ISL70003ASEH

Single Event Effects (SEE) Testing

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Introduction

The intense proton and heavy ion environment encountered in space applications can cause a variety of Single-event Effects (SEE) in electronic circuitry, including Single Event Upset (SEU), Single Event Transient (SET), Single Event Functional Interrupt (SEFI), Single Event Gate Rupture (SEGR) and Single Event Burnout (SEB). SEE can lead to system-level performance issues including disruption, degradation and destruction. For predictable and reliable space system operation, individual electronic components must be characterized to determine their SEE response. This report discusses the results of SEE testing performed on the ISL70003ASEH buck regulator.

Product Description

The ISL70003ASEH is a metal mask variant of the radiation tolerant ISL70003SEH part previously released by Intersil. The changes to the ISL70003ASEH were confined to improving the load regulation of the part at higher current levels. The basic operation of the part is unaffected by the changes and the description of the ISL70003SEH, serves as an excellent reference for the ISL70003ASEH version. The ISL70003ASEH part can support input voltages up to 14.7V and output currents to up 9A.

Product Documentation

For more information about the ISL70003SEH and ISL70003ASEH Buck Regulators, refer to the documentation shown below.

- ISL70003SEH, “Radiation Hardened and SEE Hardened 3V to 13.2V, 6A Buck Regulator”
- ISL70003ASEH, “Radiation and SEE Tolerant 3V to 13.2V, 9A Buck Regulator”
- AN1913, “Single Event Effects Testing of the ISL70003SEH, a 3V to 13.2V, 6A Synchronous Buck Regulator”
- AN1897, “Radiation Hardened and SEE Hardened 3V to 12V, 6A Synchronous Buck Regulator Evaluation Board User’s Guide”
- Standard Microcircuit Drawing (SMD): 5962-14203

SEE Test Objectives

Since the ISL70003ASEH, is only a metal mask variant of the ISL70003SEH the single event testing was concentrated on validating the single event performance as comparable to the parent ISL70003SEH. This consisted of duplicating the original testing results of the ISL70003SEH.

SEE Test Facility

Testing was performed at the Texas A&M University (TAMU) Radiation Effects Facility of the Cyclotron Institute heavy ion facility. This facility is coupled to a k500 superconducting cyclotron, which is capable of generating a wide range of particle beams with the various energy, flux and fluence levels needed for advanced radiation testing. The Devices Under Test (DUTs) were located in air at 40mm from the aramica window for the ion beam. Ion LET values are quoted at the DUT surface. Signals were communicated to and from the DUT test fixture through 20 foot cables connecting to the control room. Testing was done May 28th 2015.

SEE Test Setup

The test setup consisted of an ISL70003SEH engineering evaluation board with ISL70003ASEH mounted on it. The schematic for the engineering board is shown in Figures 1 and 2. A cable connector was added to the board to allow cabling of signals from the irradiation cave to the monitor room.

The board was modified depending upon the test being run. For all tests only 150µF of output capacitance (CO1) was used. For SET testing at PVIN = 13.2V, a 6.8µH inductor was used, while for all other tests the 3.3µH inductor of the schematic was used. During SEB testing at sourcing 11A the Schottky diode D1 was in place, however for the other tests the Schottky diode was removed. For the low voltage tests (V_{IN} = 3V and 5.5V) the PORR2 resistor was 64.7Ω, whereas for the V_{IN} = 13.2V and higher tests the PORR2 resistor was 7.1Ω. For the SEB testing the ROC (A&B) resistors were 2.37Ω while for the SET testing at 3A the ROC (A&B) resistors were 8.45Ω.

