«UltraTest» - the Portable Device for Measuring of PD Acoustic Signals in Ultrasonic Frequency Range

The «UltraTest» is the portable device for effective remote detection of various defects in the equipment, which are accompanied with acoustic emission.

The «UltraTest» is used for:

- The remote measurement of the acoustic signals from partial discharges in different types of high-voltage equipment insulation, the location of the defects in the high-voltage insulation;
- The remote measurement of the acoustic signals from the defects of rolling bearings of rotating machines and the defect type diagnostics;
- The remote measurement of the acoustic signals from leakage of fluids or gases in pipes and valves of various purposes and the leakage location.

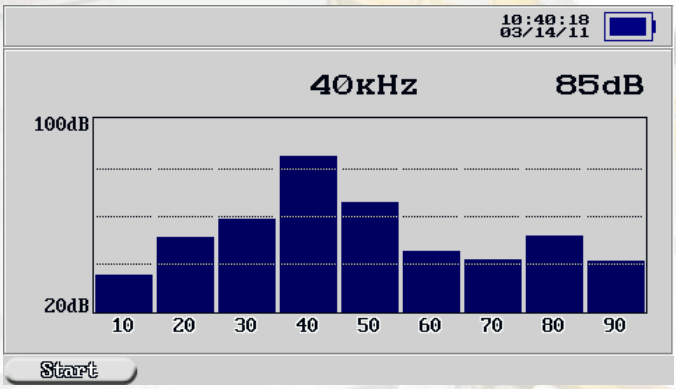
Though all the defects, mentioned above seem physically rather different from each other they all have one mutual feature: they all produce acoustic signals. Such signals can be measured distantly by the **«UltraTest»** device in the frequency range from 20 to 100 kHz, thus the sphere of the practical use of the device is rather wide.

The maximum distance from source of the acoustic signals can be measured with **«UltraTest»** device depends on the defect progress and the acoustic activity of the processes in it. If some cases the distance can be as much as ten meters.

The principle of the acoustical activity measurement is rather simple: the device microphone should be directed as accurately as possible to the supposed defect zone. The intensity of the acoustic processes measured in decibel will be shown on the device color screen.

Moving the microphone, the operator can easily reveal the zone where the acoustic processes are mostly intensive. This zone will always correspond to the zone of the maximum defect progress in equipment.

If necessary, it is possible to specify the acoustic activity in the revealed defect zone. First of all it is possible to find out the frequency distribution of the acoustic activity in the defect zone using inbuilt filters. The example of such a frequency diagram copied from the device screen is given in the figure to the right.



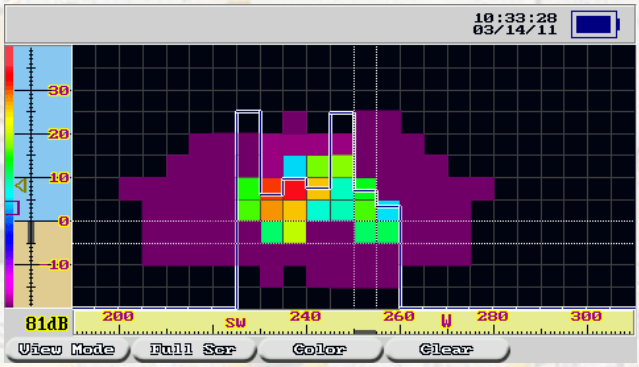
At the **«UltraTest»** screen, it is possible to see the form of the measured acoustic impulses, evaluate the impulses' frequency and receive the frequency spectrum of each of the measured impulse. This information can be is rather valuable for giving more accurate diagnostic decisions.

All the primary and the processed information can be stored in the device memory and analyzed by means of the PC software supplied together with the device.

Unlike all the similar devices, measuring acoustic activity offered by other companies, **«UltraTest»** device has two very interesting functions.

The first specific feature is the three-dimensional control of the **«UltraTest»** device position (the sensor axes) in the hands of the operator. It means that at any moment of an acoustic activity measurement, that is several times a second at minimum, the acoustic sensor axes direction is measured. Firstly, the sensor axes direction is measured in horizontal plane in Earth magnetic coordinate system and secondly the angle of the sensor axes slope up and down the horizon is measured. The angle measurements are “ascribed” to each of the acoustic activity measurement carried out by the device at this moment.

Thus the **«UltraTest»** operator can draw a two-dimensional “acoustic activity graph” of the object online at the device screen. At the horizontal axes the sensor axes angle of slope to the magnetic pole will be shown, at the vertical axes –the angle of slope to the horizon. The intensity of the processes will be shown at the graph by color.



Later such an “acoustic activity graph” can be laid over the photo of the controlled object. Thus, the operator can definitely diagnose and analyze the cause of the “acoustic defect”. For that purpose the digital photo of the object should be made from the very point of the acoustic measurements, and the borders of the “acoustic activity graph” should coincide to the linear dimensions of the object.

The example of the “acoustic activity graph” is shown in the figure to the left. The acoustic information shown at the figure has been received from a laboratory control unit.

The second specific feature of the **«UltraTest»** device is the ability to effectively diagnose the type of the defect at the high-voltage equipment insulation by using the in-built **«PD-Expert»** expert system. The **«PD-Expert»** system has been developed for identifying the images of the defects which cause partial discharges in insulation.

For that purpose there is a source voltage phase sensor **«PFR-1»** supplied together with the device. The sensor passes the necessary phase information to the portable **«UltraTest»** device through the radio-channel.

If the time of the “acoustic impulse flying” from the object of control to the measuring device is taken into account then the canter phase of each of the recorded partial discharge impulse in insulation relative to the source voltage phase can be specified rather precisely.

Knowing the amplitude-frequency characteristics of every partial discharge impulse, as well as the time of its arising in relation to the source voltage sinusoid phase enables the operator to specify the type of the defect in the insulation of the high-voltage equipment with high precision. The advantage of the diagnostic is that it is carried out effectively at the place of the measurement.

«UltraTest» Specifications

№	Parameter	Value
1	Frequency range of the measured acoustic signals, kHz	20 ÷ 100
2	Number of the acoustic sensors	1 ÷ 3
3	Dynamic measurement range , dB	80
4	Sensor for synchronization of measurements to the power main phase by the radio channel	PFR-1
5	PC interface	USB
6	Operation time from the in-built battery, hour	7
7	Dimensions, mm	230 * 130 * 245