Designation: F1662 – 16

# Standard Test Method for Verifying the Specified Dielectric Withstand Voltage and Determining the Dielectric Breakdown Voltage of a Membrane Switch or Printed Electronic Device[1]

This standard is issued under the fixed designation F1662; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This test method covers the verification of a specified dielectric withstand voltage or dielectric breakdown voltage of a membrane switch or printed electronic device.

## 2. Referenced Documents

2.1 *ASTM Standards:*[2]

F1680 Test Method for Determining Circuit Resistance of a Membrane Switch

F1663 Test Method for Determining the Capacitance of a Membrane Switch or Printed Electronic Device

## 3. Terminology

3.1 *Definitions:*

3.1.1 *dielectric withstand voltage*—a voltage, above rated voltage, applied for a specific time between mutually insulated test points or between an insulated test point and ground, which results in no visual change or specified leakage current.

3.1.2 *dielectric breakdown voltage*—the voltage at which a disruptive discharge or excessive leakage current occurs.

3.1.3 *disruptive discharge*—flashover (surface discharge), spark over (air discharge), or breakdown (puncture discharge).

3.1.4 *leakage current*—current between mutually insulated test points when a voltage is applied.

3.1.5 *membrane switch*—a momentary switching device in which at least one contact is on, or made of, a flexible substrate.

3.1.6 *printed electronic device*—electrically functional device manufactured primarily using additive processes, with or without attached conventional or other electronic components, often in flexible format.

3.1.7 *test points*—two preselected mutually insulated locations on switch assembly.

## 4. Significance and Use

4.1 Dielectric withstand voltage testing is useful for design verification, quality control of materials, and workmanship.

4.2 This test method is used to verify that the membrane switch or printed electronic device can operate safely at its rated voltage, and withstand momentary overpotentials due to switching, surges and other similar electrical phenomena.

4.3 Specific areas of testing are, but not limited to:

4.3.1 Conductor/dielectric/conductor crossing point,

4.3.2 Close proximity of conductors, and

4.3.3 Any other conductive surface such as shielding or metal backing panel.

4.4 Dielectric withstand voltage testing may be destructive and units that have been tested should be considered unreliable for future use.

4.5 Testing using ac voltage may be useful for switches intended for control circuits powered by ac voltages.

## 5. Interferences

5.1 The following parameters may affect the results of this test:

5.1.1 Humidity,

5.1.2 Contamination, and

5.1.3 Temperature.

## 6. Apparatus

6.1 *Electric Device,* suitable to provide a controlled dc or ac voltage, leakage current measurement.

## 7. Procedure

7.1 *Dielectric Withstand Test Method:*

7.1.1 *Membrane Switch:*

7.1.1.1 Measure and record the following characteristics prior to performing test:

[1] This test method is under the jurisdiction of ASTM Committee F01 on Electronics and is the direct responsibility of Subcommittee F01.18 on Printed Electronics.

Current edition approved May 1, 2016. Published May 2016. Originally approved in 1995. Last previous edition approved in 2010 as F1662 - 10. DOI: 10.1520/F1662-16.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

*(1)* Open and closed circuit resistance of the test points in accordance with Test Method F1680.

*(2)* Capacitance of the test point in accordance with F1663.

7.1.1.2 Connect two test points on the switch assembly, each to a separate polarity, on the voltage source.

7.1.2 *Printed Electronic Device:*

7.1.2.1 Measure and record functional test data based on specification for the device.

7.1.3 Select test voltage from Table 1.

7.1.4 Apply the test voltage from zero to specified value as uniformly as possible, at a rate of approximately ½ of the test voltage per second (V/s), unless otherwise specified. For example, Level 2 in Table 1, the ramp rate is 250 V/s for a test voltage of 500 V dc.

7.1.5 Apply test voltage to switch assembly for 60 s.

7.1.6 Record visual changes or leakage current, or both, if any.

7.1.7 Dissipate all charges to ground using appropriate methods prior to continuing test to next test voltage (repeat 7.1.3 to 7.1.7 as needed).

7.1.8 Repeat measurements recorded in 7.1.1 and 7.1.2.

7.2 *Dielectric Breakdown Method:*

7.2.1 Connect two test points on the Membrane Switch or Printed Electronic Device, each to a separate polarity, on the voltage source.

7.2.2 Apply the voltage incrementally from zero to breakdown as uniformly as possible, at a rate of 250 V/s unless otherwise specified.

7.2.2.1 Apply test voltage to switch assembly for 60 s at each incremental test voltage.

**TABLE 1 Test Voltage[A]**

| | Test Voltage | Ramp Rate (V/s) |
|---|---|---|
| Level 1 | 250 dc | 125 |
| Level 2 | 500 dc | 250 |
| Level 3 | 1000 dc | 500 |
| Level 4 | As specified (ac or dc) | As specified |

[A]All dwell times at maximum voltage = 60 s.

7.2.3 Record visual changes and magnitude of breakdown voltage, if any.

7.2.4 Dissipate all charges to ground using appropriate methods prior to continuing test to additional test points (repeat 7.2.1 to 7.2.4).

## 8. Report

8.1 Report the following information:

8.1.1 Temperature,

8.1.2 Relative humidity,

8.1.3 Specified dielectric withstand voltage (pass or fail),

8.1.4 Circuit resistance pre and post (Dielectric Withstand Test), Membrane Switch only,

8.1.5 Capacitance pre and post (Dielectric Withstand Test), Membrane Switch only,

8.1.6 Dielectric breakdown voltage,

8.1.7 Actual applied voltage or failure voltage,

8.1.8 Duration of applied voltage,

8.1.9 Description of test equipment,

8.1.10 Voltage ramp rate,

8.1.11 Part number or description of switch, or both,

8.1.12 Description of test points,

8.1.13 Date of test,

8.1.14 Description of visual change (if applicable),

## 9. Precision and Bias

9.1 *Precision*—It is not possible to specify the precision of the procedure in Test Method F1662 for measuring the dielectric withstand because inter-laboratory studies have proven inconclusive due to insufficient participating laboratories with the appropriate equipment.

9.2 *Bias*—No information can be presented on the bias of the procedure in Test Method F1662 for measuring dielectric withstand because no standard sample is available for this industry.

## 10. Keywords

10.1 dielectric withstand voltage; dielectric breakdown voltage; membrane switch