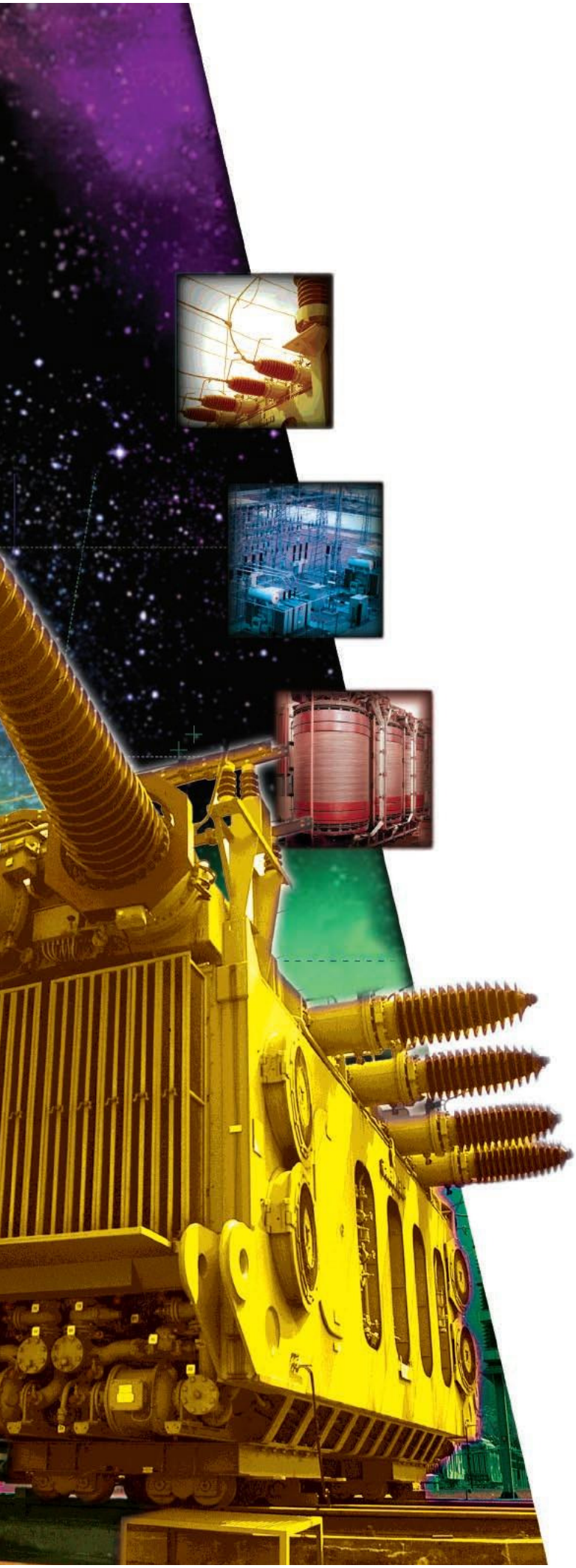


OMICRON

FRAnalyzer

SWEEP FREQUENCY RESPONSE ANALYZER

Reliable Core and Winding Diagnosis for Power Transformers



Sweep Frequency Response Analysis

The OMICRON FRAnalyzer detects mechanical and electrical changes of the core and winding assembly of power transformers. By finding winding or core defects after faults, mechanical shocks (e.g. earthquakes) or transportation, it offers a valuable opportunity to improve the reliability of transformers, to reduce maintenance costs and, most of all, to avoid expensive unexpected outages.

What is FRA?

Frequency Response Analysis (FRA) is a powerful and sensitive method to evaluate the mechanical integrity of core, windings and clamping structures within power transformers by measuring their electrical transfer functions over a wide frequency range.
OMICRON uses the SFRA principle (sweep frequency response analysis) – a worldwide proven method for measurements in frequency domain. The SFRA is a comparative method, i.e. an evaluation of the transformer condition is done by comparing an actual set of SFRA results to reference results. Three methods are commonly used to assess the measured traces:

