IDAX 300/350
Insulation Diagnostic Analyzers

- **Fast and accurate complete insulation diagnostics of power transformers**
- **Automated analysis of moisture content, oil conductivity, tan delta at 20°C reference temperature - All in one single test**
- **True frequency domain measurement for highest interference rejection**
- **Well proven technology; IDA/IDAX units have been in field use for more than 15 years**

Description

IDAX 300 is a very compact instrument and is used together with an external PC. The IDAX 350 has a built-in computer but can also be used with an external PC.

IDAX 300/350 provides an accurate and reliable condition assessment of insulation in transformers, bushings, generators and cables. The IDAX system maximizes the outcome of maintenance activities allowing for load and service life optimization.

IDAX 300/350 are smaller, lighter and faster than their predecessor IDAX 206. It maintains better accuracy and ability to provide reliable data using true AC DFR (Dielectric Frequency Response), also known as FDS (Frequency Domain Spectroscopy), for reliable test results in high interference environments. The state-of-the-art software makes testing both easier and faster, allowing transformer moisture and oil assessment in about 20 minutes (30°C).

IDAX measures the capacitance and tan delta/power factor of the insulation between power transformer windings at multiple frequencies. Analyzing the results using modelling technique makes it possible to assess the moisture level in the solid insulation, oil conductivity/tan delta and power frequency tan delta at reference temperature (20°C). The test can be performed at any temperature as the temperature dependence of the dissipation factor can be estimated.

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 about 20 to 40 minutes depending on the temperature of the test object.

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, VTs and other components. 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. Experience has shown that this method tends to overestimate the amount of water in the insulation.

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 frequency response at a specific temperature is obtained (Fig 2).

This frequency response 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 analysis software formula varies all insulation parameters to simulate every possible geometrical design. The model also applies Arrhenius equation to calculate and 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 percent of moisture in paper, oil conductivity and an individually corrected tan delta value at 20°C reference temperature (Fig 4 and 5).

What controls the response

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).

