NASA
Technical
Paper
3423

June 1993

CRRES Micro–Electronics Package Flight Data Analysis

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PREFACE

The work reported herein was sponsored by the Defense Nuclear Agency, RAEE, and was partially supported by special Goddard Space Flight Center funding.

A follow-on study and correlation to magnetospheric processes may be conducted when the data from the scientific experiments on board the satellite become available and funding can be secured.

It should be remembered that most comments and findings are device-type and technology specific and are not necessarily valid for general application, although some generic trends may exist. Hence, caution is advisable when using the contents of this document.

Acknowledgements

The authors wish to thank the many individuals who contributed to this work, but especially Lt. Kevin Ray, USAF/PL, Dique Gonyea, Telenetics, and Pat McDonald, SFA, for their valuable assistance in the early stages of the analysis.

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CRRES MICROELECTRONICS PACKAGE (MEP) FLIGHT DATA ANALYSIS

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Abstract

A detailed in-depth analysis was performed on the data from some of the CRRES MEP devices. These space flight measurements covered a period of about fourteen months of mission lifetime. Several types of invalid data were identified and corrections were made. Other problems were noted and adjustments applied, as necessary. Particularly important and surprising were observations of abnormal device behavior in many parts that could neither be explained nor correlated to causative events. Also, contrary to prevailing theory, proton effects appeared to be far more significant and numerous than cosmic ray effects. Another unexpected result was the realization that only nine out of thirty-two p-MOS dosimeters on the MEP indicated a valid operation. Comments, conclusions, and recommendations are given.

This work was supported by DNA/Electronic Effects Division

CRRES MICROELECTRONICS PACKAGE FLIGHT DATA ANALYSIS

Introduction

Advances in the complexity and scale of integration in semiconductor devices have increased the problems of spacecraft builders. Hardware, software, and system engineers have been driven by the continuous expansion of space applications to incorporate these more modern devices in the electronic systems of new satellites. Concurrent with the increase in complexity of electronic systems is the growth in ground testing and characterization of parts to survive and operate reliably for long mission lifetimes which may extend up to 30 years, as it is for the Space Station Freedom. Design engineers are faced with the formidable task of designing the ground tests to obtain the basic parts-data to enable them to predict the slow gradual degradation of component parameters and consequently, to properly design the systems with tolerance for these effects.

In addition to this requirement of gradual decay, there are the possibilities of temporary device/system upsets which may or may not lead to catastrophic failures. Laboratory tests have to be designed to address this upset threat, and thus allow the engineers to accurately predict parts/system behavior over long mission lifetimes. Predictions for both degradation and upset effects require not only test data but also accurate modelling of component behavior and radiation environments. The CRRES spacecraft and program were the first projects which were specifically designed to address these issues by accumulating ground test data, modelling, total dose degradation and heavy ion upset based on existing models of radiation environments, and eventually compare these efforts to CRRES space measurements of component decay and upset together with observations of radiation environments. The plan was to eventually improve these models and parts data so that spacecraft engineers would have more accurate tools to use.

In order to achieve these goals, the CRRES flight data had to be extracted from satellite tapes, and analyzed. The objectives of this study were to extract selected data, examine them and then discard all non-valid measurements, make decay and upset predictions of space results, upgrade environmental models with CRRES data, and finally modify models to fit observations. This report is only a first step in achieving all of these objectives.

Thus, a comprehensive analysis of the CRRES Microelectronics Package (MEP) flight data has been performed for select device types and technologies. In this process, many of the bugs discovered in the CRRES access software system were eliminated, and difficulties in the interpretation of the instructions in the CRRES user's manual were overcome. There still remain some questions to be answered, and problems which need to be solved in this investigation of the CRRES data. These issues are being addressed and will eventually be resolved. All available CRRES manuals, documents, and reports were consulted in this study, especially the "CRRES-MEP Flight Data Analysis User's Manual", Version 3, of 21 April 1992 (1). In order to proceed with the analysis, several preparatory activities were necessary, as for example:

(1) Specially designed software package was developed to analyze the device SEU data extracted from the CRRES Data Bank.

(2) The following device blocks (Table 1) were extracted and analyzed by the above special software:

Table 1: Blocks and Device Types Analyzed and Evaluated

Blocks	Bd. level	Device	Type	Technology
00	1	80E200001-2001	SRAM	GaAs
01	1	80E200002-3	SRAM	GaAs
03	1	30283-1K	SRAM	GaAs
06	1	XTA12702A	SRAM	CMOS/SOS
1B	3	AM93L422ADMB	SRAM	Bipolar
1C	3	AM93422DMB	SRAM	Bipolar
1D	3	S82S212F/883C	SRAM	Bipolar
10	3	HM-6504-2 RADPAK RH6504 RADPAK	SRAM SRAM	CMOS/B CMOS/B
11	3	HSL-HM-6504 HS1-6504-RH-8	SRAM SRAM	CMOS/B CMOS/B
15	3	AM92L44CDMB	SRAM	NMOS
16	3	3232-8-7 Honeywell VHSIC	SRAM	CML
17	3	VHSIC 185.1 TI VHSIC	SRAM	NMOS
23	2	IDTSC0271	SRAM	CMOS
24	2	IDT6116RS	SRAM	NMOS
3C	3	F4122120 D2164A-20	DRAM	NMOS

(3) Several of these blocks were identified as having invalid readings on the basis of these analyses.

(4) Space upset rates were determined for investigated parts (Table 8b), using only valid data that were corrected for multiples, invalid readings, hard failure counts, missing data tapes, and periods over which devices were disabled from interrogation (where information was available) (Table 10), for future comparison with predictions.

(5) Location of parts and dosimeters were identified relative to the three basic circuit boards and their partitioning into 9 sections as shown in Table 2a.

Table 2a: Physical Boards and Their Sections

Physical Board Level	Section Designation* (CRRES MEP Experimenter Interface Meeting 10/21/86)		
1:	1A	4	1B
2:	2A	5	2B
3:	3A	6	3B

*According to Reference (13), where all sections are called BOARDS, Figures 1, 2, 3.

(6) The dose data for 32 dosimeters, side B, were extracted and analyzed for valid data. Of these 32 sensors the following 9 normal-range devices were identified for that purpose, as shown in Table 2b (explanations and comments in section "Discussion: P-MOS Dosimeters"):

Table 2b: Dosimeters Analyzed and Evaluated

Dosimeter Identification*	Section#
0C, 0D, 1C	2B
11, 15	5
10, 13	3B
1B, 1E	6

* All are normal range dosimeters on board levels 2 and 3 which have a saturation value at ≈30 Krads

It should be noted that all of the data processed and analyzed in this study were received from the MEP Data Base at the Naval Research Laboratory by the software package QUERY, versions 4.05b - 4.07b.

Results of Analysis

Block 24 (NMOS SRAM)

Tables 3a, b, and c illustrate the value of the special software designed by this office to establish strong evidence of a malfunctioning or defective part that provides invalid upset information. Tables 3a and b are hard copies of the breakdown analysis of upsets by orbit, electrical address, and bit number for two of the three samples of the IDT6116RS memory in block 24. **Comparison of the breakdown by address and bit number of device 3 (Table 3c) to samples 1 and 2, Table 3a and 3b, respectively, shows that 11670 upsets were all for the same bit and at the same address location. In contrast, the breakdown data for device 1 and 2 are distributed randomly over all addresses and bit numbers. It can be concluded that the number of 11670 upsets is not valid.** It is not reasonable to assume that such a large number of upsets occurring only in one of the three devices and all in one and the same bit address is anything else but a malfunction of a defective part.

Block 06 (CMOS/SOS SRAM)

Another example of a device malfunctioning and supplying an erroneous number of upsets was in block 06 of the XTA 12702A CMOS/SOS memory group. Tables 4a, b, and c contain similar types of data analyses performed with this software tool. Again, one of three samples was bad whereas the other two performed normally throughout all orbits. Results obtained with sample 1 are shown in Table 4a giving the breakdown analysis of upsets by orbit, electrical address, and bit number. This sample began showing large numbers of upsets starting at orbit 687 and these continued to increase throughout the remaining orbits of the mission as shown in this table. The total number reached 30684 at orbit 1067. In contrast to this behavior, Tables 4b and 4c show that sample 2 reached a total of two upsets and sample 3 showed no upsets for the entire mission of

1067 orbits, for a combined total of 30686 upsets for all three parts. In fact, 30677 of the total of 30684 upsets in sample 1 all occurred at address 7294, plus 5 hard errors in other locations. **There is no question that this part malfunctioned at about orbit 687, and continued in this manner throughout the remaining orbits. This means that the error rate for this part type should be calculated on the basis of a total number of 4 upsets rather than 30686 upsets for the group of three samples. Obviously, a very large miscalculation would occur if the upset breakdowns were not investigated and identified.**

Block 03 (GaAs SRAM)

The above two device types involved very significant numbers of non-valid upsets. In the investigated group of 15 blocks of devices, there was another part type which contained some non-valid data, but not nearly as severe as the above two parts. This block was 03 which involved two samples of a 1k x 1 GaAs memory, the 30283-1K. **The CRRES manual indicated that these parts showed intermittent hard and soft upsets during functional and environmental ground testing before they were launched into space.** This means that some of the space upsets could have been caused by device malfunctions and not by the space radiation. Tables 5a and b for samples 1 and 2 of this part type contain the hard copy printouts obtained with the analysis code. These data are sufficient to illustrate the evidence that both samples fortuitously showed malfunctioning behavior after orbit number 793 when some 688 hard upsets occurred in each sample. Although the evidence in this case is not as strong as it was for the 6116 and 12702 parts, it still suggests that all upsets after orbit 793 should be excluded for samples 1 and 2; that is, 723 and 705 upsets, respectively. Thus, a total of 7753 valid upsets for this group of two parts is obtained (3080 for part 1 and 4673 for part 2; see Table 8a). Of course, in arriving at this total number, the hard upsets have all been excluded as well as the soft upsets that have been considered invalid for orbits beyond 793, i.e., orbits 794, 854, as well as 855 (see Table 5a and 5b). No data are available for orbits between 794 and 854, after orbit 855. An explanation of this problem is given in the section: "Discussion: Block 03 (GaAs SRAM)". **The initial ground test data still imply that some unknown number of this total contains non-valid upsets which were caused by device malfunctions and not by protons or heavy ions.**

Block 00 (GaAs SRAM)

Most of the upset data for the gallium arsenide parts were obtained with block 03 samples, as described above. However, there were two additional blocks, 00 and 01, which also provided upset data for this technology. It was interesting to examine these measurements since failures and non-valid data similar to block 03 also occurred in these two blocks. Table 8a summarizes the total, invalid, and valid data for all devices with abnormal behavior, including these two blocks. Table 5c shows the occurrence of surges of upsets (as in block 03) for samples 1 and 2 of block 00. For sample 1, these occurred (as in block 03) at orbit 794 where 215 hard upsets appeared and later 77 additional upsets in orbit 855. Thus, only 9 soft upsets are valid for this sample. Similarly, sample 2 showed surges of hard upsets of 215 at orbit 794 and 77 at orbit 855. **Consequently, the total number of soft, valid upsets for both samples is 46 for the entire exposure time.**

Block 01 (GaAs SRAM)

Very similar behavior occurred in block 01. The data for this block are shown in Table 5d for samples 1 and 2. It can be seen that 344 and 312 hard upsets occurred in sample 1 at orbits 794 and 855, respectively. Sample 2 also showed 344 and 312 hard upsets at the same orbits. Thus, a total of 656 hard upsets were eliminated for each sample. **Elimination of these non-valid data yields a total of 40 valid upsets for both samples.**

Block 3C (NMOS DRAM)

There remains one more suspicious set of device data and that is block 3C, the group of INTEL 2164 dynamic memories. **Similar to the gallium arsenide parts, these memories showed intermittent soft errors for 10 samples during environmental and functional ground testing, prior to launch.** In this study, we have restricted our considerations to side B of the MEP experiment since side A was turned off after 43 days and side B continued to operate for the full mission time. Five of the group of ten samples that were on side B were analyzed. Table 6 shows a small selected section of the hardcopy printout of the analysis for this part type. Note that there are large spurts of upsets at orbits 113, 114, 116, 286, 447, and 911. These levels greatly exceed the average behavior during the majority of the mission time. Table 7 lists the above mentioned six orbits and the total surge upsets which occurred during these periods. The corresponding ephemeris data is also given in this table for these specific upset totals.

