PHENIX TECHNOLOGIES

POWER TRANSFORMER FREQUENCY RESPONSE ANALYSIS TEST SET MODEL FRA-100

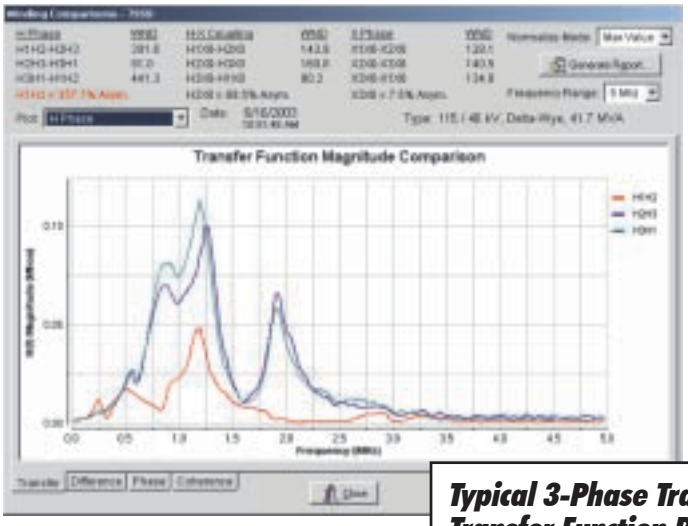
The PHENIX Technologies model **FRA-100 Frequency Response Analysis** test system is a portable, off-line system designed to detect winding movements resulting from shipping damage, subjection to low impedance through faults, or general looseness of clamping structures brought on by the normal effects of aging, in distribution and power transformers. The technology used in this highly sophisticated diagnostic tool was developed in the United States by the National Electric Energy Testing, Research and Applications Center (NEETRAC), a center of Georgia Institute of Technology. PHENIX Technologies and NEETRAC have teamed together to bring this powerful testing technique to the electric power industry.

THEORETICAL BACKGROUND:

The test is accomplished through the application and subsequent analysis of a series of low voltage impulses of varying duration, and approximately 300 V magnitude. Based on the resulting current impulse measured by the current probe, the frequency response is calculated for frequencies up to 5 MHz. This technique is designed to detect winding shifts through non-destructive methods, and can either be used as a stand alone test to detect winding damage, or as a diagnostic tool to pinpoint damages discovered in other test results such as insulation power factor tests, dissolved gas analysis, or short circuit impedance.

The testing software provided calculates objective estimates of the degree of movement based on two different patented analysis techniques, the Weighted Normalized Difference (WND) number is used in analysis of all types of transformers, and the Objective Winding Asymmetry (OWA) percentage, for use especially on three phase transformers and single phase identical sister units.

Basic WND analysis allows comparison to previous FRA "fingerprints", baseline data that may have been made on the transformer at the factory, or at an earlier date in the substation. This alone can be used as an effective technique to detect winding damages.



Typical 3-Phase Transformer Transfer Function Plots with OWA Results Displayed

The more advanced OWA technique has been developed especially for use in cases where no baseline data exists, but a condition assessment of the mechanical integrity of the windings is still required. This technique may be used very effectively in cases both with and without baseline data to detect and pinpoint damages to a specific phase and winding. This is accomplished through an objective (numerical) comparison of the three individual phase responses against each other, and a knowledge of the fact that while the individual phase responses of a three phase transformer are not identical, they should differ from each other in a predictable manner based on the symmetrical design and construction of the transformer.

Even though the OWA test method has been shown to be very successful in locating mechanical winding shifts without historical data, development testing has shown that the most sensitive indicator of winding damage may result from the combination of the OWA test and the historical comparison. Comparison of a previous OWA test result to a present OWA test result on a given transformer provides a means of comparing differences in the frequency response records obtained from the same transformer at different times that is largely unaffected by variables such as temperature and oil condition, since changes in these parameters have a common influence on the phase-to-phase frequency response comparison.

Extensive development testing has been done over a wide range of transformers in the power range of a several hundred kVA distribution transformers through several hundred MVA Class I, Class II substation and generator step up transformers to determine the evaluation criteria used in the PHENIX Technologies FRA-100 system. The OWA technology has been the only technology to date that has shown the ability to detect and locate problems on transformers even after they have been de-tanked, and have had their leads cut and bushings removed!

HARDWARE:

System Power Requirements

Battery Operated for Onsite Use
100 to 240 VAC, 50 or 60 Hz source for charging

Digitizer Data

Resolution:	12 bit
Number of Channels:	2
Sampling Rate (per Channel)	50Ms/sec

Lap Top PC (included)

Processor:	Intel Pentium
Operating System:	Windows
Monitor:	Color LCD
Compact Disc Drive:	CDRW
Power Supply:	100 to 240 VAC, 50 or 60 Hz, with internal battery for on site use

Current Probe

Type:	Low Inductance Shunt
Resistance:	10 Ω

Test Leads

All required test leads and clamps are provided, with pulse output and signal measuring leads provided in 60 Ft lengths. This allows the test technician to locate the PC and pulse source at ground level while performing the test.