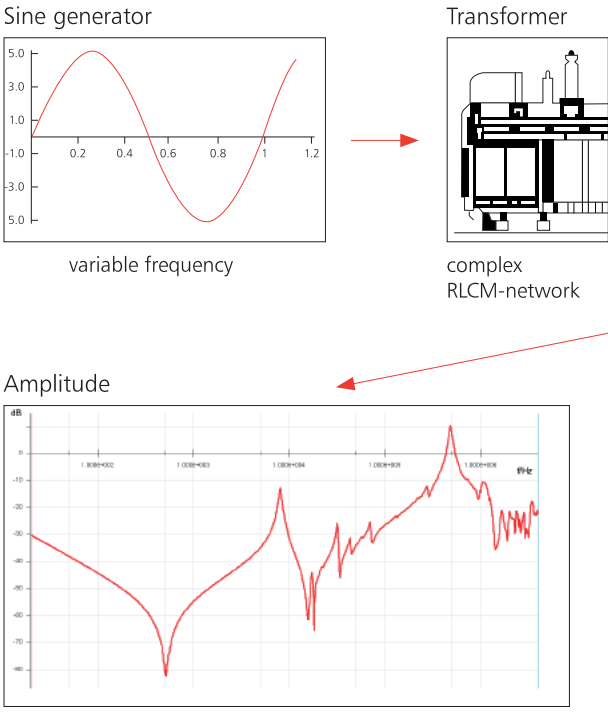
1. time-based (current SFRA results will be compared to previous results of the same unit)
2. type-based (SFRA of one transformer will be compared to a type-equal one)
3. phase comparison (SFRA results of one phase will be compared to the results of the other phases of the same transformer)

When to use SFRA?

Typical applications of SFRA measurements are:

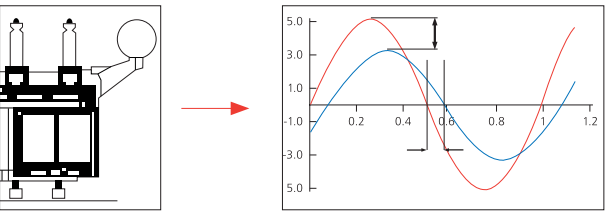
- Transformer check after short circuit testing
- Integrity verification of transformers after transport
- Condition assessment after the occurrence of high transient fault currents
- routine diagnostic measurement
- diagnosis after transformer alarm or protection tripping
- testing after significant changes of monitored values (e.g. combustible gases)
- further inspection after the observation of unusual routine test results
- scientific investigations

SWEEP FREQUENCY RES

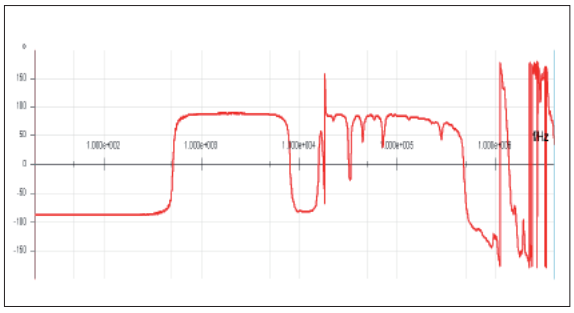


The FRAnalyzer injects a sinusoidal excitation voltage with a continuously increasing frequency into one end of the transformer winding and measures the signal returning from the other end. The comparison of input and output signals generates a unique

PONSE ANALYSIS (SFRA)



Phase



frequency response which can be compared to reference data. Deviations indicate geometrical and/or electrical changes within the transformer. No additional data processing is required due to a direct measurement in the frequency domain.

Why OMICRON FRAnalyzer?

- Use of the SFRA principle – the industry standard for measurements in frequency domain
- Extremely small size and weight using leading edge technology, for easy handling
- Highest convenience resulting from battery operation
- Best repeatability due to an innovative connection technique based on the latest scientific findings
- Easy-to-use creative software with implemented standard-based assessment solution
- World-class OMICRON customer support and valuable trace assessment help by technology experts
- Free access to the OMICRON SFRA-User Forum
- Effective, practice-oriented trainings offered at OMICRON training centers or on-site at your location



Benefits to you:

