ECMA

EUROPEAN COMPUTER MANUFACTURERS ASSOCIATION

ELECTROSTATIC DISCHARGE SUSCEPTIBILITY

TR/23

September 1984

Free copies of this document are available from ECMA,
European Computer Manufacturers Association
114 Rue du Rhône – 1204 Geneva (Switzerland)

ECMA

EUROPEAN COMPUTER MANUFACTURERS ASSOCIATION

ELECTROSTATIC DISCHARGE SUSCEPTIBILITY

TR/23

September 1984

TABLE OF CONTENTS

1. SCOPE

This Technical Report ECMA/TR23 defines tests to be applied to Information Technology Equipment (ITE) to assess its susceptibility to typical electrostatic discharges which can occur in vicinity of and to the external surfaces of the equipment for particular environment and installation conditions.

The target of the test procedures defined in this Technical Report is to achieve reproducibility of the test results in the laboratory and correlation with those in actual usage conditions.

This Technical Report defines the environment and the parameters concerning the test conditions, defining :

- the test laboratory reference conditions (see section 5) ;
- the test generator (see section 6) ;
- the test set-up (see section 7) ;
- the test procedure (see section 8).

Further work is required in order to finalize a standard test method which could be suitable for type testing.

2. FIELD OF APPLICATION

This Technical Report applies to ITE. These tests are recommended for equipment that, due to environmental and installation conditions, can be subjected to electrostatic discharges in normal use.

3. REFERENCES

This Technical Report is based on work done in the ITE industry and in IEC TC65 which resulted in Publication 654-5.

ECMA is of the opinion that Publication 654-5, which was prepared for process control equipment, requires considerable modification in order to cater for the environment and technology of ITE. To this end this Technical Report specifies the adverse conditions anticipated in the ITE environment.

4. DEFINITIONS

For the purpose of this Technical Report the following definitions apply.

4.1 Energy Storage Capacitor

The capacitor of the Electrostatic Discharge (ESD) generator representing the capacitance of a body charged to the test voltage value.

4.2 Equipment Under Test (EUT)

The EUT may be a single unit or a total system of interconnected units.

4.3 Ground Reference Plane

A conductive sheet or plate used as common voltage reference level for the EUT, the ESD generator, the operator and the auxiliary equipment.

4.4 Information Technology Equipment (ITE)

Electrical/electronic units or systems which predominantly generate a multiplicity of periodic binary pulsed electrical/electronic wave forms and are designed to perform functions such as electronic word processing, electronic computation, data transformation, recording, filing, sorting, storage, retrieval and transfer, and reproduction of data and/or images.

4.5 Static Electricity Discharge

The transfer of electrostatic charge between bodies of different electrostatic potential.

4.6 Susceptibility

The incapability of a device, equipment or system to resist an electromagnetic disturbance (see IEV 902-01-63).

5. TEST CONDITIONS

5.1 General

In order to ensure repeatability the tests shall be carried out in the conditions defined below. The actual environment conditions prevailing during the test shall be logged for future correlation purposes. Unless otherwise stated all tolerances are ± 10 %.

5.2 Climatic Conditions

Unless different conditions are defined by the manufacturer the tests shall be made within the following conditions :

- temperature 15 °C to 35 °C
- relative humidity 45 % to 75 %
- atmospheric pressure 85 kPa to 105 kPa

NOTE 1

Tests can be done outside the specific climatic conditions provided the manufacturer can demonstrate that the results are not affected. ECMA will appreciate any feedback on influence of climatic conditions on test results.

5.3 Electromagnetic Conditions

The ambient electromagnetic conditions shall be such as not to influence the results of this test.

6. TEST GENERATOR

6.1 General

The test generator shall include an energy storage capacitance (Cs) and a discharge resistance (Rd), the capacitance being charged to the specified test voltage by means of a high voltage generator (see Fig. 1).