ISL70003ASEH Board Schematic

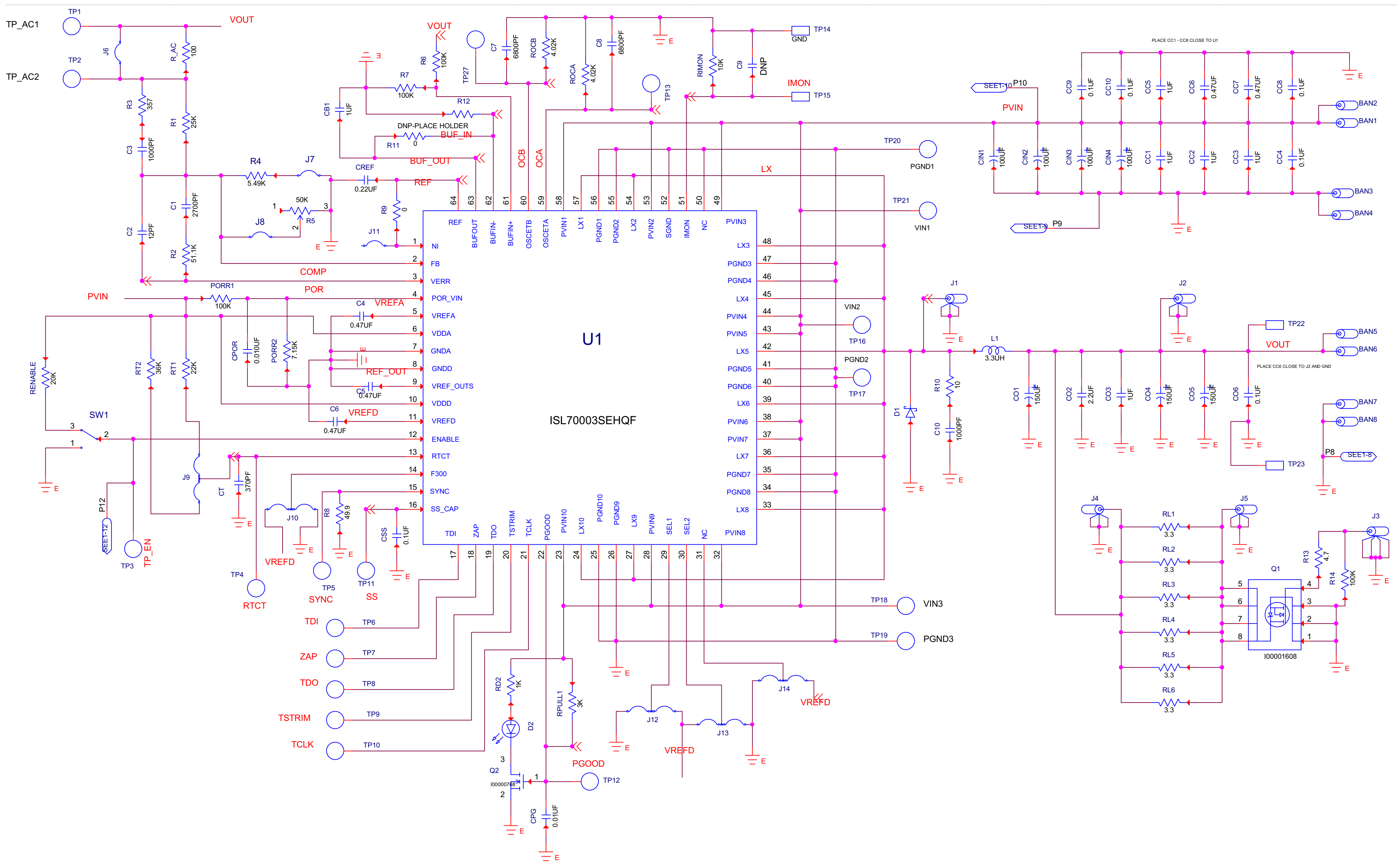

FIGURE 1. ISL70003ASEH ENGINEERING BOARD SCHEMATIC

ISL70003ASEH Board Schematic (Continued)

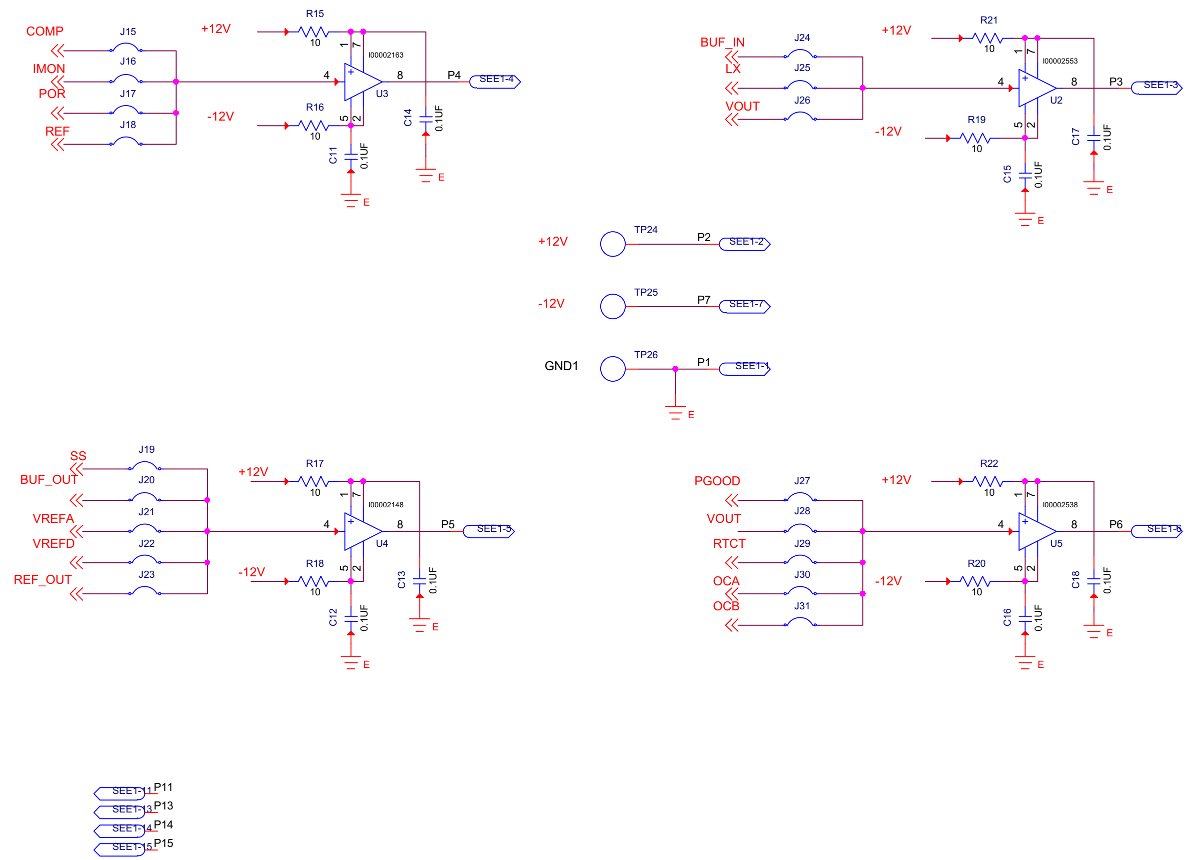

FIGURE 2. ISL70003ASEH ENGINEERING BOARD SCHEMATIC

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SEB Testing of the ISL70003ASEH

Four units were first run to duplicate the SEB qualification testing originally done on the ISL70003SEH. The first three tests strictly duplicated the ISL70003SEH qualification testing. Two extra runs were also run on the ISL70003ASEH, both sourcing 11A at V_{OUT} = 3.3V and V_{IN} = 14.7V and 15.5V.