Table 7. INTEL 2164 Dynamic RAMs Abnormal Performance

Orbit #	Surge of Upsets*	Altitude	Lat.	Long.	L-Shell
113	217	10205.212	-3.04	-73.62	2.7404
	510	10209.070	-3.04	-73.61	2.7412
114	510	13890.489	0.79	145.24	3.2204
	228	14268.110	1.12	145.75	3.2785
	510	14278.123	1.12	145.76	3.2800
116	510	27232.883	17.86	-168.67	5.7212
286	510	28114.643	18.26	-124.18	6.8977
447	405	33327.531	4.90	154.21	6.5665
911	190	28442.281	-8.94	172.5	5.8785

*Normally, upsets ranged from 0 to 30 per measurement interval. Any such interval showing upsets of 190 or more was classified as "Surge of Upsets".

Summary of Upsets

Table 8a summarizes the device types with abnormal behavior and Table 8b the space upset rates determined from these analyses for all device blocks. Note that total upset rates were corrected for invalid information, multiples, power outages, and missing data tapes. The corrections for multiples were based on the standard CRRES definition of multiples as described in the fourth paragraph of the section: "Discussion: Corrections

to Data". Multiples, power outages, and missing data tapes are discussed in subsequent sections of this report.

Other SEU Measurements

Finally, the measurements of blocks 1B, 1C, 1D, 10, 11, 15, 16, 17, and 23 were also investigated and no abnormalities or invalid data were found (Table 8b).

Space Radiation Dosimeter (SRD)

This dosimeter was designed to measure the radiation dose from both electrons and protons as well as the differential and integral flux of these particles (15). The instrument is made up of four solid state, P-I-N diffused junction, silicon diodes. Each of the diodes is located behind a hemispheric aluminum shield thickness of 82.5, 232.5, 457.5 and 886.5 mils, respectively. A detailed description of its design, operation, and the results obtained with this scientific package can be found in reference (15). Dose measurements made with the SRD provided a second set of dose versus time or orbit number for comparisons with the results of the P-MOS dosimeters located on the three boards of the Microelectronics Package (MEP). Figure 4 contains plots of dose-depth curves based on the SRD measurements and on calculations determined from the standard NASA AP8 and AE8 proton and electron models for the CRRES orbit and for a mission life of 14 months.

Table 9a gives the mission integrated dose for parts on board-level 1, as obtained from the SRD, dome #1 with total shield of 93 mils Aluminum.

P-MOS Dosimeters

It was determined that several of the P-MOS dosimeters on board levels 1, 2, and/or 3 did not perform satisfactorily. Table 9b lists the good P-MOS dosimeters (sensor numbers identified) located closest to each device type. Figure 5 contains plots of dose versus "CRRES Universal Time" for all valid dosimeters (see "Discussion: P-MOS Dosimeters").

Discussion

Corrections to Data

In order to determine the total number of upsets and upset rates for any device type and block of parts, certain corrections were necessary. The special software program which was developed during this reporting period has proved to be a valuable tool in analyzing the SEU data. It extracted and organized the CRRES measurements so that non-valid data were identified and these spurious upsets were subtracted from the number of total upsets. Application of this program to device blocks has identified erroneous upset data which were eliminated from the number of total upsets previously accepted by several investigators (5, 8, 9, 10) as valid values for some devices. Examples of these devices are given in Tables 3a, b, c, 4a, b, c, 5 a, b, c, d, 6, and 7. This was our most important correction in these analyses.

Corrections were also made to account for periods of time when devices were powered down and measurements of SEUs were not possible. A third correction accounted for tapes which were lost in shipment from the ground control center to Hanscom Air Force Base. This correction was made by adding up relevant orbits and/or parts of orbits

where data were recorded on these missing tapes and, subsequently, converting these values to a period of time (# of days) for which no data were available. This correction was then made to the exposure times on all parts listed in Table 8b.

Additionally, a correction was made for time intervals over which devices were disabled from SEU data acquisition. Table 10 addresses these last three corrections as well as the exposure times based on them. These exposure times were used to calculate upset rates which are shown in Table 8b. Column three of Table 10 contains the accepted orbit ranges for the device blocks indicated in column one. These ranges represent the orbits where valid data were identified for the indicated blocks. Column 4 is a summation of orbits within the accepted ranges. Column 5 contains the universal times corresponding to the beginning and the end of each range in column 3. Column 6 lists the differences in the corresponding universal time ranges, expressed in units of days. Total durations in units of seconds, which correspond to times within each orbit range where data were lost due to missing tapes, are given in column 7. Lastly, column 8 contains the exposure times corresponding to periods when valid SEU data were collected for each block shown in column 1.

Finally, a correction to the upset rate calculation for the occurrence of multiples was necessary. The CRRES data bank contains measurements of upsets which are identified as multiples. In addition, the system classifies the multiples as to whether they are doublets (two upsets), triplets (three upsets), etc., out to a value greater than four upsets. The definition in references (9) and (10) of a CRRES multiple was **"two or more SEUs seen in one device within the same 128 milliseconds time period". However, in this study, it has been determined that the time of interrogation on measurement of SEUs was ≈ two seconds (11, 12, 13).** Figure 6 displays a drawing of the Mission Test Scenario and Figure 7 is a page from a report which identified the testing time. It can be seen from Figure 6 that the total time required to make the SEU upset and rate meter measurements is actually two seconds. This is the time which is necessary for the system to revisit a bit for the next measurement, consequently, the time resolution for determination of multiples is two seconds. The 128 ms is only the timing accuracy of the clock which places a time tag on the observations. Thus, a multiple is the occurrence of two or more upsets in a two second period. We have some reservations about using this criterion as the only one in defining multiples. However, for this report, the multiples supplied by the CRRES data bank will be used to correct the total number of upsets and, consequently, the upset rates by subtracting the multiples from the total according to the following formula:

$$\text{total \# upsets} - (\#D) - 2(\#T) - 3(\#Q) - 4(\#5^{+}) = \text{total \# events}$$

and using the total number of events for the rate calculations, where D=doublets, T= triplets, Q=quadruplets, and 5^{+}=five and more.

It is our judgement that the proximity of adjacent bits should be used to obtain the correct number of multiples. **Previous tests (14) have shown that even a one second time resolution may not be short enough to guarantee valid measurements of multiples.** In reference (8), the author assessed the number of multiples which were actually adjacent bits in the physical memory plane of four part types. **However, it is now believed that an incorrect bit map was used in the case of the 93L422 part type.** Thus, the application of this proximity criterion will be addressed at a later time when all available physical bit maps have

been verified. Presently, we have no conclusive evidence how many, if any, multiple upsets occurred.

Block 24 (NMOS SRAM)

Tables 3a and 3b for IDT6116 samples 1 and 2 show a normal distribution of upsets throughout all orbits of the entire spacecraft mission. Orbits containing zero upsets are simply not printed out. It can be seen that both samples behaved similarly. Summaries of upsets and breakdowns into soft, hard, and totals in each bit position are provided at the end of each table. The breakdown of total upsets per electrical address is particularly interesting. It can be seen that for these two samples the distribution of upsets is random for the 8 bits at any address. However, examination of Table 3c for sample 3 indicates a very different behavior as a function of orbit number relative to the number of upsets, particularly in the breakdown of total upsets per electrical address. Samples 1 and 2 showed only 31 and 32 total mission upsets, respectively, whereas sample three shows 11699 soft upsets. **A soft error is defined to be an error at a specific address which can be erased and new valid, complementary data rewritten in this address. A hard error is one which can not be erased and rewritten with complementary data.** Clearly, if one were to simply use the sum of all three samples as representing the response of this device type, then an erroneous upset rate would be attributed to this part. It can be seen from the address breakdown that 11670 upsets occurred at a single address, namely 977. Apparently, this sample malfunctioned after orbit 988. Consequently, these 11670 upsets must be discarded from the calculation of upset rate for comparison to predictions. The true total number of upsets for all three IDT6116 devices, excluding those 11670 upsets for sample 3, is only 92. **It can be concluded that breakdowns by orbit, sample number, electrical address, soft errors, hard errors, and bit location are necessary in order to identify non-valid data.**

Upset data for the IDT6116 were used in several papers (8, 9, 10). It is not clear whether or not the total number of upsets used in references (8) and (9) included the sample which gave the 11670 upsets for the same bit and address; however, **reference (10) did show in Table 1 that this number was included in their analysis. An upset rate of 4.92 x 10^{-4} upsets/bit-day was quoted for this part type, whereas, by excluding the erroneous upsets of the malfunctioning sample, this analysis yields a value of 4 x 10^{-6} upsets/bit-day:** a vast difference of over two orders of magnitude.

Block 06 (CMOS/SOS SRAM)

The special program provided also an interesting analysis of upset data for the XTA12702A, CMOS/SOS static RAM which is illustrated in Table 4a, b, and c. This device type in block 06 represents one of the technologies which is intrinsically hard to SEU upsets. The threshold LET for these parts is 25 MeV-cm^2/mg (7) with an asymptotic cross section of 9.8 x 10^{-9} cm^2/bit for heavy ions. Its proton sensitivity is very small with a Bendel "A" parameter estimated to be 40 MeV. Consequently, only a few upsets, if any, were expected for this part. The 30677 upsets were totally unexpected and could not be explained. **However, it was clear from the analysis and breakdown by bit and address, that all of these upsets occurred at one and the same address, namely 7294, which implies a defective bit.** Thus, one can conclude that these data are not valid and should be excluded from

consideration. As it turned out, this part type and its calculated upset rate based on partial data appeared only in a table of reference (9). However, no significant conclusions were based on these results. A more detailed description of the analysis and comparison with the published data is presented in Appendix A.

Block 03 (GaAs SRAM)

The gallium arsenide devices in block 03 malfunctioned during orbit 794. As shown in Tables 5a and b, both samples suddenly increased in upset rate for no apparent reason to a high level about an order of magnitude or more above the average behavior during all of the prior orbits. **We were informed that at orbit 794 the software safety feature turned off power to block 03 and subsequently turned it on again at orbit 854. Then, this high rate appeared again at orbit 855, at which time the devices were shut down permanently.** In our judgement, only data up to and through orbit #793 should be accepted as valid data. It can be seen from the tables that both samples also showed 688 hard failures as well as the soft upsets. Clearly, all hard errors should also be eliminated from the total.

These data were used in reference (9), where block 03 data were employed in establishing the upset frequency versus altitude for GaAs parts compared to silicon. The comparison curves are for time periods before, during, and after the March 1991 flare. Since these devices began to malfunction during orbit 794 which occurred long after the flare (orbit ≈ 585), removal of the invalid data could only affect the curve depicting upset behavior "after the flare". It isn't clear from the text whether or not these invalid upsets were included in the plots.