DIMENSIONS AND WEIGHTS:

FRA-100 Pulse Source with Digitizer
14" W x 11" D x 6½" H; 21 lbs.

Laptop Computer
13" W x 11" D x 1½" H; 8 lbs.

Cable Lead Bag
19" W x 10" D x 10" H; 17 lbs.

IMPULSE SOURCE:

An internal 300 V impulse source provides the exciting impulses required for the FRA test. The pulse source is automatically controlled by the PC, with all pulse application and data collection being managed by the test computer, following an initiation command by the test technician to acknowledge that the test leads have been connected to the proper terminals of the transformer, and that all personnel are clear of the test leads.

For each connection configuration, the PC will collect data from a series of ten applied impulses. Each impulse is of approximately 300 V magnitude, with a steep rise time on the order of a few hundred nanoseconds, and a variable time to chop that is controlled by the test set computer that ranges over a time interval of approximately 10 to 90 microseconds during the series of 10 applied impulses.

"FRA-100 Test System Components"

Note: Due to continual development, specifications are subject to change without notice.

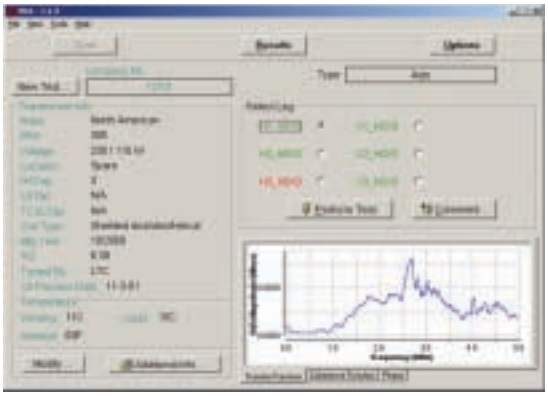
SOFTWARE ANALYSIS AND DATA MANAGEMENT PACKAGE

The FRA-100 software package is a Windows based application that provides both testing control as well as data management functions.

Upon selecting the type of transformer from a list of standard single phase, three phase and auto connections, the software provides prompts to the user to connect the leads and initiate each sequence of impulses. Built in safety checks will prompt the user if there is a problem with the lead connection that is recognized by the computer, based on the data collected.

In addition, on three phase transformers the test technician can select whether or not he or she wants to perform an OWA test on the transformer. The OWA test is recommended on all three phase transformers even if a comparison to historical data is also desired. The OWA test has been shown to be generally the most sensitive to actual mechanical changes in the winding geometry, while at the same time looking over changes that commonly affect all three phases, resulting from temperature differences, oil condition, etc.

The data management portion of the software provides for convenient storage and retrieval of test records, allowing the comparison of both WND results and OWA results on any two transformer test records that are selected. This allows comparison between historical data and present data, as well as comparison with the frequency response of sister units if it is desired to make this comparison.



Main Test Screen Shot

A test report can be generated and stored that provides the results of the comparison of any two test records selected, and that provides written application guidelines that prompt the test technician about possible reasons for the results obtained, based on the type of transformer and the results encountered. The guidelines are based on the extensive development investigations performed during the development of the FRA-100 test system, and provide valuable insight into the results. Additionally, the software generates a Green/ Yellow/Red condition assessment as an immediate visual indication to the test technician of whether a significant change exists between frequency responses under comparison. This visual condition assessment can be used as the basis in deciding whether additional electrical tests or internal visual inspections should be made on the transformer before approving it to be energized in service.

COMPANY PROFILE

PHENIX TECHNOLOGIES is a leading manufacturer of high voltage, high current, and high power test systems and components. Our test systems are in operation around the world satisfying the testing requirements of our customers.

Our 65,000 square foot headquarters is a modern manufacturing facility where all the major components of our systems are produced. All aspects of electrical and mechanical design, software design and actual production are performed in this facility and controlled by an ISO9001 quality program. Our engineers offer a unique blend of theoretical knowledge and practical experience. Our ever-expanding Service & Calibration Department stands ready to assist you during and after installation to insure years of trouble free service.

Our engineering resources, manufacturing capability and commitment to flexibility have earned us the reputation as the supplier of choice. From portable test equipment to large, cutting edge automated test systems, PHENIX Technologies provides solutions for your testing needs. You owe it to yourself to discuss your testing requirements with PHENIX Technologies today.

Your Local Representative is:

ISO 9001 CERTIFIED

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