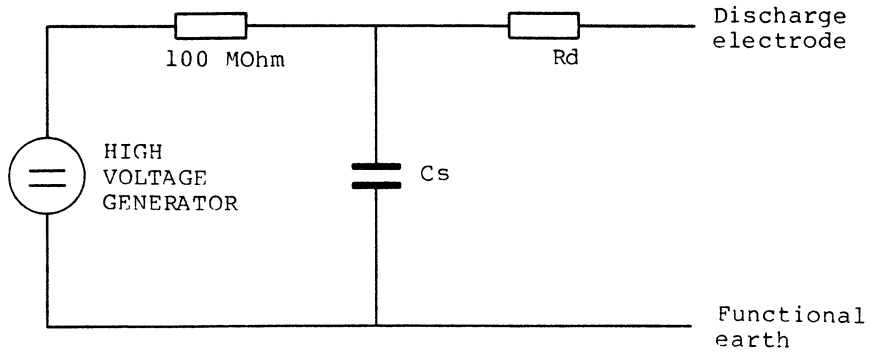


Fig. 1a Test Generator with External Gap

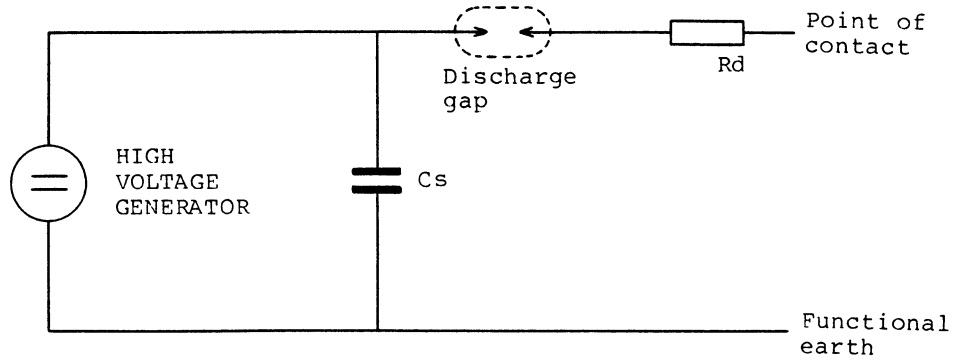


Fig. 1b Test Generator with Internal Gap

Fig. 1 - Main Parts of Test Generator Circuits

The discharge shall occur between the storage capacitance and the EUT.

The discharge spark may be arranged to occur in an appropriately designed gap within the probe to improve repeatability.

6.2 Discharge Characteristics

Two sets of different characteristics have been chosen to simulate the extreme conditions which the EUT may experience in use.

The applicability of these characteristics and the test voltages to be specified shall be chosen according to the anticipated exposure of the equipment surface concerned.

There is no fundamental reason why the test voltage appropriate to each set of characteristics should be the same.

These conditions are :

- Discharge specification I : direct finger discharge
- Discharge specification II : discharge from or through a metal object.

DISCHARGE SPECIFICATION	I	II
Storage Capacitance (Cs) pF	150	150
Discharge Resistance (Rd) Ohm	1000	20
Current Rise Time (10 % - 90 %) ns (±30 %)	< 5	5

The following characteristics pertain to the two conditions :

- Pulse repetition rate, minimum range : 1 Hz - 20 Hz.
- Maximum average current, under either condition : 3,5 mA.
- Charge voltage continuously adjustable within the test range.
- Polarity of charge voltage : selectable.

The test generator shall be designed so that it does not superimpose spikes which exceed 100 V peak on the mains power suplly lines to the EUT. These spikes are to be measured between the supply conductors and between any one supply conductor and the earth.

6.3 Construction

The test generator shall comprise a test probe to apply the discharges to the test point and a high voltage generator. The two units can be combined into a single unit.

The test generator and its probe shall be provided with :

- protective earth terminal, if the power supply is mains driven ;
- means to adjust the charge voltage ;
- means to adjust the discharge repetition rate.

In addition, an optional discharge indicator (acoustical or visual) can be provided.

The test probe shall have the following characteristics :

- allow exploration of any test point ;
- if hand-held, its handle shall not introduce an additional capacitance of more than 15 pF. This capacitance shall be measured between metal foil wrapped around the handle and the live terminal of Cs ;
- if hand-held and with a metallic handle, the handle shall be connected to the protective earth terminal ;
- be provided with a functional earth terminal, internally, connected to the zero reference voltage, for connection to the earth terminal of the EUT (see Fig. 2) or to the ground plane or alternatively provided with a self-contained reference plane which is capacitively coupled to the conductive floor ground plane (see Fig.3) ;
- have a discharge electrode terminated by a convex hemisphere with a radius of 2 mm, where the spark occurs between the discharge electrode and the EUT, or
- have a needle point to provide good electrical contact with the EUT where the spark occurs internal to the test probe.