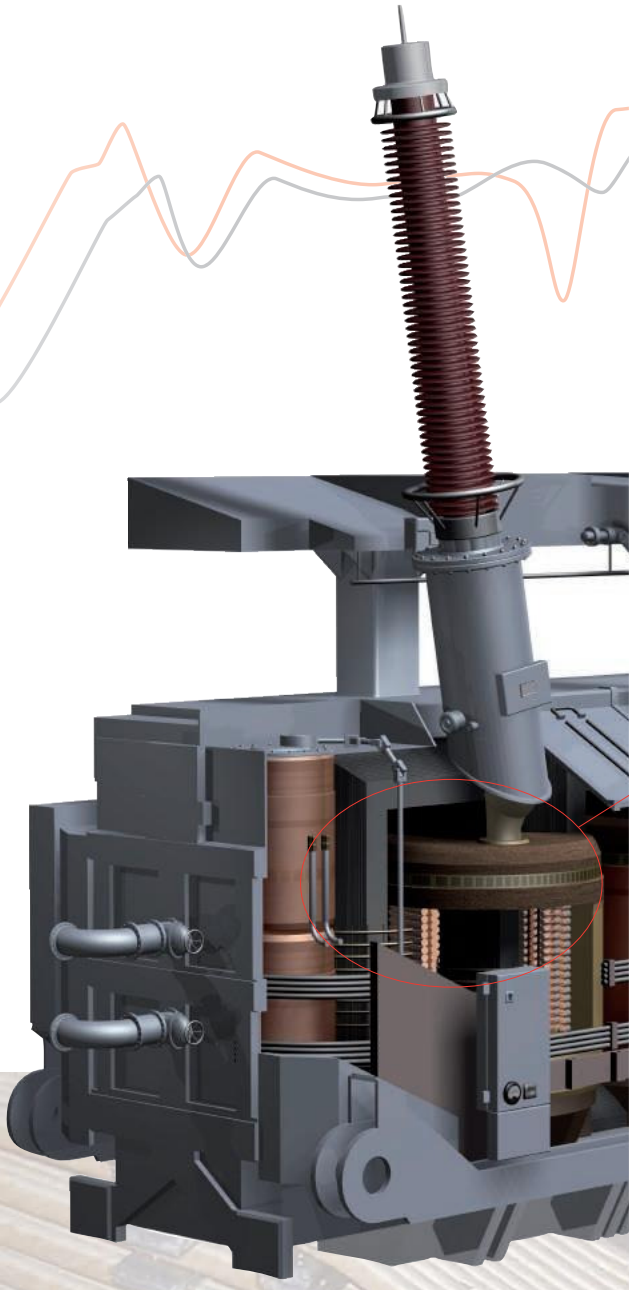
- SFRA is a non-intrusive test method, easy and fast to perform
- SFRA also covers low frequencies and thus can detect core faults, shorted or open turns
- Direct measurement in frequency domain (as opposed to the time domain measurement method) – thus no further mathematical handling of data is necessary
- Increasing possibilities for SFRA knowledge transfer and improvement of method through growing number of users and scientific research efforts

Power Transformer Core & Winding D

What problems can be detected?

The FRAnalyzer can detect problems such as:

- winding deformation – axial & radial, like hoop buckling, tilting, spiraling
- displacements between high and low voltage windings
- partial winding collapse
- shorted or open turns
- faulty grounding of core or screens
- core movement
- broken clamping structures
- problematic internal connections





