SEE Test Report V3.0
Heavy ion SEE test of MFP0507S from Interpoint

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I. Introduction

This study was undertaken to determine the susceptibility of the MFP0507, Single DC/DC Converters, for transient interruptions in the output signal and for destructive events such as gate rupture and burnout induced by exposing it to a heavy ion beam at the Radiation Effects Facility at The Cyclotron Institute located on the campus of Texas A&M University. This test was performed for the investigation of radiation susceptibility of transient events and destructive events for Crane Interpoint. This work is in conjunction with the NASA Electronics Parts and Packaging (NEPP) Program. NEPP is a HQ sponsored program that seeks to find new developments that will benefit NASA.

The Interpoint MFP0507S is a single output non isolated point of load converter. The MFP will produce any output voltage from 0.8VDC to 3.3VDC. The rated output current is 7Amps at 0.8V and 5Amps at 3.3V. Input voltage range for the MFP is from 3.3V to 6V, however the selected output voltage should not exceed 80% of the input voltage. Any one of four precision output voltage set points can be selected by the combination of open or grounding of the two trim pins. Maximum output power of 16.5W is with output set for 3.3V and 5A. Maximum output power with the output voltage set for 0.8V and 7Amp is 5.6W. They are best suited for high reliability and high radiation assurance requirements with an LET of 80 MeV cm^2/mg for SEU. This document serves as a Test Plan intended to supplement any governing standards, for conducting and recording SEU on the MFP0507S due to several heavy ion species ($Z \geq 2$).

II. Devices Tested

The sample size of Device Under Test (DUT) for testing was four. Each device was exposed to the radiation beam and the results were compared for verification. For the MFP0507S, the test samples code markings for DUT1 is SN-0077, .8V output; DUT2 SN-0078, .8V output; DUT3 SN-0082, 3.3V output; & DUT4 SN-0083, 3.3V output. The device is packaged in a 10-pin lead metal can package. The device was prepped for test by delidding.

The MFP Series™ of DC/DC converters does not require any external components to achieve all specified performance levels. They are a high-reliability, high-efficiency point of load converter for use with a 3.3 VDC input bus or a 5 VDC input bus. The

MFP0507S model has the flexibility to be set for any output voltage from 0.64 VDC to 3.5 VDC. The converter operates from an input of 3.0 to 6.0 VIN with an undervoltage shutdown at 2.75 V, an overvoltage shutdown of 8.5 V and up to a 15 V transient for up to 1 second. The non-isolated, feature-rich MFP uses a Buck converter design with synchronous rectification. The design allows the unit to operate synchronously to no output load, ensuring high efficiency at the lightest loads without switching off the synchronous devices. Important features include a solid state switch, inrush current limiting, and synchronization with an external system clock and the ability to current share allowing multiple devices to supply a common load.

The MFP includes an internal housekeeping supply that is active at inputs as low as 2 VDC and provides a boosted and regulated voltage supply for internal use. This internal supply is one of the reasons that this product can provide full power at very high efficiency at input voltages as low as 3 VDC. No external power source or external bias is required.

III. Test Facility

Facility: Texas A&M Cyclotron Radiation Effects Facility, 15 MeV/u beams
Flux: 1.23×10^2 to 1.20×10^5 particles/cm^2/s.
Fluence: For destructive events, all tests were ran to 1×10^7 p/cm^2 or until destructive events occurred
For non destructive events, all tests were ran to 1×10^6 p/cm^2 or until a sufficient (>100) number of transient events occurred.

The ions and LET values used for these tests were Xe, Ta, & Au.

IV. Test Conditions and Error Modes

Test Temperature: Room Temperature
Bias conditions V_{in} = 6V, V_{out} = .8V & 3.3V
See Figure 2 for detailed conditions

Table 1: Test conditions

	Vsupply (V)	**Isupply (A)**	**Vin (V)**	**Loading %**
DUT 1	+.8V	.121	6V	0
DUT 1	+.8V	.445	6V	30
DUT 1	+.8V	.685	6V	50
DUT 1	+.8V	.947	6V	70
DUT 1	+.8V	1.38	6V	100
DUT 2	+3.3V	.117	6V	0
DUT 2	+3.3V	.997	6V	30
DUT 2	+3.3V	1.60	6V	50
DUT 2	+3.3V	2.22	6V	70
DUT 2	+3.3V	3.17	6V	100
DUT 3	+.8V	.120	6V	0
DUT 3	+.8V	.440	6V	30
DUT 3	+.8V	.680	6V	50
DUT 3	+.8V	.941	6V	70
DUT 3	+.8V	1.375	6V	100
DUT 4	+3.3V	.122	6V	0
DUT 4	+3.3V	.999	6V	30
DUT 4	+3.3V	1.60	6V	50
DUT 4	+3.3V	2.22	6V	70
DUT 4	+3.3V	3.17	6V	100

PARAMETERS OF INTEREST: Power supply currents, output voltage

SEE Conditions: SEL, SEGR, SET

V. Test Methods

The block diagram, as shown in Figure 1, for the DC-DC Converters contains a power supply for +/- input voltages, an electronic load, a DUT board for the test circuitry and devices, a computer for GPIB control of measurement equipment, and a digital scope to capture any output anomalies, and after the desired voltage input is applied, each of the two device outputs will display on the digital scope, which is set to trigger on voltages that are above or below a predetermined threshold (set to 250 mV). Each device output was tested one after each other.

