

IDAX 300

Insulation Diagnostic Analyzer



- **Fast and accurate moisture assessment in power transformers**
- **Well proven technology; IDA/IDAX units have been in field use for more than 10 years**
- **Reliable results at any temperature**
- **Automated analysis of moisture content and oil conductivity — decisions at your finger tip**
- **True frequency domain measurement for highest noise immunity**
- **Performs non-intrusive insulation testing of transformers, bushings, cables and generators**

DESCRIPTION

IDAX 300 provides an accurate and reliable condition assessment of insulation in transformers, bushings, generators and cables. The IDAX 300 system maximizes the outcome of maintenance activities allowing for load and service life optimization.

IDAX 300 is smaller, lighter and faster than its predecessor IDAX 206. It maintains the same accuracy and ability to provide reliable data using true DFR (Dielectric Frequency Response), also known as FDS (Frequency Domain Spectroscopy), without compromises. The state-of-the-art software makes testing both easier and faster, allowing transformer moisture assessment in less than 18 minutes.

IDAX 300 measures the capacitance and tan delta/power factor of the insulation between power transformer windings at multiple frequencies. Plotting the results as a curve makes it possible to assess the condition of the oil and solid insulation, assess the moisture level in the solid insulation and other potential insulation problems. The test can be performed at any temperature.

APPLICATION

With an aging power transformer population, today's electrical utility industry faces a tough challenge as transformer failures and consequent repair and revenue loss costs millions of dollars. Transformers have become one of the most mission critical components in the electrical grid. The need for reliable monitoring and diagnostic methods drives the world's leading experts to evaluate new technologies that improve reliability and optimize the use of every grid component [1].

IDAX is a revolutionary insulation diagnostic instrument based on DFR (Dielectric Frequency Response), also known as FDS (Frequency Domain Spectroscopy). This analysis technique has been used in laboratories for decades and IDA/IDAX was the first instrument designed for field use (1997). The IDA/IDAX instrument and measurement principle has been used and verified around the world over the last ten years.

One of the most important applications for IDAX is to determine the moisture content in transformer insulation. Moisture in the insulation significantly accelerates the aging process. Moisture can cause bubbles between windings, resulting in catastrophic failures. IDAX provides reliable moisture assessments in one test. The test can be made at any temperature and takes less than 18 minutes.

Decisions on maintenance and/or replacement should be based on knowing the condition of the insulation and the expected loading of the unit. Adding just a few operational years to the expected end-of-life for a transformer, generator or cable by optimizing the working condition based on reliable diagnostic data means substantial cost savings for the equipment owner.

The FDS technology can also be used to assess the condition and aging of the insulation in bushings, CTs and circuit breakers. Numerous ongoing research projects at institutes and universities around the world is adding experience and value to users of IDAX.

Water in Oil vs. Paper

Assessing reliable moisture content in transformer insulation based on oil sample tests is unreliable as the water migrates between the solid insulation and oil as temperature changes. An oil sample has to be taken at relatively high temperature and when the transformer is in equilibrium. Unfortunately, this is a rare state for transformers thus resulting in unreliable assessments.

Figure 1 shows how the significant and potentially critical difference of 0.5% respectively 3.0% moisture in paper, correlates to the insignificant difference of 1 respectively 4 Parts Per Million (PPM) in an oil sample obtained at 20°C (68°F) [2].

The Test

Dielectric loss or power factor is frequency and temperature dependent, so by injecting test signals at discrete frequency steps typically between 1 kHz and 1-2 MHz while recording results at each point, a curve is created (Fig 2).

This profile represent the properties of the insulation material in the transformer and will be used in further analysis as described below. The oil temperature is recorded to be used in the model analysis described below.

The Model

The insulation between the windings in a transformer consists of a solid and a liquid part. The solid part consists of barriers and spacers to create an oil duct for cooling purposes (Fig 3). The model formula varies all insulation parameters to simulate every possible geometrical design. The model also applies Arrhenius equation to compensate for temperature dependence in the material [3].

The IDAX software creates new model curves and compares them to the measured curve until the best possible match is reached. The final results are presented as a percent of moisture in paper and a separate value for oil conductivity (Fig 4 and 5).

What Controls the Curve?

The general rule is that moisture is visible in the highest and in lowest frequencies. Oil conductivity is dominant in the medium frequency and the temperature shifts the curve to the right and to the left respectively (Fig 6).