Deformed core



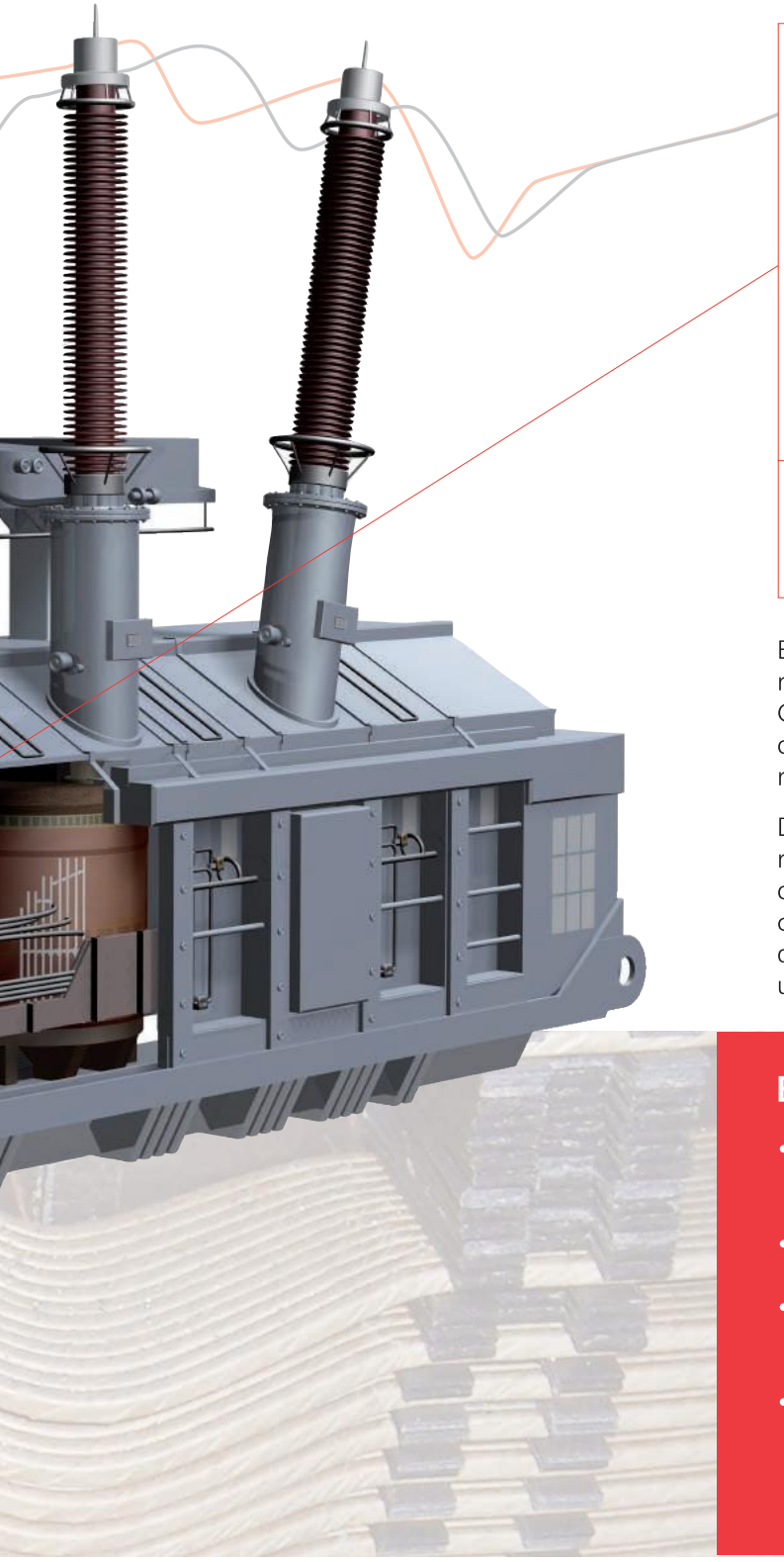
Collapsed tap winding



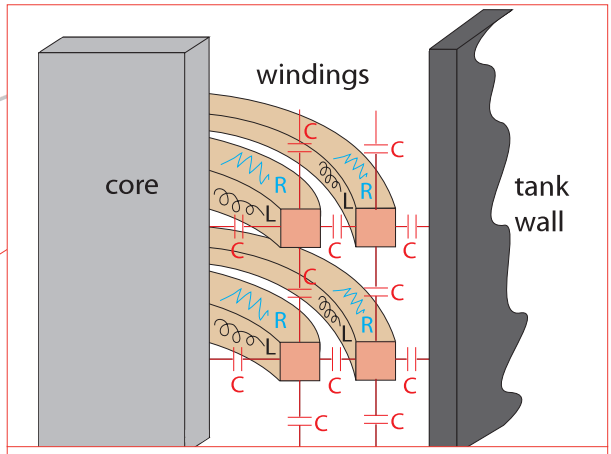
Damaged main winding



Displaced internal connections



How does it work?



The core-and-winding-assembly of power transformers can be seen as a complex electrical network of capacitances, inductances and resistors.

Each electrical network has got its unique frequency response. Therefore it is usually called a fingerprint. Geometrical changes within and between the elements of the network cause deviations of its frequency response.

Differences between an SFRA fingerprint and the result of an actual measurement are an indication of positional or electrical variations of the internal components. Different failures are directly related to different sections of the frequency range and can usually be discerned from each other.

Benefits to you:

- High reliability of test results due to the applied measurement method and high repeatability of test results due to sophisticated connection technique
- SFRA can detect winding and core problems which remain hidden using any other diagnostic method
- Valuable and cost-effective tool for deciding whether a transformer can be powered up again after protection tripping or not
- Informative failure analysis helps avoid expensive defueling of transformer's active part

Unique Connection Technique

The OMICRON FRAnalyzer uses an innovative connection technique to enable exceptional repeatability of the test results.

