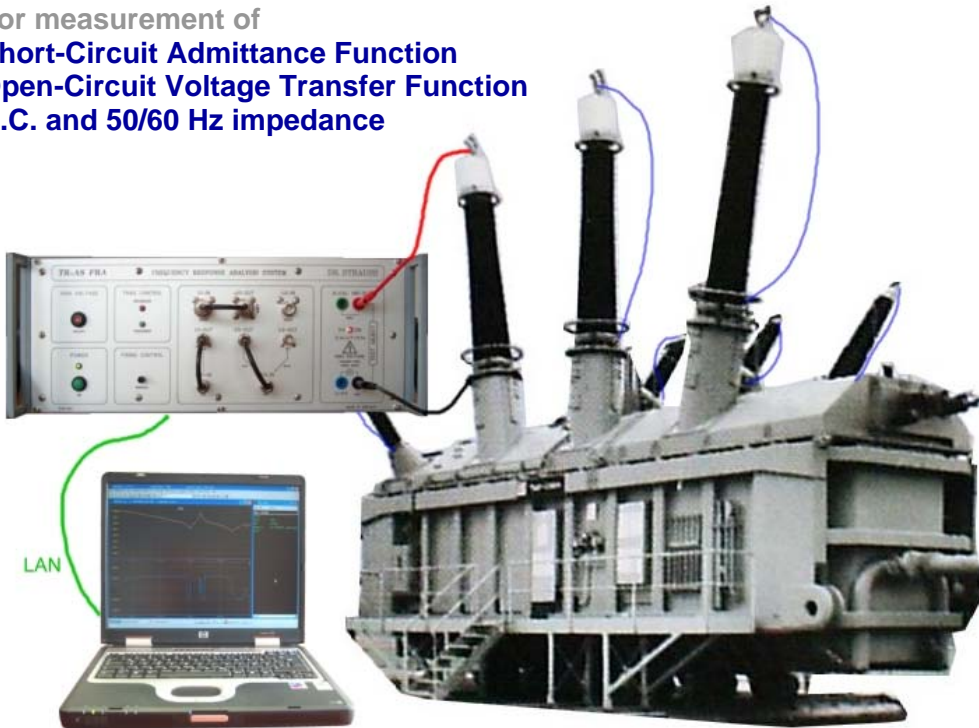


TR-AS® FRA High Resolution Frequency Response Analysis (FRA) System for Power Transformer Diagnosis and Network Analysis

DR. STRAUSS

Impulse Measurement
Calibration - Diagnosis
www.strauss-mess.de

For measurement of
Short-Circuit Admittance Function
Open-Circuit Voltage Transfer Function
D.C. and 50/60 Hz impedance



Remote controlled
High Resolution
TR-AS®
Transient Recorder

Impulse Voltage
Generator for
STEP Excitation

Connection Unit for
Voltage, Current and
transferred Voltage

Easy 2-pole
connection for
reproducible On-Site-
Tests

The Frequency Response Analysis (FRA) on power transformers is used for diagnosis at works, after putting into operation and for maintenance on site. The frequency-dependent admittance is determined and recorded as fingerprint.

The FRA taken before and after a transport should show no differences, otherwise a movement e.g. of a winding must be assumed. Because small movements results in very small deviations in the FRA lapse, the measurement method must be very stable and sensitive.

The application of the step response method gives a complete measuring result after applying the STEP voltage and calculating the frequency-dependent admittance with help of the frequency spectra of voltage and current lapse determined by the fast Fourier transform (FFT).

A minimum of 12 Bit resolution and 64K data for FFT is required, with 256K or 1M data finest frequency resolution is resulting.

Testing Method

The Frequency Response Test System was designed for direct measurement of the frequency behaviour of transformer windings with the step voltage method.

The test object is connected as a 2-pole to the step voltage impulse generator RIG with 350 V peak voltage and sufficient energy without additional measuring lines and shunts.

Voltage and current are picked directly at the step voltage generators output and therefore not subject of variation of external connections.