Block 00 (GaAs SRAM)

It should be noted that all of the three blocks (00, 01, 03) of gallium arsenide parts showed abnormal behavior of the same type and during the same orbit 794, as discussed in a previous section. This anomalous coincidence was traced back to a software commanded turn-off of power when all blocks showed some type of malfunction. However, the spacecraft control program does not identify and report the malfunction type, for example, a sudden surge of current in excess of threshold. It appears from the records that power was reapplied to each of these blocks at orbit 854, but finally, software again turned off blocks 03 and 01 at orbit 855 and it remained "off" to these blocks until the end of the mission. It can be seen from Table 5c that, in contrast to the devices on the other two blocks (03 and 01), block 00, samples 1 and 2 did succeed in remaining "on" with some additional soft errors occurring up to orbits 1028 and 1057, respectively. These soft errors were included in our valid totals, but only for this block 00.

Block 01 (GaAs SRAM)

Both devices in block 01 showed abnormal behavior at orbit 794 which was of the same type as the parts in blocks 03 and 00. As mentioned above, block 01 was turned off at orbit 794, then back on again at orbit 854, and then finally permanently off at orbit 855. Thus, block 01 parts were identical in behavior to those in block 03 and the total of valid upsets were similar to those in block 00. It appears that some type of malfunction in the measuring hardware or software which was common to all three blocks of devices caused these failures.

Block 3C (NMOS DRAM)

The dynamic memory, INTEL 2164A, in block 3C had been expected to upset at a very high rate, and thus it was identified as an SEU ratemeter. However, this did not happen in space as expected. There was a relatively large number of upsets, but when the total number of bits is accounted for, the upsets/bit-day turn out to be low. **All of these parts showed transient upsets during environmental and functional ground tests prior to launch.** This means, five samples on side A and five samples on side B were involved. Since we are only analyzing side B, five dynamic RAM samples were investigated. As shown in Tables 6 and 7, there were sudden surges or large numbers of upsets which occurred. For example, orbit 113 shows 217 upsets at a given time followed immediately by 510 upsets at the next measurement. **This means that 217 or 510 upsets occurred within each measurement interval of 2 seconds. Clearly, if one compares this to the average behavior over the mission duration, where the normal rate was 1 or 2 upsets per measurement interval (at which events were observed), one must conclude that these surges should be excluded from the total number of events in order to arrive at a valid number of upsets because, obviously, these are spurious data. No reasonable explanation has been given to explain this abnormal behavior.**

Block 3C dynamic memory SEU data were used in reference (5) to compare with calculated upset rates for this part type. A value of 8.1×10^{-5} upsets/bit-day was quoted for this part for 450 orbits in Table 1 of reference (5). The upsets were only for the inner proton belts. The interesting result is that the values calculated by those authors (3.5×10^{-5} upsets/bit-day) were lower than their measurement rate by about a factor of 2. However, from Table 8b of this report, our rate is given as 4.1×10^{-5} upsets/bit-day which is in close agreement with their calculated value of 3.5×10^{-5}. It is expected that if the heavy ion rates were to be subtracted out , this value of 4.1×10^{-5} would approach the calculated value of reference (5). It appears that the model for DRAMs is better than those for other memory types.

Reference (8), Table 2, includes the dynamic RAM in its list of parts and upsets. The number quoted in that table for this part is 5626 total upsets for side B over the first 590 orbits. In this study, we obtained a total of 6470 upsets for the corresponding orbits. If we adjust this number of upsets by subtracting the invalid events (see Table 8a) within the time interval of the first 590 orbits (i.e. 217 + 510 + 510 + 228 + 510 + 510 + 510 + 405 = 3400) (see Table 7), this total then becomes 3070 valid upsets rather than 5626 given in reference (8).

Table 8a: Summary of Devices with Abnormal Behavior

Block#	Device Type	Device#	Data Table	Total Upsets	Orbits of Anomalies	Invalid* # of Upsets	Valid Upsets
24	IDT6116RS	1	3a	31		0	31
	NMOS	2	3b	32		0	32
		3	3c	11699	989-1067	11670	29
06	XTA12702A	1	4a	30684	687-1067	30682	2
	CMOS/SOS	2	4b	2			2
		3	4c	0			0
03	30283-1k	1	5a	3803	794, 854, 855	723	3080
	GaAs	2	5b	5378	794, 854, 855	705	4673
00	80E200001-2001	1	5c	301	794, 855	292	9
	GaAs	2	5c	329	794, 855	292	37
01	80E200002-3	1	5d	670	794, 855	656	14
	GaAs	2	5d	682	794, 855	656	26
3C	F4122120 D2164A-20 NMOS	1-5	6,7	9445	113-911	3590	5855

*Includes hard errors and other upsets not considered valid.

Table 8b. Summary of Corrected Space Upset Rates for 15 Device Blocks

Blk #	Device	Type	Organi-zation	Upsets all dev. side B	Apparent Multiples+	Upset Rate* (upsets/ bit-day)	Board Level	#** Dev	Correct Exposure (days)
00	80E200001-2001	SRAM, GaAs	256x1	46	0, 0, 0,3	$1.4x10^{-4}$	1	2	386.7
01	80E200002-3	SRAM, GaAs	1kx1	40	0, 2, 0, 0	$6.5x10^{-5}$	1	2	270.2
03	30283-1K	SRAM, GaAs	1kx1	7753	57, 1, 0, 0	$1.4x10^{-2}$	1	2	270.2
06	XTA12702A	SRAM, CMOS /SOS	16kx1	4 0	0, 0, 0, 0 0, 0, 0, 0	$2.8x10^{-7}$ $<1.6x10^{-7}$	1 1	2 1	432.8 387.6
1B	AM93L422ADMB	SRAM, Bipolar	256x4	3249	170, 8, 0,0	$3.5x10^{-3}$	3	2	432.8
1C	AM93422DMB	SRAM, Bipolar	256x4	4215	240, 13, 0, 0	$4.5x10^{-3}$	3	2	432.8
1D	S82S212F/883C	SRAM, Bipolar	256x8	1718	18, 0, 0 ,0	$9.6x10^{-4}$	3	2	432.8
10	HM-6504-2 RADPAK RH6504 RADPAK	SRAM, CMOS/B SRAM, CMOS/B	4kx1 4kx1	2 0	0, 0, 0, 0 0, 0, 0, 0	$5.6x10^{-7}$ $<1.9x10^{-7}$	3 3	2 3	432.8 426
11	HSL-HM-6504 HS1-6504-RH-8	SRAM, CMOS/B SRAM, CMOS/B	4kx1 4kx1	0 1	0, 0, 0, 0 0, 0, 0, 0	$<2.8x10^{-7}$ $1.9x10^{-7}$	3 3	2 3	432.8 432.8
15	AM92L44CDMB	SRAM, NMOS	4kx1	1028	9, 0, 0, 0	$1.4x10^{-4}$	3	4	432.8
16	3232-8-7 Honeywell VHSIC	SRAM, CML	32x8	1662	127, 2, 7, 4	$7.5x10^{-3}$	3	2	387.6
17	VHSIC 185.1 TI VHSIC	SRAM, NMOS	8kx8 8kx8	1012 1359	9, 0, 0, 0 9,0,0,0	$9.8x10^{-5}$ $1.0x10^{-4}$	3	1 1	156.4 202.0
23	IDTSC0271	SRAM, CMOS	4kx4	109	0, 0, 0, 0	$5.1x10^{-6}$	2	3	432.8
24	IDT6116RS	SRAM, NMOS	2kx8	92	8, 0, 0, 0	$4.0x10^{-6}$	2	3	432.8
3C	F4122120 D2164A-20	DRAM, NMOS	64kx1	5855	0, 0, 0, 0	$4.1x10^{-5}$	3	5	432.8

*Note: Upset rate calculations were corrected for invalid readings, power off, disabled devices, multiples, and missing data tapes.

**Note: Numbers in this column represent number of samples which have contributed to valid data.

+Note: This column contains four entries which relate, in sequence, to doubles, triples, quadruples, and greater than quads. Regarding the use of these data, see section "Discussion: Corrections to Data".

Table 9a. Board-Level 1 Parts Exposure

Block	Device	Board Level	Dosimeter Identification	Accum. Dose krads*
00	80E200001-2001	1	SRD	165
01	80E200002-3	1	SRD	165
03	30283-1K	1	SRD	165
06	XTA12702A	1	SRD	165

*From SRD - Space Radiation Dosimeter, Dome #1(total shield thickness ≈ 93 mils Al.)

Table 9b. P-MOS Dosimeter Sensor Numbers Located Closest to Devices.

Block	Device	Board Level	Dosimeter* Identification	Accum. Dose krads
1B	AM93L422ADMB	3	10	2.4
1C	AM93422DMB	3	13	1.86
1D	S82S212F/883C	3	13	1.86
10	HM-6504-2 RADPAK RH6504 RADPAK	3 3	13 13	1.86 1.86
11	HSL-HM-6504 HS1-6504-RH-8	3 3	13 13	1.86 1.86
15	AM92L44CDMB	3	10	2.4
16	3232-8-7 Honeywell VHSIC	3	10	2.4
17	VHSIC 185.1 TI VHSIC	3	10	2.4
23	IDTSC0271	2	0C, 1C	6.18/8.09
24	IDT6116RS	2	0C, 1C	6.18/8.09
3C	F4122120 D2164A-20	3	10	2.4

*Dosimeter (see CRRES user's manual)

Space Radiation Dosimeter (SRD)

The SRD instrument proved to be a valuable source of dose data for comparison to the P-MOS dosimeters and, also, for providing a measurement of dose on board 1, covering the entire mission. As discussed in reference (15), dome 1 of this instrument supplied a dose/time profile for this board whereas the P-MOS dosimeters on on it saturated after 30 krads. The total accumulated dose reached 165 krads at the end of the mission on board 1.