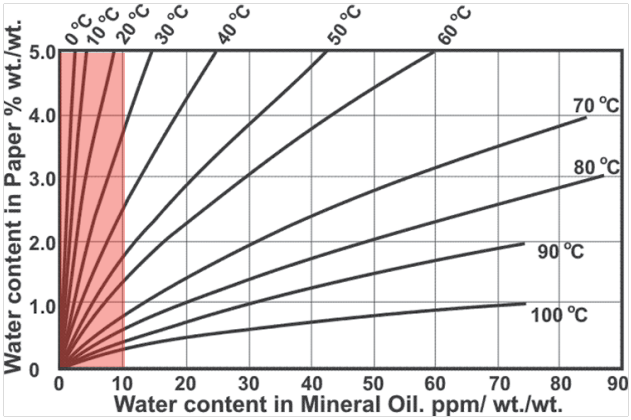

Fig. 1: Water in oil vs. paper correlation is unreliable at low temperature

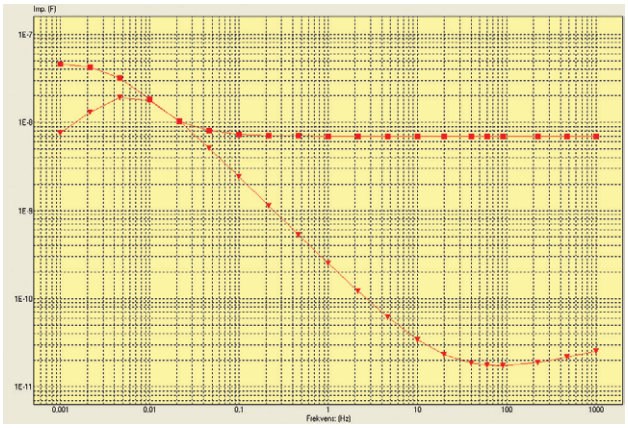

Fig. 2: Power factor curve presented as capacitance and loss

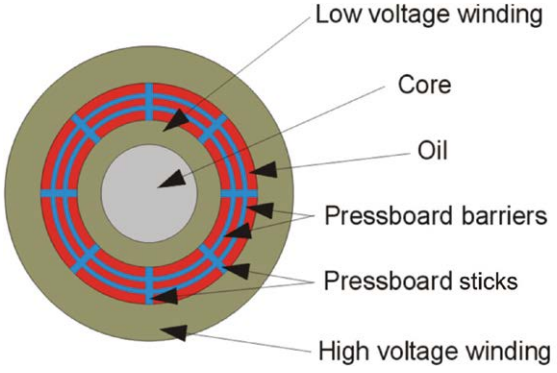

Fig. 3: Typical insulation design

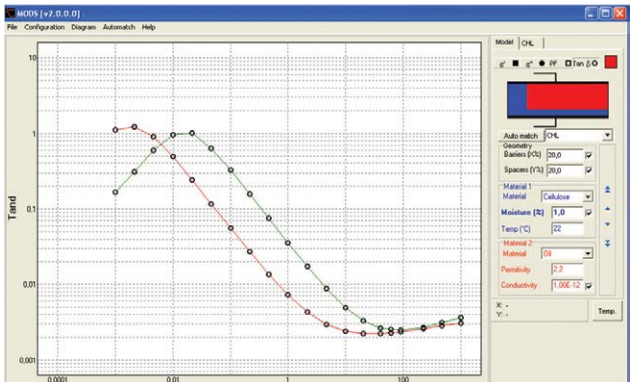

Fig. 4: Before matching — green-model, red-measurement

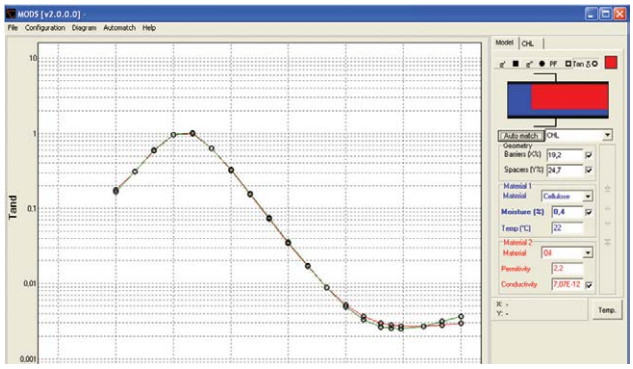

Fig. 5: After matching — result: 0.4%

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 regenerated. 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, Vista and 7 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 and unlike DC-methods there is no need for discharging the test object.

IDAX 300 is equipped with an input circuitry capable of measuring multiple test modes without having to change cable connections on the transformer.

The extended versions IDAX 300S and IDAX 350 have an additional current measurement channel, that allows for two completely independent measurements at the same time, thus minimizing test time.

Calibration

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.

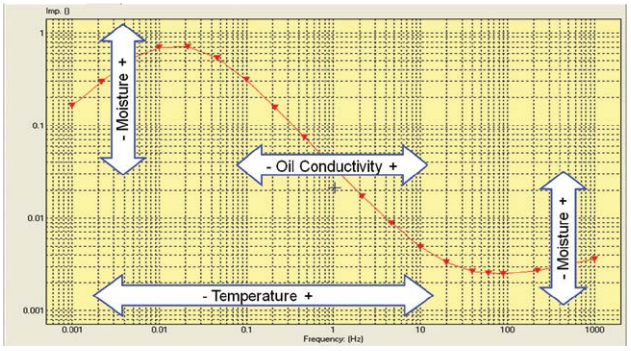

Fig. 6: Oil conductivity and moisture influence

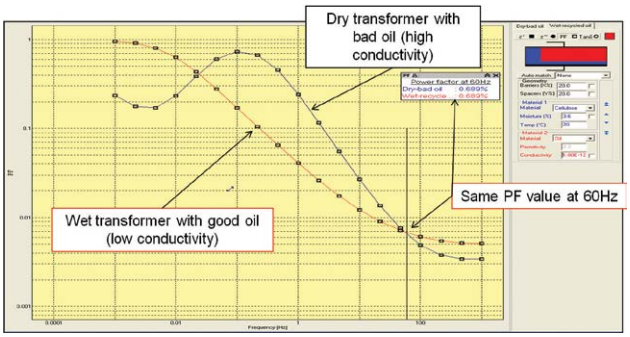

Fig. 7: Blue — dry with bad oil. Red — wet with good oil

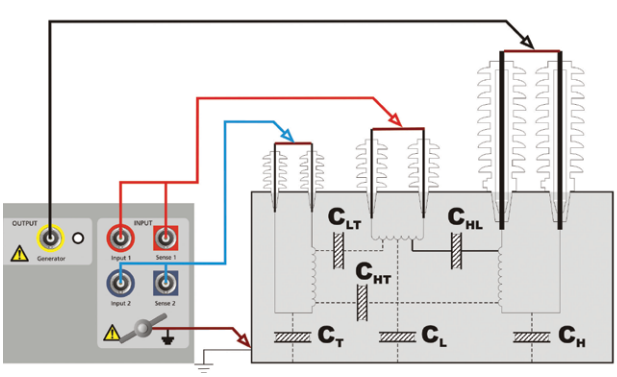

Fig. 8: Example of connections to a three-winding transformer

Specifications IDAX 300/350

Environmental

Application field	The instrument is intended for use in medium and high-voltage substations and industrial environments.
Ambient temperature	
Operating	-10°C to +55°C (14°F to +131°F)
Storage	-20°C to 70°C (-4°F to +158°F)
Humidity	< 95%RH, non-condensing