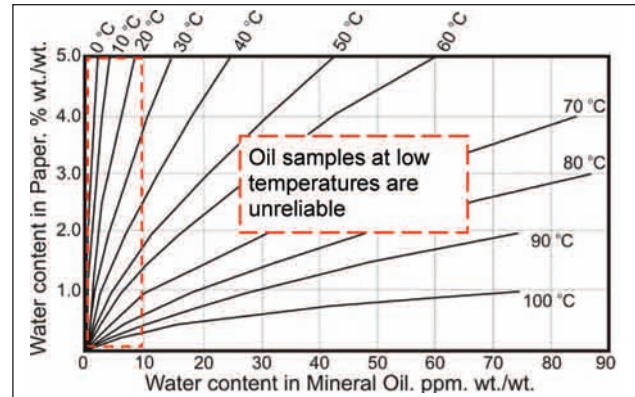


Figure 1: Water in oil vs. paper correlation is unreliable at low temperature

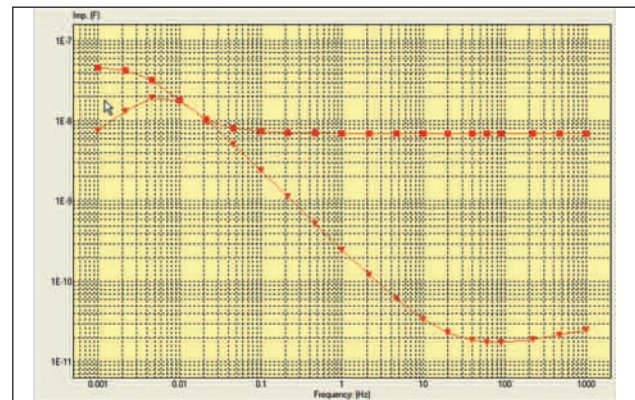


Figure 2: Power factor curve presented as capacitance and loss

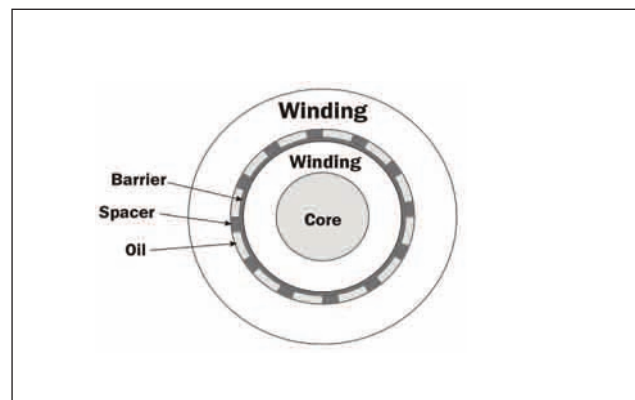


Figure 3: Typical insulation design

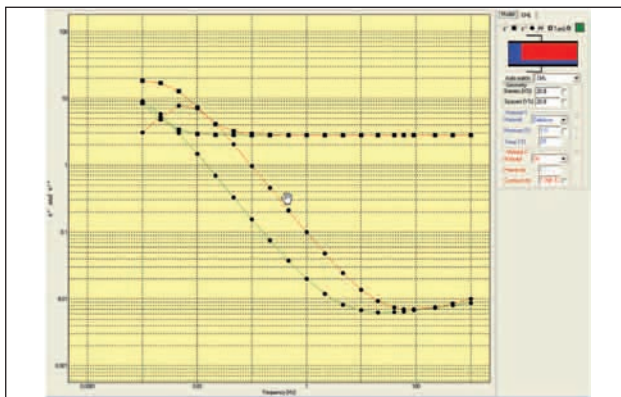


Figure 4: Before matching — green-model, red-measurement

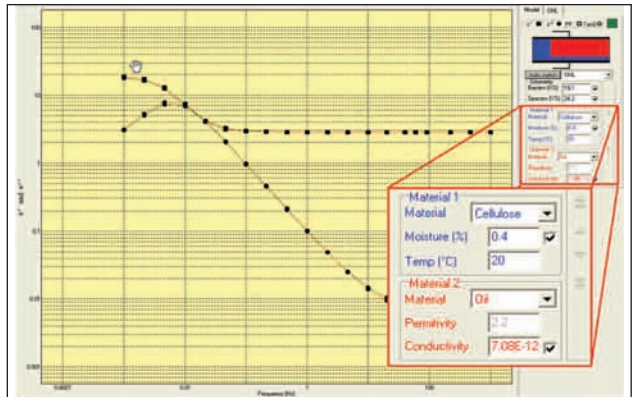


Figure 5: After matching — result: 0.4% at 20°C

One Point Is Not Enough

Traditional tan delta/power factor testing provides one value at mains frequency 50/60 Hz. This is where the IDAX method makes the difference. Figure 7 show that a single power factor value cannot provide conclusive information about the potential problem. At best it can provide information that a problem exists. In this example, two transformers have the same power factor value at 60 Hz. However, one of them is wet (3.6%) and should be considered for a dry-out while the oil in the other unit should be replaced or refurbished. The IDAX method provides accurate and conclusive information in one test.