TABLE 10

CRRES: DETERMINATION OF CORRECTED EXPOSURE TIME FOR UPSET RATE CALCULATIONS ON INVESTIGATED PARTS

Block	Device #	Accepted Orbit Range	# Of Orbits In Accepted Range	Corresponding Univ. Time Range	Number Of Days In Range	*Seconds Of Missing Tapes Within Range	Corrected Exposure Time (Days)
00	1-2	116.1-249.0	132.9	254.520833-309.113542	54.592709	113129	
		251.0-283.1	32.1	309.934750-323.109653	13.174903	8434	
		286.3-794.0	507.7	324.413194-532.850703	208.437509	393286	
		795.0-855.0	60.0	533.276417-558.930600	25.654183	11309	
		856.0-1068.0	212.0	559.359059-650.375694	91.016635	5028	
			944.7		392.875939	531186	386.7
01,03	1-2	116.1-249.0	132.9	254.520833-309.113542	54.592709	113129	
		251.0-283.1	32.1	309.934750-323.109653	13.174903	8434	
		286.3-794.0	507.7	324.413194-532.850703	208.437509	393286	
			672.7		276.205121	514849	270.2
06	1-2	4.0-249.0	245.0	208.468768-309.113542	100.644774	185219	
		251.0-283.1	32.1	309.934750-323.109653	13.174903	8434	
		286.3-1068.0	781.7	324.413194-650.375694	325.962500	409623	
			1058.8		439.782177	603276	432.8
	3	116.1-249.0	132.9	254.520833-309.113542	54.592709	113129	
		251.0-283.1	32.1	309.934750-323.109653	13.174903	8434	
		286.3-1068.0	781.7	324.413194-650.375694	325.962500	409623	
			946.7		393.730112	531186	387.6
10,11	1-5	4.0-249.0	245.0	208.468768-309.113542	100.644774	185219	
		251.0-283.1	32.1	309.934750-323.109653	13.174903	8434	
		286.3-1068.0	781.7	324.413194-650.375694	325.962500	409623	
			1058.8		439.782177	603276	432.8
15	1-4	4.0-249.0	245.0	208.468768-309.113542	100.644774	185219	
		251.0-283.1	32.1	309.934750-323.109653	13.174903	8434	
		286.3-1068.0	781.7	324.413194-650.375694	325.962500	409623	
			1058.8		439.782177	603276	432.8
16	1-2	116.1-249.0	132.9	254.520833-309.113542	54.592709	113129	
		251.0-283.1	32.1	309.934750-323.109653	13.174903	8434	
		286.3-1068.0	781.7	324.413194-650.375694	325.962500	409623	
			946.7		393.730112	531186	387.6
17	1	251.0-283.1	32.1	309.934750-323.109653	13.174903	8434	
		286.3-604.0	317.7	324.413194-454.733341	130.320147	292948	
		647.0-687.0	40.0	472.340986-488.715984	16.374998	0	
			389.8		159.870048	301382	156.4
	2	4.0-117.0	113.0	208.468768-254.897230	46.428462	72090	
		251.0-283.1	32.1	309.934750-323.109653	13.174903	8434	
		286.3-604.0	317.7	324.413194-454.733341	130.320147	292948	
		647.0-687.0	40.0	472.340986-488.715984	16.374998	0	
			502.8		206.298510	373472	202.0
1B,1C,1D	1-2	4.0-249.0	245.0	208.468768-309.113542	100.644774	185219	
		251.0-283.1	32.1	309.934750-323.109653	13.174903	8434	
		286.3-1068.0	781.7	324.413194-650.375694	325.962500	409623	
			1058.8		439.782177	603276	432.8
23,24	1-3	4.0-249.0	245.0	208.468768-309.113542	100.644774	185219	
		251.0-283.1	32.1	309.934750-323.109653	13.174903	8434	
		286.3-1068.0	781.7	324.413194-650.375694	325.962500	409623	
			1058.8		439.782177	603276	432.8
3C	1-5	4.0-249.0	245.0	208.468768-309.113542	100.644774	185219	
		251.0-283.1	32.1	309.934750-323.109653	13.174903	8434	
		286.3-1068.0	781.7	324.413194-650.375694	325.962500	409623	
			1058.8		439.782177	603276	432.8

*Note: Missing tape list was provided by AF/PL (Lt. K. Ray)

P-MOS Dosimeters

Of the 32 dosimeters on the CRRES MEP, 23 were eliminated on the basis of the following criteria:

a. eight (8) apparently failed or malfunctioned and showed a zero (0) reading throughout the mission;

b. on all eight (8) extended range devices bias was not fixed and its value not known (stray leakage currents loaded down voltage);

c. seven (7) devices were saturated, i.e. dose exceeded limiting range of 30 krads; all were on board level #1.

The remaining nine (9) normal range dosimeters were used in the analysis.

Since the SRD was located in the region of the first board, the dose values measured by dome 1 of the 4 diodes, with its total shield thickness of 92.5 mils Al, comes closest to representing the dose measured by the P-MOS dosimeters in TO-5 kovar cans which were located on this board (15). The thickness of the kovar lids of the TO-5 cans is about 12 mils which is equivalent to 36 mils Al. With the addition of the 10 mil thermal cover, a total of 46 mils Al should represent the shielding for these dosimeters. However, all boards were conformally coated and painted with titanium oxide. This additional shielding has been estimated to be approximately 29 mils of equivalent aluminum. Thus, a total shielding thickness of 75 mils (reference 15) should be considered for the P-MOS dosimeters. Figure 5 contains the plots of dose versus "CRRES Universal Time" for the nine valid dosimeters identified in Table 2b.

Comparison of SRD Results with Predictions

Figure (4) compares the dose versus shield thickness curves as measured by the SRD instrument, with the curves predicted by NASA models AP8 and AE8 for the CRRES orbit and a 14 month mission time. The calculations are for two shielding geometries, slab-2π and sphere-2π, assuming omnidirectional incidence. In addition, the measured curve was extrapolated back to a shield thickness of 40 mils aluminum which represents the outer thermal shield, covering the MEP experiment plus an approximate device package thickness of 30 mils equivalent aluminum. It can be seen from the figure that the plot for the spherical geometry shows the best agreement with the measured curve for the thin shields out to about 300 mils. In this range it lies below the measured curve (dominated by the trapped electrons), but at the thicker shields above 300 mils, the measurements fall above the calculations by about a factor of 2 (dominated by energetic protons).

Predictions of Upset Rates

At this time the CRRES experimental particle data are not yet released so the standard NASA AP8 proton distributions for the CRRES orbit are the only environment available to be used together with the Bendel methodology to obtain proton upset rates. Corrections for the flare-generated second proton belt, the solar flare protons, modifications of the AP8 model by magnetic field variations or perturbations, and corrections for heavy ion induced upsets will be made when the particle data is provided by the CRRES experimenters. SEU device parameters (e.g. σ, LET, sensitive volume, critical charge) will be obtained from several sources, namely, references (2, 3, 4, 5,

6, 7). An appropriate magnetic field model and specifications of L-shell values for all orbits are also necessary before these predictions can be accurately carried out. For example, it is required that the upset rates be calculated for the time spent by the spacecraft in the L-shell region where the additional proton belt was located (dwell time). Then, the upset contributions from this flare induced environment can be determined.

Conclusions

Table 11 summarizes the several adjustments and corrections that were applied to the CRRES data analyzed and investigated in this study.

Table 11. Corrections and Adjustments to CRRES Data

1. elimination of non-valid data
2. adjustment for periods of time when devices were powered down
3. adjustments for tapes lost in shipment to Hanscom AFB
4. adjustments for multiple upsets
5. adjustments for time intervals over which devices were disabled from acquisition of SEUs

It can be concluded from these results that it was necessary to break down SEU upsets to the level of address and bit location in order to identify valid data. This procedure was made possible by the development of special software under this effort. Elimination of non-valid data from upset totals for six blocks of device types significantly decreased some of the upset rates for this group of parts. **These corrected rates may impact the comparisons of space observations to calculated predictions based on laboratory experiments, and thus, enable a better check of ground test data and modeling.** Calculations of final error rates and comparisons to these rates and those of other investigations remain to be accomplished. The issue of multiples and their definition remains to be clarified so that final upset totals can be achieved. It turns out from this investigation that the resolution time of the SEU measurements is more like 2 seconds rather than 128 milliseconds, as was originally believed. An effective two second interrogation time requires additional criteria, such as bit proximity, in the definition and identification of multiple upsets.

Looking at table 8a it is evident that no specific orbit or point of time during the mission can be identified as significant for the anomalous events observed, not even the occurrence of the major solar flare at orbit 586. However, for the strange performance identified in the case of blocks 24 (NMOS SRAM) and 06 (CMOS/SOS, SRAM), the data suggest that these were caused by malfunctioning of a single bit and address in only one sample of the groups. In contrast to these results, all five samples of block 3C (NMOS DRAM) may have malfunctioned. Since there is no breakdown by individual device for this part type, as it is for the other blocks, we can not say for certain if one or more devices showed surges. The occurrence of surges of upsets (see Table 7) were not continuous but sporadic in nature in these parts. Yet, these same parts yielded valid measurements during the more normal periods of flight time. It is possible that a transient condition in the measurement system, rather than anomalous parts, was responsible for this performance, but their behavior on the ground prior to the launch suggests anomalous samples as the probable cause of these upsets. It appears that the

blocks 00, 01, and 03, GaAs SRAM devices, as a group, responded to some system triggered perturbation affecting orbits 794, 854, and 855, as explained in the corresponding section of the text. The uniformity of this anomalous behavior for all three blocks, all six samples, and two different vendors, tend to support this explanation.

Some overall conclusions, at this point in the study, are that SEU events are a lot less frequent than was originally thought at the start of the CRRES project. A similar conclusion is the fact that multiple upsets are less frequent than originally thought. The upset predictions for DRAMs were in closer agreement with observations than any of the other device types. It appears that based on our preliminary results, the design margins presently being applied to spacecraft electronic systems by using existing upset and/or radiation models are larger than necessary. Eventual modifications of radiation models, when the environmental measurements are released by the experimenters, may change this situation. This analysis definitely suggests that spacecraft builders must test more than one or two parts and additional new test procedures must be designed in order to uncover the existence of mavericks, and consequently, enable predictions of malfunctions and failures which, for now, appear to be of a random nature.

Lessons Learned:

1. If parts experience intermittent soft and/or hard errors during functional and environmental testing on the ground, these should be flagged and recorded. Any predictions of performance in space should include not only ground testing characterization results (which may qualify the parts as acceptable for a given mission) but, also, these other (non-radiation induced) errors in terms of frequency and impact on performance (which may disqualify the part for a specific application).

2. The fact that individual parts or groups of parts from lots that appear perfectly normal and that pass all screening and testing requirements on the ground before launching, do "misbehave" in a random and unpredictable fashion in space, should be of great concern to project managers and system designers. For example, of the investigated device types, the following displayed abnormalities at the indicated orbits:

No. of Samples	Part Type	Orbit No.
1 of 3	CMOS-SRAM	after 988
1 of 3	CMOS/SOS	after 686
5 of 5	NMOS-DRAM	at 113, 114, 116, 286, 447, 911

Obviously, there is no correlation on a temporal scale (orbit no.) between any of these breakdowns and, by all indications, they are not related to the radiation environment. Worse yet, the erratic and anomalous behavior of these parts can not be linked to any known natural cause and it is definitely not correlated to the solar flare proton event of March 23, 91 (orbit no. 586).

It is to be expected that such peculiar phenomena may also occur at any other mission, with other part types. As ground testing and characterizations prior to launch did not provide a clue and did not indicate that these kind of events can happen, it is impossible to reliably predict the performance of parts in space, even after thorough ground testing.

It is, therefore, important to assess the impact of such abnormal behavior on systems performance, particularly for parts used in critical circuits. Until we understand what causes these strange failures (how, when, why), it is prudent to expect their occurrence, be prepared for them, and design systems that can correct, compensate, or circumvent them.

We do not believe that current normal, standard testing procedures (electrical, environmental, functional, or radiation effects) can identify or flag these anomalous events.

3. It appears that the number of upsets observed on the MEP in the actual space environment to which CRRES was exposed, are a lot less frequent then expected. This suggests several possible reasons, any combination of which may be involved. The lack of relevant data or measurements does not allow a clear definition of cause. The eventual availability of such data in the future should support or refute any of these hypotheses:

a) the ground testing (device characterization) process is yielding data (e.g. asymptotic cross section, LET threshold) that overestimate the upset rate;

b) the testing methods and procedures, including beam calibration and diagnostic systems, may bias results;

c) the environment models overpredict the heavy ion intensities (protons and cosmic rays) incident on the spacecraft;

d) transport and shielding calculations are not sufficiently accurate and reliable;

e) geomagnetic field attenuation (magnetospheric deflection) of cosmic rays (galactic and solar) is more effective than models or calculations indicate;

f) critical parameters (e.g. sensitive volume: size,shape; critical charge; device structure and composition; etc.) are more important than previously assumed; in most cases, this type of information is not readily available;

g) structure, layout, composition, and packaging of devices may affect their performance in space; this implies that relative information has to be considered in the testing and evaluation process and in the subsequent predictions;

h) frontal testing of delidded (or even lidded) devices, even when occasionally rotated to angles of up to 60°-70°, may not provide a realistic assessment of device sensitivity because of substantial asymmetries; the frontal incidence of the unidirectional laboratory beam may be exploring the weakest, most sensitive direction of a part; these results are then folded into the environment calculations, assuming that the omnidirectional incidence in space (uniform distributions over 4π steradians) will have identical effects.