Each test was done with irradiation by gold at LET = 86.4MeV • cm^2/mg to a fluence of $5x10^6$ ion/cm^2 with the parts heated to a case temperature of +125°C ±10°C. Twelve parameters were monitored both before and after each irradiation to see if any change. The twelve parameters and the associated percentage changes are listed in Table 2.

TABLE 1. SEB TESTS DONE WITH 86MeV • cm^2/mg, T_{CASE} = ±125°C ±10°C, AND 500kHz SWITCHING FREQUENCY. EACH TEST ON EACH UNIT WAS TO A FLUENCE OF $5x10^6$ ions/cm^2.

	PVIN (V)	V_{OUT} (V)	I_{OUT} (V)
Test86 1	14.7	Disabled	0
Test86 2	14.7	3.3	+7
Test86 3	13.7	3.3	-4
Test86 4	14.7	3.3	+11
Test86 5	15.5	3.3	+11

TABLE 2. MONITOR PARAMETER DELTAS FOR THE DESTRUCTIVE SEE TESTING AT 86MeV • cm^2/mg.

DUT	TEST	ENABLE THRES (V)	DISABLE THRES (V)	I_IN AT LOAD (A)	I_MON AT LOAD (V)	V_OUT AT LOAD (V)	VERR (V)	V_BUFOUT ENABLE (V)	OCP DC THRESHOLD (A)	I_IN AT I_OUT = 0 (mA)	I_MON ZERO LOAD (mV)	V_BUFOUT DISABLE (mV)	I_SHUTDOWN (mA)
DUT1	Test86 1	0%	0%			0%	0%	0%	0%	1%	1%	0%	0%
	Test86 2	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-2%	0%	0%
	Test86 3	0%	0%			0%	0%	0%	0%	1%	-2%	0%	0%
	Test86 4	0%	0%	0%	-2%	0%	0%	0%	0%	-1%	-6%	0%	0%
	Test86 5	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-1%	0%	0%
DUT2	Test86 1	0%	0%			0%	0%	0%	0%	0%	2%	0%	0%
	Test86 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	0%	0%
	Test86 3	0%	0%			0%	1%	0%	1%	0%	2%	0%	0%
	Test86 4	0%	0%	0%	1%	0%	0%	0%	0%	0%	-1%	0%	1%
	Test86 5	0%	0%	0%	-1%	0%	0%	0%	1%	-1%	-2%	0%	0%
DUT3	Test86 1	0%	0%			0%	0%	0%	0%	1%	11%	0%	0%
	Test86 2	0%	0%	0%	0%	0%	0%	0%	1%	0%	2%	0%	0%
	Test86 3	0%	0%			0%	0%	0%	0%	0%	-1%	0%	0%
	Test86 4	0%	0%	0%	-2%	0%	0%	0%	0%	0%	4%	0%	1%
	Test86 5	0%	0%	0%	-1%	0%	0%	0%	-1%	-1%	-3%	0%	1%
DUT4	Test86 1	0%	0%			0%	0%	0%	1%	0%	3%	0%	0%
	Test86 2	1%	0%	0%	0%	0%	0%	0%	-1%	0%	-3%	0%	1%
	Test86 3	0%	0%			0%	0%	0%	0%	0%	-3%	0%	2%
	Test86 4	0%	0%	0%	-2%	0%	0%	0%	0%	-1%	-3%	-4%	3%
	Test86 5	0%	0%	0%	-1%	0%	0%	0%	1%	1%	4%	0%	-2%

With few exceptions the deltas are all within a few percent and those that are not, they are still small enough to be attributed to measurement repeatability. The conclusion is that the parts did not display any indication of destructive single event effects. The last two tests are especially interesting in that they went beyond the limits of the original ISL70003SEH SEE qualification testing.

An attempt was made to push PVIN to 16.5V with I_{OUT} at 11A, but the first part tested there showed clear changes in the zero load operating current (114.0mA to 120.5mA) and the shutdown current (7.51mA to 32.4mA) so that it was clear some permanent damage had resulted. The other three parts were not run to this level as a failure was already in hand.

Destructive SEE testing was also carried out at an LET of 43MeV • cm^2/mg (silver and zero degree incidence). The testing done was slightly different from that done at the higher LET in that the PVIN was pushed increased and the 7A I_{OUT} was skipped. The tests carried out are listed in Table 3.

TABLE 3. TESTS DONE WITH 43MeV • cm^2/mg, T_{CASE} = 125°C ±10°C AND 500kHz SWITCHING FREQUENCY. EACH TEST FOR EACH UNIT WAS TO A FLUENCE of 5x10^6 ion/cm^2.

TEST	PVIN (V)	V_{OUT} (V)	I_{OUT} (A)
Test43 1	15.5	Disabled	0
Test43 2	15.5	3.3	+11
Test43 3	14.5	3.3	-4
Test43 4	16.5	Disabled	0
Test43 5	16.5	3.3	+11
Test43 6	15.5	3.3	-4

The percentage change in the monitored parameters is presented in Table 4.