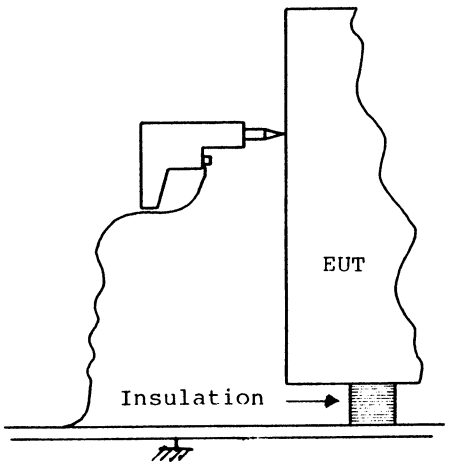


Fig. 2 - Grounding of basic ESD tester via functional ground strap

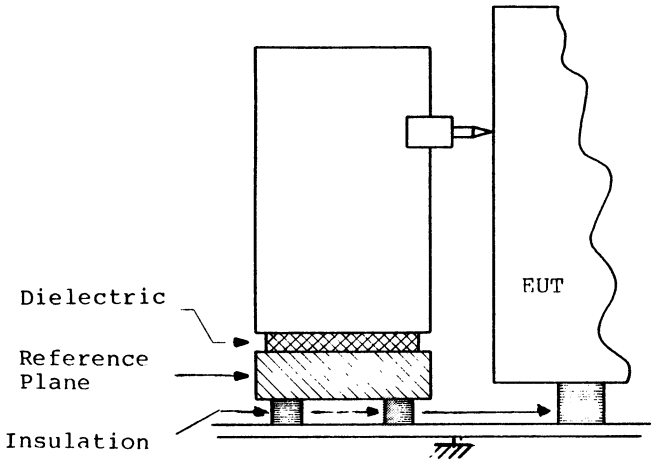


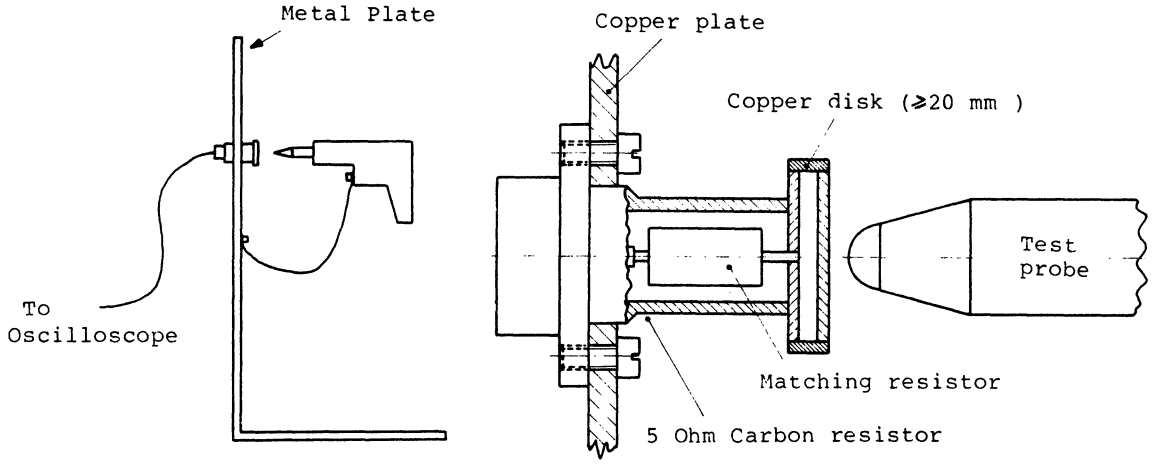
Fig. 3 - Grounding of ESD tester via self-contained reference plane

