DRAFT

Enpirion POL Converter

Heavy Ion Testing

Discussion

Heavy ion testing was performed August 15, 2008 at the 88" cyclotron of Lawence Berkeley Laboratory (http://cyclotron.lbl.gov/.) 10MeV Xenon was the only ion used in the test of the Enpirion devices. Two devices of each part type were irradiated at normal angle and at 45 degrees. One of the 5360 was heated to 84℃, and one of the 5365 was heated to 69℃. The highest effective LET was 83.3 Mev/cm^2/mg, and fluence was 1E7 on all runs. Latchup, or significant increase in current were never observed. Transients were observed in both devices, and the amplitude of the transients increased with effective LET. At the highest effective LET used in this test, transients were on the order of +/- 175mV on the 1.2V output. This was true for both devices. Duration of the transients were on the order of 50uSec.

Test Setup

Both parts were installed on a 2 layer circuit board designed at LANL. Low ESR ceramic capacitors were used in the design and although the board was laid out based on application notes proved by Enpirion, measured ripple exceeded the manufactures specification. Time did not allow much investigation and we are confident the ripple can be brought

closer to specification at a later time. It was decided that the out of spec ripple would not have a large impact on the heavy ion testing.

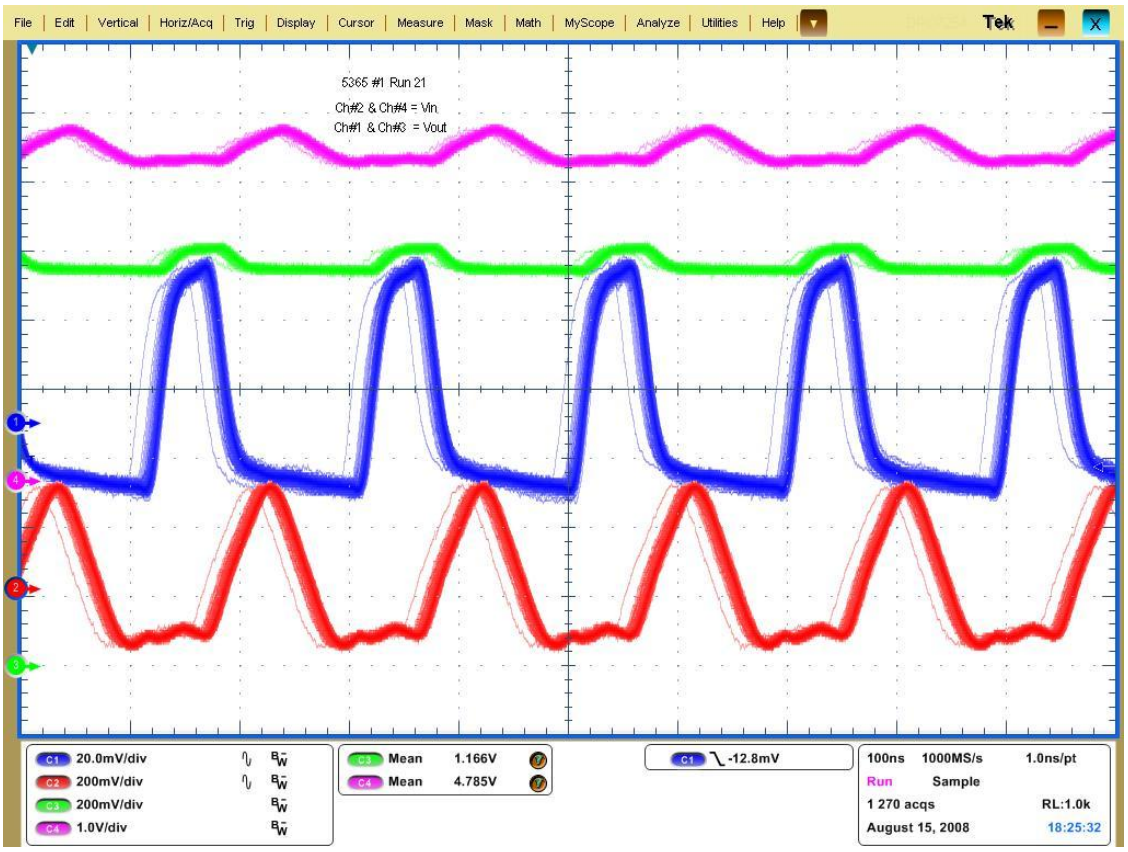
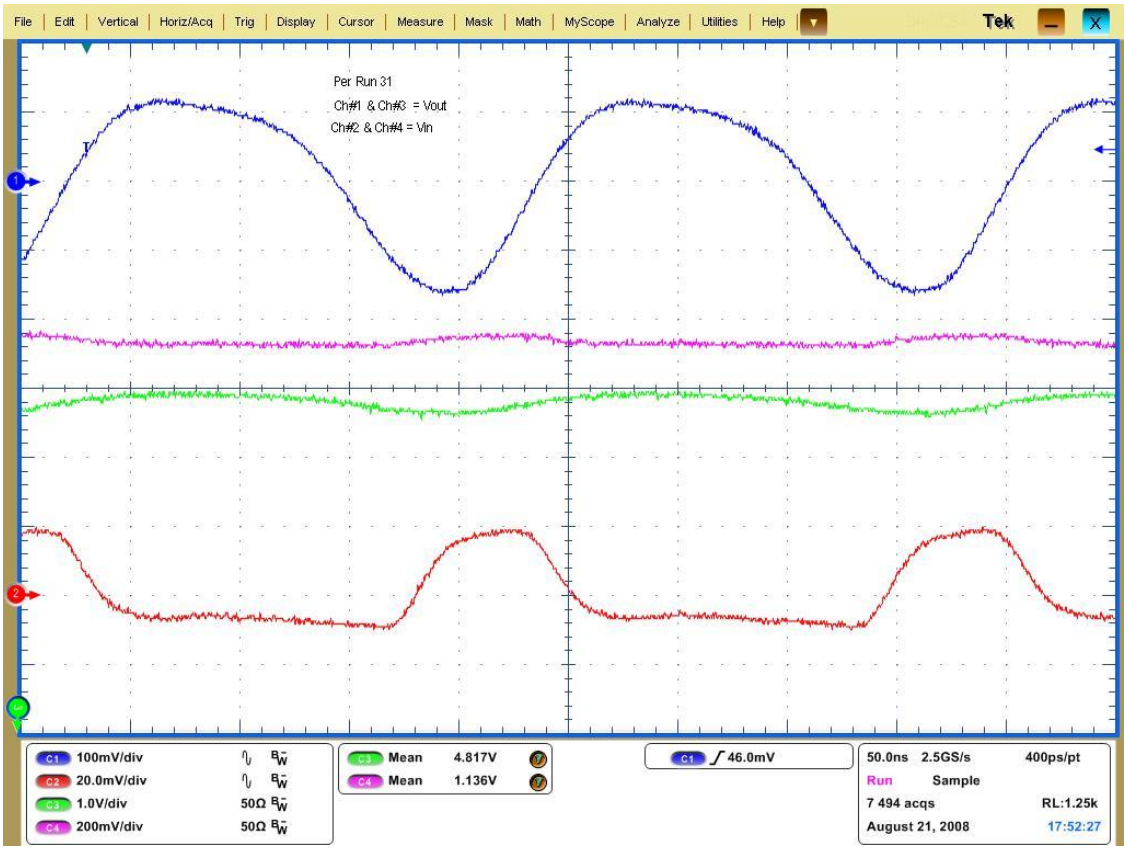


Figure 1. Ripple measurement of 5365. Ch's 2&4 are the input. Ch's 1&3 are output. Ch's 1&2 are AC coupled. Scope is set to 20MHz Bandwidth.



