

Risks of damage to electronics with reference to charged clothing

By

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ESTAT
Garments

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Outline

- ESTAT-Garments project objective
- Presentation:
 - Goals
 - Why use ESD protective clothing?
 - ESD protective clothing requirements
 - Conclusion
- Project references

Project objective

- Risk assessment for devices with respect to normal clothing.
 - Direct discharges
 - Induction charging
- Description of the system / Modelling of the system
- Evaluation of present test methods
 - Development of new test methods
- Round robin test and evaluation
- Recommendation of new test methods to TC101

Goals

In this paper we are looking for answers to questions:

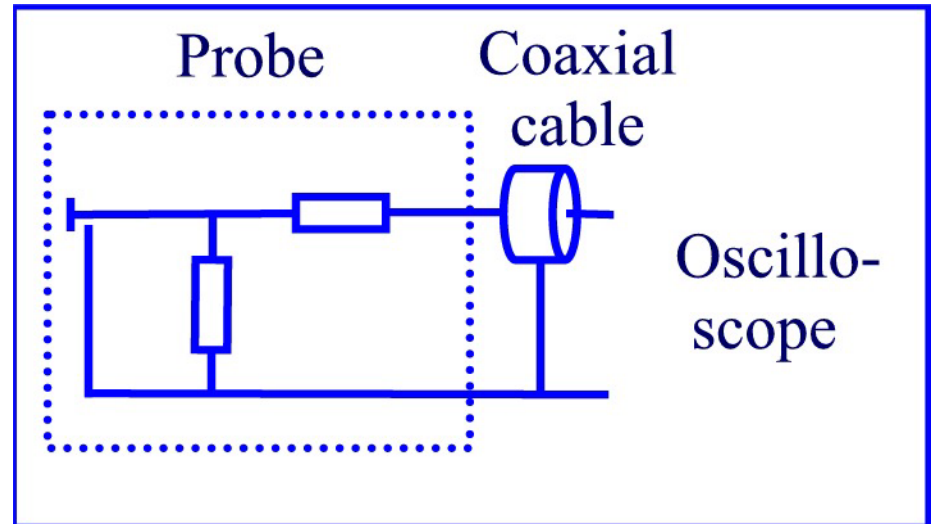
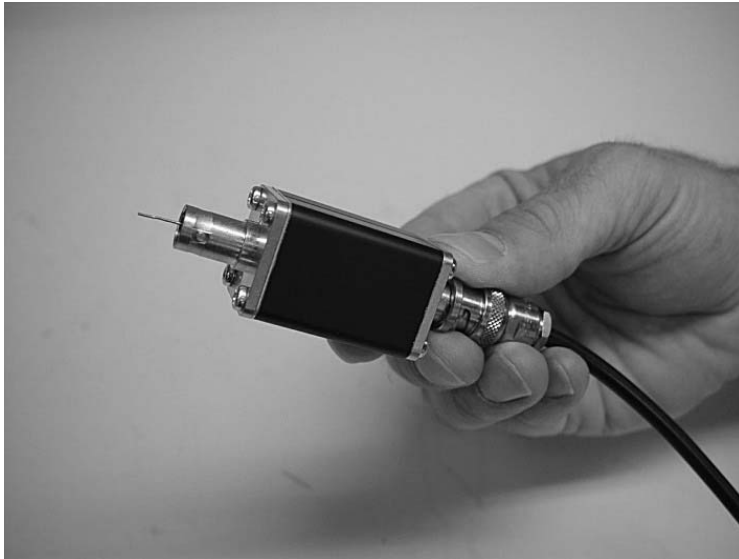
- What are the key parameters of ESD which must be controlled with reference to charged clothing in order to minimise risk of damage to ESD sensitive devices (ESDS)?
- What are the threshold levels of these parameters below which the ESD risk is low?

Why use ESD protective clothing ?

- ESD sensitive devices (ESDS) can potentially be damaged due to static electricity in three ways:
 - 1) Through a direct discharge to a grounded ESDS.
 - 2) Through a direct discharge from a charged ESDS.
 - 3) By EMI induced voltages (ESD or other pulse induced).
- Normal clothing:
 - can easily be charged to several kV and with additional rubbing be charged up to 20 kV.
 - can at a direct discharge, give peak currents up to 0.8 A and deliver up to 320 nC of charge (we measured a maximum of 320 nC).