Table 1, shows the test conditions where tests were conducted for an input nominal voltage of 6V with and without loading and also with loading conditions of 30, 50, 70, and 100% loading with both .8V & 3.3V outputs. Figure 1 also shows the test schematic circuit of the MFP0507S and Figure 2 shows the device exposed for ion beams at TAMU.

VI. Test Performance

- Destructive test at high LET (>85 MeVcm^2/mg) on 4 parts up to a fluence of 10^7 #/cm^2.
- SET test on 4 parts for at least 3 LET values (starting from lowest LET) for each device output and each condition described in Table 1.

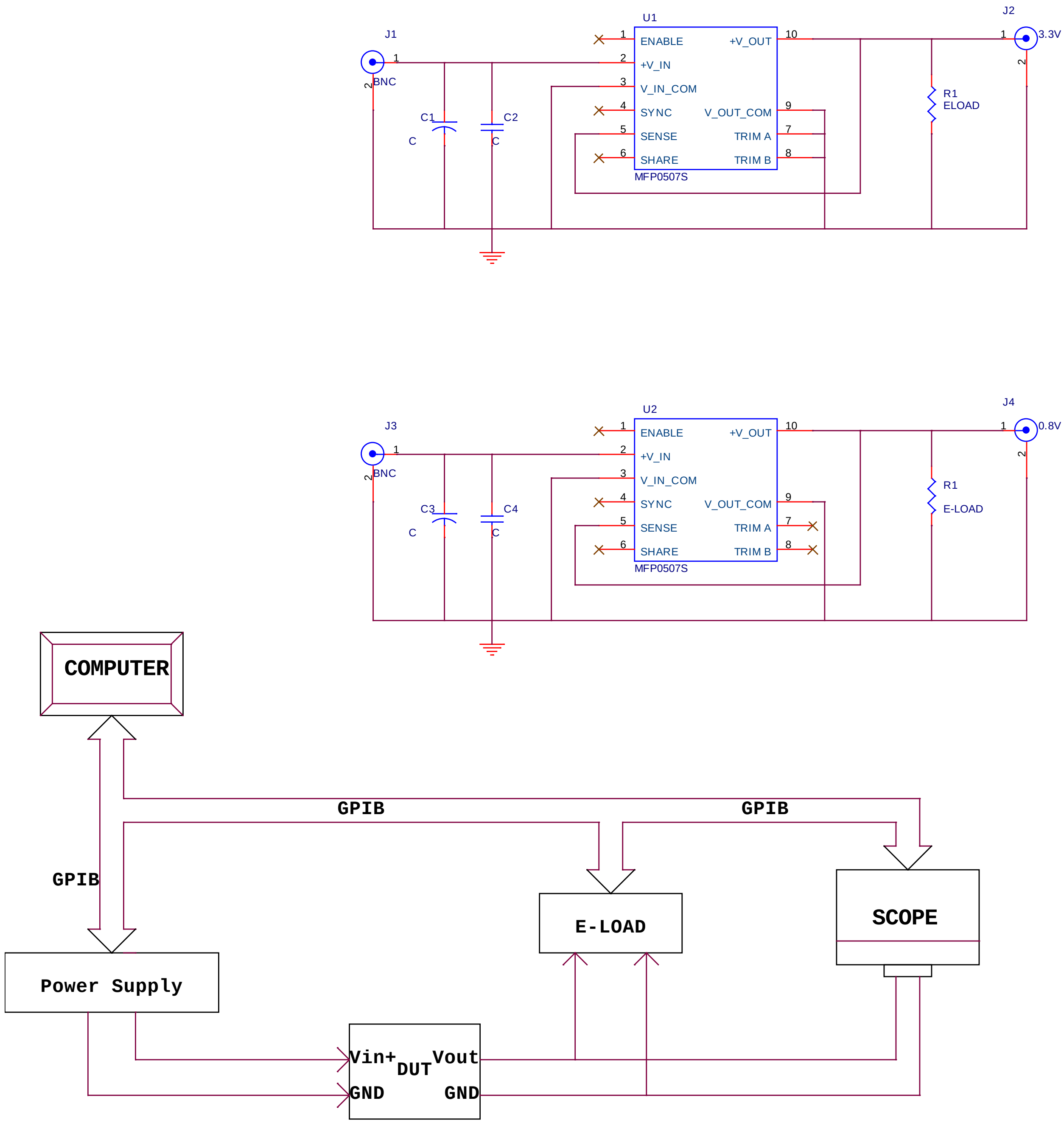
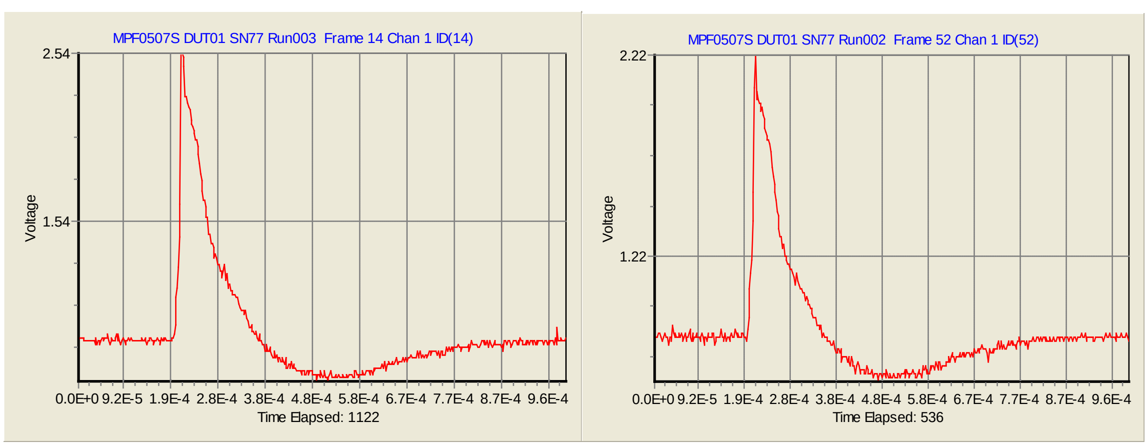