Enpirion 5360 ripple, pre radiation

Both converters were set for an output voltage of 1.2V. The 5365 was loaded with a 0.4Ω resistor corresponding to a 3A output current. The data sheet specifies a typical efficiency at this setting to be over 80%. We measured only 65% at best, and we have not had time to investigate why, although we suspect the excessive ripple. The 5360 was loaded with a 1Ω resistor since the 0.4Ω load caused very high ripple. Efficiency of this device was measured to be 46-49%.

Power was supplied to the devices by a Tek PS2521G power supply positioned next to the vacuum chamber. The power supplies were controlled and the output voltages and currents were monitored over GPIB. In addition, DC-DC converter input and output analog signals were brought up to the control room over coax and monitored on a Tektronix DPO7254 oscilloscope.

Each device has a thermal pad on its bottom which is connected through vias to the ground plane. A thermocouple was placed on these vias on the bottom of the circuit card. The thermocouples were connected to an IOTECH PDAQ56(?) data acquisition system and monitored in the control room over USB. A small strip heater was placed on the bottom of the cards on the ground plane for the final test.

Data Summary

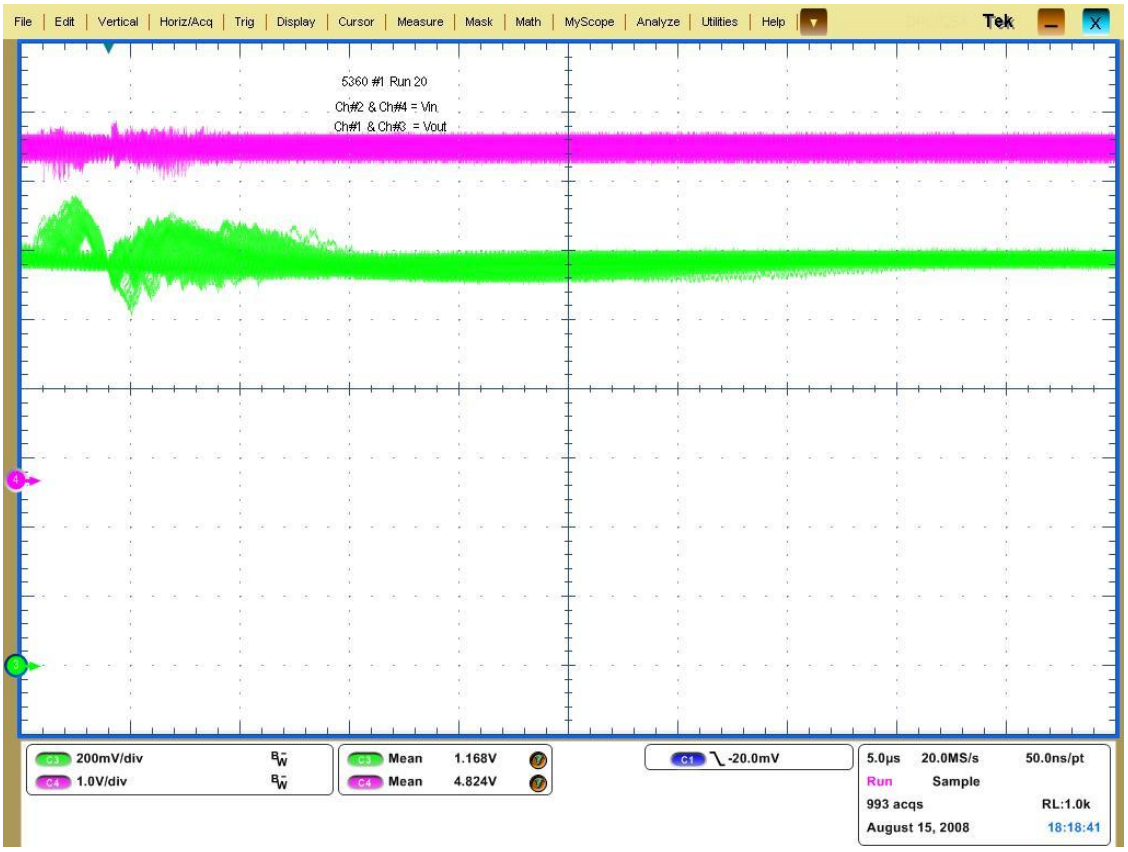
RUN	PART	V IN	I in	V out	LOAD	ANGLE	EFFECT LET	EFFECT FLUEN	PART TEMP
16	5360-1	5.0	0.58	1.17	1	0	58.78	1E7	42.7
18	5360-1	5.0	.587	1.17	1	0	58.78	1E7	44.6
19	5360-1	5.0	.589	1.173	1	45	83.3	1E7	45.3
20	5360-1	5.0	.589	1.17	1	45	83.3	1E7	45.5
21	5365-1	5.0	1.048	1.1663	0.4	0	58.78	1E7	46.3
22	5365-1	5.0	1.053	1.1681	0.4	45	83.3	1E7	48.8
23	5360-2	5.0	0.595	1.17	1.0	0	58.78	1E7	82.6
24	5360-2	5.0	.637	1.17	1.0	45	83.3	1E7	94.0
25	5365-2	5.0	1.054	1.169	0.4	0	58.78	1E7	65.5
26	5365-2	5.0	1.068	1.117	0.4	45	83.3	1E7	70.4