To what extent any of these hypotheses actually affect the device performance predictions is unknown. The fact is that the uncertainties involved in each and all of the items listed above are substantial. Their cumulative effect has never been evaluated, to the best of our knowledge. The resulting error bars, attached to predictions of single event phenomena in space, should be very large.

Testing, modeling, and environment definition capabilities need to be significantly improved; quantitatively they have to become more exact and definitive, if the quality of predictions is to reach a level where they can be used with confidence by satellite builders, system designers, project managers, etc. In our opinion, the occasional agreement of predictions with space truth is fortuitous and is not based on scientific, engineering, or mathematical certainty.

Our recommendation is to modify the margins imposed on designers, that is, reduce the safety factors to lower values (e.g. from 5 to 3, or from 3 to 2).

4. Contrary to prior belief, it seems that single event phenomena occurred more frequently in regions of space populated by trapped protons, that is, regions that should be inaccessible to most cosmic ray heavy ions, instead of in regions that are easily accessible to cosmic rays.

This finding raises some important questions, particularly in view of two newly reported "discoveries":

Discovery #1: apparently, a new high intensity proton belt was observed in the slot region of the magnetosphere (between L=2 and L=3) that normally does not contain many high energy protons; this new belt was supposedly created by a major solar flare event;

Discovery #2: another group of scientists claimed that within the same region of space (slot) a new population of a very energetic, singly ionized anomalous cosmic ray component was trapped, also supposedly injected by a major solar flare event;

Whether both claims are valid or whether the two groups may be observing the same cause but measuring it differently and interpreting it differently, can not be determined at this time.

The fact remains that protons appear to have a far greater impact and capacity for the generation of single events than previously assumed. This implies that in the future greater attention has to be paid to proton testing and performance evaluation.

5. The limited data available, the long device interrogation intervals (2 seconds), and the lack of accurate bit maps make it difficult (if not impossible) to assess correctly, with any degree of confidence, the occurrence of single event multiple upsets. It is apparent, however, that the number of multiples are much less than originally thought. **Considering that only a few of the MEP components were studied and analysed in this report, it can be stated that, at least for the part types investigated, the spacecraft builders do not have to be concerned about multiple upsets. This, of course, may not be true for other device types or technologies. Therefore, caution is still advised until reliable test results or flight data will be available.**

6. A published comparison of calculated and measured upset rates on DRAMs indicated that the results from the models used in the upset calculations, in conjunction with the trapped proton and cosmic ray fluxes provided by the respective environment models for this orbit, are in very good agreement.

Since we are aware of only one valid comparison of flight data to ground measurements and calculations, it remains to be seen if this was a fortuitous coincidence or if indeed the model(s) are that good, both the upset and environment versions. **In either case, it is reasonable to assume that this combination would be equally effective for other devices of similar design (DRAMs) in a similar environment.**

Important Findings:

1. Regarding Cosmic Rays (z > 1)
   - Ground testing **overpredicted** space results
2. Regarding Protons (z = 1)
   - Ground testing **underpredicted** space results
   - Relatively little testing has occurred, inadequate to fully study/evaluate/analyze proton effects

Recommendations:

1. Data should include breakdown by:

   -orbit number (time sequence)
   -sample number
   -electrical address and bit location
   -number of soft errors
   -number of hard errors.

2. Physical bit maps should be made available and be verified.

3. Layout and control of parts should be in independent groups containing only identical part types; e.g., do not mix commercial 6504's with 6504 RHs, or IDT 6116s (NMOS=soft) with Honeywell 6116s (CMOS=hard). Reason: if one of the commercial parts would start to draw too much current, possibly due to total dose effects, the whole group of devices would have to be powered off thus disabling the testing of the rad-hard parts in the group.

For this reason, it would be desirable to be able to remove independently power from any device or devices within a group so that the remaining devices in the group could continue to be tested. When and for how long the power was removed from selected device(s) should be made part of the database for evaluation purposes. (In addition, the database should also include information on when SEU or total dose testing was enabled or disabled and when Test Pattern changes were performed);

4.(a) The degree to which intermittent soft or hard errors are experienced during functional and environmental ground testing should be recorded and made part of the data base.

4.(b) Detailed results of functional and environmental ground testing should be included in data base, particularly as a function of temperature.

5. Time resolution of measurements (i.e. device interrogation interval) should be short enough to allow, in conjunction with accurate bit maps, a reasonable definition of real multiples.

6. Current, threshold voltage, and access time measurements should be made on all SRAM devices and not on just one sample from a group. These data should be available for the entire mission duration. Measurement techniques need to be improved. These data are essential for device performance evaluation and for the effective modelling of slow decay or degradation of parts (ionization dose damage and upset).

7. A reliable 3-D solid angle sectoring and ray-tracing analysis on the entire S/C should be performed on important missions, particularly with respect to sensitive instruments and parts, each becoming the center of reference in regards to mass distribution and composition.

8. Improved P-MOS dosimeters and measurement techniques should be used in place of the CRRES device and setup. The valid operation of only 9 out of 32 devices is not an acceptable situation.

9. The "User's Manual" should contain detailed information on parts radiation-tested on the ground (test results, conditions, variables, parameters, etc.) and should provide more adequate explanations/interpretations for the data contained in the data base, including description of procedures and examples for extracting data on individual devices.

10. The "User's Manual" should, also, contain specific information about the type of data collected in space (quantities, units, number of parts, number of bits, etc.). Some of the data obtained from the CRRES data base were not properly or adequately identified as to units, etc.

11. The "User's Manual" should be carefully checked for errors or mistakes, particularly in the designation/identification of parts. In the CRRES "User's Manual", ambiguities/inconsistencies existed between part numbers found in the headers and part numbers in the description (text) that followed, making it difficult to determine which was valid or correct (e.g. Blocks 10, 23, 24, 3C);

Block	Header	Text
10	HM1-6504-xx	RH6504 RADPAK and HM-6504-2
23	IDT_71681155	IDTSCO271 and IDT71682TCRE
24	IDT_6116L90	IDT6116RS and IDT6116CBRE
3C	Intel(TMS4164)	F4122120 D2164A-20

12. In addition to a "User's Manual", another set of manuals should be available, containing (a) block and schematic diagrams of "MEP" (or new MPTB), (b) detailed descriptions of the internal logical operations of the test system, and (c) procedures for interpreting the telemetered data within the context and conditions of their measurement.

13. A future CRRES-type mission should include an error correcting circuitry in the telemetry hardware so that errors introduced into the data stream during telemetry transmission of the buffered measurements would be corrected. Such a system should include a retransmit capability if an error were to be detected either on board or on the ground. Data distortion, contamination, or loss should be minimized.

14. Analyze space data as soon as possible.

15. Maintain and disseminate a complete mission ephemeris (tape or disc) containing at least the following trajectory information:

- Continuous positional geodetic coordinates (lat, lon, alt) at regular intervals (1 min., 2 min., 5 min.)
- universal time
- julian date

Summary of Highlights from the CRRES MEP Data Analysis

General Comments: Software Difficulties, Lack of Information, Inadequate Documentation, etc.

- "Bugs" in the CRRES access software system were identified and corrected.
- Difficulties in interpretation of instructions in the CRRES User's Manual were noted as follows:
  - -explanations not sufficiently detailed
  - -descriptions not clear
  - -examples not sufficient.
- Problems with software performance and products were experienced.

Corrections Applied to Data:

- Multiple events were considered.
- Invalid readings were eliminated.
- Hard failure counts were deleted.
- Time intervals pertaining to missing data tapes were accounted for.
- Time intervals at which devices were disabled were taken into account.

Correct Data Acquisition Time Period:

- It was established that SEU and DRAM measurements were actually made every two (2) seconds and not every 128 milliseconds, as reported in the literature.

P-MOS Dosimeters:

- It was determined that twenty-three (23) of the thirty-two (32) P-MOS dosimeters did not perform satisfactorily; consequently, only nine (9) were considered acceptable for the study.

Upsets:

- One out of three NMOS SRAMs (in Block 24) was identified as a defective part; i.e.,11670 upsets occurred at the same bit, the same address location after orbit #988. We considered these invalid data.
- One out of three CMOS/SOS SRAMs (in Block 06) was identified as a defective part; i.e., 30677 upsets occurred at the same bit, the same address location after orbit #686. We considered these invalid data.
- All GaAs devices in blocks 03, 00, and 01 (SRAMs) suffered abnormal behavior in orbits 794 and 854/855, producing large amounts of invalid data (hard upsets). No cause has been identified.

- It appears that the system powered off the corresponding blocks when these devices started drawing too much current.

- One or some of five samples of NMOS DRAMs (in Block 3C) experienced unusually large spurts of upsets, significantly exceeding average behavior. These occurred as one, two, or three spurts, each at single discrete measurement times in orbits 113, 114, 116, 286, 447, and 911 at random s/c positions corresponding to L-Shells ranging from 2.7 to 6.9. The normal upset rates for these parts varied from 0 to 30 per 2-seconds measurement interval, whereas, the sudden surges ranged from 190 to 510 upsets per 2 second interval. Over the entire mission duration, there are only these six isolated incidences which do not correlate with any known causative event. Again, we considered these invalid data. Because no resolution has been provided by the CRRES system design as to which individual part(s) is responsible for these anomalous upsets, this analysis had to treat the data as a value representing the whole group.

Important Information Affecting Device Performance and Evaluations:

- All GaAs devices (Blocks 03, 00, and 01) experienced intermittent soft and hard errors before launch, during functional and environmental ground testing. This implies that some of the upsets recorded in space may not have been caused by radiation.

- All NMOS DRAMs (Block 3C) experienced also intermittent soft errors before launch, during functional and environmental ground testing. Again, this implies that some of the upsets recorded in space may not have been caused by radiation.

References

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3. Petersen, E.L., "The Relationship of Proton and Heavy Ion Upset Thresholds", IEEE Trans. Nucl. Sci., Vol. NS-39, No. 6, December 1992.

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9. Campbell, A.B., P. McDonald, and K. Ray, "Single Event Upset Rates In Space", IEEE Trans. Nucl. Sci., Vol. NS-39, No. 6, December 1992.

10. McDonald, P., W. Stapor, and D. Gonyea, "CRRES MEP Multiple Bit Upsets", Presented at the IEEE Nuclear and Space Radiation Effects Conference in New Orleans, July 1992.

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12. Ray, K., private communication 3/11/93.

13. "CRRES Microelectronic Package (MEP) Experimenter Interface Meeting", Space Systems Development Dept., U.S. Naval Research Laboratory, Aug 16-17, 1989.

14. Brucker, G.J., E.G. Stassinopoulos, and C.A. Stauffer, "Bit Reversals and Multiple Upsets for One Second Resolution Intervals, and Long Term Annealing Periods", To be submitted to IEEE Trans. Nucl. Sci., 1993

15. Ray, K.P., E.G. Mullen, W.J. Stapor, R.R. Circle, P.T. McDonald, "CRRES Dosimetry Results and Comparisons Using the Space Radiation Dosimeter and P-Channel MOS Dosimeters", IEEE Trans. Nucl. Sci., Vol. 39, No. 6, December 1992.