Figure 1. Overall Block Diagram and Schematic for the testing of the MFP0507S

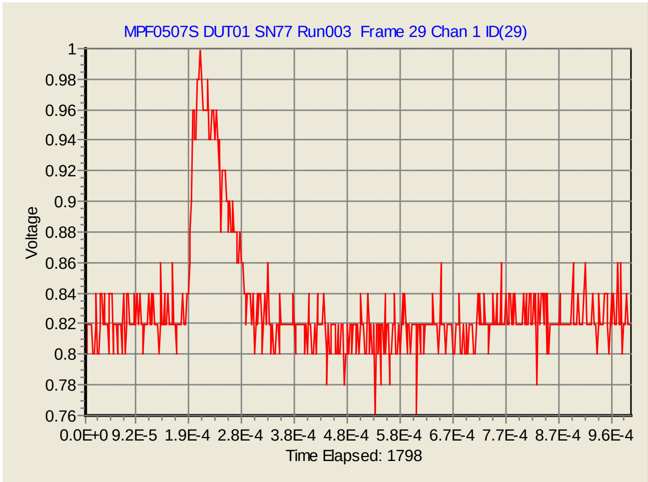
Figure 2. MFP0507S device exposed for ion beam test at TAMU

VII. Test Results

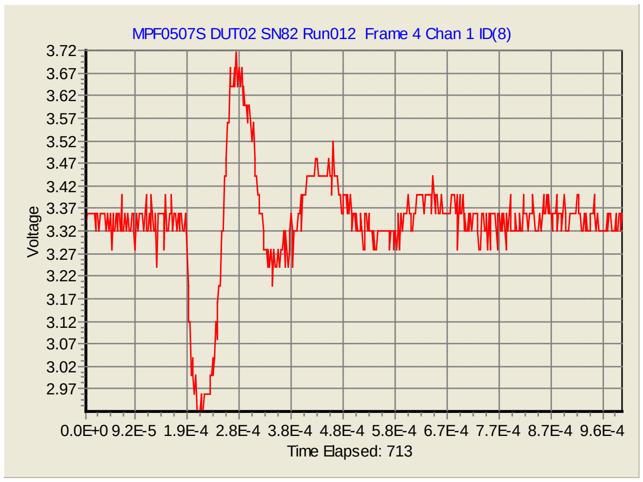
Detailed test results are shown in Table 2 below. The devices were exposed from a fluence of 1.00 x 10^3 to 1.00 x 10^7 particles/cm^2 of the Xenon, Tantalum, and Gold ion beams. Observations for destructive and non-destructive events were for energies up to the maximum LET of 85.4 MeV-cm^2/mg at normal angle of incidence. There were no destructive events observed for the MFP0507S, but the device was sensitive to SETs and did experience transient events with larger transients occurring at the .8V output greater than 2V and approximately 200us for worse case width duration shown in Charts 1&2. This large spike may need to be mitigated with using the appropriate LC filtering circuitry in conjunction with this DC-DC converter. The 3.3V output transients were <500mV and 100us for worse case width duration shown in Charts 3&4. The tests were run with an input of 6V with .8V and 3.3V output configurations at 30%, 50%, 70%, and 100% loading conditions. Charts 5&6 show typical histograms of amplitude using the absolute values attained and Chart 7 shows the SET cross sections observed. In general most SETs were small for the 3.3V output which is the common use for designers for space flight applications; therefore this device is suitable for space applications.



Charts 1&2: Worse Case Transients of approx 1.74V and 200us with .8V Output



Charts 3: Typical Transient of appox 200mV and 100us with .8V Output



Charts 4: Typical Transient of approx 800mV Peak-to-Peak and 200us with 3.3V Output

