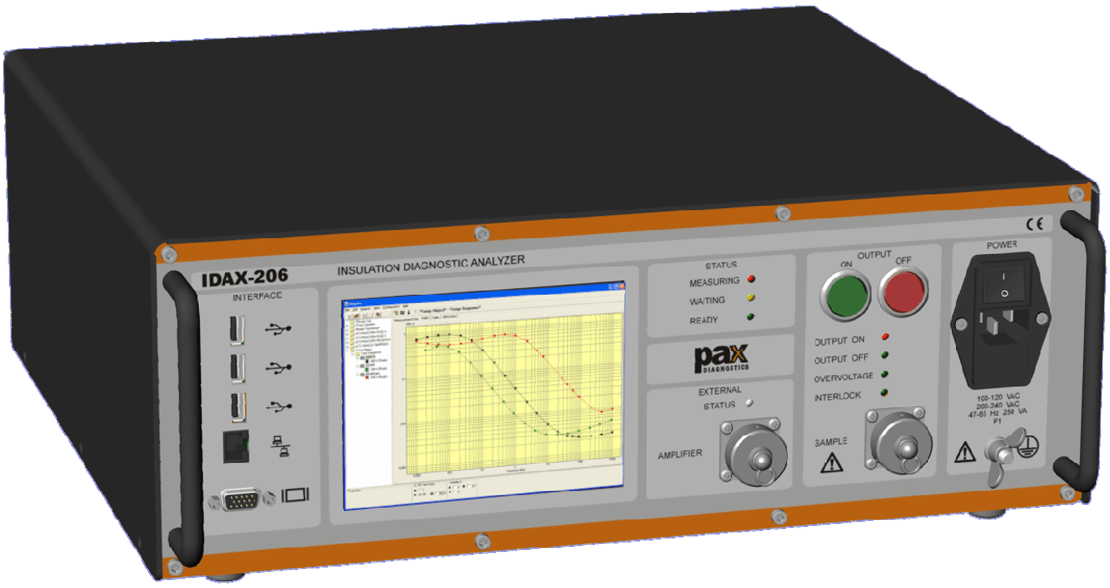
IDAX-206

INSULATION DIAGNOSTIC ANALYSER

Accurate and reliable moisture assessment of Power Transformers



IDAX-206, (successor of IDA 200) provides accurate and reliable power transformer condition assessment. The IDAX system maximizes the outcome of maintenance activities allowing for load and service life optimization.

IDAX-206 utilizes dielectric spectroscopy, a method that has been available for decades in laboratories. This field proven instrument measures the insulation inside the transformer in a frequency sweep, which makes it possible to differentiate problems related to moisture, contamination or oil conductivity.

A closer look at the IDAX solution

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 dielectric spectroscopy. This analysis technique has been used in laboratories for decades but IDAX is the first instrument designed for field use. The IDAX instrument and measurement principle has been used and verified around the world over the last ten years.

Application

One of the most important applications for IDAX is to determine the aging or moisture content in transformer insulation as moisture in the insulation significantly accelerates the aging process.

IDAX provides reliable moisture assessments in one test. The test can be made at any temperature.

Water in Oil vs. Paper

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

Figure 1 reveals that the dramatic difference of 0.5% and 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 ^{o}C (68 ^{o}F) [2].

The Test

Dielectric loss or power factor is frequency and temperature dependent, so by injecting test signals at discrete frequency steps between 1 kHz and 0.001 Hz while recording results at each point, a curve is created (Fig 2).

This profile represents the properties of the insulation material in the transformer and will be used in further analysis as described below. The internal oil temperature is recorded for reliable results.