TABLE 4. MONITOR PARAMETER DELTAS FOR THE DESTRUCTIVE SEE TESTING AT 43MeV • cm^2/mg

DUT	TEST	ENABLE THRES (V)	DISABLE THRES (V)	I_IN AT LOAD (mV)	I_MON AT LOAD (mV)	V_OUT AT LOAD (V)	VERR (V)	V_BUFOUT ENABLE (V)	OCP DC THRESHOLD (A)	I_IN AT I_OUT = 0 (mA)	I_MON ZERO LOAD (mV)	V_BUFOUT DISABLE (mV)	I_SHUTDOWN (mA)
DUT5	Test43 1	0%	0%			0%	0%	0%	0%	-1%	2%	0%	0%
	Test43 2	0%	0%	0%	-1%	0%	0%	-1%	0%	-1%	-6%	0%	3%
	Test43 3	0%	0%			0%	0%	0%	-1%	0%	1%	0%	-1%
	Test43 4	0%	1%			0%	0%	0%	1%	0%	0%	0%	-1%
	Test43 5	0%	0%	0%	-1%	0%	0%	0%	0%	0%	-1%	0%	1%
	Test43 6	0%	0%			0%	0%	0%	0%	0%	0%	0%	-1%
DUT6	Test43 1	0%	0%			0%	-1%	0%	0%	1%	3%	0%	0%
	Test43 2	0%	0%	0%	-1%	0%	0%	0%	0%	0%	-2%	0%	-1%
	Test43 3	0%	0%			0%	0%	0%	0%	0%	2%	0%	1%
	Test43 4	0%	0%			0%	0%	0%	0%	1%	5%	0%	0%
	Test43 5	0%	0%	0%	-1%	0%	0%	0%	0%	1%	-2%	0%	0%
	Test43 6	0%	0%			0%	0%	0%	0%	1%	1%	0%	0%
DUT7	Test43 1	0%	0%			0%	0%	0%	0%	0%	3%	0%	0%
	Test43 2	0%	0%	0%	-1%	0%	0%	0%	0%	-1%	-3%	0%	4%
	Test43 3	3%	0%			0%	0%	0%	0%	0%	3%	0%	-1%
	Test43 4	0%	0%			0%	0%	0%	0%	0%	3%	0%	-1%
	Test43 5	0%	0%	0%	-1%	0%	0%	0%	0%	2%	-12%	0%	0%
	Test43 6	0%	0%			0%	0%	0%	0%	1%	-5%	0%	0%
DUT8	Test43 1	0%	0%			0%	0%	0%	0%	2%	-1%	0%	-2%
	Test43 2	0%	0%	0%	0%	0%	0%	0%	0%	1%	2%	0%	2%
	Test43 3	0%	0%			0%	0%	0%	0%	0%	8%	0%	1%
	Test43 4	0%	0%			0%	0%	0%	0%	-1%	-4%	0%	1%
	Test43 5	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-3%	0%	1%
	Test43 6	0%	0%			0%	1%	0%	0%	1%	9%	0%	0%

It is worth noting that the ISL70003ASEH survived at operating conditions to PVIN = 16.5V and I_{OUT} = 11A with an LET of 43MeV • cm^2/mg.

SEFI Testing of the ISL70003ASEH

One of the noted SEE for the ISL70003SEH was the shutdown and spontaneous restart Single Event Functional Interrupt (SEFI) noted at low supply voltage and high LET (Refer to AN1913). These events are highlighted by a dropout and recovery of the PGOOD signal. Table 5 presents the SET count statistics for the PGOOD cycling that identify these SEFI for the ISL70003ASEH.

As with the ISL70003SEH, the self-recovering SEFI only occurred at low PVIN of 3V and high LET (86MeV•cm^2/mg, Au at zero degrees incidence). At a PVIN of 5.5V and above or at PVIN = 3V and LET = 58MeV•cm^2/mg (PR at zero degrees incidence) there were no SEFI registered to a total of $4x10^7$ion/cm^2 across the four units tested. Even so, the cross section of these SEFI events calculates to only $6.1x10^7$/cm^2 at an LET of 86MeV•cm^2/mg. At an LET of 58MeV•cm^2/mg the nominal SEFI cross section is below $2.5x10^{-8}$/cm^2. Thus there is the same narrow application space where the ISL70003SEH and ISL70003ASEH are both subject to these low probability self-recovering SEFI.

TABLE 5. ISL70003ASEH SEFI COUNTS BY PGOOD CYCLES FOR VARIOUS OPERATING CONDITIONS. FLUENCE OF $1x10^7$ion/cm^2 WAS RUN FOR EACH UNIT AT EACH TEST.

LET MeV•cm^2/mg	PVIN (V)	FREQUENCY (kHz)	SEFI COUNTS BY PGOOD CYCLES			
			DUT14	DUT15	DUT16	DUT17
86	3.0	300 internal	6	10	4	4
86	3.0	500 external	6	3	5	11
86	5.5	500 external	0	0	0	0
58	3.0	300 internal	0	0	0	0
			DUT10	DUT11	DUT12	DUT13
86	13.2	300 internal	0	0	0	0
86	13.2	500 external	0	0	0	0

V_{OUT} SET Testing of the ISL70003ASEH

During the same irradiations as used to monitor SEFI, the V_{OUT} was also monitored for SET. Initially a trigger of ±100mV was attempted (DUT10) but that failed to produce any captures so the trigger was reduced to ±50mV. At the ±50mV trigger level the SET counts were quite variable as the trigger straddled the relative maximum of the SET. The SET capture statistics are presented in Table 6. It should be noted that for the low voltage SET tests (the top four rows of Table 6) the output inductor was 3.3µH, while for the PVIN = 13.2V tests (the bottom two rows of the table) the inductor was 6.8µH.

TABLE 6. ±50mV TRIGGERED SET COUNTS FOR VARIOUS OPERATING CONDITIONS. FLUENCE OF $1x10^7$ion/cm^2 WAS RUN FOR EACH UNIT AT EACH TEST.