NOTE 2

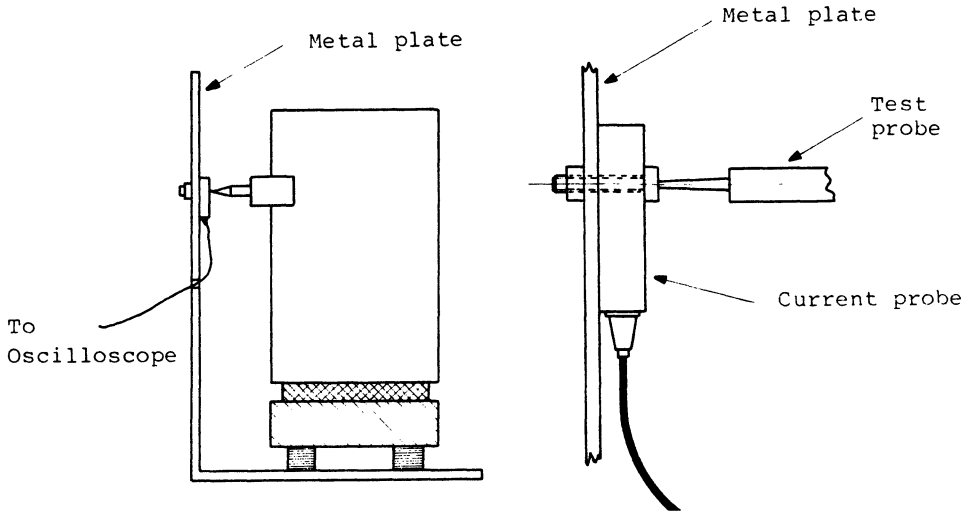
In order to meet the requirements of the waveform specified in 6.2, it is recommended that the storage capacitance and the discharge resistor be mounted in the probe or in close proximity to it, or alternatively a portion of the storage capacitance might be formed by a metallic structure forming one plate of a distributed capacitance as normally presented by a human body. It is also recommended that the charge resistor or at leat a portion of it of a value not less than one hundred times Rd, is placed closely to Cs in order to decouple Cs from the capacity of the cables, if any.

6.4 Verification of the Characteristics

The characteristics of the test generator defined in 6.2 shall be verified with a probe connected to an oscilloscope (see Fig. 4).



Calibration fixture with voltage divider



Calibration fixture with current clamp

Fig. 4 Set-up for the checking of ESD Generator Characteristics.

The probe and the oscilloscope shall have an adequate transient response. The following parameters of the test generator shall be verified.

- rise time of the discharge current (10 % - 90 %),
- pulse duration (50 % - 50 %),
- current peak value (this shall relate to the nominal values of the output voltage and discharge resistor within ± 30 %).

7. TEST SET-UP

7.1 General

7.1.1 Test generator

The functional earth terminal shall be connected to the ground of reference. Where galvanic connection is required, this shall be implemented with low impedance connections, by using for example clamping devices for high current, high frequency applications.

The test generator shall be earthed in close proximity to the EUT on the ground of reference of the installation (see Fig. 2). Test generators having a self-contained reference plane shall be capacitively coupled to the floor plane by the inherent capacitance (see Fig. 3).

7.1.2 EUT

The EUT shall be tested under normal operating conditions, with particular attention to the installation specifications.

All interfaces available shall be operational.

Additional ground connections other than in the installation specifications shall not be used during testing.

The EUT shall be placed at a minimum horizontal distance of 1 m from any metallic structure.

7.2 Table-top-Equipment

The ground of reference for table-top-EUT shall be represented by a conductive plate on the table which shall extend at least 100 mm around the EUT and be connected to the safety earth system of the installation. The EUT shall be insulated from the conductive plate by 1 mm insulation thickness. Mounting feet, if any, shall be left in situ. Thickness and dielectric constants of the insulation are not critical.

Signal cables shall be allowed to rest on, but insulated from, the conductive plate either for their full length or for the width of the conductive plate, whichever is the least.

7.3 Floor-standing Equipment

The ground plane of reference for floor-standing equipment shall be represented by a conductive plate laid on the floor under the equipment, which shall extend at least 500 mm around all sides of the equipment. The minimum size of the ground plane shall be 2 m by 2 m. The ground plane shall be connected to the safety earth system of the installation. The EUT shall be insulated from the conductive plate. The signal cables shall be separated from the ground plane by 100 mm.

8. TEST PROCEDURE

8.1 Selection of Test Voltage Value

It is recommended that the value of the test voltage be selected in accordance with the actual environmental conditions where the equipment is installed ; in particular the materials or fabrics involved in the production of static electricity and the relative humidity shall be taken into account.

NOTE 3

Electrostatic voltage values obtained by conventional electrotastic voltmeters on computer sites are not necessarily an indication of the voltage setting that shall be applied in the use of these testers. The correlation between electrostatic voltage values and test voltage values has to be established for each type of probe. Correlation between the types of probes is under consideration.