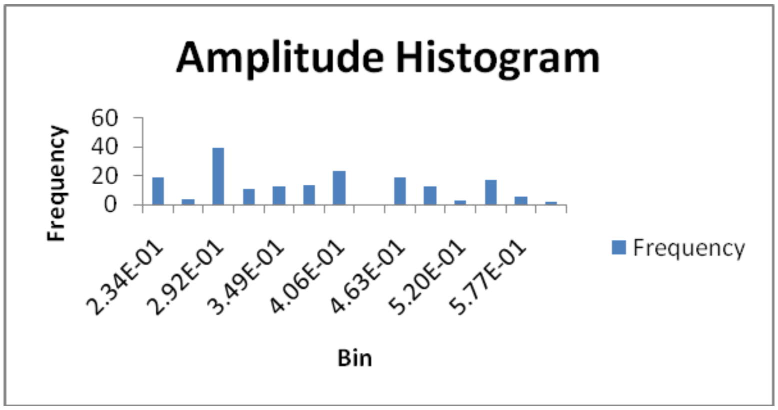


Chart 5: MFP0507S Amplitude Histogram for 3.3V input

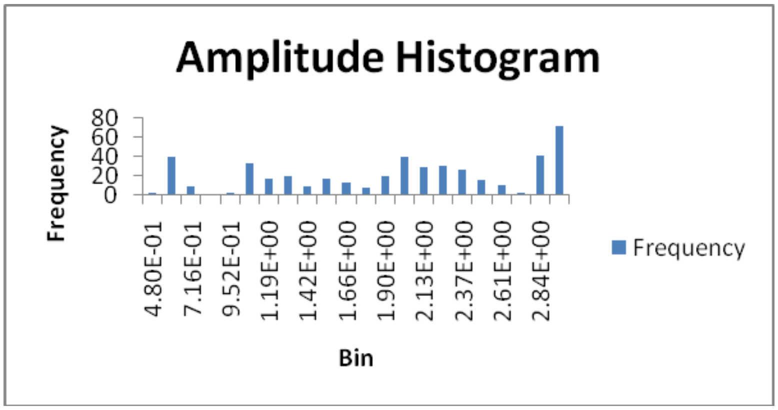


Chart 6: MFP0507S Amplitude Histogram for 0.8V input

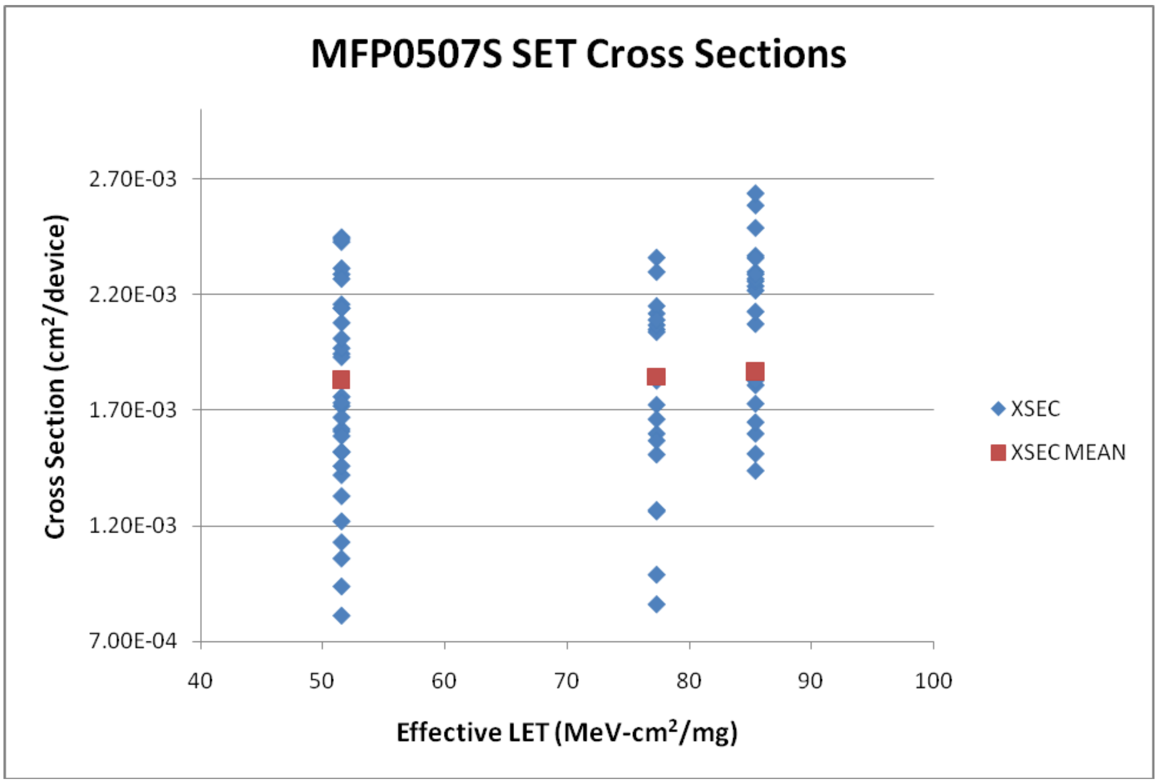


Chart 7: MFP0507S SET Cross Sections

Table 2: MFP0507S Data Collected at TAMU

Run#	#	OUT	IN (V)	Trig mV	Current(A)	Ion	Energy	LET	LET(eff)	angle	Flux	$Fluence_{eff}$	SET	SEL	σ_{seu}
1	77	0.8V	6	120	0.121	Xe-15	1512	51.5	51.5	0	1.10E+04	2.76E+05	97	0	8.13E-04
2	77	0.8V	6	120	0.121	Xe-15	1512	51.5	51.5	0	8.81E+02	1.00E+05	90	0	9.39E-04
3	77	0.8V	6	120	0.123	Xe-15	1512	51.5	51.5	0	9.28E+02	1.00E+05	99	0	1.06E-03
4	77	0.8V	6	120	0.445	Xe-15	1512	51.5	51.5	0	8.46E+02	1.00E+05	195	0	2.14E-03
5	77	0.8V	6	120	0.445	Xe-15	1512	51.5	51.5	0	8.07E+02	9.97E+04	176	0	1.95E-03
6	77	0.8V	6	120	0.685	Xe-15	1512	51.5	51.5	0	8.64E+02	1.00E+05	196	0	2.16E-03
7	77	0.8V	6	120	0.685	Xe-15	1512	51.5	51.5	0	7.77E+02	1.00E+05	194	0	2.08E-03
8	77	0.8V	6	120	0.947	Xe-15	1512	51.5	51.5	0	7.62E+02	1.00E+05	211	0	2.29E-03
9	77	0.8V	6	120	0.947	Xe-15	1512	51.5	51.5	0	7.49E+02	9.98E+04	208	0	2.32E-03
10	77	0.8V	6	120	1.38	Xe-15	1512	51.5	51.5	0	7.43E+02	9.99E+04	201	0	2.14E-03
11	77	0.8V	6	120	1.38	Xe-15	1512	51.5	51.5	0	7.14E+02	9.99E+04	180	0	1.93E-03
12	82	3.3V	6	120	0.117	Xe-15	1512	51.5	51.5	0	6.15E+02	1.00E+05	125	0	1.33E-03
13	82	3.3V	6	120	0.117	Xe-15	1512	51.5	51.5	0	6.14E+02	1.00E+05	157	0	1.61E-03
14	82	3.3V	6	120	0.997	Xe-15	1512	51.5	51.5	0	5.92E+02	1.00E+05	160	0	1.72E-03
15	82	3.3V	6	120	0.997	Xe-15	1512	51.5	51.5	0	5.75E+02	1.00E+05	185	0	1.97E-03
16	82	3.3V	6	120	1.6	Xe-15	1512	51.5	51.5	0	6.15E+02	9.99E+04	184	0	2.01E-03
17	82	3.3V	6	120	1.6	Xe-15	1512	51.5	51.5	0	6.08E+02	1.00E+05	167	0	1.76E-03
18	82	3.3V	6	120	2.22	Xe-15	1512	51.5	51.5	0	5.84E+02	1.00E+05	156	0	1.62E-03
19	82	3.3V	6	120	2.22	Xe-15	1512	51.5	51.5	0	5.69E+02	1.00E+05	158	0	1.67E-03
20	82	3.3V	6	120	3.17	Xe-15	1512	51.5	51.5	0	5.63E+02	1.00E+05	153	0	1.59E-03
21	78	3.3V	6	120	3.17	Xe-15	1512	51.5	51.5	0	5.47E+02	9.98E+04	166	0	1.73E-03