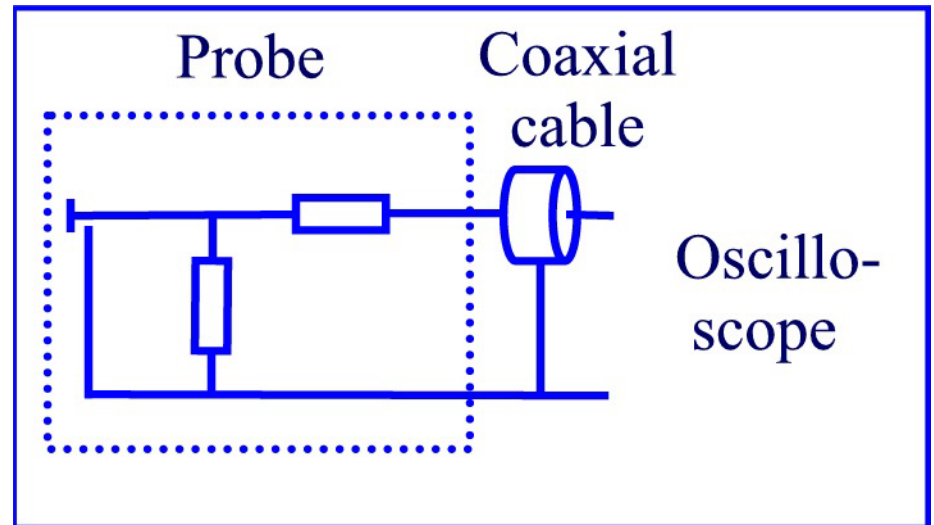
Why use ESD protective clothing ?

- Discharge probe (SP type):



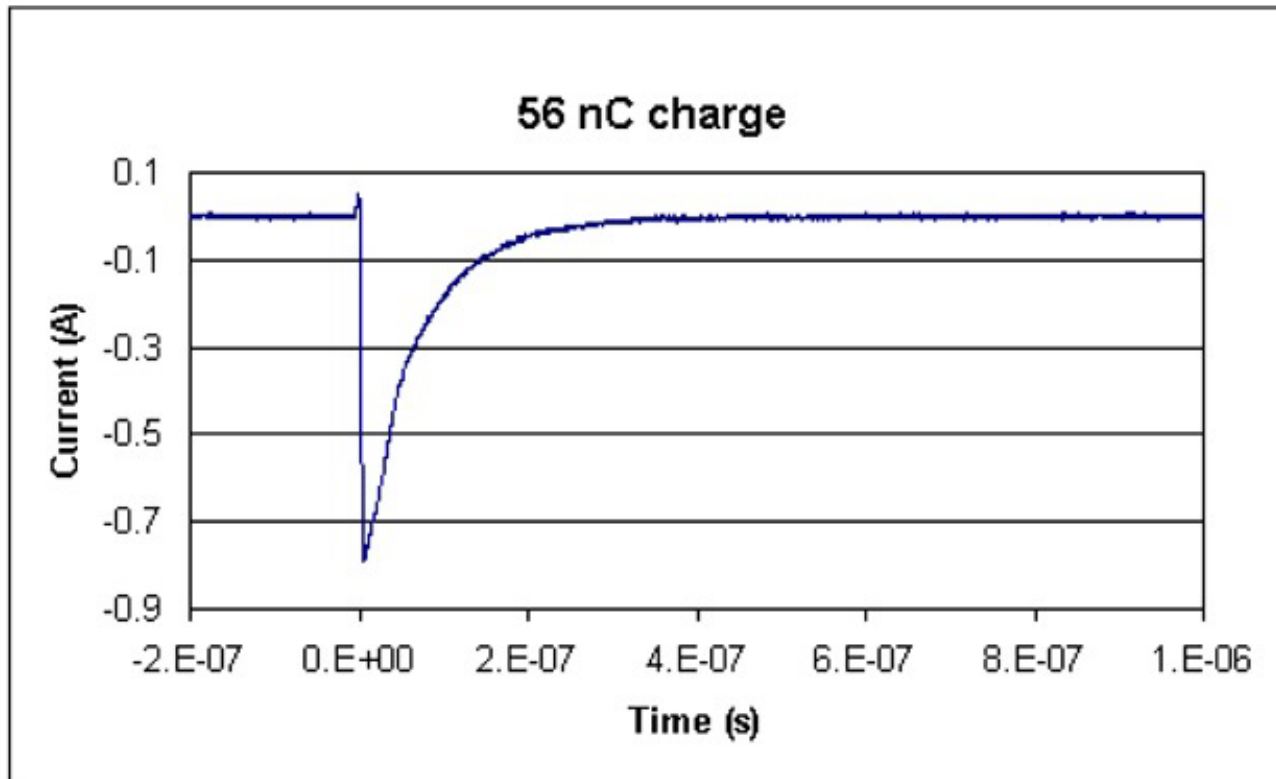
Why use ESD protective clothing ?