Exceptional repeatability with advanced connection technique

Since SFRA is a comparative method, it is of vital importance that measurements on the same object under the same conditions produce identical results regardless of the external noise level.

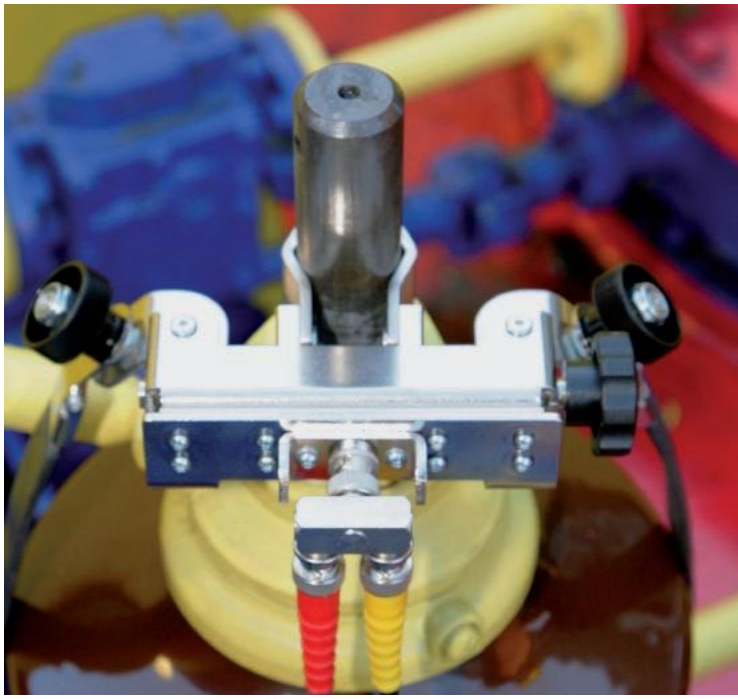
Only a very high degree of repeatability can ensure that even small deviations of compared SFRA-traces are related to changes within the observed transformer and not to inaccuracies within the measurement setup.

According to the standard of knowledge, the connections between the measuring device and the transformer terminals, as well as the grounding technique, have a key influence on reproducibility.

Unique connection technique

In close cooperation with leading Universities in the field of FRA testing on power transformers, OMICRON has developed a sophisticated connection solution to achieve highest possible repeatability of the results.

Specially designed screw-type-connection clamps provide reliable electrical contact to the transformer. The FRAnalyzer uses double shield coax cables (RG223U) to ensure the highest available signal-to-noise-ratio (SNR).





To enable the grounding of the coaxial cable shields at the transformer housing, which is the reference potential, an additional connection from the terminal adapter to the transformer tank is required.

A poor grounding technique can lead to unreproducible and therefore unusable SFRA results. In order to achieve the best possible SFRA measurements, the grounding connections should be of lowest inductance and provide a large surface area.

Therefore the use of braids, which are less sensitive to interferences and make the measurement independent from the cable positioning is strongly recommended.

The double-braid concept

OMICRON provides a double-braid solution which forms a shield around the bushing arranged in a defined position. In order to achieve a high degree of repeatability, the extension leads should run tightly along the body of the bushings. This is ensured by screw clamps which connect the braids always with ideal length to the base of the bushing.



Due to their high flexibility the tester can lay the braids tightly to the bushing. This clamp-and-braid arrangement complies with the strict demands of engineers around the globe requiring a "ground extension as short as possible and with the smallest achievable loop" – only the FRAnalyzer provides this in such an exceptional manner.

Benefits to you:

- True-value results due to accurate reproducibility
- High-end clamps for exceptional repeatability
- Minimal noise interference due to the use of two broad ground braids
- Time saving because of cutting functionality of screw-type clamps

Fast, Easy and Efficient Software

The FRAnalyzer software is specially designed to fit the needs of the on-site testing personnel as well as the requirements of the engineers analyzing the data. The tests are easy to establish and fast to perform. The software suggests useful test sequences according to transformer type and vector group. An implemented assessment algorithm gives the user a powerful tool for a fast analysis of the results. The auto-report functionality generates a complete report within seconds.

Getting started

Usually the test sequence starts with the establishment of the transformer to be tested. The nameplate data will be stored with all measured data. The terminal markings can be chosen from different templates such as IEC or ANSI. If there is older data of the same transformer (fingerprint) available in the database, this test can be used as a template.