22	78	0.8V	6	120	0.12	Xe-15	1512	51.5	51.5	0	4.52E+02	9.99E+04	117	0	1.22E-03
23	78	0.8V	6	120	0.44	Xe-15	1512	51.5	51.5	0	4.42E+02	1.00E+05	229	0	2.43E-03
24	78	0.8V	6	120	0.68	Xe-15	1512	51.5	51.5	0	4.38E+02	1.00E+05	239	0	2.45E-03
25	78	0.8V	6	120	0.941	Xe-15	1512	51.5	51.5	0	4.24E+02	1.00E+05	221	0	2.27E-03
26	78	0.8V	6	120	1.375	Xe-15	1512	51.5	51.5	0	4.27E+02	1.00E+05	231	0	2.44E-03
27	83	3.3V	6	120	0.122	Xe-15	1512	51.5	51.5	0	4.10E+02	9.99E+04	112	0	1.13E-03
28	83	3.3V	6	120	0.999	Xe-15	1512	51.5	51.5	0	4.13E+02	1.00E+05	146	0	1.52E-03
29	83	3.3V	6	120	1.6	Xe-15	1512	51.5	51.5	0	4.13E+02	9.99E+04	138	0	1.42E-03
30	83	3.3V	6	120	2.22	Xe-15	1512	51.5	51.5	0	3.87E+02	1.00E+05	141	0	1.46E-03
31	83	3.3V	6	120	3.16	Xe-15	1512	51.5	51.5	0	3.87E+02	9.99E+04	150	0	1.52E-03
32	83	3.3V	6	120	0.124	Ta-15	2076	77.3	77.3	0	1.40E+03	1.00E+05	153	0	1.84E-03
33	83	3.3V	6	120	1	Ta-15	2076	77.3	77.3	0	1.34E+03	9.95E+04	161	0	1.83E-03
34	83	3.3V	6	120	1.6	Ta-15	2076	77.3	77.3	0	1.23E+02	9.95E+04	169	0	2.05E-03
35	83	3.3V	6	120	2.22	Ta-15	2076	77.3	77.3	0	1.23E+03	9.95E+04	197	0	2.36E-03
36	83	3.3V	6	120	3.17	Ta-15	2076	77.3	77.3	0	1.00E+03	1.20E+05	172	0	1.73E-03
37	78	0.8V	6	120	0.122	Ta-15	2076	77.3	77.3	0	9.85E+02	9.98E+04	82	0	8.62E-04
38	78	0.8V	6	120	0.443	Ta-15	2076	77.3	77.3	0	8.94E+02	9.97E+04	119	0	1.26E-03
39	78	0.8V	6	120	0.683	Ta-15	2076	77.3	77.3	0	8.34E+02	1.00E+05	141	0	1.51E-03
40	78	0.8V	6	120	0.943	Ta-15	2076	77.3	77.3	0	8.72E+02	1.00E+05	149	0	1.60E-03
41	78	0.8V	6	120	1.37	Ta-15	2076	77.3	77.3	0	7.31E+02	1.00E+05	189	0	2.04E-03
42	77	0.8V	6	120	0.126	Ta-15	2076	77.3	77.3	0	7.95E+02	1.00E+05	56	0	5.70E-04
43	77	0.8V	6	120	0.447	Ta-15	2076	77.3	77.3	0	7.79E+02	1.00E+05	94	0	9.90E-04
44	77	0.8V	6	120	0.688	Ta-15	2076	77.3	77.3	0	7.64E+02	1.00E+05	122	0	1.27E-03
45	77	0.8V	6	120	0.951	Ta-15	2076	77.3	77.3	0	7.19E+02	1.00E+05	150	0	1.57E-03
46	77	0.8V	6	120	1.39	Ta-15	2076	77.3	77.3	0	7.07E+02	9.98E+04	158	0	1.66E-03
47	82	3.3V	6	120	0.123	Ta-15	2076	77.3	77.3	0	6.74E+02	1.00E+05	196	0	2.07E-03

Table 2: MFP0507S Data Collected at TAMU (Cont.)