Test Procedure

The test preparation and procedure is similar to a standard tan delta/power factor test, which means that the transformer has to be off-line and preferably disconnected.

The IDAX software operates on Windows XP and Vista and utilizes standard USB communication. The software guides the user through a test template where all connections are illustrated in Figure 8. Color markings on clamps makes it easy to connect according to the built in instructions. The test can be started as soon as the test cables are connected. Error messages on the screen inform the user if there are any problems with connections or cables.

IDAX 300, in the standard version, is equipped with an input circuitry capable of measuring multiple test modes without having to change cable connections on the transformer. As an option, the IDAX 300 can be equipped with an additional current measurement channel that allows for two completely independent measurements at the same time, thus minimizing test time.

The calibration set enables simple and reliable calibration of the IDAX system. It also reduces instrument downtime and transport cost as the calibration box is the only part that needs to be sent in for calibration. The new design allows calibration in any local certified calibration facility to avoid long shipment turn-around times and transport costs.

Conclusion

IDAX is a well-proven system for determining moisture content in transformer insulation. The instrument and method including the modeling software has been tested and verified with numerous customers.

References

- [1] S.M. Gubanski, J. Blennow, L. Karlsson, K. Feser, S. Tenbohlen, C. Neumann, H. Moscicka-Grzesiak, A. Filipowski, L. Tatarski "Reliable Diagnostics of HV Transformer Insulation for Safety Assurance of Power Transmission System" Cigre Paris Aug 2006
- [2] From. P. J. Griffin, C. M. Bruce and J. D. Christie: "Comparison of Water Equilibrium in Silicone and Mineral Oil Transformers", Minutes of the Fifty-Fifty Annual Conference of Doble Clients, Sec. 10-9.1, 1988
- [3] U. Gäfvert, L. Adeen, M. Tapper, P. Ghasemi, B. Jönsson, "Dielectric Spectroscopy in Time and Frequency Domain Applied to Diagnostics of Power Transformers", Proc. Of the 6th ICPADM, Xi'an, China, 2000