This is an important advantage especially for on-site tests after shipping or for maintenance, because of the easy connection

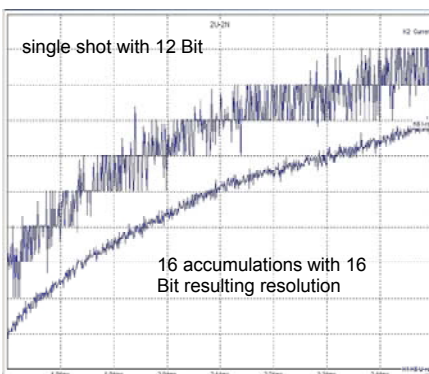
reproducible measurements can be expected.

The output voltage and the respective current are recorded with help of a special designed transient recorder TR-AS® with a basic resolution of 12 Bit at 10 or 40 MS/s maximum sampling rate, an adapted bandwidth of 5 MHz and minimized noise of 0.013% (type test).

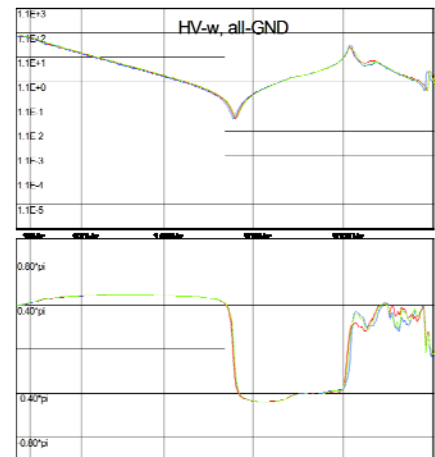
The basic resolution of 12 Bit is improved by a repetitive averaging technique accumulating a number of voltage and current records phase-equivalent in the time domain.

Depending on the number of accumulations, resulting resolutions up to 32 Bit are reached with a significant reduced noise.

For e.g. 16 accumulations 16 Bit resolution and for 1024 accumulations 26 Bit resolution are resulting.



current lapse in the time domain
400x zoomed up to 0,025% per
div. vertically



FRA on the windings u, v, w against N

Perfect EMI-reduction

Because the instant of the step voltage excitation is not correlated to external electromagnetic fields, e.g. caused by power transformers, switchgear or radio stations, their influence is reduced corresponding to the number of accumulations applied. The optimal No. of accumulations as the best compromise between test time and

Selecting 16 accumulations is a good compromise, testing time for each winding is few Minutes, distortions are reduced 16 times and resolution is increased to 16 Bit corresponding to 0,0015% accuracy of digital data used for FFT calculations.

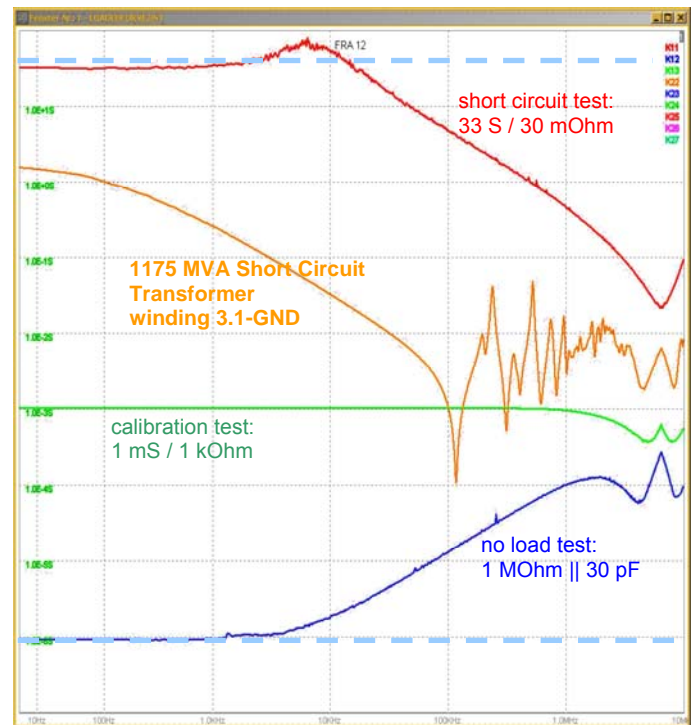
This aspect allows to get best results also during on-site FRA-measurements

