



FRA 5310

Sweep Frequency Response Analyser for Power Transformer Diagnosis



The FRA 5310 Sweep Frequency Response Analyser detects transformer winding movements and mechanical failures due to mechanical shock, transportation or short circuits.

APPLICATION

Many dielectric and mechanical failures in large power transformers are preceded by mechanical changes in the winding structure. These changes, or displacements in the winding, may be the result of:

- Transportation damage occurring between the manufacturer and the final location
- Short circuit forces imposed on the windings resulting from a low impedance fault occurring close to the transformer
- Natural effects of aging on the insulating structures used to support the windings

Detection of these displacements ahead of a dielectric failure can reduce unplanned maintenance costs, and provide the possibility to improve system reliability by preventing outages. Additionally, when damage is discovered, repairs may be targeted to a specific phase winding.

METHOD

The corresponding HF circuit of a transformer winding is a complex R-L-C-network. The measured frequency response (transfer function) of this network is unique like a fingerprint.

Changes in the winding geometry will be reflected by deviations between repeated measurements. Even small winding movements or distortions will cause legible changes in the measured transfer function, which is clearly detectable.

Deviations can be caused by short-circuited turns, open windings, mechanical damage to windings or core, loose turns, faulty clamps, etc.

DESIGN

The FRA 5310 software and the large touch-screen interface guarantee a very easy-to-use instrument. Load measurements, set configurations, obtain connecting information, repeat previous measurements and do comparisons just on a fingertip. Integrated analysis tools, reporting capability and additional PC software complete this advanced Sweep Frequency Response Analyser.

FEATURES AND BENEFITS

- **High measurement reliability and reproducibility** due to active probes design and a clear defined connection and grounding technique
- **High signal-to-noise ratio** due to output voltage up to 12 V_{peak-peak} at 50 Ω (24 V_{peak-peak} at 1 MΩ)
- **Automatic Interpretation** according to Chinese Standard DL / T 911 - 2004
- **Ease of use** due to automated Windows test software and large color touch screen interface and remote start button
- **Rugged, lightweight and small** all-in-one field design
- **Measuring modes** (amplitude & phase):
 - Transfer Voltage Function U₁/U₂ (f)
 - Impedance Function U₁/I₂ (f)

Previously stored curves are accessed using the History tab sheet, where information can be edited and updated at a later date.

Automatic Test Setting (Sequence)

No	Start	Stop	Points	Voltage	Source	Receiver	Ground	Short	Tap	Imp	Z-Cal	Notes
1	10 Hz	5 MHz	800	10 Vpp	X1	X0	--	--	1	50 Ohm	Yes	
2	10 Hz	5 MHz	800	10 Vpp	X2	X0	--	--	1	50 Ohm	Yes	
3	10 Hz	5 MHz	800	10 Vpp	X3	X0	--	--	1	50 Ohm	Yes	
4	10 Hz	5 MHz	800	10 Vpp	H1	H0	--	X1-X2...	1	50 Ohm	Yes	
5	10 Hz	5 MHz	800	10 Vpp	H2	H0	--	X1-X2...	1	50 Ohm	Yes	
6	10 Hz	5 MHz	800	10 Vpp	H3	H0	--	X1-X2...	1	50 Ohm	Yes	

Analysis page with limits set according to the standards

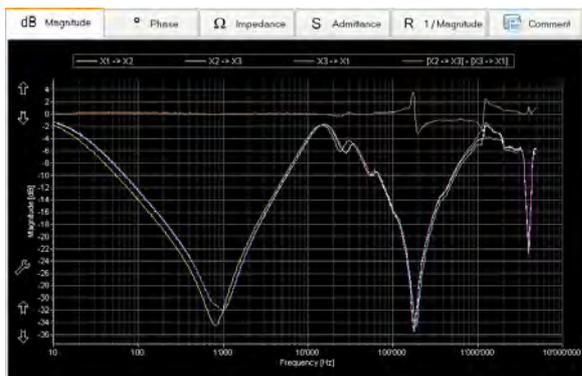
A complete transformer test measurement list (sequence) can be predefined and executed automatically when required, making it simple to repeat a previous fingerprint measurement, even if the operator has no previous knowledge of the setup.

ANALYSIS TOOLS

The analysis system allows multiple stored measurements to be loaded for detailed analysis, comparison, verification, reporting, etc.

The measured transfer function curves can be displayed as **Magnitude [dB]**, **Phase [°]**, **Impedance [Ω]**, **Admittance [S]** and **Ratio**.

Additional comments can be stored with the single analysis displays so expert interpretation and assessments, further test instructions, etc can be included. Various **display tools** are easily accessible from the touch screen to allow simple analysis: Zoom-in and -out, auto scaling, linear and logarithmic scaling, curve shifting, measuring point labels, save as meta-file, printout, title editing, setup information editing, frequency band display, etc.