The model

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

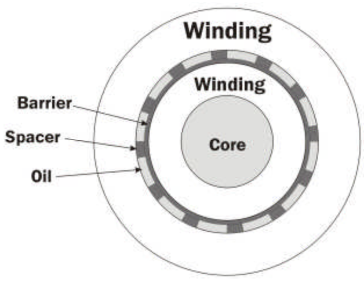


Fig 3. typical insulation design

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 % of moisture in paper and a separate value for oil conductivity. (Fig 4 and 5)

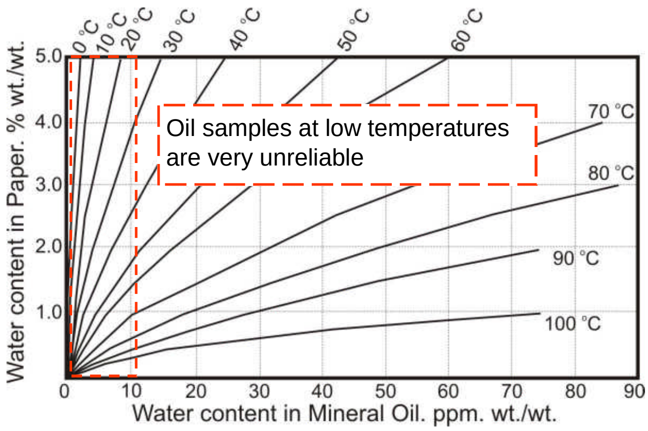


Fig 1. Water in oil vs. paper correlation is unreliable at low temp

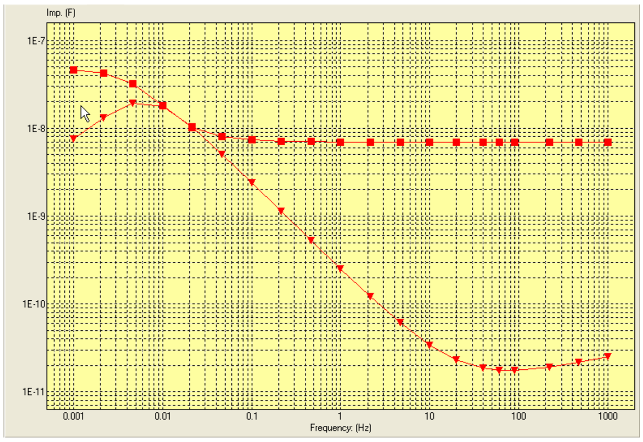


Fig 2. Power factor curve presented as capacitance and loss

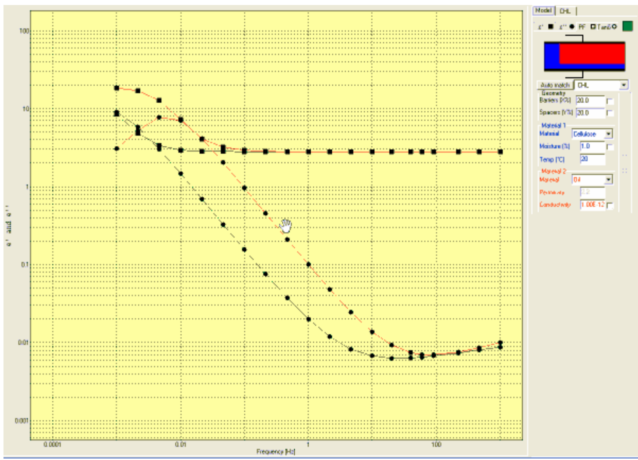


Fig 4. Before matching. Green-Model, Red-Measurement

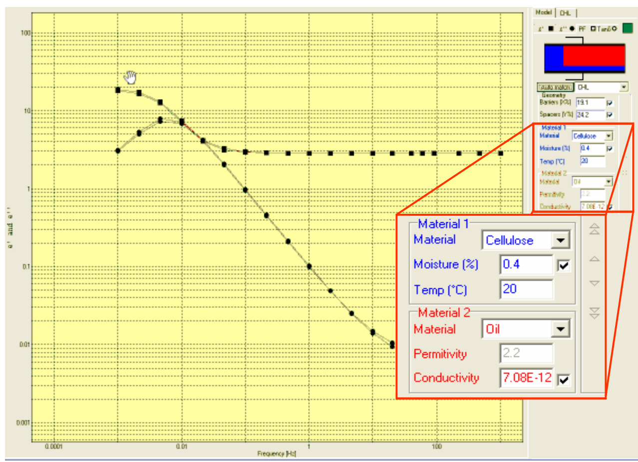


Fig 5. After matching. Result: 0.4 % at 20 deg C

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).

