3i – Portable Device for On-line Insulation Monitoring in Switchgear Cells and HV/MV Cables by Partial Discharges

The multipurpose 3i device is used for on-line insulation condition assessment in the following equipment:

- 6 ÷ 35 kV switchgears of various designs;
- Cable terminations and joints;
- High-voltage gas-insulated equipment (Gas-Insulated switchgear, GIS) of any rated voltage;

The Device Basics

The 3i multipurpose portable device (Intellectual Insulation Indicator) is used for effective online monitoring of high-voltage equipment insulation.

The 3i device measures and analyses partial discharges (PD). For effective PD measurement and noise rejection, there are two types of inbuilt sensors used in the device: an acoustic sensor and a TEV method sensor (Transient Earth Voltage). As both the sensors are inbuilt, and so there is no need in any connection cables.

The device is supplied in a strong plastic case; at the faceplate, there are the colored screen and two buttons: power button and function button.

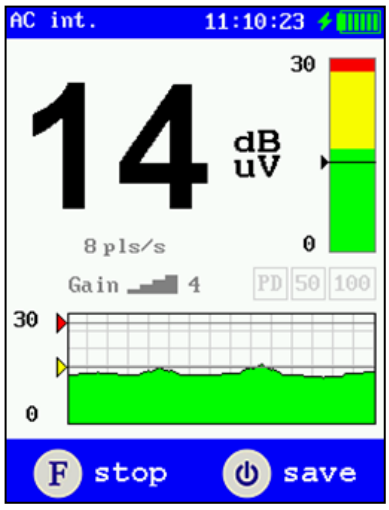
At the top of the device, there are the in-built sensors: the acoustic sensor, the TEV-method sensor and the RFID antenna.

At the side of the device, there are the external connections for USB, headphones and external sensors (acoustic sensor, TEV-method sensor).

The in-built battery is charged by the standard USB port. The same port and cable is used for PC connection.

The staff with no special training can use the device, as the device is easy to operate and maintain. In the measurement mode, the switch button on the faceplate operates the device. After pressing the button, the device switches on and starts measuring. After second pressing of the switch button, the measurements stop and the data is saved in the device memory. For the next measurement, press the switch button again.

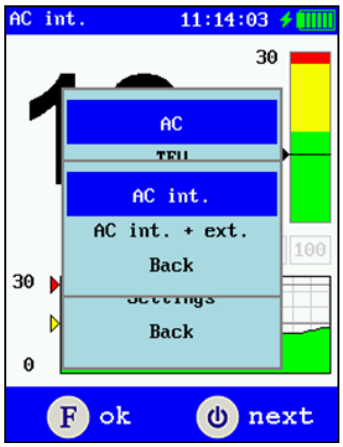
If partial discharges are measured with the acoustic sensor, the sensor should be pointed at the object of measurement. Moving the device along the object allows identifying the zone of maximum PD activity. If partial discharges are measured with the inbuilt TEV-method sensor, then the device top should be pressed to the metal surfaces of the enclosure or the tank.



In addition, the user can efficiently monitor the PD level and intensity with the stereo headphones.

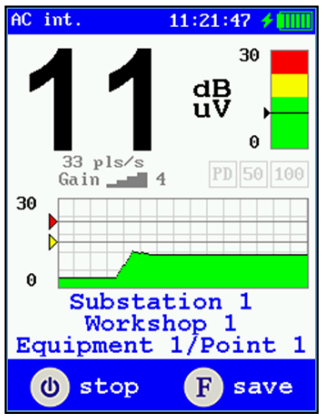
For each type of the equipment, you should set the levels of insulation condition, determined by PD activity. The levels are «normal level» (green color signal light), «warning level» (yellow) and «alarm level» (red). With the color signal lights, you can effectively assess the insulation condition while measuring.

The selection of the measurement circuit and the type of sensor is done in the instrument menu.



