Energy Calibration of IEC/HMM Sources
9/3/2011
JEB

The purpose of WG 5.6 is to identify and prepare a standard for HMM test methods using IEC guns developed for System Level testing. This test source has now become the primary HMM test method for testing of interface devices to identify immunity levels. We also use the wide IEC waveform tolerances which are acceptable for System Level testing but which present wide energy threats to devices in HMM testing. Our charge is to provide a standard test method with a goal of improving test tolerances. The IEC system level waveform tolerances, which we use has been a fundamental limitation in our attempts to reduce immunity level variations. System level testing permits these wide waveform tolerances; but make it impossible to improve the failure level variations with test levels defined by voltages.

The IEC specifies +/- 30% current waveform tolerances at 30 and 60 ns. It also allows a +/- 15% tolerance for the peak current. Possible current variations permit more than +/- 60% variations in energy. The limited waveform parameter specifications put no limit on additional current variations at times other than the peak, 30 ns, and 60 ns. Because the HMM test determines failure by energy dissipation, WG 5.6 needs to improve test specifications which relate to energy. The energy in the IEC pulse cannot be accurately related to test pulse voltage; but over its voltage range gun energy can be measured.

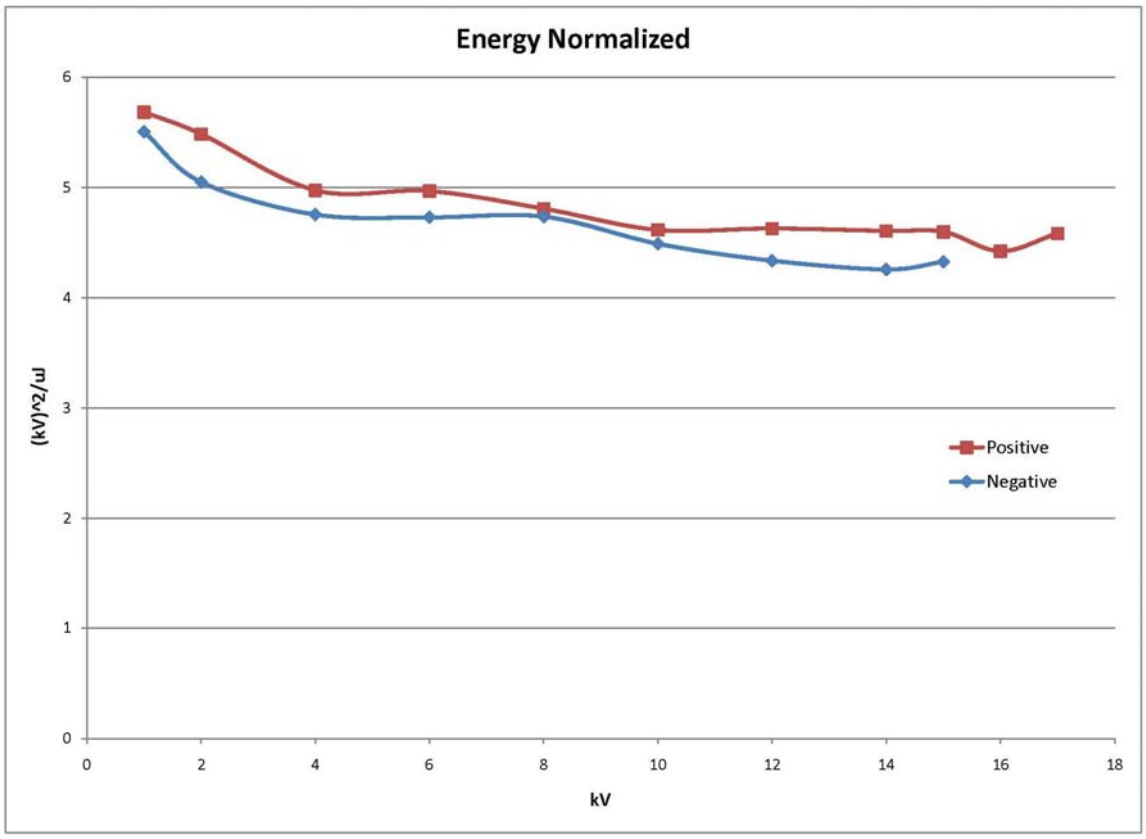
Although we cannot change existing guns to produce repeatable energy levels, we can calibrate them to identify their energy level delivered at specific test pulse voltages. The goal is to identify the energy delivered over its voltage range for each gun.

When the energy delivered at any voltage setting is known, the user can select their gun's test voltage to provide any level of DUT energy. ESD designers can use test pulse voltage specifications which then identify μJoules delivered.

The ESDA symposium is a technical gathering that has similar interests in improving ESD testing. This year is an excellent opportunity to begin the HMM calibration effort. We sent a notice to all on our mailing list who may attend the 2011 EOS/ESD symposium exhibits, to bring their IEC guns for calibration. We will have our wide bandwidth, one ohm current sensor in our 2 meter diameter ground plane at our exhibit booth #119. It will take only a few minutes to measure and digitize the current waveform of each HMM source over its range of voltages. The measured waveforms will be put into an Excel spreadsheet which will calculate and plot its energy at selected test pulse voltages. It will also identify the test pulse energy variation from its nominal value, at both polarities.

If WG 5.6 chooses to use this calibration method, we can begin a new and improved definition of HMM test threat which will improve failure/immunity level measurements.

Calibration of energy at kV settings for a commonly used ESD gun is shown below.



Normalized $kV^2/\mu Joule$ for an IEC gun over its kV range

Once a HMM source is calibrated, testing at voltage will identify its pulse energy and provide all concerned users with the equivalent threat levels from that source. There will be variations in nominal energy with different guns, and within each gun's voltage range. This large amount of data may need to be available on an internet data base. Manufacturers and users of ESD protected silicon can set their IEC source test pulse voltage to match whatever energy value another tester may use.

Requirements for testing at voltage test levels can continue in the same way with the same gun; but now the actual energy produced will also be available. Known HMM energy test levels by manufacturers and users will improve their correlation by testing at equal energy levels.

My long held suspicion that gun energy is not proportional to voltage squared was found to be correct in our measurements and calibration of the above gun. The variations with pulse voltage are clearly identified when plotted in this manner. The variation from the normalized $kV^2/\mu Joule$ for both polarities over this gun's total voltage range is 34%. I can only assume that other HMM pulse sources may have similar variations over their voltage range. Calibration will also identify average $kV^2/\mu Joule$ factors.

The cause of this nonlinearity can be discussed at our next 5.6 meeting along with questions about this calibration method.

If WG 5.6 votes to accept this calibration method, we will begin a major improvement in specifying a test method that reduces variations in failure levels.

Barth Electronics is starting this process at the 2011 Symposium exhibits. If you would like to have your gun or 50 ohm source calibrated for free, bring it to Anaheim. Calibration later will not be free.

I will be interested in hearing the best explanation as to why you took an ESD gun on your flight. Although I am asking you to bring your ESD gun to the exhibit, I cannot provide funds to bail you out.

Regards,
Jon Barth