Table 1: Summary of data taken during various runs.

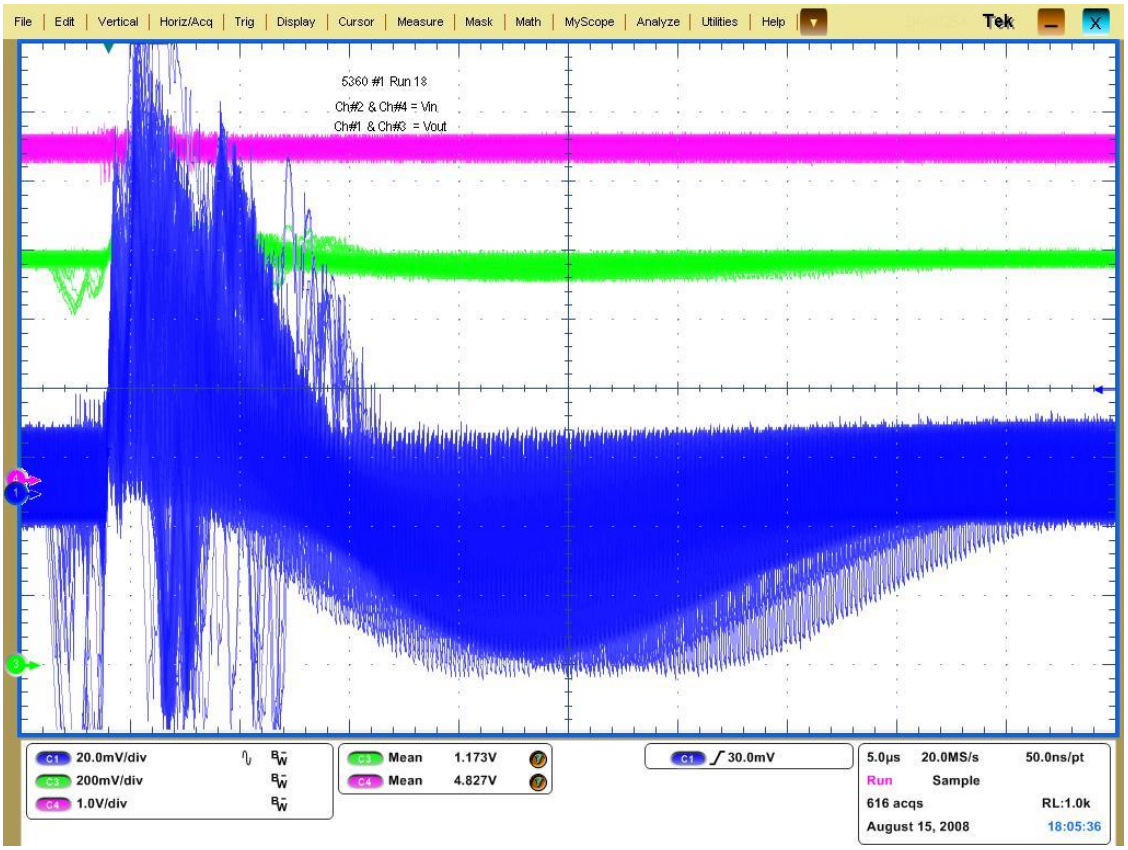
Transient Data

With each part type, runs were repeated in order to look for both positive and negative going transients. The pink line is the monitored voltage at