8.2 Selection of Test Points

To speed up the test procedure and to increase the probability of malfunction detection it is desirable to select test points using a higher repetition rate in order to establish the more vulnerable areas. Both discharge specifications (see 6.2) shall be considered for each test point.

The electrostatic discharges shall be applied to the EUT on preselected, operator-accessible, points and in the case of table-top equipment, to the surface of the metal plate supporting the equipment under test.

The test points to be considered shall include the following locations as applicable :

- any point in the control or keyboard area and any other point of man-machine communication devices such as switches, knobs, buttons and other operator-accessible areas ;

- points of each portion of the metallic cabinet where such portions are isolated electrically from ground ;

- points on insulated enclosures which are nearest to conductive portions of the enclosed circuitry. This is to check that, if the insulation breaks down, there is a significant effect ;

- a parallel metal plate, having the same dimension as the presented face of the EUT, bonded to the ground plane and in close proximity (100 mm) to the EUT, where a surface of the equipment cannot be contacted directly. This plate shall be presented in turn to each face of the EUT.

  The plate might be the body of the tester itself that will be discharged into the internal reference ground (see Fig. 5) ;

NOTE 4

A small metal plate might be used, which can be repositioned in order to cover all surfaces of the EUT.

- other points which may be considered vulnerable.

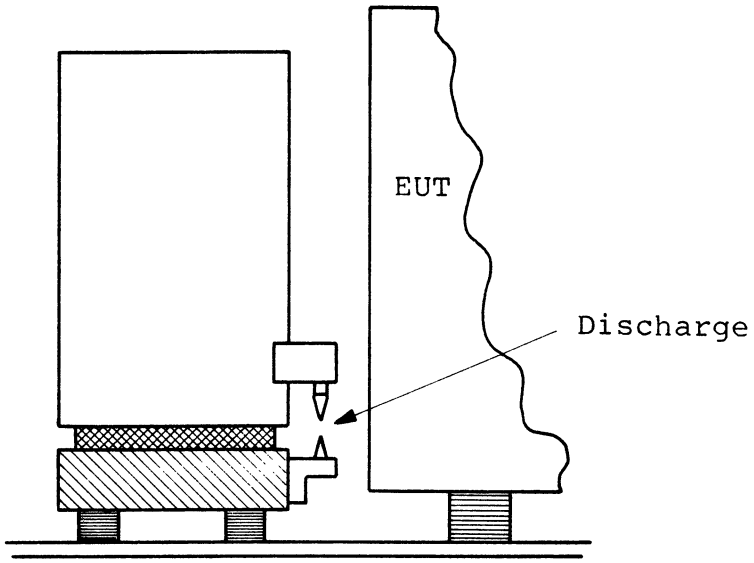


Fig. 5 - Indirect Discharge for Testing Dielectric Surfaces

Where equipment metalwork or the test plate is isolated from ground it may acquire a charge which inhibits further discharge pulses ; in which case that item shall be discharged to earth in between discharges from the test probe.

The discharge to earth shall be effected by an earthed probe similar to the tip of the tester or by a suitable resistor.

The discharges shall be applied to each interconnected equipment or peripheral, if any.

8.3 EUT Software

EUT software shall be chosen in such a way as to exercise all modes of normal operation.

8.4 Application of the Discharges

Discharges shall be applied to all previously selected test points with the equipment operating normally. The output voltage of the test generator shall be adjusted at the appropriate value and at least 50 discharges, with a repetition rate sufficiently low as not to introduce any cumulative effect, shall be applied at each selected point.

Where the discharge occurs at the surface of the EUT (see Fig. 1a), the test finger of the probe shall be brought towards the surface until the discharge occurs ; actual contact shall be avoided.

During the test the probe shall be substantially perpendicular to the discharge application surface.

In order to stabilize the effect of the ground strap, the functional ground strap where required shall be kept as short as practical and be perpendicular to the surface under test (see Fig. 2).

8.5 Evaluation of Results

During testing the EUT shall conform to the manufacturer specifications. The following criteria shall be considered :

- software recovery
- operator intervention
- corruption of data
- damage to media
- protective devices operation
- damage to equipment

The test results shall be evaluated and compared with the acceptable values stated in the functional specifications (or upon agreement between manufacturers and users).

Any incident requiring operator intervention or correction or where wrong output data is generated is to be regarded as a failure.