

The KIV-500/110 Device – 110÷750 kV High Voltage Bushing Protection and Diagnostics

The KIV-500/110 device is the multipurpose device for condition monitoring and protection of power transformer's high voltage bushings with OIP (Oil Impregnated Paper) insulation and RIP (Resin Impregnated Paper) insulation.

The KIV-500/110 device addresses two main problems:

- The device does effective high voltage bushings' diagnostics, defect detection at early stages, defect type identifying.

- The device effectively gives the "warning" and "alarm" signals on the bushing condition, which allows bringing the transformer out of service timely and thus minimize the possible consequences of the bushing damage.

The KIV-500/110 Device Operation Specifics.

- The KIV-500/110 device could be used with any bushings of 110÷750 kV. The high sensitivity electronic measurement circuit is able to monitor bushings of different types with the leakage current of 0.5 to 200 mA.

- The KIV-500/110 device is also effective in case there are several types of bushings installed in one and the same transformer by some reason, and even if the bushings installed are of different insulation types, such as OIP and RIP.

The KIV-500/110 Device Diagnostic Capabilities.

The KIV-500/110 device bushing condition diagnostics and bushing protection is based on insulation leakage currents' analyses. The leakage current has two components: the active one, connected with the irreversible losses in insulation and the re-active, determined by the basic bushing capacity value C_1 .

The most widespread cause of bushing damage are the local short circuits in between insulation layers. This causes voltage re-distribution and voltage grows at the rest of the conductive layers, which can end in the insulation layers' avalanche breakdown and bushing failure. The only way to reliably reveal the local sort circuits in between the bushing insulation layers is to monitor the leakage current, that is to monitor C_1 capacity.

To calculate the C_1 capacity, the KIV-500/110 device measures the leakage current in which the capacitive current component exceeds 99%. The leakage current grows unevenly, in leaps, the leap magnitude depends on the number of the conductive layers in the bushing. The operation of all the known bushing protecting devices, is based on C_1 monitoring.

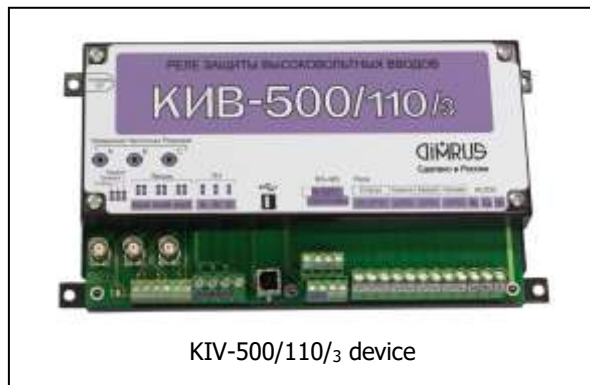
The second important bushing condition diagnostic factor is **the dissipation factor**. The higher is the dissipation factor, the worse is the bushing insulation.

The dissipation factor parameter is effective for bushing condition diagnostics. But to use it as the base factor for bushing protection is non-effective, as not all the bushings' defects are accompanied dissipation factor change.

The dissipation factor can be measured in two ways: using the reference phase voltages from the measuring voltage transformer (direct dissipation factor measurement) or without them (relative dissipation factor). Both the methods have their pros and cons.

The KIV-500/110 device could be supplied in one of the two versions:

- **The KIV-500/110/3** device, with three inputs for bushing's leakage current connection and three inputs for measurement voltage transformer's phase voltage connection. The device monitors both direct and relative dissipation factor values for a group of three bushing.



KIV-500/110/3 device

- **The KIV-500/110/6** device with six inputs for bushings' leakage currents' connection. This version allows measuring relative dissipation factor value, but for a group of six bushings. The advantage of this version is that it

can monitor and protect six high voltage bushings of two transformer windings, i.e. High Voltage and Low Voltage.

A very useful option of the KIV-500/110 device is the possibility of partial discharge measuring device connecting to it. Connecting a PD measuring device to the coaxial terminals at



KIV-500/110/6 device

the face panel of the KIV-500/110 one can measure the partial discharges in the transformer.

This becomes possible, as there are three DB-2 sensors supplied together with the KIV-500/110 device for leakage current and partial discharge measurement in the bushings and the transformer itself. This function is especially important for diagnostics and defect searching in the RIP-insulated bushings.

Effective Defect Diagnostics

in Bushing Insulation.

In addition to performing the main function of protecting the transformer from bushing damage, the of the KIV-500/110 device expert software allows you to identify defective bushings at the early stages of insulation problems' development.

This makes it possible, along with the implementation of the main function of the protective device - minimizing the consequences of an inevitable accident - to implement a more modern function: to carry out a preliminary warning of personnel about a possible emergency. Then the repair services will have enough time to carry out operational actions prevent it.

If the thresholds are exceeded, the device always indicates which phase bushing caused the signalization to turn on. This greatly facilitates diagnostics.

The KIV-500/110 device has very good noise immunity due to the use of digital signal processing and filtering algorithms.

The KIV-500/110 device modern interfaces for SCADA communication allow you to continuously analyze the

transformer bushings' condition and use the data obtained for complex transformer's diagnostics.

The KIV-500/110 design and installation.

Structurally, the KIV-500/110 device is designed as a stand-alone device cased in metal, which is installed inside an outdoor metal enclosure, protecting it atmospheric influence.

Thus protected, the device can be mounted outdoors beside the transformer.

On the transformer control panel, the KIV-500/110 device can be installed without a protective enclosure.

When installing the KIV-500/110 device, there is no need to use matching transformers, which significantly reduces the cost of delivery and installation. In addition, in this case, DB-2

sensors are used, with the internal protection of 100 V, which also increases the reliability of the entire system.

The KIV-500/110 delivery set includes:

- The KIV-500/110 device in the protective enclosure with the inbuilt heater the system to be used at temperatures as low as -60°C.
- Three (six) DB-2 sensors of pre-agreed design suitable for definite types of high-voltage bushings. The advantage of the DB-2 sensors is the duplicated protection against signal cable breakage.
- A set of coaxial cables for sensors-to-device connection.

The KIV-500/110 Device Specifications

№	Parameter	Value
1	The number of monitored bushings	3 or 6
2	Bushing rated voltage, kV	110 ÷ 750
3	Bushing leakage current range, mA	0,5 ÷ 200
4	"Warning" threshold setting range, %	1 ÷ 10
5	"Alarm" threshold setting range, %	3 ÷ 20
6	Status threshold setting accuracy, %	± 0,1
7	Response time delay at each threshold, sec	0.8 ÷ 20 (step 0.2)
8	DB-2 sensor operation temperature range, °C	-60 ÷ +90
9	Supply voltage, V	AC/DC 80 ÷ 260
10	Power consumption, W	50