Run#	#	OUT	IN (V)	Trig mV	Current(A)	Ion	Energy	LET	LET(eff)	angle	Flux	$Fluence_{eff}$	SET	SEL	σ_{seu}
48	82	3.3V	6	120	1	Ta-15	2076	77.3	77.3	0	6.69E+02	1.00E+05	196	0	2.12E-03
49	82	3.3V	6	120	1.6	Ta-15	2076	77.3	77.3	0	6.28E+02	1.00E+05	217	0	2.30E-03
50	82	3.3V	6	120	2.23	Ta-15	2076	77.3	77.3	0	6.18E+02	9.99E+04	199	0	2.15E-03
51	82	3.3V	6	120	3.18	Ta-15	2076	77.3	77.3	0	6.13E+02	9.99E+04	194	0	2.09E-03
52	82	3.3V	6	120	0.13	Au-15	2247	85.4	85.4	0	1.28E+03	1.00E+05	164	0	1.81E-03
53	82	3.3V	6	120	1.01	Au-15	2247	85.4	85.4	0	1.18E+03	9.97E+04	208	0	2.59E-03
54	82	3.3V	6	120	1.61	Au-15	2247	85.4	85.4	0	1.22E+03	9.96E+04	189	0	2.24E-03
55	82	3.3V	6	120	2.23	Au-15	2247	85.4	85.4	0	1.12E+03	1.00E+05	216	0	2.64E-03
56	82	3.3V	6	120	3.19	Au-15	2247	85.4	85.4	0	1.13E+03	1.00E+05	192	0	2.30E-03
57	77	0.8V	6	120	0.129	Au-15	2247	85.4	85.4	0	9.11E+02	1.00E+05	161	0	1.73E-03
58	77	0.8V	6	120	0.415	Au-15	2247	85.4	85.4	0	9.61E+02	9.98E+04	191	0	2.07E-03
59	77	0.8V	6	120	0.691	Au-15	2247	85.4	85.4	0	1.02E+03	9.96E+04	193	0	2.13E-03
60	77	0.8V	6	120	0.955	Au-15	2247	85.4	85.4	0	1.04E+03	1.00E+05	205	0	2.37E-03
61	77	0.8V	6	120	1.39	Au-15	2247	85.4	85.4	0	1.06E+03	1.00E+05	187	0	2.22E-03
62	78	0.8V	6	120	0.124	Au-15	2247	85.4	85.4	0	1.12E+03	1.00E+05	198	0	2.36E-03
63	78	0.8V	6	120	0.446	Au-15	2247	85.4	85.4	0	1.16E+03	1.00E+05	188	0	2.26E-03
64	78	0.8V	6	120	0.686	Au-15	2247	85.4	85.4	0	1.12E+03	1.00E+05	193	0	2.27E-03
65	78	0.8V	6	120	0.949	Au-15	2247	85.4	85.4	0	1.16E+03	1.00E+05	204	0	2.49E-03
66	78	0.8V	6	120	1.39	Au-15	2247	85.4	85.4	0	1.15E+03	1.00E+05	188	0	2.29E-03
67	83	3.3V	6	120	0.132	Au-15	2247	85.4	85.4	0	1.18E+03	1.00E+05	134	0	1.44E-03
68	83	3.3V	6	120	1.01	Au-15	2247	85.4	85.4	0	1.15E+03	1.00E+05	140	0	1.60E-03
69	83	3.3V	6	120	1.61	Au-15	2247	85.4	85.4	0	1.13E+03	1.00E+05	161	0	1.83E-03
70	83	3.3V	6	120	2.23	Au-15	2247	85.4	85.4	0	1.20E+03	9.98E+04	134	0	1.51E-03
71	83	3.3V	6	120	3.18	Au-15	2247	85.4	85.4	0	1.17E+03	1.00E+05	141	0	1.65E-03
72	83	3.3V	6	120	3.18	Au-15	2247	85.4	85.4	0	5.55E+04	1.00E+07	551	0	5.34E-04
73	83	3.3V	6	120	3.35	Au-15	2247	85.4	85.4	0	1.09E+05	8.98E+06	238	0	3.57E-04
74	83	3.3V	6	120	3.46	Au-15	2247	85.4	85.4	0	1.37E+04	9.98E+06	424	0	5.46E-04
75	83	3.3V	6	120	3.64	Au-15	2247	85.4	85.4	0	9.51E+04	1.00E+07	425	0	5.45E-04
76	83	3.3V	6	120	3.8	Au-15	2247	85.4	85.4	0	8.23E+04	6.11E+06	184	0	3.68E-04
77	83	3.3V	6	120	3.8	Au-15	2247	85.4	85.4	0	8.21E+04	6.17E+06	275	0	5.55E-04
78	78	0.8V	6	120	1.38	Au-15	2247	85.4	85.4	0	7.77E+04	1.00E+07	520	0	6.30E-04
79	78	0.8V	6	120	1.52	Au-15	2247	85.4	85.4	0	8.31E+04	1.00E+07	488	0	5.31E-04
80	78	0.8V	6	120	1.61	Au-15	2247	85.4	85.4	0	8.26E+04	1.00E+07	491	0	5.33E-04

