ESD CURRENT WAVES

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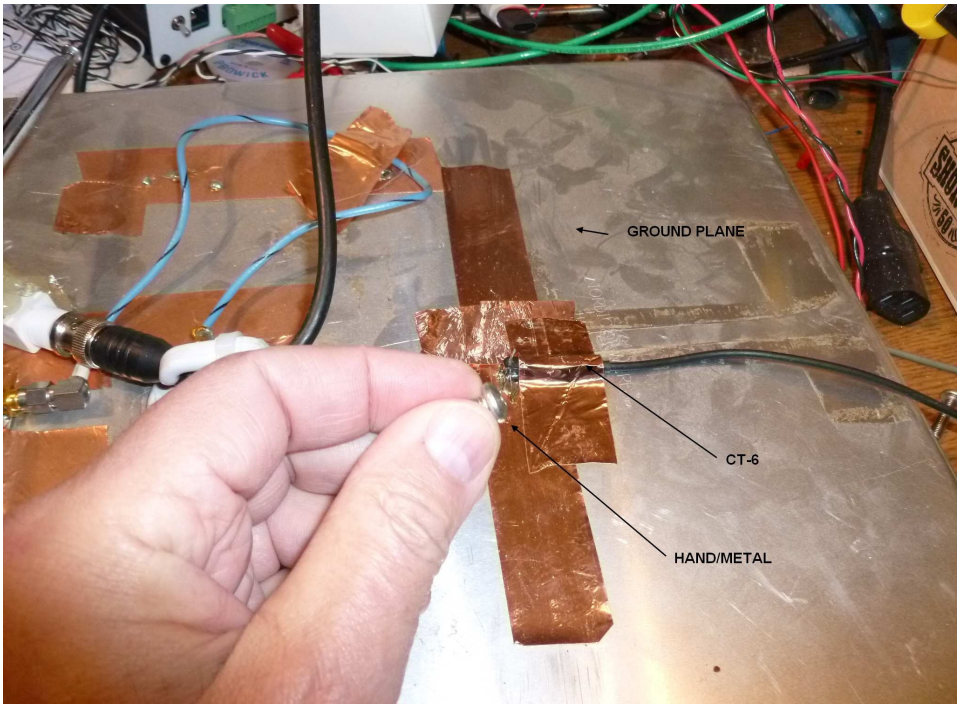
Current waveforms taken with a Tektronix SCD1000 digitizer and a CT-6 current probe on a ground plane. The SCD-1000 is 1 GHz bandwidth; the CT-6 is 2 GHz. Combined system rise time is 391 ps.



Test setup. The ground plane is an aluminum cookie sheet. Evidence of previous experiments visible, only the CT-6 was active for this data. The hand and other objects were charged through a 10 meg low capacitance resistor.

Human Hand/Metal

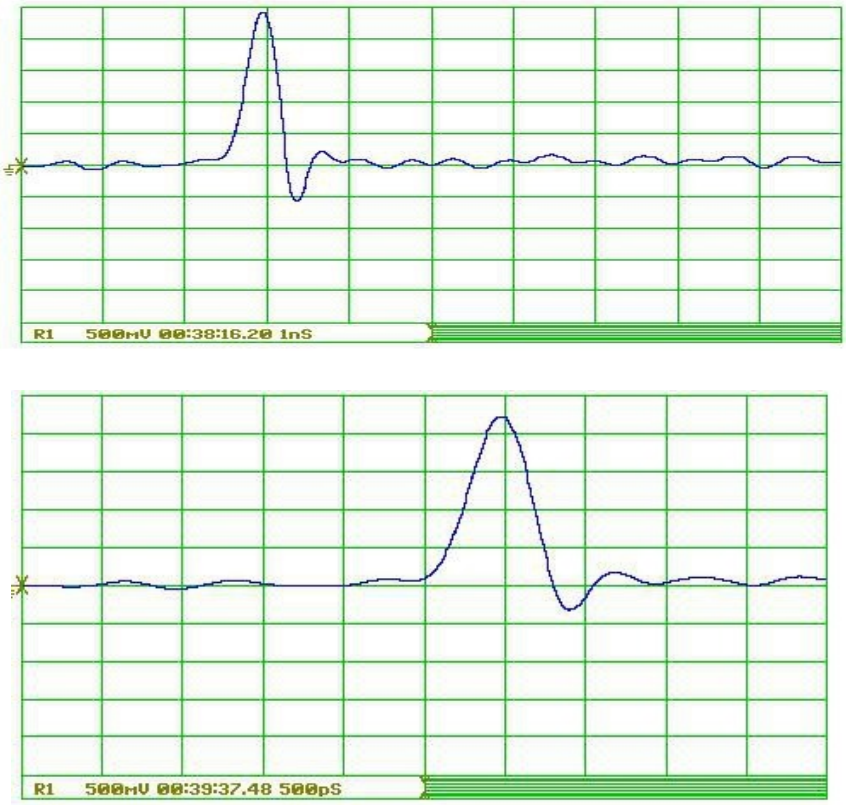
Human Hand/Metal discharge. Note the lower left corner of the figure, this is the volts and time per division. These numbers will vary between these figures, note carefully. The scale factor is such that 1V = 1A of discharge current unless otherwise noted. This and all other discharges performed at 1 kV. The high amplitude initial spike associated with Hand/Metal discharges is clearly visible, above 4A/kV.