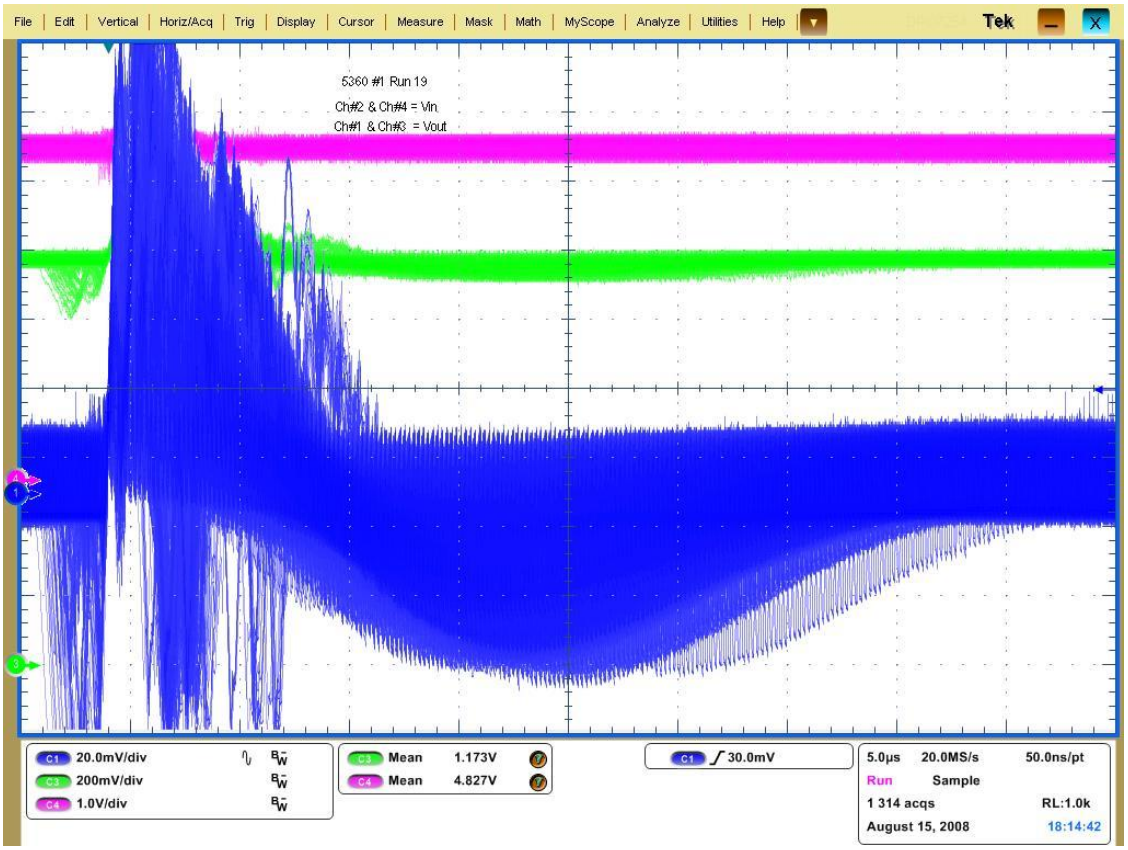
the input to the circuit board while the green is the output. These signals are DC coupled. The blue trace is the output transients and is AC coupled in order to be displayed and a bigger scale.



