EMC PARTNER

White Paper

INS series integral measurement

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2 Introduction

INS is EMC PARTNER's latest insulation test generator series with voltages up to 30 kV. Unlike other similar generators where breakdown is detected by simple peak measurement of voltage and/or current, the INS series utilizes the time integral for a more accurate and reliable discharge detection.

The purpose of this document is to explain the advantages of using time integral measurement in comparison to traditional peak measurements for breakdown detection. Additionally, basic guidance is given for setting the time integral detection threshold in INS series generators.

3 Advantage of integral measurement

4 Time integral of voltage

When testing insulators with 1.2/50 us surge pulses, it is likely that breakdown occurs near the peak voltage of the impulse or even after the voltage has reached its peak value. If breakdown detection is made with simple peak measurement, those voltage breakdowns that occur after the peak amplitude cannot be detected. Time integral measurement of the voltage impulse can easily detect breakdown, even if it occurs well after the voltage peak.

In Figure 1 a 1.2/50 us surge waveform with a breakdown near the voltage peak is shown in blue and the same signal without breakdown is shown in black. In this example, a voltage peak detector would not be able to detect the breakdown because the maximum value for both signals is the same.

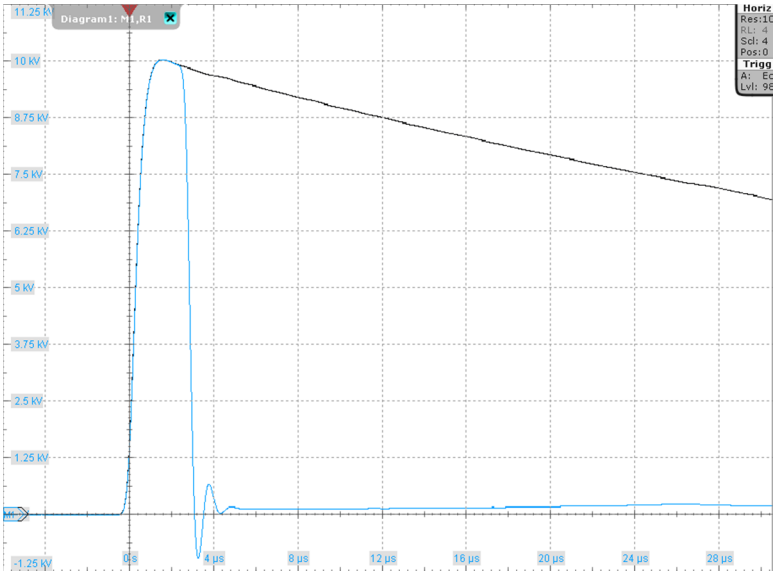

Figure 1: Example of breakdown close to voltage peak

6 Time integral of current

If the DUT has a large input capacitance, a short initial charging current may occur. Depending on the impedance at the breakdown point, the initial current may even be higher than the current flowing through the breakdown point of the insulation. Simple current peak detection circuits may be triggered by the initial current or fail to detect the lower breakdown current. This problem can be solved with a time integral measurement of the current pulse by setting the detection threshold large enough to ignore the time integral of the initial charging current.

Figure 3 shows the current at a DUT with large input capacitance. The black signal is the current without breakdown and the red signal is the current with later breakdown. In this example, the initial charging current exceeds the maximum breakdown current and a simple peak detector would fail to differentiate between initial current and breakdown current.