LET MeV•cm^2/mg	PVIN (V)	V_{OUT} (V)	FREQUENCY (kHz)	±50mV TRIGGER V_{OUT} SET			
				DUT14	DUT15	DUT16	DUT17
86	3.0	1.8	300 internal	128	82	169	192
86	3.0	1.8	500 external	54	2	77	82
86	5.5	1.8	500 external	0	0	0	11
58	3.0	1.8	300 internal	58	2	103	123
				DUT10	DUT11	DUT12	DUT13
86	13.2	3.3	300 internal	0*	501	95	384
86	13.2	3.3	500 external	0*	83	0	128

NOTE: * Indicates a trigger of ±100mV was used. In all cases I_{OUT} = 3A.

The captured transients were post processed with some digital filtering to minimize the switching transient noise and then analyzed to find the largest V_{OUT} SET occurring in each irradiation run. Figure 3 depicts the worst case SET for each of the units tested on the first line of Table 6 PVIN = 3.0V, V_{OUT} = 1.8V, 300kHz, 86MeV•cm^2/mg). In each plot the deviation in percentage of V_{OUT} is accompanied by plots of the switching node, LX, the error amplifier output voltage, VERR and the reference voltage, VREF. Since all the larger SET resulted from missing LX pulses, all the larger SET were negative going transients. All of the SET seem to start with a disruption on VERR. The worst V_{OUT} SET recorded (in 4x10^{7}ions/cm^2 at 86MeV•cm^2/mg) was -81mV or about -4.5% of the 1.8V V_{OUT}.

The worst SET captured for each unit tested in the second row of Table 6 (500kHz switching frequency) were marginally smaller than those of the first row SET with a worst occurrence of -4% or -72mV. In other regards they look as VERR being the initiating SET followed by missing LX pulses and a drop in V_{OUT} just as shown in Figure 3. Since there is no fundamental difference in the SET plots for the second row are not presented.

For the third row of Table 6 (PVIN = 5.5V, V_{OUT} = 1.8V, 500kHz) only eleven events, all on DUT4, were captured. The largest of these eleven events was -2% deviation or about -36mV. Again a disturbance of VERR preceded a missing LX pulse and resulted in a drop of V_{OUT}. The combination of the higher switching frequency and the larger step-down ratio from V_{IN} = 5.5V to V_{OUT} = 1.8V seems to have resulted in less of a V_{OUT} disturbance for same form of missing pulses as seen in Figure 3.

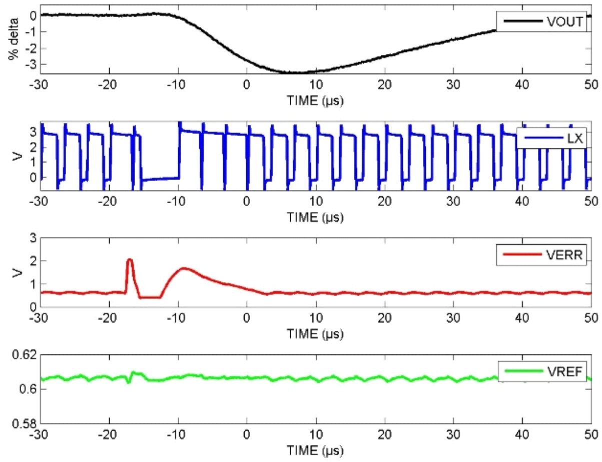

FIGURE 3A.

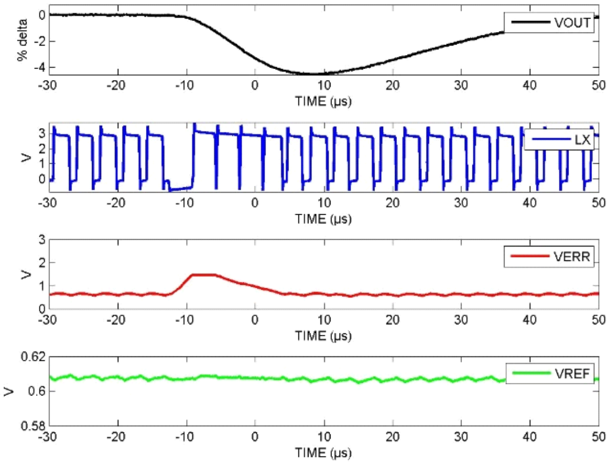

FIGURE 3B.

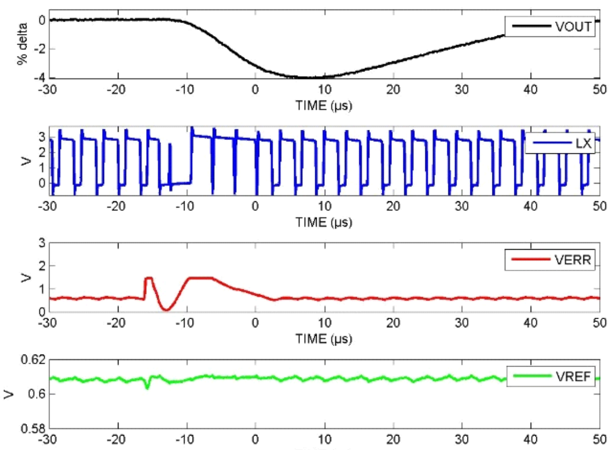

FIGURE 3C.

