Annex 4B

ISOLATION RESISTANCE MEASUREMENT METHOD FOR COMPONENT BASED TESTS OF REESS

1. Measurement method

The isolation resistance measurement shall be conducted by selecting an appropriate measurement method from among those listed in Paragraphs 1.1. through 1.2., depending on the electrical charge of the live parts or the isolation resistance, etc.

If the operating voltage of the Tested Device (Vb, Figure 1) could not be measured (e.g. due to disconnection of the electric circuit caused by main contactors or fuse operation), the test may be performed with a modified test device to allow measurement of the internal voltages (upstream the main contactors).
These modifications shall not have negative influence of the test results.

The range of the electrical circuit to be measured shall be clarified in advance, using electrical circuit diagrams, etc. If the high voltage buses are galvanically isolated from each other, isolation resistance shall measured for each electrical circuit. The total isolation resistance of the Tested Device shall be calculated from each single isolation measurement.

Moreover, modification necessary for measuring the isolation resistance may be carried out, such as removal of the cover in order to reach the live parts, drawing of measurement lines, change in software, etc.

In cases where the measured values are not stable due to the operation of the isolation resistance monitoring system, etc., necessary modification for conducting the measurement may be carried out, such as stopping of the operation of the device concerned or removing it. Furthermore, when the device is removed, it shall be proven, using drawings, etc., that it will not change the isolation resistance between the live parts and the ground connection.

Utmost care shall be exercised as to short circuit, electric shock, etc., for this confirmation might require direct operations of the high-voltage circuit.

1.1. Measurement method using DC voltage from external sources

1.1.1. Measurement instrument

An isolation resistance test instrument capable of applying a DC voltage higher than the nominal voltage of the tested device shall be used.

1.1.2. Measurement method

An insulation resistance test instrument shall be connected between the live parts and the ground connection. Then, the isolation resistance shall be measured.

If the system has several voltage ranges (e.g. because of boost converter) in a galvanically connected circuit and some of the components cannot withstand the working voltage of the entire circuit, the isolation resistance between those components and the ground connection can be measured separately by applying at least half of their own working voltage with those component disconnected.

1.2. Measurement method using the Tested Device as DC voltage source

1.2.1. Test conditions

The voltage level of the Tested Device throughout the test shall be at least the nominal operating voltage.

1.2.2. Measurement instrument

The voltmeter used in this test shall measure DC values and shall have an internal resistance of at least 10 MΩ.

1.2.3. Measurement method

1.2.3.1. First step

The voltage is measured as shown in Figure 1 and the operating voltage of the Tested Device (Vb, Figure 1) is recorded. Vb shall be equal to or greater than the nominal operating voltage of the Tested Device.

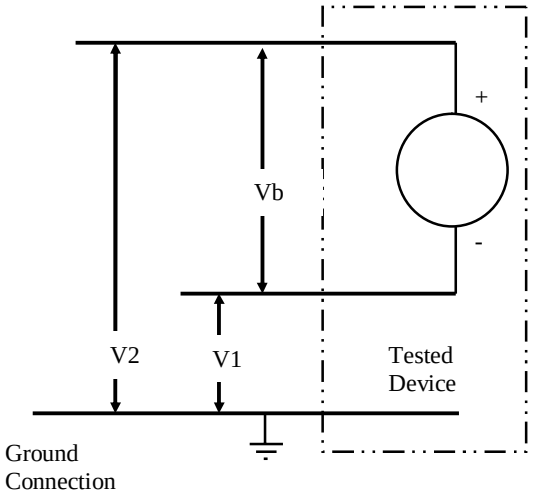

Figure 1

1.2.3.2. Second step

Measure and record the voltage (V1) between the negative pole of the Tested Device and the ground connection (Figure 1).

1.2.3.3. Third step

Measure and record the voltage (V2) between the positive pole of the Tested Device and the ground connection (Figure 1).

1.2.3.4. Fourth step

If V1 is greater than or equal to V2, insert a standard known resistance (Ro) between the negative pole of the Tested Device and the ground connection. With Ro installed, measure the voltage (V1') between the negative pole of the Tested Device and the ground connection (see Figure 2).

Calculate the electrical isolation (Ri) according to the following formula:

Ri = Ro*(Vb/V1' – Vb/V1) or Ri = Ro*Vb*(1/V1' – 1/V1)

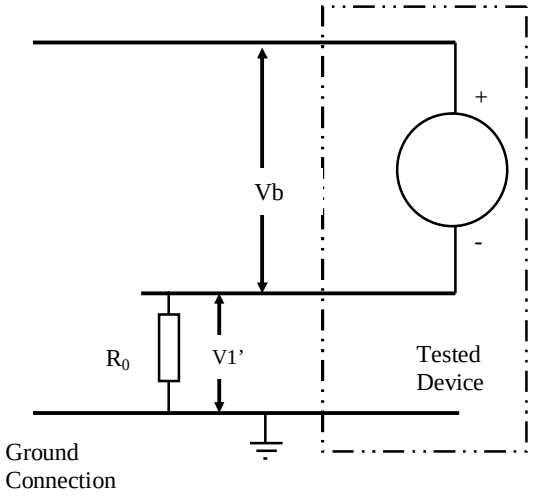

Figure 2

If V2 is greater than V1, insert a standard known resistance (Ro) between the positive pole of the Tested Device and the ground connection. With Ro installed, measure the voltage (V2') between the positive pole of the Tested Device and the ground connection (see Figure 3).
Calculate the electrical isolation (Ri) according to the following formula:

Ri = Ro*(Vb/V2' – Vb/V2) or Ri = Ro*Vb*(1/V2' – 1/V2)

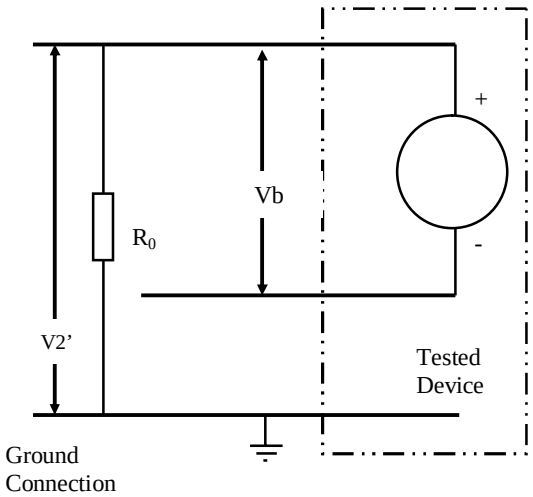

Figure 3

1.2.3.5. Fifth step

The electrical isolation value Ri (in Ω) divided by the working voltage of the Tested Device (in volts) results in the isolation resistance (in Ω/V).

NOTE 1:The standard known resistance Ro (in Ω) should be the value of the minimum required isolation resistance (in Ω/V) multiplied by the working voltage of the Tested Device plus/minus 20 per cent (in volts). Ro is not required to be precisely this value since the equations are valid for any Ro; however, a Ro value in this range should provide good resolution for the voltage measurements.