking the degradation and the ageing of the solid and liquid insulation.

TAP 1		TAP 11 (NOM)		TAP 21	
Phase	Theor. Vac (V)	Meas. Vac (V)	Meas. I (A)	Meas. Vac (V)	Meas. I (A)
U	51.68	3.408	87.70	15.16	87.70
V	51.71	3.513	87.81	14.72	87.81
W	51.71	3.491	88.01	14.82	88.01

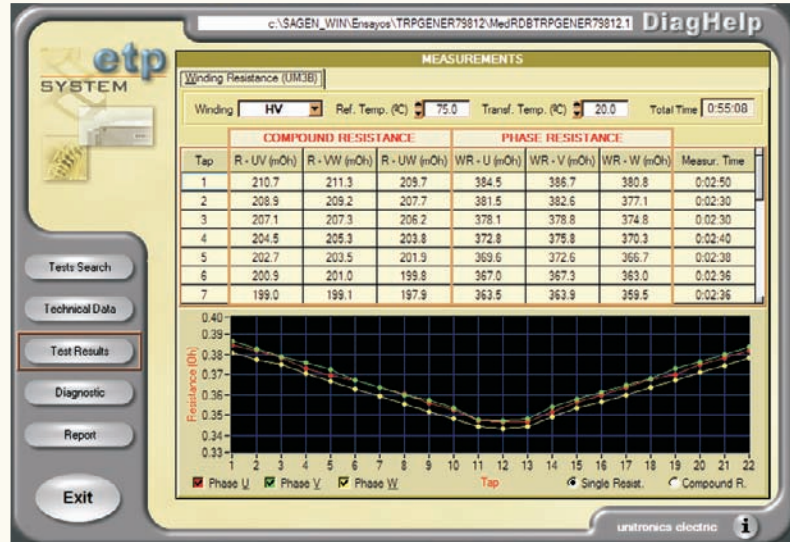
Diagnostic Category	Test Name	Result
Electrical Circuit	Block Connection or Hot Spot	No trace
	Tap Changer Problem	Traces. Check contacts...
	Short-Circuit between Turns	No trace
Dielectric Circuit	Winding is Open	No trace
	Regulation Turns Short-Circuit	No trace

How to understand the results?

All the measured and calculated parameters are only too well defined, contrasted and delimited by the main international standards (IEEE, IEC). The experience in the diagnostic and the help brought by our diagnostic software **ETP DiagHelp** allow relating quickly all these parameters, and then defining the issues in the transformer condition.

However, it's necessary to remark that the basis of the condition based maintenance is the trend analysis. The **ETP Trends** software allows a quick and graphical view of all the results: every parameter of successive tests performed in the same machine is shown in a table and a graph.

Thanks to this feature, we can optimize the scheduling of the shutdowns and revisions to perform in the machine. This reduces both the intervention costs and the out of service time.



Failure	Detected Damage	UM1B	UM2B	UM3B	UM5B
Core	General Status	• •	—	• •	—
	Tap changer breakdown	• •	—	• •	—
Connection	Connection slackening	•	—	• •	•
	Windings displacement	—	—	—	• •
Windings Integrity	Open Winding	• •	—	• •	• •
	Winding hot spot	—	—	• •	—
	Short circuit between turns	•	—	• •	• •
	Winding partial short circuit	• •	—	• •	• •
Liquid and Solid Insulation	Degradation of solid dielectric	—	• •	—	—
	Degradation of liquid dielectric	—	• •	—	—
	Contamination of the insulation	—	• •	—	—
	Anomalous aging	—	• •	—	—