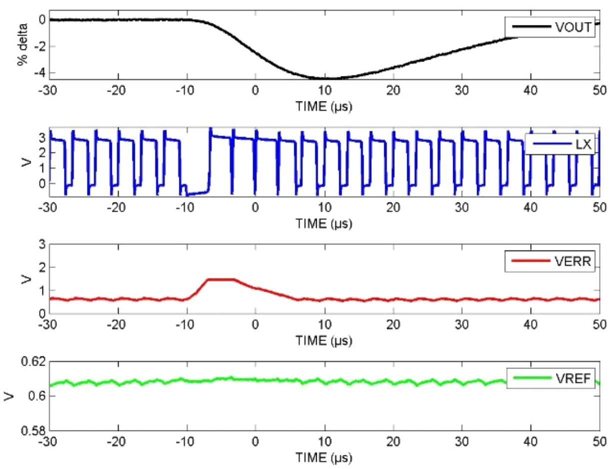

FIGURE 3D.

FIGURE 3. Worst case SET captured for each of the four units tested at PVIN = 3V, V_{OUT} = 1.8V, I_{OUT} = 3A, frequency = 300kHz internal and LET = 86MeV•cm^2/mg. Worst case SET was -4.5% or 81mV.

The fourth row of Table 6 (LET = 58MeV•cm^2/mg) again generated SET very similar in form to those presented in Figure 3 on page 7. The worst case recorded was -4.1% or -72mV from the nominal V_{OUT} of 1.8V. Again missing LX pulses following a disturbance to VERR were the forms taken.

The fifth row of Table 6 represents SET with V_{IN} = 13.2V and V_{OUT} = 3.3V. For the three units for which SET were recorded, the largest SET for each unit is presented in Figure 4. The -40mV worst case SET represents only about -40mV or -1.2% of the larger V_{OUT} = 3.3V than represented in Figure 3. It should also be recalled that the output inductor in this case was 6.8µH, whereas for the earlier cases the inductor was 3.3µH. The combination of the smaller duty cycle and larger inductor led to smaller V_{OUT} disturbance for the same missing LX pulses as seen previously.

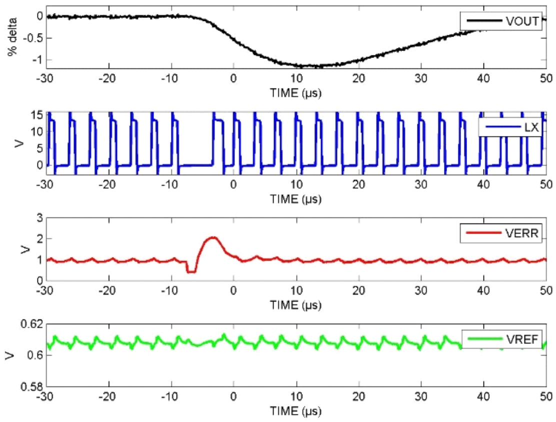

FIGURE 4A.

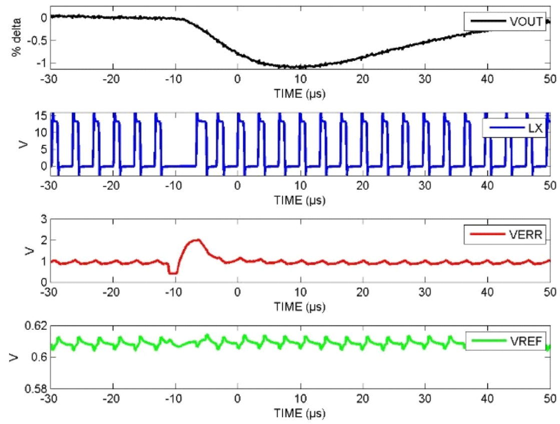

FIGURE 4B.

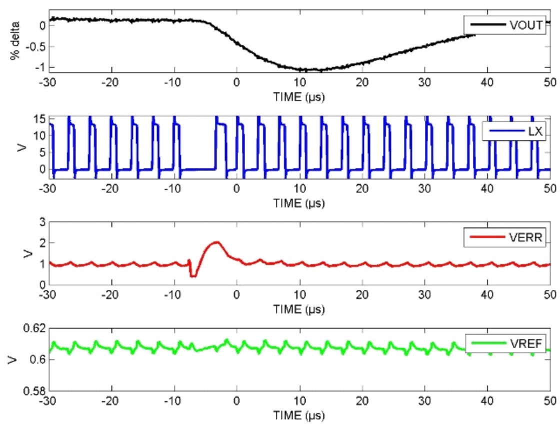

FIGURE 4. Worst case SET captured for each of the three units tested at PVIN = 13.2V, V_{OUT} = 3.3V, I_{OUT} = 3A, frequency = 300kHz internal and LET = 86MeV•cm^2/mg. Worst case SET was -1.2% or 40mV.

Interestingly, the sixth row of Table 6 only had SET recorded for two of the three units tested with ±50mV triggering, and the worst case SET for those recorded was -0.6% or about -20mV. The two worst cases are shown in Figure 5 and do not exhibit any missing LX pulses, which leads to the reduced size of the SET. The events still started with a disruption on VERR, but did not result in missing LX pulses. A single shortened pulse seems to be the hallmark of these events. The higher frequency (500kHz versus 300kHz) may have contributed to somewhat smaller SET than those in Figure 4, but it does not seem to explain why the missing LX pulse events vanished.

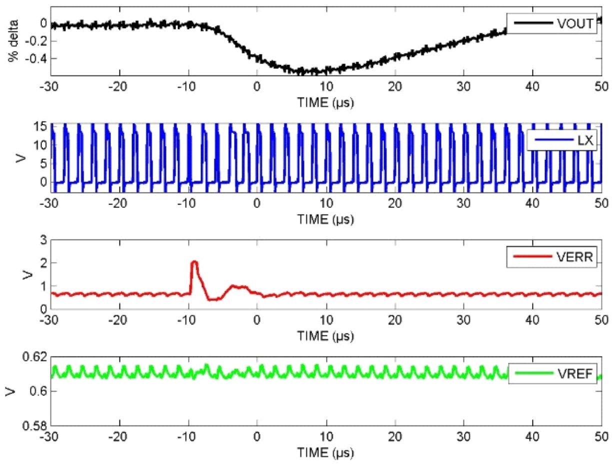

FIGURE 5A.