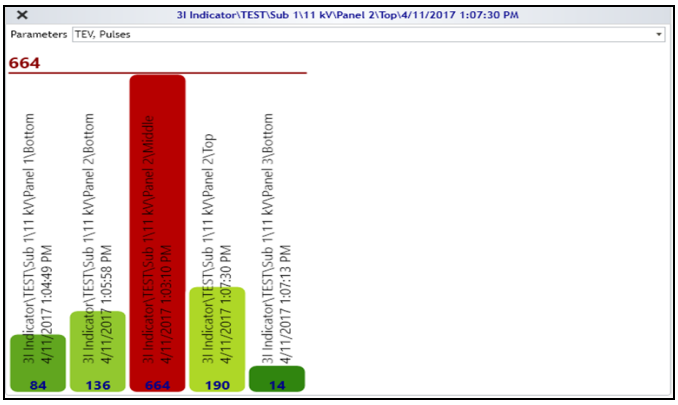
In addition, there is an external acoustic sensor AR-Sensor in the standard delivery set. The joint use of the built-in and external sensors allows carrying out measurements at different points of the equipment, and gives an opportunity to more precisely locate the defects. The use of external sensors is also effective in hard-to-reach places, where the device is impossible to install.

The 3i device is for mass periodic inspections of the high-voltage equipment. For this purpose, a routing measurement technology is realized in the device.



First in this mode, the database of the monitored equipment is created with iNVA software, and all the points for periodic PD measurements are defined. This mode is for routing way of the measurements. The measurement route is generated on PC and is downloaded into the device. The measurements are taken according to the given route; the data is stored in the device memory and is easily transferred into iNVA database. In addition, the routing information can be recorded into RFID tags. The measurements in this way can be tied to a definite piece of equipment and a definite place on it.

After loading the data from the device, one can observe the distribution of the "defect field" in cells, the influence of neighboring cells on each other, which will help to quickly locate a problem cell.



Maintaining the periodic measurements database allows you to effectively assess the defect development and calculate the remaining life of the equipment. In this case, the use of the indicator type device is the most effective. The use of the INVA Portable software allows you to create reports on the equipment condition (exceeding the thresholds) and remaining resource, schedule the repairs and the next measurements.

The 3i Base Delivery Set

#	Name	Quantity, pcs.
1	3i device	**1**
2	Charger with USB slot	**1**
3	USB - Micro USB adapter cable	**1**
4	Headphones	**1**
5	AR-Sensor external acoustic sensor	**1**
6	I-PD2 calibrator	**1**
7	iNVA Portable software	**1**
8	Transportation case	**1**
9	User manual and test report	**1**

Advantages of using the extended set of sensors

The use of additional sensors included in the extended kit allows the use of new functions of the 3i device.

The AR-Loc external directional microphone with a parabolic antenna allows for efficient analysis of discharge activity remotely at distances up to 100 m with the accuracy of 1 m. The sensitivity gain is +20dB.

For the good location, the directional microphone has a bright laser pointer.

The external TSM-2 sensor (TEV-method) is attached directly to the grounded metal housing of the monitored object. The sensor is fixed at the equipment by the in-built magnet inside the sensor housing.

External RFCT-5 sensor (Radio Frequency Current Transformer), is used for recording pulses from partial discharges in high-voltage switches, switchgear cells and suitable cable lines, in neutral circuits of power transformers.

Together with the PFR-2 reference signal transmitter, it is possible to work with the PRPD (Phase Resolved Partial Discharge) diagram. It is possible to save the diagram in the device, load it into the INVA Portable software for further analysis by the PD-Expert expert system, and determine the defect type.

The 3i Extended Sensors Delivery Set

#	Name	Quantity, pcs.
1	AR-Loc - external acoustic sensor with parabolic dish	**1**
2	TSM-2 - external TEV-method sensor with cable	**1**
3	RFCT-5 - external radio frequency current transformer with cable	**1**
4	PFR-2 - reference signal transmitter	**1**
5	Transportation case	**1**

The 3i Device Specifications

Parameter	Value
In-built PD sensors	AC, TEV
Acoustic sensor frequency range, kHz	40 ± 2
TEV-method sensor frequency range, MHz	10 ÷ 100
Acoustic channel dynamic range, dB	80
TEV channel dynamic range, dB	60
External connections	USB, headphone, external sensor
Battery life, hours	12
Operating temperature range, °C	-20 ÷ +55
Dimensions, mm	85 × 45 × 220
3i weight, kg	0.4

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