

## «FreDA» - the portable device for frequency response analysis of high voltage equipment insulation and power transformers windings



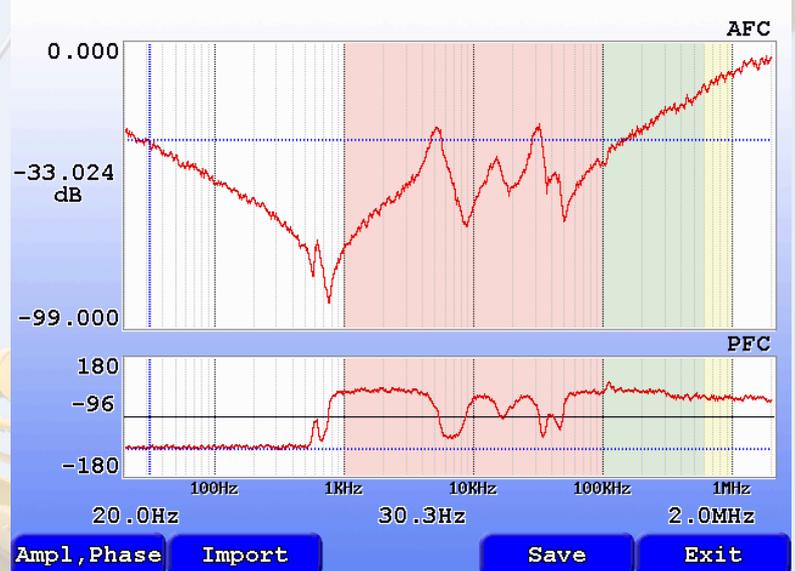
The portable device «FreDA» (Frequency Domain Analyzer) allows defining electrical parameters of high-voltage equipment in the broad band; this device is used for solution of 2 important diagnostics problems:

- Search the defects which are in the malfunction of winding shape after influence through short-circuit current, in the power transformers by the **SFRA** (Sweep Frequency Response Analyzer) method.
- Defining the parameters of high-voltage insulation condition which are excess by variable frequency. It is possible to analyze condition of bushings, transformers, cables, electrical machines.

Measurement the frequency parameters of power transformers windings by the **SFRA** method allow defining deviation of winding geometrical shapes in the operation process. This danger defect is bringing to deformation the insulation gap in the winding. It is arisen in the power transformers if there are 2 related conditions: weakening of the efforts of pressing the windings and as a result of large short-circuit current through the windings.

For operational analysis of distortions of the transformer windings are connected to the built-in AC voltage and variable frequency source with frequency value from 20 Hz up to 2.0 MHz. It is necessary to take into account that measuring the frequency response of transformer winding on the frequency less 5 kHz is not informative because there is big influence of magnetic core. Using more high frequency also hasn't practical meaning because these frequencies in the best cases penetrate only in the top level of transformer winding.

Monitoring of defining the geometrical shapes changing of transformer winding by the device «FreDA» is made by the following. Dependence of signal complex attenuation coefficient in the winding, which are defined in the function of applied voltage frequency, is measured for every transformer phase.



Frequency responses for every winding phase are compared between themselves. There is differences by amplitude value or attenuation phase of signal even in the narrow frequency band, it means that there is changing in geometrical shape of winding where was these changing.

If diagnosticians have base or «support» dependence of attenuation coefficient from frequency which are defined for this type of transformers or for concrete transformer on the manufacture, analysis could be made more accuracy.

The «FreDA» device also can define dependence of high voltage insulation parameters from frequency. These measurements are made in the frequency band from one thousands up to hundreds Hz. Quality of these measurements is in it: they allows measuring the sum of very important “diagnostics currents” which are running through high-voltage insulation, in one measurement.

At first, this is capacitive conduction current of high-voltage insulation, which are depend on dielectric penetrability. This current is always getting involving with frequency of resting voltage and it is maximal by higher frequencies. Vector of this current defines the dielectric dissipation of insulation on frequencies which are near to nominal frequency of rated voltage.

At second, these are currents of absorption processes in the high-voltage insulation, its value is nonlinearly arises if frequency of applied voltage is reduced. Parameters of these currents are got involved with insulation remaining life. These currents are maximally by frequencies from part to unit of Hz.

At third, this is active conduction current of insulation, it has conductor components, moisture and pollution of different origin nature. This current is maximal by very low frequencies; it is need to measure by lay down to the insulation of constant testing voltage.

Measurement of sum of these three very informative currents in one measurement gives much useful information for assessment of condition and remaining life of insulation in the high-voltage equipment.

There is shown frequency zones where is insulation influence is maximally on the figure with graphic of dissipation factor changing. By analysis of graphic in every frequency zone you can access intensity of different processes in the insulation.



We think measurement of insulation dialectical parameters (oil, solid insulation and its combination) in the widen frequency band is more reliable case of detection the remaining life of high-voltage insulation of any type.

### Specifications of «FreDA» device

No	Parameter	
1	Frequency band for analysis of insulation parameters, Hz	0,001 ÷ 1000
2	Frequency band for monitoring of winding shape, MHz	0,00002 ÷ 2,0
3	Dynamical range of measured signals, dB	130
4	PC interface	USB
5	Operation time from build-in accumulator, hours	7
6	Dimensions of measuring device, mm.	220 * 130 * 120
7	Dimensions of measuring device in transportation case, mm.	520 * 430 * 220