One Point is not enough

This leads to another advantage of the IDAX method. Traditional Power Factor testing presents only one value at mains frequency.

Figure 7 show that a single power factor value cannot provide conclusive information about the potential problem.

In this example, two transformers have the same Power Factor value at 60Hz. 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 reclaimed.

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. Tenbolen, 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 6^{th} ICPADM, Xi'an, China, 2000

Test Procedure

The test preparation and procedure is similar to a standard Power Factor test which means that the transformer has to be off line and disconnected from all connection hardware.

The IDAX Software will guide the user through a test template where all connections are illustrated as per figure 8. Color markings on clamps (fig 9) make 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 will inform the user if there are any errors in the connections.

Analysis on the built in screen can be done parallel to active testing.

The new updated IDAX-206 operates on Windows XP and supports all networking and USB communication solutions.

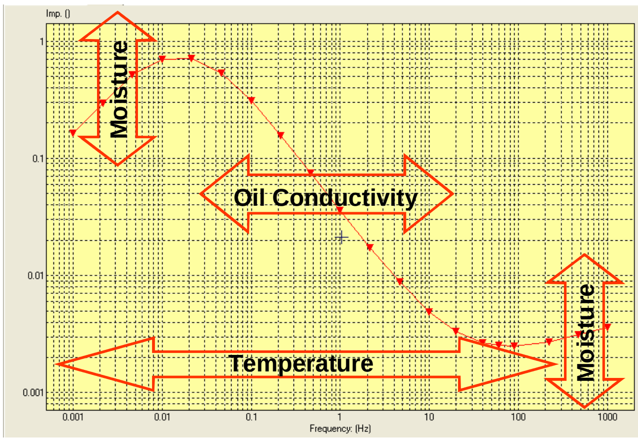


Fig 6. Oil conductivity and moisture influence

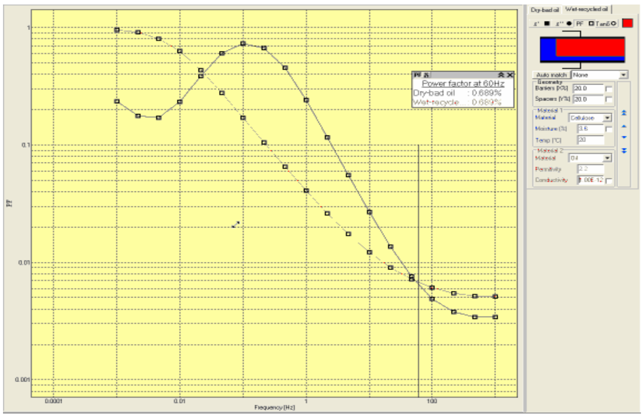


Fig 7. Blue: Dry with bad oil. Red: Wet with good oil

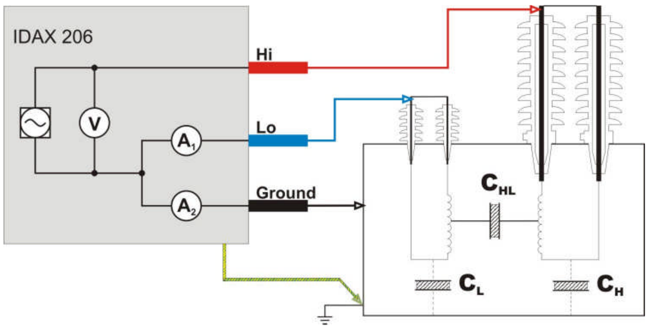


Fig 8. Connections for a two phase UST connection

Fig 9. Termination box with test cables

Ordering Information

IDAX-206 system with all accessories AD-290-90

Includes:

IDAX-206 instrument

Test cables with termination box

Hard transport case

Calibration box

Software and Manuals

Specification

Specifications are subject to change without notice.