- Discharge probe (ESL):



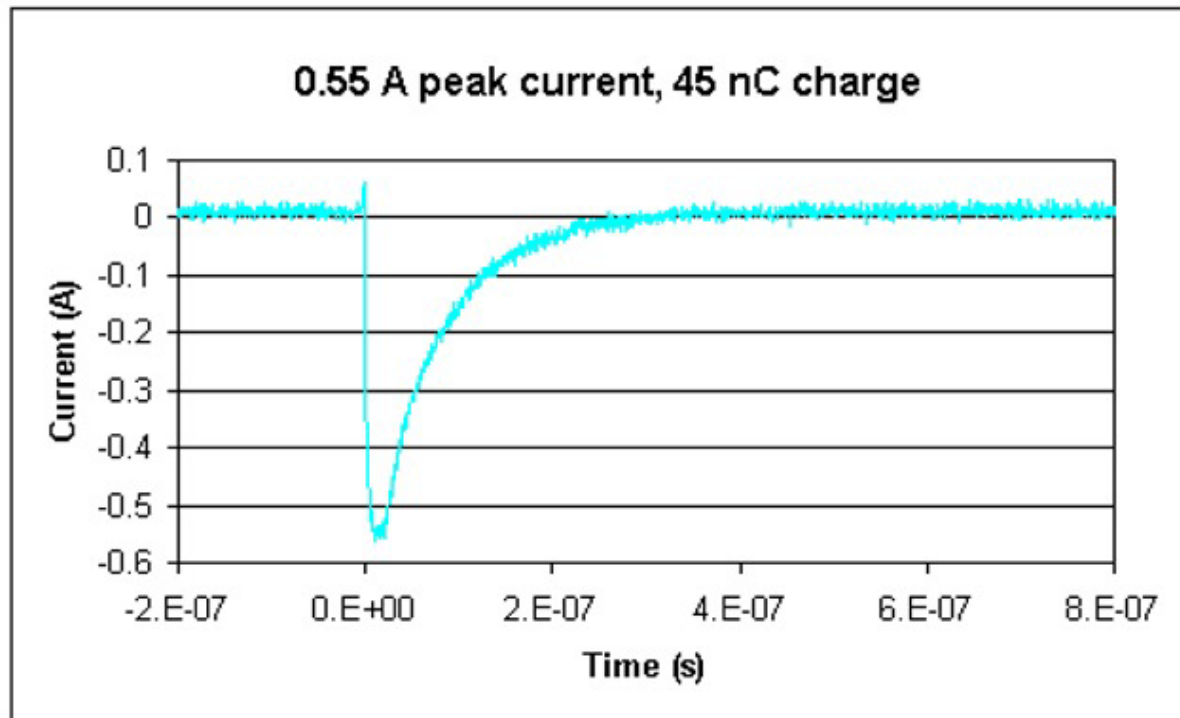
Why use ESD protective clothing ?

- Direct discharge from a charged normal polyester coat.



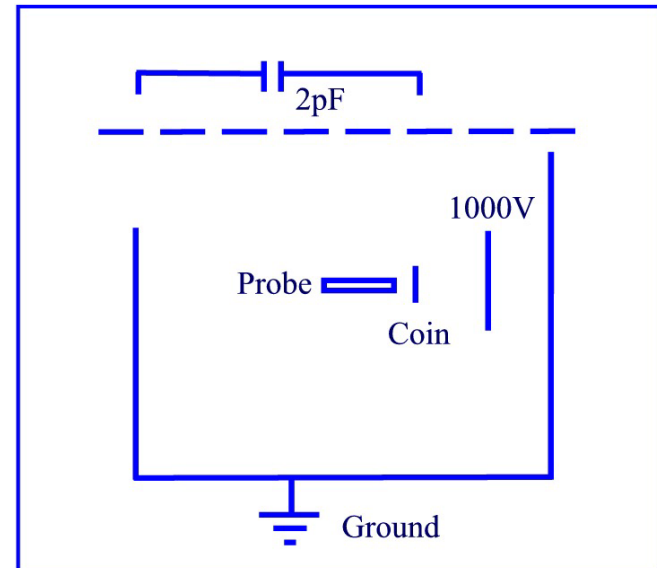
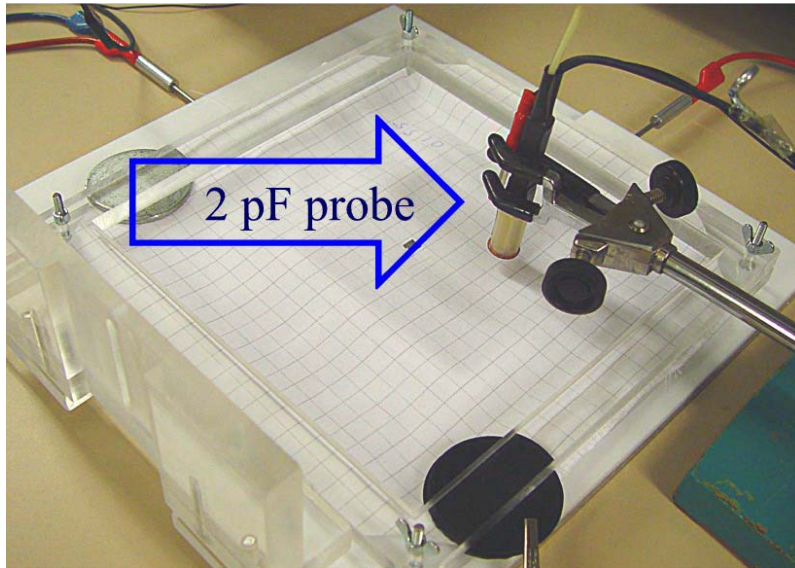
Why use ESD protective clothing ?