CE-marking

EMC	2004/108/EC
LVD	2006/95/EC

General

Mains voltage	90 – 265V AC, 50 / 60 Hz
Power consumption	250 VA (max)
Dimensions	
IDAX 300	335 x 300 x 99 mm (17.7" x 6.3" x 16.1")
IDAX 300 Flight case	520 x 430 x 220 mm (20.5" x 17" x 8.7")
IDAX 350	520 x 430 x 220 mm (20.5" x 17" x 8.7")
Weight	
IDAX 300	4.9 kg (11 lbs), 9.9 kg (22 lbs) incl. flight case
IDAX 350	13.5 kg (29.8 lbs)
Accessories	8.5 kg (18 lbs) soft bag

Measurement section

Inputs	Channel 1, channel 2, ground
Capacitance range	10 pF – 100 µF
Inaccuracy	0.5% + 1 pF
Dissipation factor range	0 - 10 (with retained accuracy of capacitance; otherwise higher)
Inaccuracy	< 0.5% + 0.0001, 45-70 Hz, C > 100 pF (with VAX020) < 0.5% + 0.0002, 45-70 Hz, C > 300 pF < 1% + 0.0003, 1 mHz-100 Hz, C > 1000pF < 2% + 0.0005, 100 Hz-1 kHz, C > 1000 pF
Max AC interference	1 mA (IDAX) or 10 mA (with VAX020) or 1:20 SNR
Max DC interference	1 µA or 10 uA (with VAX020)
*Test modes**	UST-1, UST-2, UST-1+2, GST, GST-Guard-1, GST-Guard-2, GST-Guard-1+2. *IDAX 300S/350 can measure two test modes simultaneously.
Calibration	Calibration set allows field calibration

Time Domain Current Measurement (PDC)

Range	±20 mA
Resolution	0.1 pA
Inaccuracy	0.5% ±1 pA
Input resistance (DC mode)	≤10 kOhm* * 10 kOhm is input impedance in worst case situation

Outputs

GENERATOR

Voltage/current ranges, 10 V	0 – 10 Vpeak 0 – 50 mA peak
Voltage/current ranges, 200 V	0 – 200 Vpeak 0 – 50 mA peak
Frequency range	0.1 mHz – 10 kHz

EXTERNAL

For VAX amplifiers	2 to 30 kV

PC Requirements

Operating system	Windows 2000/ XP / Vista / 7
Processor	Pentium 500 MHz
Memory	512 Mb RAM or more
Interface	USB 2.0 and LAN

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

Included Accessories

Picture shows some of the included accessories. Generator cable, Ground cable and Measurement cables.

Ordering information

Item	Art. No.
IDAX 300	AG-19090
IDAX 300S	AG-19092
IDAX 350 With internal computer	AG-19192

Included accessories

Mains cable
Ground cable 5 m (16 ft), GC-30060
Generator cable 18 m (59 ft), GC-30312
Measurement cable, red 18 m (59 ft), GC-30322
Measurement cable, blue 18 m (59 ft), GC-30332
USB cable
Windows software
Transport case
Soft case for cable
User's Manual

Optional accessories

IDAX calibration box CAL 300	AG-90010
IDAX demo box IDB 300	AG-90020
2nd channel option (factory upgrade to IDAX 300S)	AG-90200
Generator cable, 9 m (30 ft)	GC-30310
Measurement cable, 9 m (30 ft), red	GC-30320
Measurement cable, 9 m (30 ft), blue	GC-30330

SWEDEN
Megger Sweden AB
Eldarvägen 4, Box 2970
SE-187 29 TÄBY
T +46 8 510 195 00
F +46 8 510 195 95
E seinfo@megger.com

UK
Archcliffe Road Dover
CT17 9EN England
T +44 (0) 1304 502101
F +44 (0) 1304 207342

Other Technical Sales Offices
Dallas USA, Norristown USA, Toronto CANADA, Trappes FRANCE, Oberursel GERMANY, Johannesburg SOUTH AFRICA, Kingdom of BAHRAIN Mumbai INDIA, Chonburi THAILAND Sydney AUSTRALIA

Registered to ISO 9001 and 14001
Subject to change without notice.
Art.No. ZI-AG01E • Doc. AG0156DE • 2012
IDAX300-350_DS_en_V05
www.megger.com