Environment

Application field	For use in high-voltage substations and industrial environments.
Temperature	
Operating	0°C to +50°C (-4° F to +131°F)
Storage & transport	-40°C to +70°C (-40° F to +158° F)
Humidity	<95% RH (non-condensing), 30 days/year, 85% RH remaining time

CE-marking

LVD	Low Voltage Directive 73/23/ EEC am. by 93/68/EEC
EMC	EMC Directive 89/336/EEC am. by 91/263/EEC, 92/31/EEC and 93/68/EEC

Standards

Safety standards	IEC 61010-1:9 0 + A1:92 + A2:95 UL 3101-1, 3111-1 (1994) CAN-CSA 22.2 No. 1010.010 – 30
EMC standards	EN 61 326-1 1997 + A1 1998

General

Mains input (nominal)	115 / 230 V AC, 50 / 60 Hz
Power consumption (max)	250 VA
Dimensions	
Instrument	450 x 160 x 410 mm (17.7" x 6.3" x 16.1")
Transport case	560 x 230 x 565 mm (22.1" x 9.1" x 22.2")
Weight	15 kg (33.1 lbs) 30 kg (66 lbs) with accessories and case
Display	TFT Color Monitor, 16 cm (6.4")
Available languages	English, French, German, Spanish, Swedish

Measurement section

Capacitance

Range	10 pF – 100 µF

Dissipation factor

Range	0 – 10 (with retained accuracy of capacitance – otherwise higher)

Outputs

Voltage / current ranges

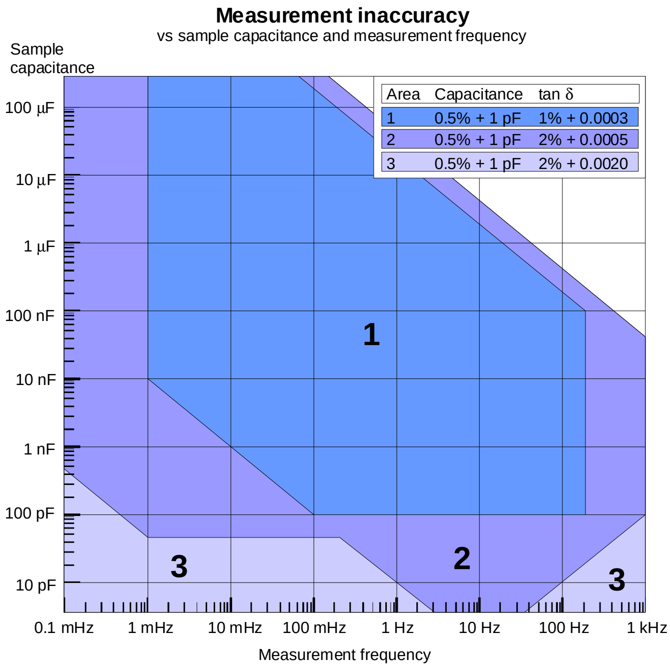
10 V	0 – 10 V_{peak} / 0 – 50 mA
200 V	0 – 200 V_{peak} / 0 – 50 mA

Frequency

Range	0.0001 Hz - 1 kHz [1]

1) Current limitation may lower the upper frequency limit

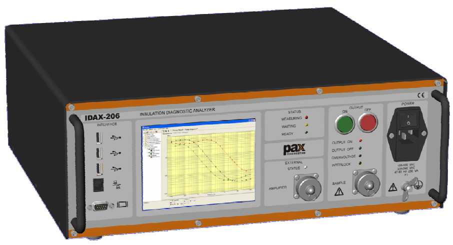
Measurement inaccuracy



The inaccuracies specified above are valid for a measurement voltage of 200 V_{peak}, provided that the optimum capacitive feedback ratio in the electrometer *CFBR* is used and that the hum current, I_H , satisfies:

$$I_H < \frac{I_{SAMPLE} \times CFBR \times f_H}{f_{SAMPLE}}$$

where, I_{SAMPLE} is the sample current, f_{SAMPLE} is the measurement frequency and f_H is the hum frequency.



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