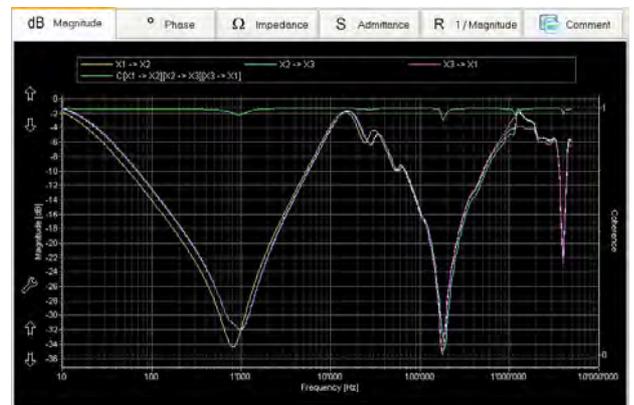


Two frequency response curves and their difference.

Cursors can easily be placed anywhere on the displayed curves giving the user information down to the last measuring point.

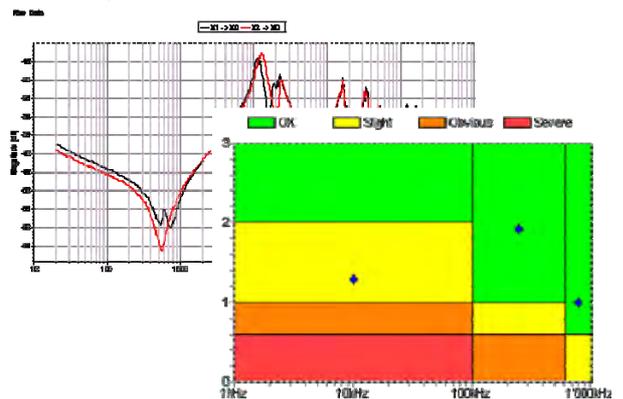
Differences of curves with a definable limiter function can be calculated allowing parts of the curve to be weighted and highlighted to help the engineer's decision-making.

Coherence between two or more curves can be calculated to give the engineer a powerful tool for the assessment and comparison of transformer transfer curves yielding valuable additional information.



Transfer functions of 3 phases and their coherence.

Interpretation according to Chinese Standard DL / T 911 - 2004 is supported. This interpretation is based on the comparison of two curve, identifies slight, obvious and severe mechanical changes and differentiate between typical origins of the damage.



Comparison of two transfer functions according to Chinese Standard DL / T 911- 2004.

REPORT GENERATION

The measured frequency response curves (raw data) are stored in a measuring data file together with all the related transformer nameplate data and other additional information. Reports can be created from the measured data file (raw data curves) or from any analysis data files previously created.

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The user can choose different report sizes from diagrams with short setup info to full reporting with all detailed setup and DUT information.

Reports are automatically generated in XML- or HTML- format allowing the report file to be opened in a web browser or word processor.

Data export

The measuring files (raw data curves) are stored in **XML** format and can also be stored in **CSV** (comma-separated-values) format.

They can be directly opened in Microsoft EXCEL or other spreadsheet programs where further customer specific data processing, calculation, comparison and documentation is possible.

Any curve can also be stored as a picture for further use in customer specific documentation or reporting.

SCOPE OF SUPPLY

Type 5310 Instrument in rugged shell case,
Cable back pack including:

- 2 Active Probes with 15 m double shielded cables,
- 2 Ground Tapes 10 m,
- 2 Ground Tape Clamps,
- User Manual, Test Certificate,
- Mains cable CD with external PC Analysis Software



TECHNICAL DATA

Measurement	
Type	Active probes
Frequency Range	10 Hz .. 10 MHz, user defined
Voltage Output	max. 12 V _{peak-peak} at 50 Ω, max. 24 V _{peak-peak} at 1 MΩ, user defined
Input Impedance	selectable 50 Ω or 1 MΩ
Output Impedance	50 Ω
Accuracy	± 0.1 dB , zero calibrated Feasible accuracy: ± 0.5 dB down to -90dB
Dynamic range	>100 dB
Measuring Points	max. 2'000, user defined, logarithmically spaced,
Protection	Against short circuit, overload

Data Display	
Scaling	Logarithmic or Linear, user defined
Frequency Range	10 Hz .. 10 MHz, user defined
Plot, Frequency vs.	Magnitude, Impedance, Phase, Admittance, Ratio

Controller	
Processor	Celeron M, 1 GHz
RAM	256 MB
Interfaces	USB 2.0 , RS232
Data Storage	40 GB Hard Disk
Display	10.4", SVGA, Color TFT
User Interface	built-in Touch Screen

General	
Operating Temperature	0 .. +50°C
Storage Temperature	-20 .. +70°C
Relative Humidity	10 .. 90 % non-condensing
Weight Instrument	8 kg (17 lbs)
Dimensions Instrument	41 x 31 x 17 cm (16" x 12.2" x 7")
Remote Start	Remote start button and indicator in probe
Mains	Universal, 90 .. 265 VAC, 50 / 60 Hz, 75 VA
Instrument OS	Windows XP embedded
External PC Software	Windows 98 / 2000 / XP

Order code	FRA 5310 No. 3490047
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