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Technical Data		
FRA-Analysis System	TR-AS® FRA	
frequency range	D.C. to 1 MHz / 10 MHz	
frequency resolution	2,4 Hz or 24 Hz selectable	
FFT filter bandwidth	1 Hz or 10 Hz	
frequency accuracy	0.01%	
discrete frequency points	512 K (524,288)	
display range	9 decades / 180 dB	
dynamic range	150 dB	
admittance range	1 μ S ... 33 S	
impedance range	30 mOhm .. 1 MOhm	
dynamic vertical accuracy	1 dB	
vertical resolution	0.00025 (-72 dB)	
with 16 accumulations to 16 Bit	0.000016 (-95 dB)	
vertical display	admittance, impedance lin, log, dB	
horizontal display	lin, log	
Digital Recorder	TR-AS® 12 RC	
Rated resolution of output data	12 Bit / 0.025 %	
accumulation range	14 ... 24 Bit	
Record Length each channel	1M Words (1,048,576)	
Input Stage		
No. Measuring Channels	2	
Measuring input, single ended	BNC / N	
Measuring range for impulse	60mV - 10 V / 10 V - 1600 V	
Bandwidth analogue (-3dB)	DC - 5 MHz	
automatically controlled	22 Stages	
Internal Noise Level	< 0.02%	
Impulse scale factor		
constancy 0,5 μ s to >> 1 s	1%	
long term stability (one year)	0.5%	
Calibration Interval		
	every 2 to 4 years recommended	
Unit-Step-Voltage-Generator		
Charge voltage	inbuilt h.v. supply	350 V
Charge capacitor	charge-capacity	5.3 μ F
Switching-device	Electronically	
	Risetime (no load)	< 10 ns (10/90%)
releasing	automatically controlled , manual	
impulse output		350 V, positiv
output peak power		250 W peak
Desktop-Housing		
	19"	
Dimensions: (BxDxH)	approx. 45x45x18 cm	
Weight:	approx. 12 kg	
Power Requirements		
Voltage	230 (115) V +10%/-20%	
Frequency	50-60 Hz	
Power	200 VA	
Environmental:		
Ambient Temp	+5...+40°C	
Humidity	...95%, non condensating	
Remote Control Computer		LAPTOP PC
CPU	Dual-Core \geq 1.6 GHz	
RAM	\geq 2GByte	
Harddisk	\geq 250 GByte	
Diskdrive	3,5"	
CD/DVD-RW	yes	
TFT-Color-Display	14" (15")	
Netconnection	LAN or WLAN	



FRA results in double-log display:

horizontal range 10 Hz .. 10 MHz

vertical display range 0,1 μ S .. 100 S or 10 M Ω .. 10 m Ω in 9 decades corresponding to 180 dB

Following tests show the performance of the FRA-System:

- short circuit test: at d.c., resulting value of 33 S / 30 mOhm
- no load test: resulting value of 1 MOhm || 30 pF corresponding to the impedance of the 160:1 input divider for voltage measurement
- calibration test: inbuilt calibration resistance 1 mS / 1 kOhm
- test on a 1175 MVA Short Circuit Transformer, secondary winding 3.1 - GND, all other terminals on GND
- the blue limits show the possible working area of the FRA-System from d.c. up to 10 MHz and 30 m Ω (33 S) up to 1 M Ω (1 μ S) corresponding to 150 dB vertical dynamic range

The shapes of the no load test and the short circuit test performed at the open respectively short-circuit output terminal of the FRA-System show approximately the limits for determining admittances respectively impedances of networks, e. g. power transformers, in the frequency domain.

Technical data and design subject to change without notice. Alternative design on request.

DKD-Calibration

The measuring systems can be calibrated in our DKD Calibration Laboratory accredited by the PTB. The Calibration Laboratory issues DKD-Calibration Certificates which documents the traceability to National Standards.

Remarks:

The Measuring System is not designed and applicable for high-voltage tests.

For more information please refer to our Product Specification and to our website www.strauss-mess.de/products/