Based on transformer type and vector group, a test sequence is suggested. Other sequences can also be added and changed freely and individually. The new Connection Scheme (shown in the upper right screenshot) is an ideal, easy-to-use graphical support for unexperienced users for a proper assignment of the connections. The preview pane gives a quick overview of curves.

Sweep settings

Any test with the FRAnalyzer is performed with a sweep settings profile. These profiles are fully customizable and can be set for any test individually. In contrast to other instruments, the spacing of the FRAnalyzer measurement points (sweep mode) can be logarithmic or linear, there can also be generated as many frequency sub-ranges as needed. In addition to the number of points, the receiver bandwidth can be adjusted to achieve an optimal signal-to-noise ratio (SNR).

With one look, the user can get an overview of the magnitude (gain) and phase angle of the transformer's transfer function. It is possible to group the shown traces, e.g. just HV measurements, or just the results of the tertiary winding. Cursors are available as well as an easy to use zoom functionality. A copy-to-clipboard function allows a fast insertion of full or zoomed trace pictures into office documents, etc. Despite the predefined sweep mode, the traces can be displayed in linear or logarithmic scaling to observe every part of the trace in a useful way.

The reference principle

After the measurement a reference test can be defined. This can be a fingerprint of the same transformer or measured data of various sister transformers. Of course it is also possible to compare the traces measured on different phases of a transformer without setting a reference test.

Implemented assessment tool

The FRAnalyzer provides the user a mathematical solution for a comparison of the traces based on the standard DL 911/2004.

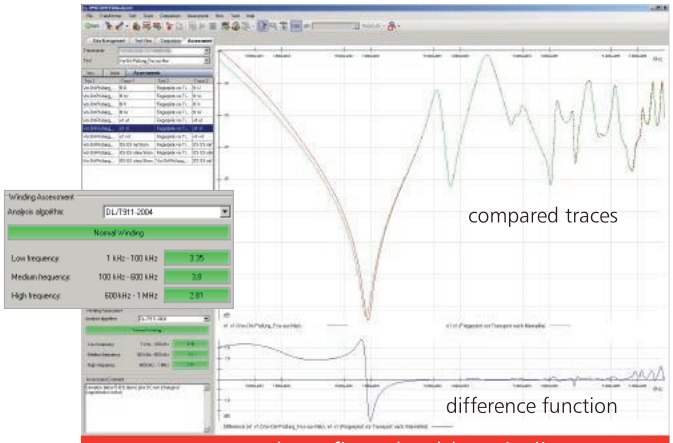
Scientific investigations and experience have proven this method to be reliable and sensitive. Therefore the implemented algorithm provides a powerful tool for a fast assessment of the test data.

Data storage, export/import

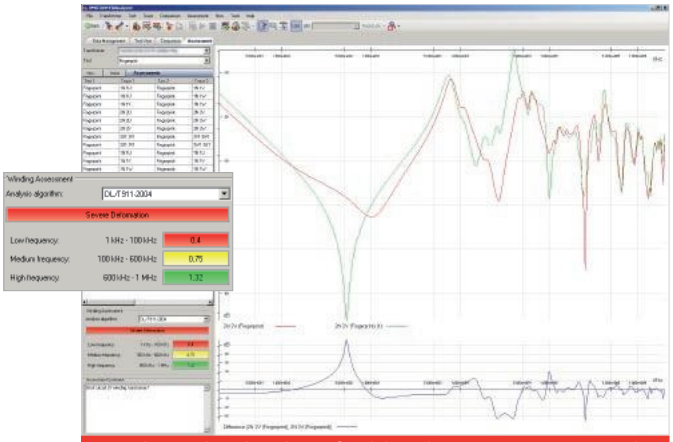
All measured data is stored within a supplied database. This ensures a time-effective data handling and avoids the problems typically arising with file storage systems for a large number of tests. These stored data can easily be arranged and sorted by several parameters. An easy-to-handle export function enables the user to store the data additionally in different formats such as CIGRE Exchange Format (.xfra) or .csv (which can be imported into MS Excel™). The FRAnalyzer software also allows the import of other manufacturers data in their specific formats such as Doble, FRAMIT, FRAX, etc.

The auto-report function

The FRAnalyzer software automatically generates a test report within seconds. It can be printed out or stored in .pdf format or MS Excel™. It contains all information about the transformer, the test, all traces and assessment results.