APPENDIX A

Block 06

In regard to this block, of concern is the value of upset rate given in Table 2 of reference (9) for these parts, obtained for a period of time related to the March 1991 solar flare. As no explanation or information was provided by the authors on how they arrived at their results, we had to employ a "reverse evaluation" approach to determine the implication of that value, based on the definition of rate:

$$R=U/(N \cdot D)$$

where R is the rate, U are the upsets, N is the number of bits, and D is the number of days. Solving for N and using the rate given in Table 2 of reference (9) as $R=5.09 \times 10^{-7}$ upsets/bit•day, the days accumulated over 586 orbits (assuming no gaps or missing tapes) as D=241, and upsets realized during that time as U=2, we obtain N=16kbits, which means, the rate evaluation was based solely on one device, over that limited time interval.

Apparently, the authors used the 2 soft errors that occurred before the March 1991 solar flare in the "maverick" (i.e. defective) part. It is obvious that they also calculated the upset rate on the basis of 1 device only and not for the group of 3 parts, which would have been more appropriate in order to express the actual behavior of this device type in space. Additionally, they indicate zero upsets for all time-intervals after the flare. This is not correct, further impacting the evaluation of the upset rate. First, there were 30677 soft upsets on the "misbehaving" part #1 in this group (see Table 4a) after the flare and another 5 hard upsets before the flare (orbits, 7, 65, 72, and 113 with 2, 1, 1, and 1 upsets, respectively), which are never mentioned in the paper. We assume that the authors discarded (correctly so) these events in their upset rate calculation (as established by our "reverse evaluation"), but they should have indicated this fact in their publication.

Finally, they seem to have missed (or ignored?) 2 upsets in part #2 (see Table 4b), one at orbit 794 and one at orbit 816, which we consider valid upsets that should be included in their rate calculation. Thus, the rate quoted in Table 2 of reference (9), 5.09×10^{-7} upsets/bit•day, is not reflecting correctly the time performance of this device in the real space environment which is actually 2.8×10^{-7} upsets/bit•day for parts #1 and #2 and $< 1.6 \times 10^{-7}$ for part #3, **a difference in sensitivity of a factor of about 2.** As previously stated, a more appropriate assessment of a rate value should be based on a statistical evaluation of all parts investigated, over all valid events, and for the real time intervals for which data are available (accounting for gaps due to missing tapes).

SPACE UPSET RATES FOR XTA12702A CMOS/SOS	
THIS STUDY	REFERENCE(9)
2.56×10^{-7} *	5.09×10^{-7} (part #1)

*Evaluation performed for the same time interval as in (9) for direct comparison purposes only.

APPENDIX B

Comments on References

The data contained in a number of published papers were used in this study for comparison to the results therein. Here, two tables are given which describe in various degrees of detail the referenced works and how they relate to these results. Table B1 is a brief overview of device blocks and their relationship to the references. Table B2 expands on these relationships and summarizes some details of the material in the references.

Table B1: Overview of Comparisons To Published Paper

Multiples
Ref. 8 and 10 = definition of multiples
Ref. 8 = bit maps

Blocks: 01, 03, 06, 1B, 1C, 1D, 10, 11, 23, 24, 15, 16, 17
Ref. 9

Blocks: 1B, 1C, 1D, 15, 23, 24, 3C
Ref. 8

Blocks: 1B, 1C, 1D, 23, 24
Ref. 10

Block: 3C
Ref. 5

Block: 00
no references for this part

Table B2: Summary of Comparisons to Published Papers

Block 24: IDT6116RS NMOS

Ref. 9: Table 2: data given are listed below:

Time Column	No. of Days	Rate (#/kb•d)	Normalization Factor	Normalized Result Rate(#/kb•day)
Before	238	0.0038	238/441	1.72×10^{-3}
During	2	0.0	2/441	0.0
Just After	4	0.00993	4/441	9.01×10^{-5}
After	197	0.0122	197/441	5.45×10^{-3}
Total	441			7.26×10^{-3}

Our Evaluation: for 433 valid days: 4.0×10^{-3} (#/kb•d)
See Table 10 for derivation of exposure time.

Ref. 10: Table 10: showed that it included the 11670 invalid upsets, quoting an upset rate of: 4.92×10^{-4} upsets/bit-day

Our Evaluation: 4.0×10^{-6} upsets/bit-day

Block 03: 30283-1K GaAs

Ref. 9: It is not clear from the text whether the invalid upsets were included in the plots of Figure 5.

Table 2: data given are listed below:

Time Column	No. of Days	Rate (#/kb•d)	Normalization Factor	Normalized Result Rate(#/kb•day)
Before	238	8.14	238/441	4.39×10^{0}
During	2	177.00	2/441	8.03×10^{-1}
Just After	4	10.60	4/441	9.61×10^{-2}
After	197	7.42	197/441	3.31×10^{0}
Total	441			8.61×10^{0}

Our Evaluation: for 270 valid days: 1.4×10^{1} (#/kb•d)
See Table 10 for derivation of exposure time.

Block 00: 80E200001-2001 GaAs

not used in any of the references

Block 01: **80E200002-3 GaAs**

Table 2: data given are listed below:

Time Column	No. of Days	Rate (#/kb•d)	Normalization Factor	Normalized Result Rate(#/kb•day)
Before	238	0.0295	238/441	1.59×10^{-2}
During	2	2.38	2/441	1.08×10^{-2}
Just After	4	0.2380	4/441	2.16×10^{-3}
After	197	1.6500	197/441	7.37×10^{-1}
Total	441			7.66×10^{-1}

Our Evaluation: for 270 valid days: 6.5×10^{-2} (#/kb•d)
See Table 10 for derivation of exposure time.

Block 3C: **INTEL 2164A NMOS**

Ref. 5: Table 1: Quotes 8.1×10^{-5}upsets/bit-day measured for 450 orbits (from inner belt with AP8 r. odel p's).
Quotes 3.5×10^{-5}upsets/bit-day for calculated rate.

Our Evaluation:
4.06×10^{-5}upsets/bit-day for 450 orbits after elimination of invalid upsets, as measured on s/c (rate value includes Cosmic Ray Contribution).

Ref. 8: Table 2: Quotes 5626 total upsets for first 590 orbits.

Our Evaluation:
6470 total upsets for first 590 orbits (including 3400 invalid), i.e. 3070 valid upsets for first 590 orbits (adjusted number).

Multiples:

Ref. 8 & 10: A multiple is defined as two or more upsets within 128 ms of measurement time.

Our Evaluation: based on standard CRRES project definition of multiples, i.e. any events that occurred within a 2-second measurement interval.

Ref. 8: The number of doublets for parts 93L422, 93422, and 82S212 are given as 89, 130, 10, respectively.

Our Evaluation: based on the standard CRRES project definition of multiples: 170, 240, 18, respectively.