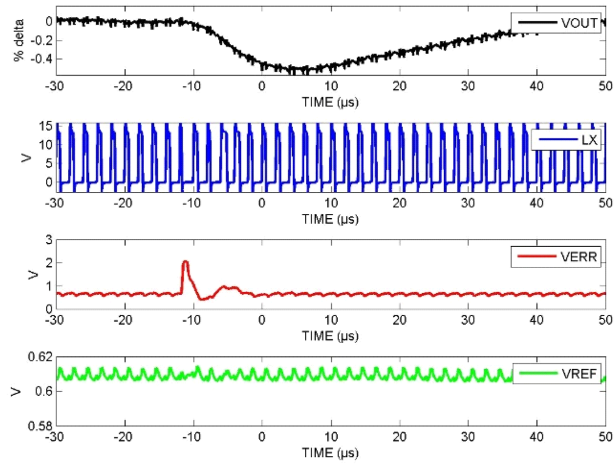

FIGURE 5B.

FIGURE 5. Worst case SET captured for each of the two units tested at PVIN = 13.2V, V_{OUT} = 3.3V, I_{OUT} = 3A, frequency = 500kHz external and LET = 86MeV•cm^2/mg. Worst case SET was -0.6% or 20mV.

TABLE 7. SET STATISTICS FOR BUFFER OUTPUT (BUFOUT)

LET MeV•cm^2/mg	PVIN (V)	V_{OUT} (V)	FREQUENCY (kHz)	±40mV TRIGGER BUFOUT SET			
				DUT14	DUT15	DUT16	DUT17
86	3.0	1.8	300 internal	0	0	0	0
86	3.0	1.8	500 external	0	1	0	0
86	5.5	1.8	500 external	52	41	50	19
58	3.0	1.8	300 internal	0	1	0	2
				DUT10	DUT11	DUT12	DUT13
86	13.2	3.3	300 internal	725	616	909	624
86	13.2	3.3	500 external	2008	1464	1873	461

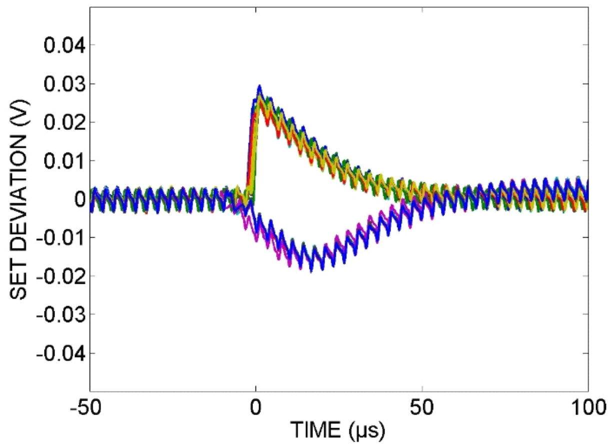

FIGURE 6A.

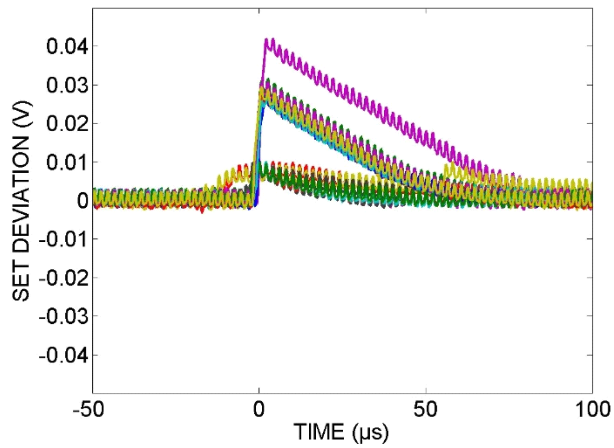

FIGURE 6B.

FIGURE 6. Examples of worst case BUFOUT SET. Plots are composites of the 10 longest and largest for each polarity in the irradiation run. Irradiation was with Au (86MeV•cm^2/mg) to 1x10^7 ion/cm^2. Left plot is DUT12 AT PVIN = 13.2V and f_{SW} = 300kHz. Right PLOT is DUT13 at PVIN = 13.2V and f_{SW} = 500kHz.

Buffer Output SET of the ISL70003ASEH

While running the V_{OUT} SET tests the Buffer Output (BUFOUT) was also monitored and triggered on SET excursions of more than ±40mV from its DC value. The capture statistics for BUFOUT SET are presented in Table 7. Only the PVIN = 13.2V cases yielded appreciable SET counts, with a few showing up for PVIN = 5.5V. Examples of worst case SET for the PVIN = 13.2V cases are shown in Figure 6.

Of the SET captured, most were positive going SET bounded by +50mV. The lack of SET for PVIN = 3.0V is likely a result of the SET being smaller than the trigger setting and not an indication that SET were not occurring. The higher PVIN levels provided SET large enough to trigger captures. The SET seem to have decayed in about 80µs from onset. The switching noise on BUFOUT as captured was several millivolts.

IMON SET of the ISL70003ASEH

During the V_{OUT} SET testing the IMON output was also monitored and triggered captures on ±80mV events. Statistics on the IMON SET captures are presented in Table 8 and show a dependence on the LET of the incident ion. LET 58MeV•cm^2/mg yielded somewhat lower counts than runs at 86MeV•cm^2/mg.