- Direct discharge from a charged normal polyester cotton coat.

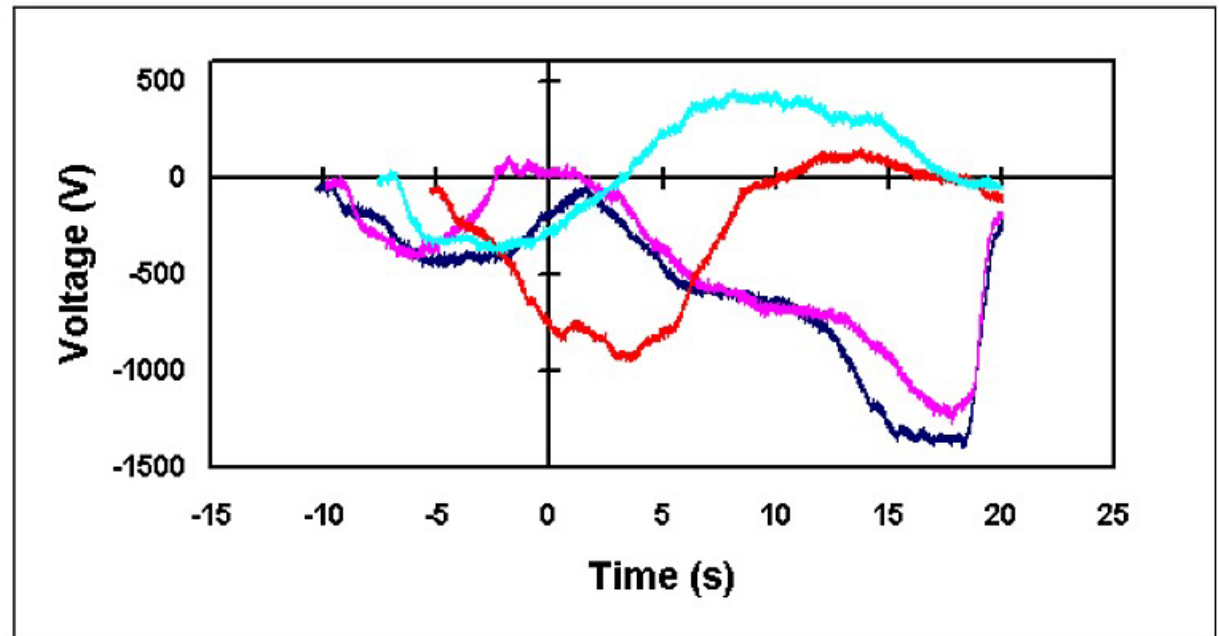


Why use ESD protective clothing ?

- DC potential probe with a 15 mm coin and a 2 pF dummy device.



Why use ESD protective clothing ?