CRRES-MEP
EXPERIMENT PART LOCATION
LEVEL ONE

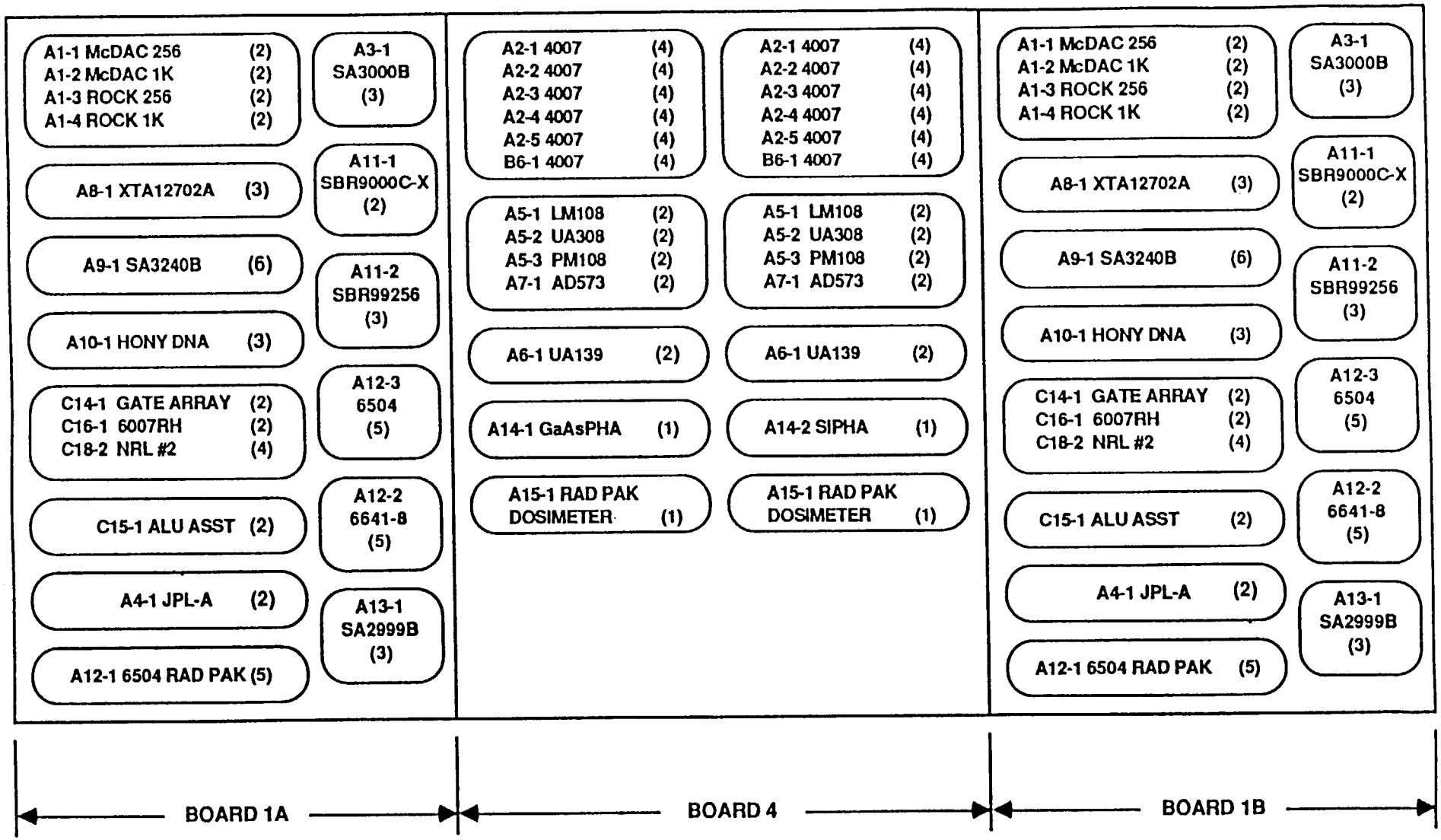

Fig. 1

CRRES-MEP
EXPERIMENT PART LOCATION
LEVEL TWO

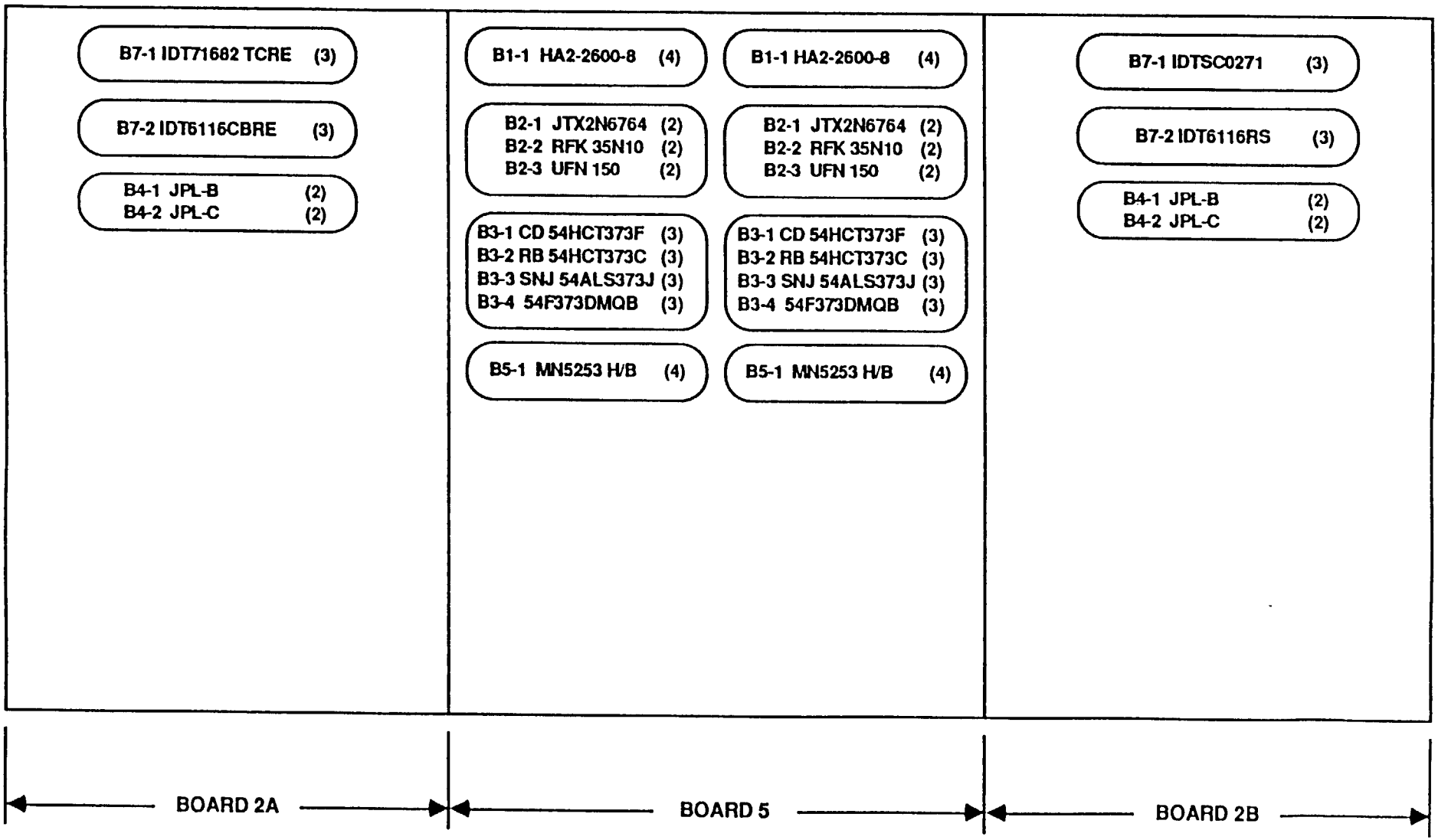

Fig. 2

CRRES-MEP
EXPERIMENT PART LOCATION
LEVEL THREE

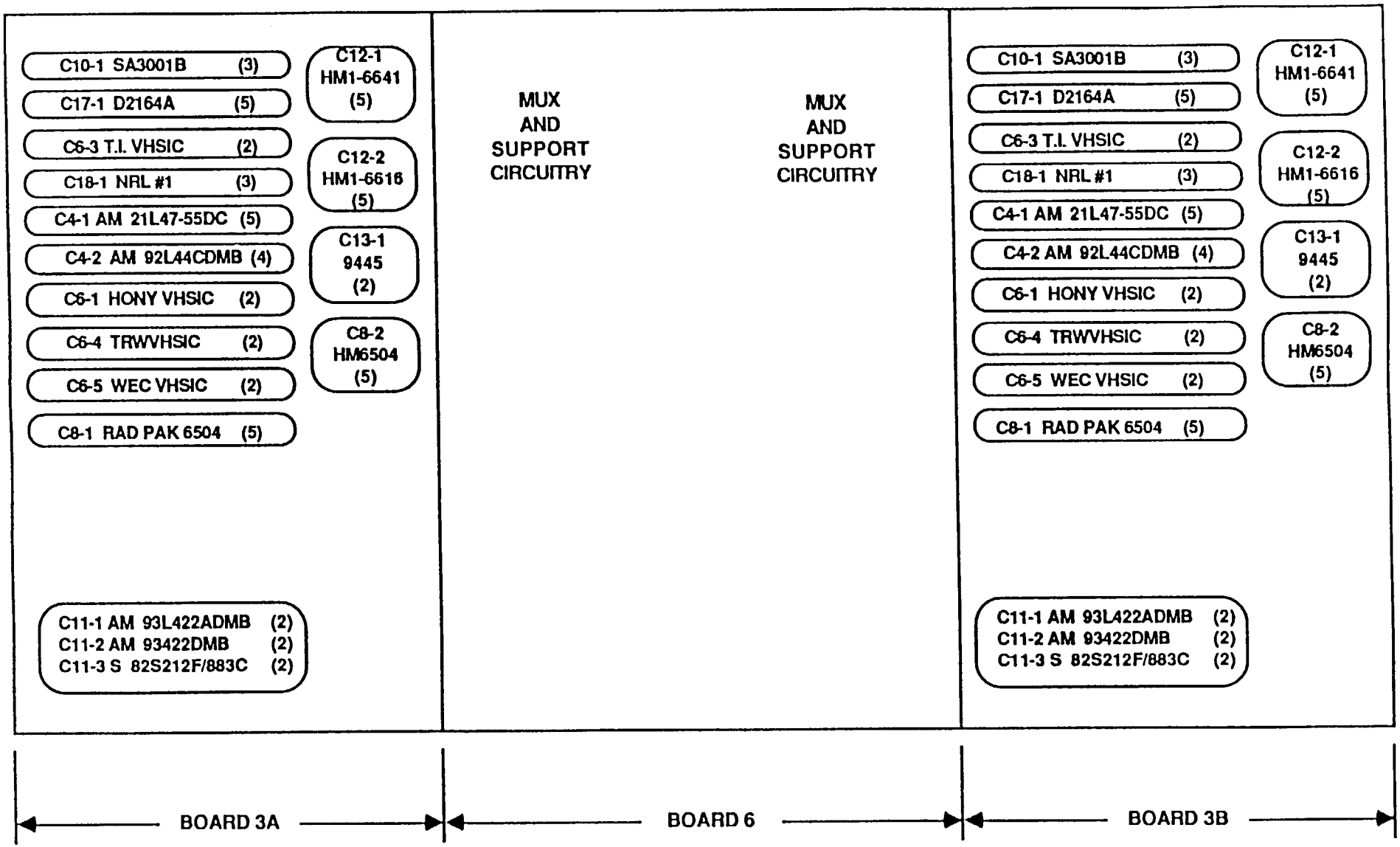

Fig. 3

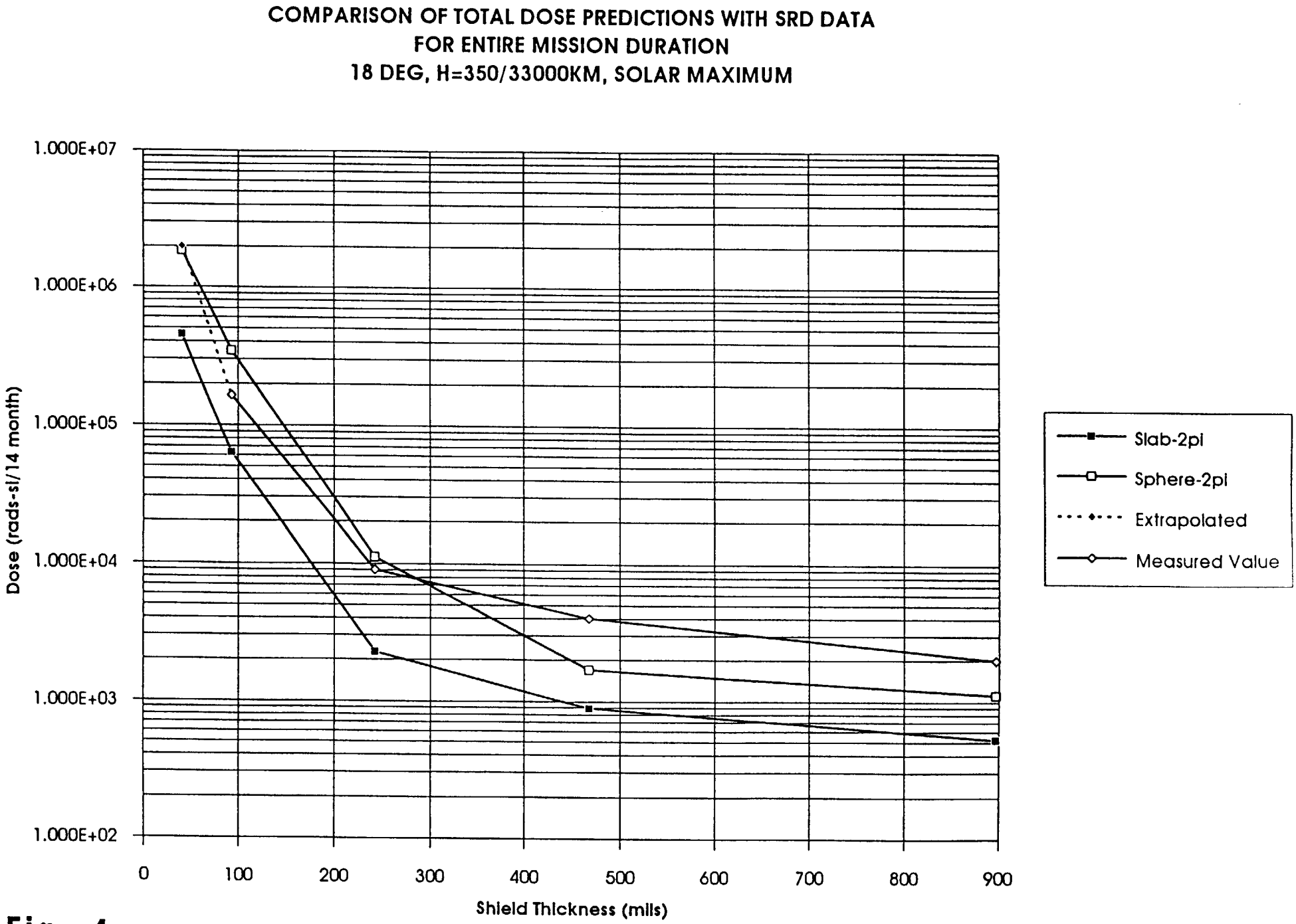
COMPARISON OF TOTAL DOSE PREDICTIONS WITH SRD DATA
FOR ENTIRE MISSION DURATION
18 DEG, H=350/33000KM, SOLAR MAXIMUM
1.000E+07
1.000E+06
1.000E+05
1.000E+04
1.000E+03
1.000E+02
Dose (rads-si/14 month)
0
100
200
300
400
500
600
700
800
900
Shield Thickness (mils)
Slab-2pi
Sphere-2pi
Extrapolated
Measured Value