Detail of the initial spike. Note that the apparent rise time is indistinguishable from the system rise time, indicating that the actual TR is much faster.

FINGERTIP DISCHARGE

Some discharges taken directly from the fingertip, no metal.
Note that the initial spike is mostly gone, and the amplitude is approx. 10% of the Hand/Metal discharge.

CDM



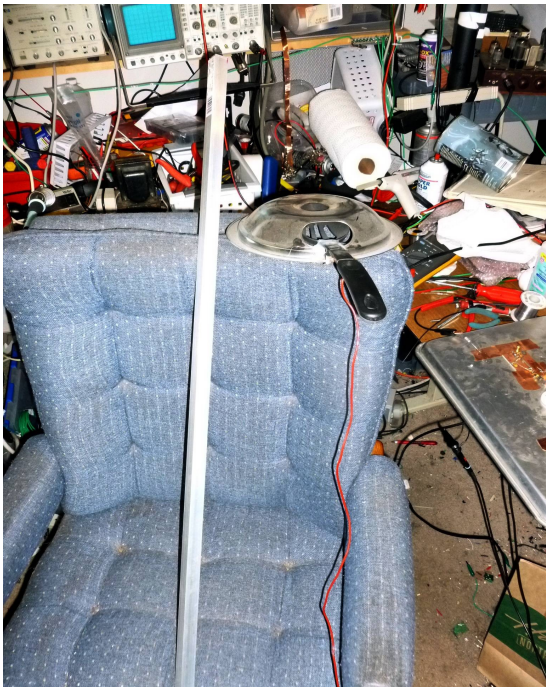
A couple of CDM discharges at different time scales. This is a 14 pin DIP package charged from a very low, (<.1 pF) source.

FURNITURE DISCHAGES

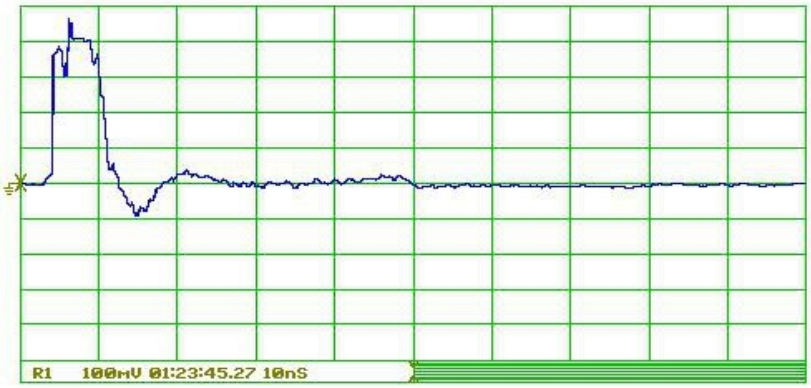
Furniture ESD has an interesting history. It dates back to 1960 when IBM began shipping their first generation of transistorized computer. They received many complaints from the field documenting crashes from events such as backing a chair into a file cabinet. This lead IBM to develop the crossed vane ESD simulator.