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Test Date(s): January 21-23, 2011

VIII. Addendum

This study was undertaken to determine the susceptibility of the MFP0507, Single DC/DC Converters, for transient interruptions in the output signal and for destructive events such as gate rupture and burnout induced by exposing it to a heavy ion beam at the Lawrence Berkeley Nuclear Laboratory (LBNL). Utilizing the Berkeley Accelerator Space Effects Facility (BASEF) this follow-on test was performed for the investigation of radiation susceptibility of transient events and destructive events for Crane Interpoint to determine the transient threshold for the device. This work is in conjunction with the NASA Electronics Parts and Packaging (NEPP) Program. NEPP is a HQ sponsored program that seeks to find new developments that will benefit NASA.

IX. Test Facility

Facility: Lawrence Berkeley Nuclear Laboratory, 10 MeV/u beams

Flux: 5.14×10^4 to 7.43×10^4 particles/cm^2/s.

Fluence: For destructive events, all tests were ran to 1×10^7 p/cm^2 or until destructive events occurred

For non destructive events, all tests were ran to 1×10^7 p/cm^2 or until a sufficient (>100) number of transient events occurred.

The ions and LET values used for these tests were Ne & Ar.

X. Test Conditions and Error Modes

Test Temperature: Room Temperature

Bias conditions V_{in} = 6V, V_{out} = .8V & 3.3V
See Figure 2 for detailed conditions

XI. Test Results

Detailed test results are shown in Table 3 below. The devices were exposed to a fluence of 1.00 x 10^7 particles/cm^2 of the Neon and Argon ion beams. Transients were observed down to Neon for both the 0.8 and 3.3V devices, but only for the higher load. The 3.3V device triggered only with 5A load. One 0.8V device showed upsets for loads of 3.5A or higher, and the other did not show any upsets. The transient events were similar in magnitude as the previous test at Texas A&M University Cyclotron.
Therefore we can conclude that the threshold is ~ LET_{th} of 3.49 MeV-cm^2/mg at normal angle of incidence.

