

The Type BAU bushing sensor is used for multiple purposes.

1. Provide a power frequency signal to the bushing monitoring equipment for the measurement, analysis and prognostics of the bushing insulation.
2. Provide a path for high frequency signals generated by partial discharges that may be occurring in the winding.
3. Provide appropriate signals to instrumentation for the analysis of leakage reactance for winding distortion measurements.

Components and Construction

The cover and body of all sensors are identical and provide the means to attach conduit to the sensor and also provides a protective enclosure for the internal circuitry.

The adapter is custom for each type of bushing capacitor tap. The adapter and approximate contact is fastened to the main body by three long screws. These screws can be easily removed to replace/change the adapter as well as provide easy access to the bushing tap for off line testing and inspection. Coax wire is used to connect the sensor to the instrumentation.

Features of the Sensor

Bushing sensor protection circuitry is an important part of a design and must provide safe operation of bushing insulation in all possible operating conditions:

1. *Open circuit.* The bushing insulation monitor (BHWM) has a relatively low input impedance which will keep the voltage at the tap to a safe level of several hundred volts. If a tap is left in an open circuit condition, high voltage may build up on the tap according to the capacitances C1 and C2/C3 which operates as a capacitive divider. Generally the C1 and C2 capacitances are of comparable values. If the tap is open circuited, up to half for the phase to ground voltage may appear at the tap providing both danger to operating personnel and the bushing insulation. In such a case, the C2 insulation is overstressed and sparking will occur inside the bushing, This sparking will contaminate the oil; which in turn will degrade the C1 insulation and cause a bushing failure. Therefore, a bushing sensor must maintain a safe voltage at the tap even if it is disconnected from an instrument or the signal cable is unintentionally cut. There are several known solutions such as: installing a resistor or a capacitor in parallel with the C2 bushing insulation or use of another voltage limiting device inside the sensor.

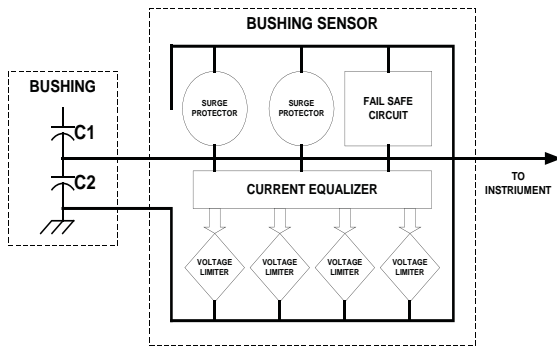




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2. *Switching and lightning strike surge protection.* In normal operation a bushing may see short duration surges created by normal switching in a substation or a lightning strike in some proximity of the bushing. Such a surge may approach double operating system voltage and have duration from less than one microsecond to several tens/hundreds of microseconds. In an open circuited bushing tap up to half of the surge may be present on the tap, overstressing the C2 insulation. Adequate surge protection must keep the surge voltage at a tap to a safe level of several hundreds of volts. Some bushing sensors in the market today provide such protection, while others do not. As an example, a resistive load that is normally in the range of several hundreds of ohms to several kilo-ohms forms a C-R circuit with the C1 capacitance. This circuit provides voltage limitation at power frequency but allows any fast surge to be almost fully applied to the C2 insulation.
3. *Fail safe protection.* This type of additional protection ensures shorting the bushing test tap if all other protection layers fail.

The BAU series of sensors have all of the above protection types built inside the sensor. The simplified protection circuit block-diagram is shown below.



Open circuit protection consists of four voltage limiting elements that keep the RMS voltage at a level of. The current equalizing circuitry is added to ensure identical operation of each circuit and override any individual difference of the limiters. Only two limiters are required for proper operation, but four are used.

Surge protection is designed to withstand at least one hundred times full BIL waves. Two protectors are used while only one is required.

The Fail Safe circuit will short the bushing tap to ground, if all other protection circuitry fails.

Specification

Mechanical design	Support all North American and most European and Russian designs. For non-supported designs, adapter and contact may be manufactured upon request.
Protection	Open Circuit, Surge, Fail Safe
Open circuit life	Continuously
Open circuit voltage limiting	< 20 Vrms
Surge life	>100 BIL Shots
Surge voltage limiting	< 600 V peak
Bushing capacitive current	0 – 100 mAmps rms
Operating temperature	-40°C - +90°C, short duration +100°C
Supplied with cable intact	65 feet, other lengths available on request
Design life	30 years

Electrical Diagnostic Innovations, Inc
 14109 54th Ave North - Plymouth, MN 55446
 www.elec-di.com e-mail: edi@elec-di.com
 612-963-0974

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