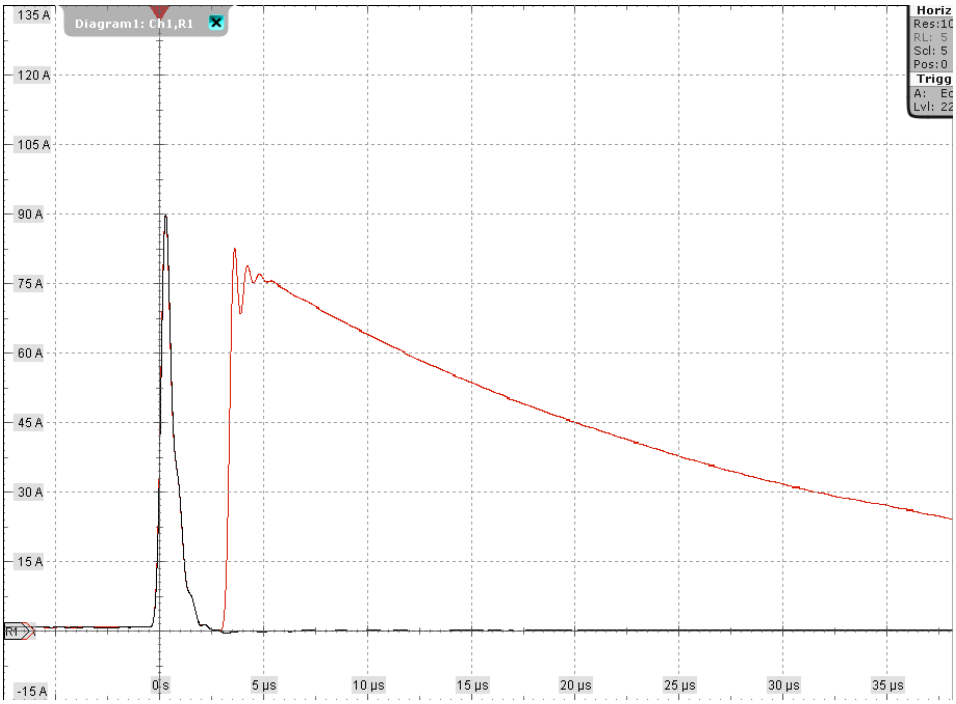

Figure 3: Initial DUT charge current

7 Setting threshold

Figure 2 shows a 1.2/50 us voltage waveform (blue) and its time integral (red) in one graph. Since the decay of the surge pulse is an exponential function, 50% of the total time integral is reached at the half time of the voltage signal (~50 us). It is very unlikely that a breakdown will occur after the voltage half time, so it is recommended to set the detection threshold to about 50%-70% of the total time integral.

Since the connected DUT may have some influence on the voltage waveform, it is further recommended to connect the DUT and check the measured time integral. This verification should be performed at a lower level where breakdown is unlikely. The measured time integral can then be adjusted to the actual test voltage.

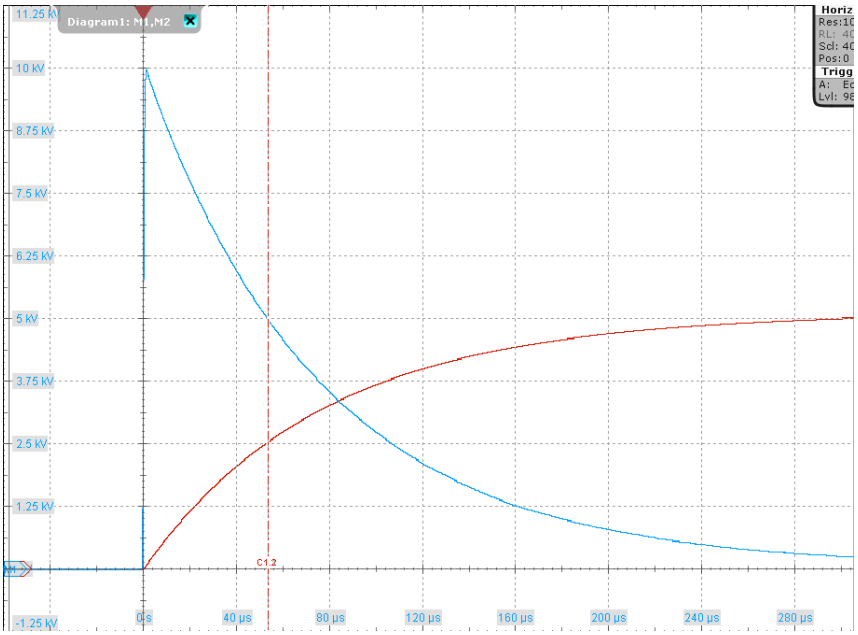

Figure 2: Voltage time integral of surge pulse

8 Quick start guide

Follow procedure can be used to set the time integral threshold:

1. Connect DUT and set generator voltage to half of the test voltage.
2. Start test and note measured time integral of the voltage. Be sure that no breakdown occurs.
3. Change generator setting to test voltage and set detection threshold to measured time integral from step 2.
4. Execute test