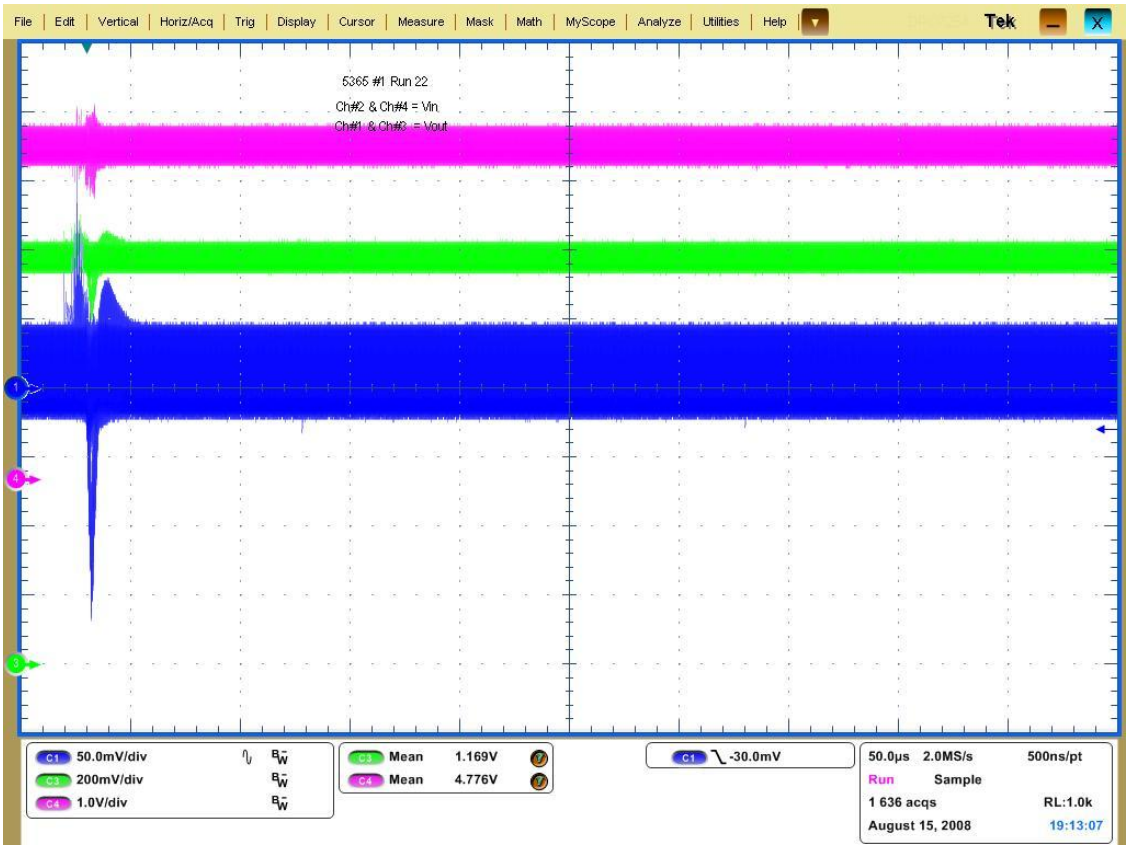
Run 20: Enpirion 5360 Device 1 after 1E7 exposure of Xenon. Green is output waveforms showing transients. Pink is input. Device under test is set at 45 degree angle and the oscilloscope is set to capture negative going transients