Assessment tool confirms healthy winding status


Failure clearly identified by the assessment tool

Benefits to you:

- Fast, easy, efficient handling through the user interface
- High flexibility due to freely selectable sweep-settings
- Cost saving due to included database solution
- Included assessment tool saves money otherwise spent on expert analyses
- Easy localization to global market via different language packages
- Effective work due to the fast auto-reporting
- Helpful connection schemes support the unexperienced user to make the right connections
- Easy to use comparison of multiple tests
- Increased import and export functionality

The "one box" Solution

The complete FRAnalyzer package comes in a firm arrangement – every component has its place. The complete package is designed for field use and has successfully passed vibration-, shock- and climatic resistance tests by an independent and accredited test laboratory.

Technical Data

General	
Frequency range	10 Hz to 20 MHz (selectable)
Meas. point spacing	logarithmic, linear, or both
Calibration interval	every 3 years
Source Output	
FRA Method	Sweep frequency
Output impedance	50 Ω
Connector	BNC (double shielded)
Amplitude	2.83 V p-p ≙ 1 Vrms at 50 Ω load
Number of meas. points	max. 3,201 (user-selectable)
Inputs (Reference – CH 1, Measurement – CH 2)	
Impedance	low 50 Ω, or high impedance 1 MΩ (selectable)
Connector	BNC (double shielded)
Dynamic range	> 120 dB
Accuracy	< 0.1 dB (down to -50 dB) and ±1 dB (between -50 dB and -80 dB)

PC Software 'OMICRON FRAnalyzer' for

- operation of the FRAnalyzer
- measurements with test templates
- advanced visualization and analysis of test results
- assessment of the measuring results
- database handling
- reporting

PC requirements (minimum)	
Interface	USB 1.1
PC operating system	Windows™ 2000, Windows™ XP or Windows Vista™ 32bit
Processor	Pentium™ 1 GHz
Memory	256 MB RAM
Drive	CD-ROM
Mechanical data / supply voltage	
Weight	< 2 kg without measuring cables
Dimensions (W x H x D)	26 x 5 x 26.5 cm / 10.25 x 2 x 10.5 in
DC power supply	DC 10 V to 24 V / 10 W
AC power supply	AC 100 V to 240 V / 50 to 60 Hz
Environmental	
Operating ambient temperature	-10…+55 °C / +14…+131 °F
Operating relative humidity	20…95 %, non-condensing









Additional Clamps Set [VEHZ0673]

Ordering Information

VE000660 **FRAnalyzer complete set (shown above)**

The complete set consists of the following accessories (in the respective quantities):

Order No.	Qty.		Order No.	Qty.	
VEHK0660	1	Coaxial-Cable Red with Cable Drum (18 m / 59 ft)	VEHZ0664	2	Bushing-Clamps
VEHK0661	1	Coaxial-Cable Blue with Cable Drum (18 m / 59 ft)	VEHZ0667	1	BNC Adapter Set
VEHK0662	1	Coaxial-Cable Yellow with Cable Drum (18 m / 59 ft)	VESD0662	1	User Manual
VEHZ0661	4	Aluminum Braid Rolls (5 m / 16 ft)	VEHZ0659	1	Power Supply and Battery Charger
VEHK0615	1	Grounding Cable 6 mm² gn/ye (6 m / 20 ft)	VEHZ0657	1	Crank Handle
VEHZ0662	4	Screw-Clamps for Aluminum Braid	-	1	FRAnalyzer Software

[all accessories listed above can also be ordered separately (one piece per order no.)]

Additional Accessory for FRAnalyzer

VEHZ0673	Clamps Set for Short Bushings (consisting of 2 short aluminum braids (1.5 m / 5 ft), 2 clamps and 1 carry bag)
VESM0661	FRAnalyzer Software Upgrade to 2.0 (for users of older software versions than 2.0)

OMICRON is an international company serving the electrical power industry with innovative testing and diagnostic solutions. The application of OMICRON products provides users with the highest level of confidence in the condition assessment of primary and secondary equipment on their systems. Services offered in the area of consulting, commissioning, testing, diagnosis, and training make the product range complete.

Customers in more than 130 countries rely on the company's ability to supply leading edge technology of excellent quality. Broad application knowledge and extraordinary customer support provided by offices in North America, Europe, South and East Asia and the Middle East, together with a worldwide network of distributors and representatives, makes the company a market leader in its sector.

With its policy of pioneering development OMICRON continues to lead the field in creating solutions to meet the needs of 21st century customers.



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