The vane structure is charged to high voltage and discharged repeatedly into the target through a relay probe at rates up to 60 Hz. It produces a highly damped sine wave at approximately 20 MHz with a fast rise over the first 45% of the peak. Wave picture N/A.

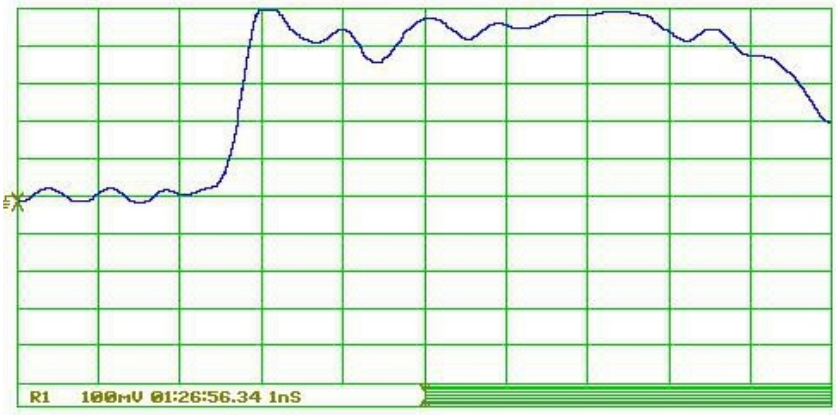
For the purposes of this data base “furniture” is considered to include any relatively large (compared to a human hand) metal object.

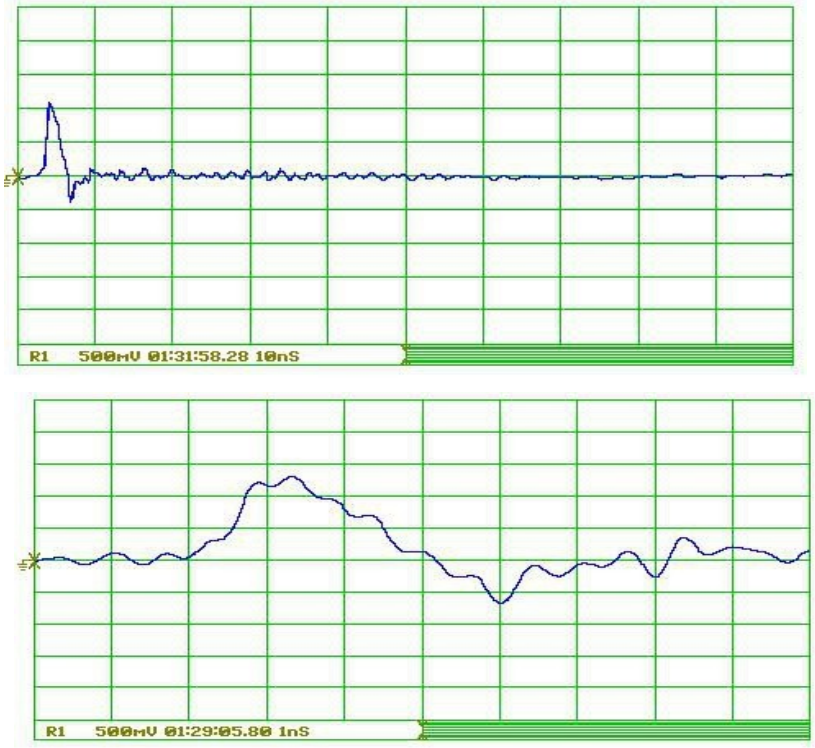


“Furniture” test objects. 3' long aluminum strip and 8” diameter heat reflector with a plastic handle. There was an additional 20 dB attenuator in the signal path due to the large amplitude of these discharges. The effective scale is 10A/V as opposed to 1A/V previously.



3' strip at 1 kV.





8” disk, 1kV. Peak I is over 10A

Conclusion:

All discharges can easily have rise times under 1 ns. The only consistent variable is duration and peak amplitude. They are mostly unipolar which has the additional complication that the Fourier series will include components down to DC. Discriminating between different ESD types in a practical ESD detector will be difficult.

Future investigations should be both a practical antenna suitable for a commercial ESD detector and a broad band E field probe to see if the radiated field collapse resembles the discharge current. Such an E field probe may make a good antenna for an ESD detector.