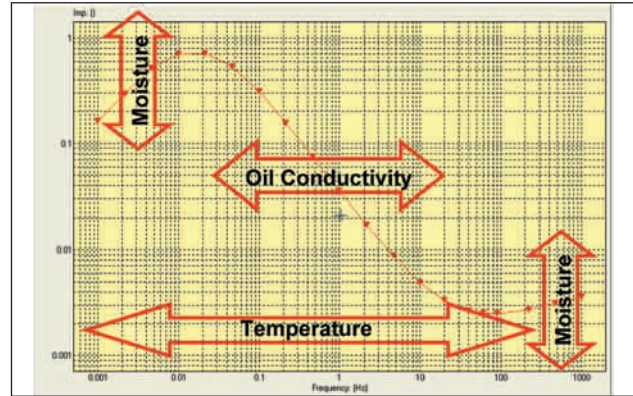


Figure 6: Oil conductivity and moisture influence

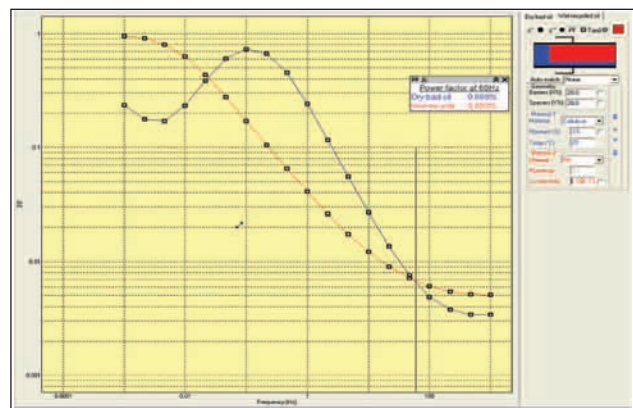


Figure 7: Blue — dry with bad oil. Red — wet with good oil

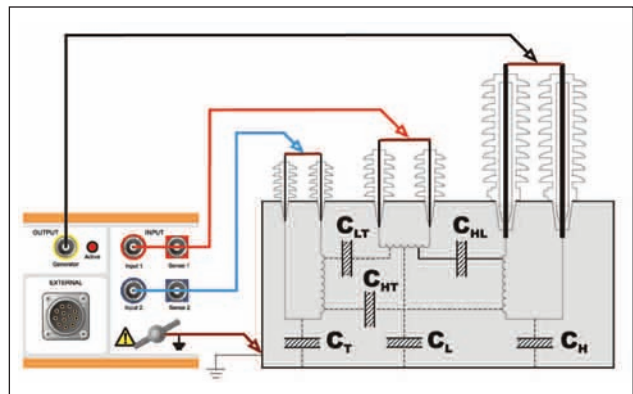


Figure 8: Example of connections to a three-winding transformer

SPECIFICATIONS

Output

Voltage/current ranges, 10 V: 0 - 10 V_{peak} 0 - 50 mA peak
 Voltage/current ranges, 200 V: 0 - 200 V_{peak} 0 - 50 mA peak
 Frequency Range: 0.1 mHz - 10 kHz

Measurements

Inputs: Channel 1, channel 2, ground
 Capacitance Range: 10 pF - 100 µF
 Accuracy: 0.5% + 1 pF
 Dissipation Factor Range: 0 - 10 (with retained accuracy of capacitance; otherwise higher)
 Accuracy: >1% +0.0003, 1 mHz - 100 Hz, C > 1 nF
 >2% +0.0005, 100 Hz - 1 kHz, C > 1 nF
 Noise Level: Max 500 µA at 50 Hz/60 Hz
 Test Modes, 2 Channels: UST-1, UST-2, UST-1+2, GST, GST-Guard-1, GST-Guard-2, GST-Guard-1+2.
 With 2-ch measurement option additionally UST-1+UST-2, UST-1+GST-Guard-2, UST-2+GST-Guard-1, UST-1+2+GST
 Calibration: Calibration set allows field calibration, recommended interval 2 years

General

Mains Input (nominal): 90 - 265 V ac, 50/60 Hz
 Power Consumption (max): 250 VA
 Communication Ports: USB 2.0 and LAN

Physical

Instrument Weight: 4.9 kg/11 lbs
 Case and Instrument Weight: 9.9 kg/22 lbs
 Accessories Weight: 8.5 kg/18 lbs (soft bag)
 Dimensions: 335 x 300 x 99 mm
 17.7 x 6.3 x 16.1 in
 Dimensions with Case: 520 x 430 x 220 mm
 20.5 x 17 x 8.7 in.

Environmental

Operating Temperature: 0°C to +50°C / -32°F to +122°F
 Storage Temperature: -40°C to 70°C / -40°F to +158°F
 Humidity: <95% RH, non-condensing
 CE Standards: IEC61010 (LVD) EN61326 (EMC)

PC Requirements

Operating System: Windows 2000/ XP / Vista
 CPU/RAM: Pentium 500 MHz/512 Mb or better
 Interface: USB 2.0

ORDERING INFORMATION

Item (Qty)	Cat. No.	Item (Qty)	Cat. No.
IDAX 300 complete with:		Optional Accessories	
mains cable, ground cable 5 m (16 ft), USB cable, transport case, Windows software, manual, generator cable 18 m (59 ft), measure cable 18 m (59 ft) red, measure cable 18 m (59 ft) blue, soft case for cable	AG-19090	Calibration set for IDAX 300	AG-90010
		IDAX demo box IDB 300	AG-90020
		2nd channel option for IDAX 300	AG-90200
		Ground cable, 5 m (16 ft)	GC-30060
		Generator cable, 9 m (30 ft)	GC-30310
		Measuring cable, 2 x 9 m (30 ft), red	GC-30320
		Measuring cable, 2 x 9 m (30 ft), blue	GC-30330
		Generator cable, 18 m (59 ft)	GC-30312
		Measuring cable, 2 x 18 m (59 ft), red	GC-30322
		Measuring cable, 2 x 18 m (59 ft), blue	GC-30332
		IDAX for Windows	SA-AG101
IDAX 300, 2 channels, complete with:			
mains cable, ground cable 5 m (16 ft), USB cable,transport case, Windows software, manual, generator cable 18 m (59 ft), measure cable 18 m red (59 ft), measure cable 18 m (59 ft) blue, soft case for cable	AG-19092		