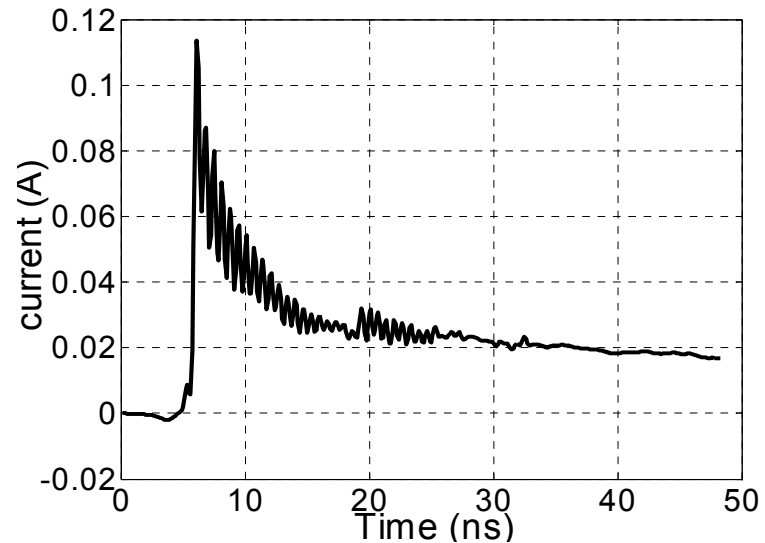
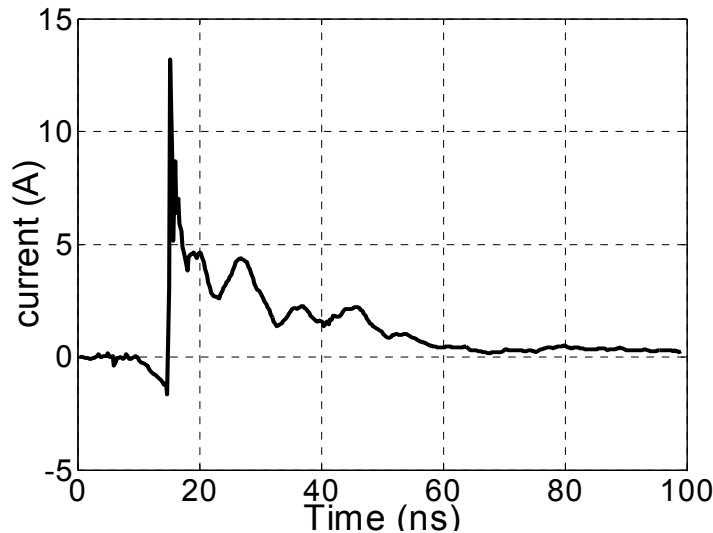


Voltage induced on a 15 mm, 2 pF, dummy device.

ESD protective clothing requirements

- ESD protective clothing should:
 - prevent direct discharges from the normal clothing to ESDS (1).
 - avoid induction charging of ESDS in the E-field originating from the normal clothing (2).
 - ESD protective clothing should itself also not cause any of the above mentioned problems.

ESD protective clothing requirements



- ESD current waveforms from unearthed ESD fabric charged to 2 kV: (a) fabric with stainless steel threads, (b) fabric with surface conducting carbon fibre threads. Only the initial part of the discharge curve is shown in the figures.

ESD protective clothing requirements

Comparison between ordinary clothing and ESD protective garments.

Both are tribo charged by hand and all measurements are done by with the 2 pF induction charging probe (dummy device).

| Type of fabric | Dynamic Max Voltage [V] | Static Max Voltage [V] |
|-------------------|-------------------------|------------------------|
| Ordinary clothing | - | 1500 |
| CC05 | 100 | 50 |
| CC10 | 180 | 130 |
| SC05 | 80 | 0 |
| SC10 | 130 | 0 |
| SS05 | 50 | <10 |
| SS10 | 100 | 20 |

ESD protective clothing can't....

- State of the art ESD protective clothing does not have any measurable damping effect on EMI.
- Energy levels from clothing induced EMI are, however, too low to damage electronics.

Conclusions

- ESD risks associated with charged clothing can be minimised by using ESD protective garments.
- It is not straightforward to give strict recommendations when there is clear benefit for the use of ESD protective garments, because the benefits depend on
 - the ESD susceptibility of devices being handled
 - costs and consequences of ESD failures
 - humidity and temperature of the environment, etc.
- The use of ESD garments should be considered
 - if the Charged Device Model (CDM) withstand of devices being handled is ≤ 500 V.
 - if the Human Body Model (HBM) withstand of devices being handled is ≤ 1000 V.

Main results of the ESTAT-Garments project have been published in

- Evaluation of existing test methods for ESD garments, VTT Research report No BTUO45-041224, 2004
- ESTAT-Garments interlaboratory tests, VTT Research report No BTUO45-051337, 2005
- Recommendations for the use and test of ESD protective garments in electronics industry, VTT Research report No BTUO45-051338, 2005
- All available at <http://estat.vtt.fi>