TABLE 8. SET STATISTICS FOR IMON

LET MeV•cm^2/mg	PVIN (V)	V_{OUT} (V)	FREQUENCY (kHz)	±80mV TRIGGER BUFOUT SET			
				DUT14	DUT15	DUT16	DUT17
86	3.0	1.8	300 internal	1009	1350	1159	1070
86	3.0	1.8	500 external	1222	1038	1261	1198
86	5.5	1.8	500 external	1521	1203	1502	1648
58	3.0	1.8	300 internal	389	373	867	768
				DUT10	DUT11	DUT12	DUT13
86	13.2	3.3	300 internal	1898	615*	1441	1672
86	13.2	3.3	500 external	2343	800*	1887	1896

NOTE: * Indicates a trigger of 120mV setting.

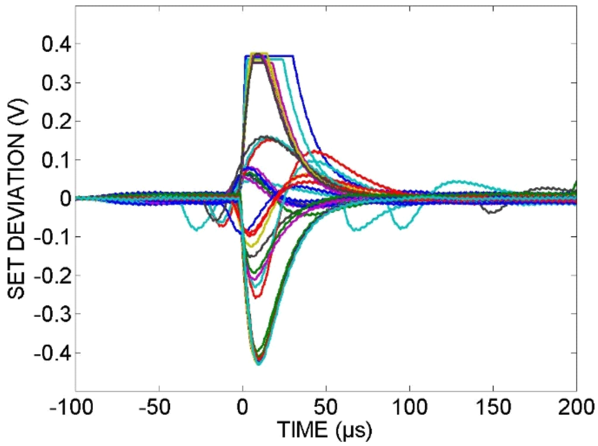

FIGURE 7A.

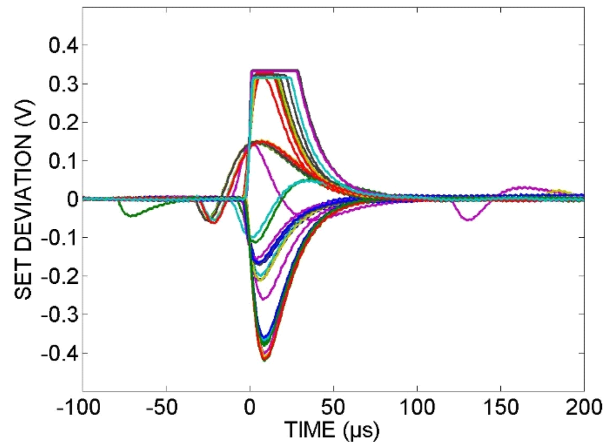

FIGURE 7B.

FIGURE 7. Examples of worst case IMON SET. Plots are composites of the 10 longest and largest for each polarity in the irradiation run. Irradiation was with Au (86MeV•cm^2/mg) to $1x10^7$ ion/cm^2. The plots are for DUT10 and DUY11 at PVIN = 13.2V and f_{SW} = 300kHz. The oscilloscope setting LED to the clipping of the positive going SET.

Examples of the IMON SET are presented in Figure 7 and show both positive and negative excursions on the IMON voltage.

The negative going IMON SET were limited to about 400mV, but the positive going SET seem to extrapolate to something more like 1V. Significant disturbance seems to have about a 100µs duration.

Conclusion

Non Damaging SEE

Four ISL70003ASEH parts survived the same SEE qualification testing as was done on the ISL70003SEH. This testing consisted of irradiation with gold at normal incidence for an LET of 86MeV•cm^2/mg to a fluence $5x10^6$ ions/cm^2 on each run. Runs were done with conditions: disabled with PVIN = 14.7V, sourcing 7A at 3.3V with PVIN = 14.7V and sinking 4A at 3.3V with PVIN = 13.7V. All of this was done at a case temperature of +125°C ±10°C.

In addition to the above testing, the parts survived irradiation while sourcing 11A at 3.3V with PVIN = 14.7V. For operation at this higher current level, the Schottky diode from GND to LX was installed on the boards. The parts also survived operation under beam with PVIN = 15.5V and I_{OUT} = 11A, but this goes beyond the performance previously seen on the ISL70003SEH.

In a separate set of tests four parts were irradiated with silver for an LET of 43MeV•cm^2/mg to $1x10^7$ ions/cm^2. During the irradiations the parts were operated at V_{OUT} = 3.3V with PVIN = 16.5V, I_{OUT} = 11A and with PVIN = 15.5V, I_{OUT} = -4A.

Single Event Transients

The ISL70003ASEH was subjected to the SET conditions used to characterize the ISL70003SEH. Since the changes between the parts were not anticipated to modify SET behavior, the objective was to demonstrate comparable behavior.

Comparable performance was observed for the spontaneous recovery SEFI at low PVIN (3V) and high LET (86MeV•cm^2/mg). The SEFI exhibited a cross section of $6.1x10^{-7}$/cm^2 at those conditions and disappeared completely for either PVIN = 5.5V or LET of 60MeV•cm^2/mg.

With an output LC of 3.3µH and 150µF operating from PVIN = 3.0V at 300kHz, the worst case SET was a drop of 4.5% (81mV) on the 1.8V output. This was in response to gold at zero incidence for an LET of 86MeV•cm^2/mg.

For operation from PVIN = 13.2V with an inductor of 6.8µH and output of 3.3V at 500kHz, the worst case V_{OUT} SET observed was -1.2% drop.

This is all consistent with the behavior observed for the ISL70003SEH (AN1913).

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