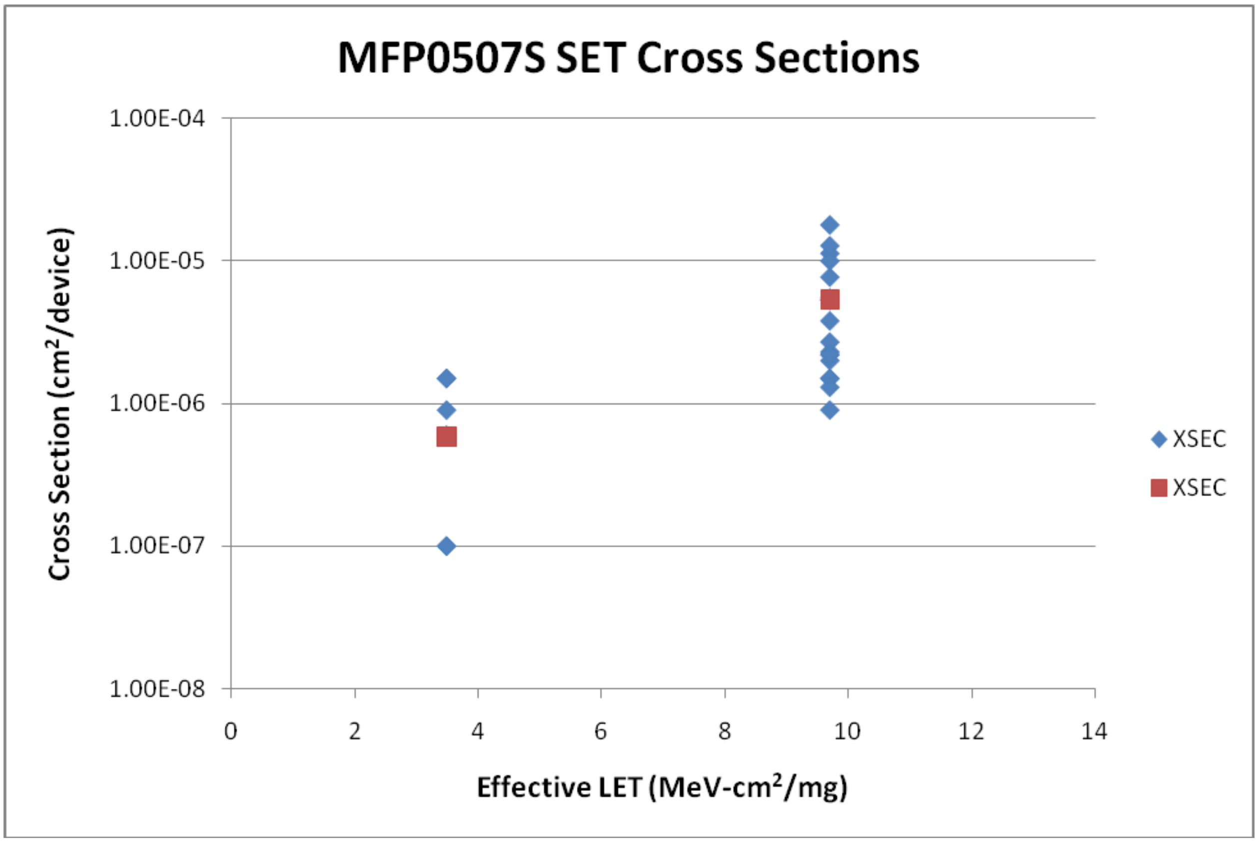

Chart 8: MFP0507S SET Cross Sections

Table 3: MFP0507S Data Collected at LBNL

Run	Serial	OUT (V)	IN (V)	Trig (mV)	Current(A)	Load(A)	Ion	E (MeV)	LET	Eff LET	Angle	Flux (cm-2. s-1)	Fluence$_{eff}$ (cm-2)	SETs	s_{seu} (cm2)
1	77	0.8	6	210	0.127	0	Ar	400	9.7	9.7	0	5.50E+04	1.00E+07	9	9.00E-07
2	77	0.8	6	210	0.451	2.12	Ar	400	9.7	9.7	0	5.52E+04	1.00E+07	23	2.30E-06
3	77	0.8	6	210	0.695	3.53	Ar	400	9.7	9.7	0	5.79E+04	1.00E+07	55	5.50E-06
4	77	0.8	6	210	0.968	4.92	Ar	400	9.7	9.7	0	5.54E+04	1.00E+07	113	1.13E-05
5	82	3.3	6	210	0.131	0	Ar	400	9.7	9.7	0	5.48E+04	1.00E+07	15	1.50E-06
6	82	3.3	6	120	1.066	1.5	Ar	400	9.7	9.7	0	5.55E+04	1.00E+07	15	1.50E-06
7	82	3.3	6	120	1.77	2.5	Ar	400	9.7	9.7	0	5.30E+04	1.00E+07	22	2.20E-06
8	82	3.3	6	120	2.52	3.5	Ar	400	9.7	9.7	0	5.50E+04	1.00E+07	38	3.80E-06
9	82	3.3	6	120	4.2	5	Ar	400	9.7	9.7	0	5.50E+04	1.00E+07	179	1.79E-05
10	82	3.3	6	120	0.138	0	Ne	216	3.49	3.49	0	7.30E+04	1.00E+07	0	0.00E+00
11	82	3.3	6	120	1.07	1.5	Ne	216	3.49	3.49	0	7.13E+04	1.00E+07	0	0.00E+00
12	82	3.3	6	120	1.79	2.5	Ne	216	3.49	3.49	0	7.08E+04	1.00E+07	0	0.00E+00
13	82	3.3	6	120	2.59	3.5	Ne	216	3.49	3.49	0	7.42E+04	1.00E+07	0	0.00E+00
14	82	3.3	6	120	4.21	5	Ne	216	3.49	3.49	0	7.37E+04	1.00E+07	15	1.50E-06
15	77	0.8	6	210	0.132	0	Ne	216	3.49	3.49	0	7.32E+04	1.00E+07	1	1.00E-07
16	77	0.8	6	210	0.454	2.12	Ne	216	3.49	3.49	0	7.40E+04	1.00E+07	1	1.00E-07
17	77	0.8	6	210	0.699	3.53	Ne	216	3.49	3.49	0	7.43E+04	1.00E+07	6	6.00E-07
18	77	0.8	6	210	0.971	4.92	Ne	216	3.49	3.49	0	7.40E+04	1.00E+07	9	9.00E-07
19	85	3.3	6	120	0.113	0	Ne	216	3.49	3.49	0	7.23E+04	1.00E+07	0	0.00E+00
20	85	3.3	6	120	2.53	3.5	Ne	216	3.49	3.49	0	7.05E+04	1.00E+07	0	0.00E+00
21	85	3.3	6	120	4.07	5	Ne	216	3.49	3.49	0	7.17E+04	1.00E+07	15	1.50E-06
22	79	0.8	6	300	0.942	4.92	Ne	216	3.49	3.49	0	7.26E+04	1.00E+07	0	0.00E+00
23	79	0.8	6	300	0.112	0	Ar	400	9.7	9.7	0	5.35E+04	1.00E+07	13	1.30E-06
24	79	0.8	6	300	0.436	2.12	Ar	400	9.7	9.7	0	5.59E+04	1.00E+07	20	2.00E-06
25	79	0.8	6	300	0.683	3.53	Ar	400	9.7	9.7	0	5.54E+04	1.00E+07	27	2.70E-06
26	79	0.8	6	300	0.961	4.92	Ar	400	9.7	9.7	0	5.38E+04	1.00E+07	77	7.70E-06
27	85	3.3	6	200	0.113	0	Ar	400	9.7	9.7	0	5.38E+04	1.00E+07	22	2.20E-06
28	85	3.3	6	200	1.048	1.5	Ar	400	9.7	9.7	0	5.14E+04	1.00E+07	53	5.30E-06
29	85	3.3	6	200	1.754	2.5	Ar	400	9.7	9.7	0	5.45E+04	1.00E+07	53	5.30E-06
30	85	3.3	6	200	2.58	3.5	Ar	400	9.7	9.7	0	5.40E+04	1.00E+07	100	1.00E-05
31	85	3.3	6	200	4.22	5	Ar	400	9.7	9.7	0	5.31E+04	1.00E+07	128	1.28E-05