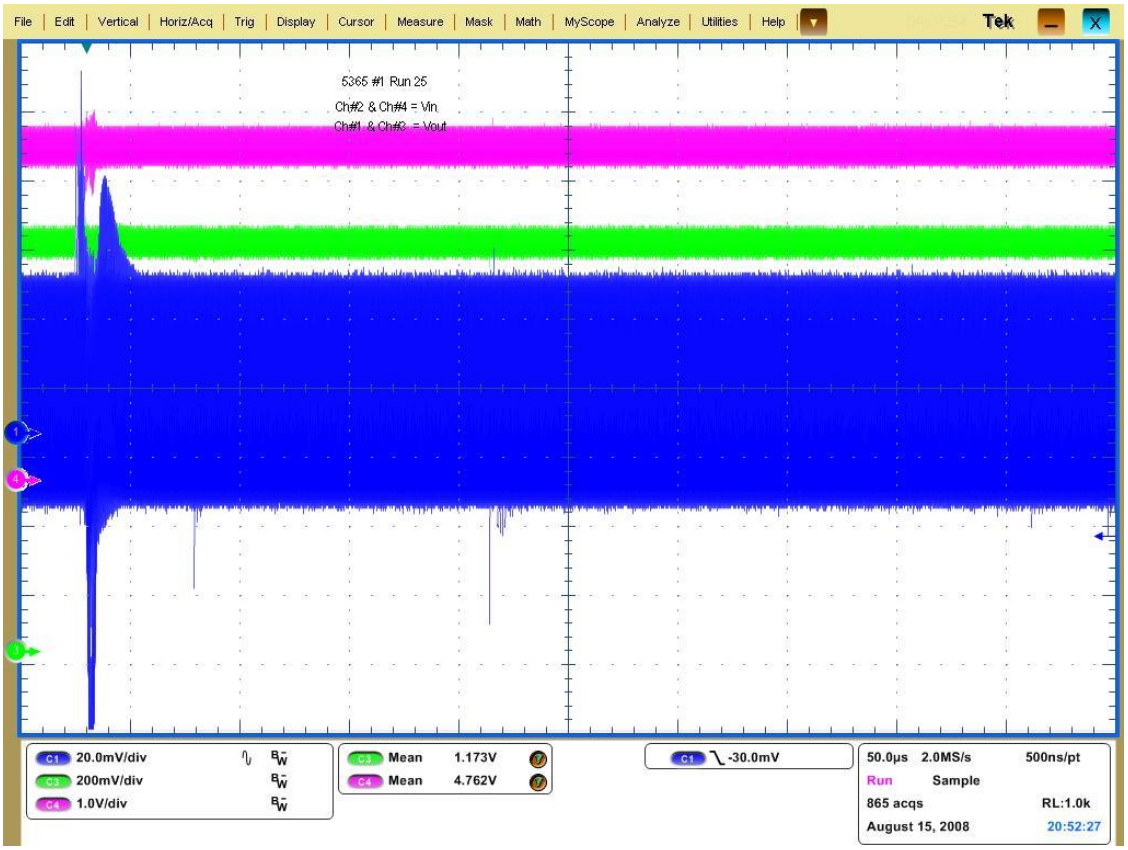
Run 18: Enpirion 5360. Blue trace is AC coupled to show transients on larger scale. Scope is set to trigger on positive going transients. Part angle is 0 degrees.



Run 19: Enpirion 5360. Same set up as Run 18 except part angled to 45 degrees to beam to achieve effective LET of 83.3 MeV-cm^2/mg. Notice increase in amplitude of transients.



Run 22: Enpirion 5365 angle at 45 degrees to the beam. Note that vertical scale is different than that used with 5360.



Run 25: Enpirion 5365. Same setup as Run 22 except part is normal to the beam. Amplitude of transients is smaller.