Fig. 4

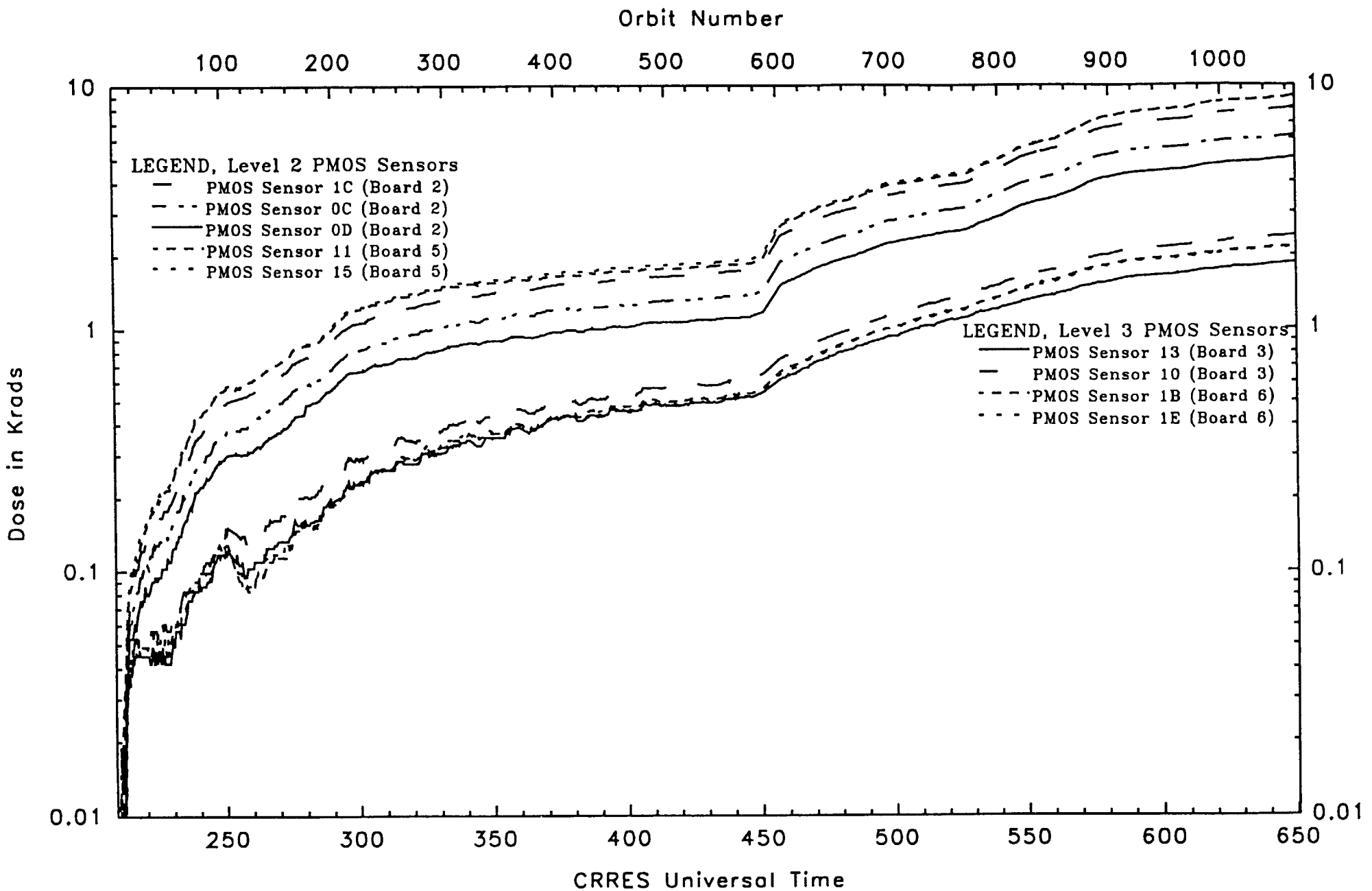
Valid CRRES PMOS Dosimeters
Orbit Number
100
200
300
400
500
600
700
800
900
1000
10
1
0.1
0.01
LEGEND, Level 2 PMOS Sensors
PMOS Sensor 1C (Board 2)
PMOS Sensor 0C (Board 2)
PMOS Sensor 0D (Board 2)
PMOS Sensor 11 (Board 5)
PMOS Sensor 15 (Board 5)
LEGEND, Level 3 PMOS Sensors
PMOS Sensor 13 (Board 3)
PMOS Sensor 10 (Board 3)
PMOS Sensor 1B (Board 6)
PMOS Sensor 1E (Board 6)
Dose in Krads
250
300
350
400
450
500
550
600
650
CRRES Universol Time

Fig. 5

MISSION TEST SCENARIO

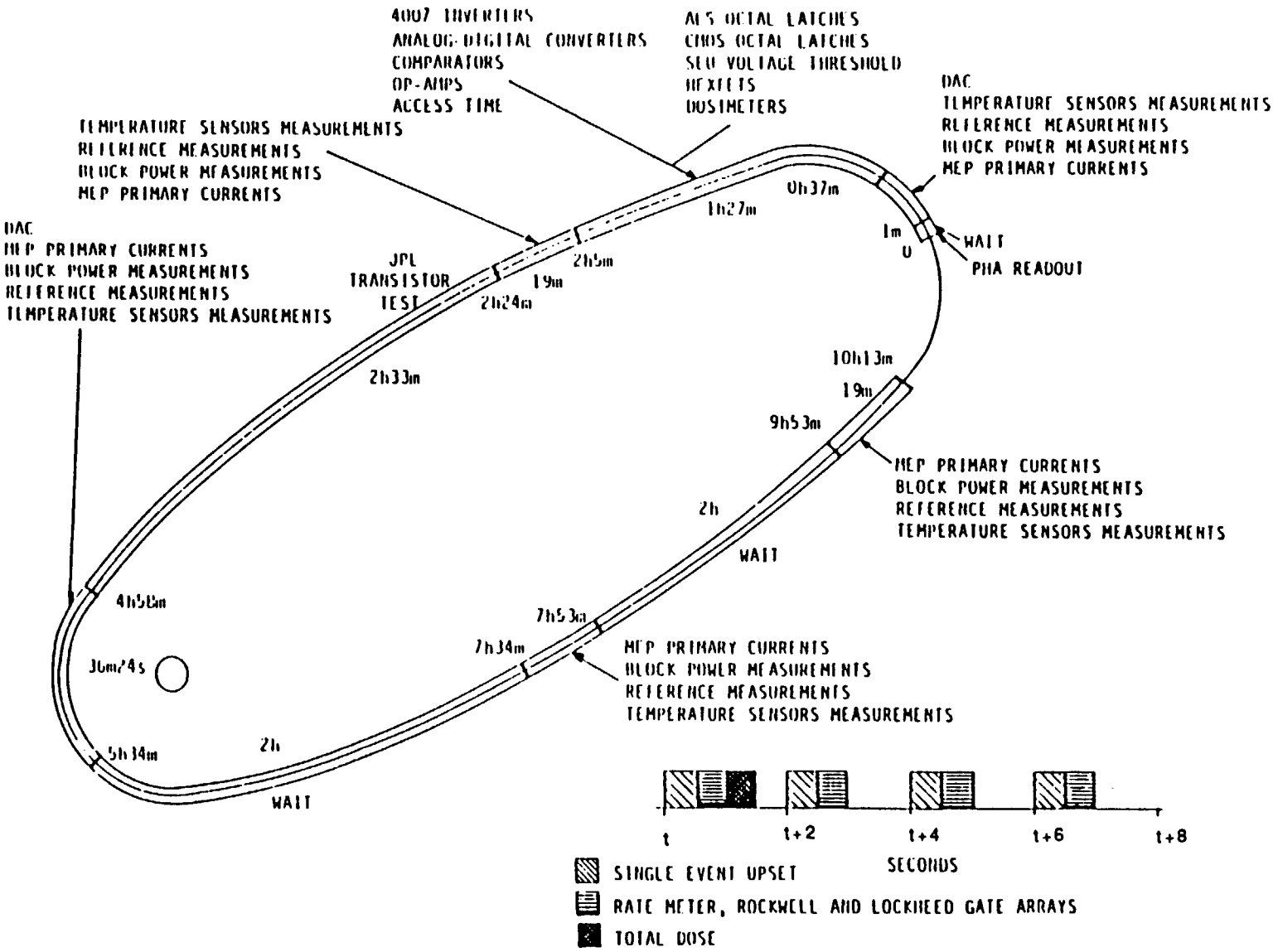

Fig. 6

MISSION SOFTWARE - SEU TESTING

PROCEDURE

- SELECT SEU TEST PATTERN
  - PATTERN 0: ALL ZEROS
  - PATTERN 1: ALL ONES
  - PATTERN 2: ALTERNATING ONE ZERO
  - PATTERN 3: ALTERNATING ZERO ONE
- POWER UP DUT BLOCK
- ENABLE DUT BLOCK FOR SEU TEST
  - *BLOCK IS TESTED EVERY TWO SECONDS*
- NO ERROR: NO TELEMETRY OUTPUT
- SOFT ERROR:
  - TELEMETRY OUTPUT IDENTIFIES DEVICE AND BIT ERROR MASK OF SOFT ERRORS
  - DATA COMPRESSION TRIGGERED IF TELEMETRY BUFFER IS FULL OR SOFT ERROR RATE EXCEEDS FIVE SOFT ERRORS PER SECOND DURING ANY EIGHTY SECOND PERIOD
  - TELEMETRY OUTPUT IN COMPRESSED MODE IDENTIFIES COMPRESSED DEVICES AND SOFT ERROR COUNTS EVERY EIGHTY SECONDS

NOTE: RAMS ARE TESTED WITH PATTERNS (0, 1, 2, 3); PROMS ARE TESTED WITH PATTERN 3

Fig. 7

Table 3a

Block: 24; Side: B; Device: 1 of 3; Part Number: IDT6116RS; U-Number: 71
Board: 2; Addresses: 2048; Bits/Addr: 8; SEU File Processed: BLK_24_a.SEU; Output File Created: BLK_24_a.DV1

Orbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Yea
98	1	(1,	0)	0	9/04/1990	247.101127	247.101127	247
149	1	(1,	0)	0	9/25/1990	268.058579	268.058579	268
172	1	(1,	0)	0	10/04/1990	277.892748	277.892748	277
208	1	(1,	0)	0	10/19/1990	292.683194	292.683194	292
267	1	(1,	0)	3	11/12/1990	316.902364	316.902364	316
321	1	(1,	0)	3	12/04/1990	338.683559	338.683559	338
347	1	(1,	0)	3	12/15/1990	349.357341	349.358337	349
348	1	(1,	0)	3	12/15/1990	349.771417	349.771417	349
380	1	(1,	0)	3	12/28/1990	362.900524	362.900524	362
417	1	(1,	0)	3	1/13/1991	378.474605	378.474605	13
432	1	(1,	0)	3	1/19/1991	384.631165	384.631426	19
463	1	(1,	0)	3	1/31/1991	397.341485	397.341485	31
473	1	(1,	0)	3	2/05/1991	401.443166	401.443166	36
522	1	(1,	0)	3	2/25/1991	421.371235	421.371235	56
593	1	(1,	0)	3	3/26/1991	450.244961	450.244961	85
596	1	(1,	0)	3	3/27/1991	451.472578	451.472578	86
671	1	(1,	0)	0	4/27/1991	482.564500	482.564500	117
729	1	(1,	0)	1	5/20/1991	505.922846	505.922846	140
740	1	(1,	0)	1	5/25/1991	510.424992	510.424992	145
747	1	(1,	0)	1	5/28/1991	513.669802	513.669802	148
844	1	(1,	0)	1	7/08/1991	554.228308	554.228308	189
861	1	(1,	0)	1	7/15/1991	561.511854	561.511854	196
893	2	(2,	0)	1	7/29/1991	575.634380	575.634380	210
905	1	(1,	0)	1	8/03/1991	580.792983	580.792983	215
926	1	(1,	0)	1	8/12/1991	589.404789	589.404789	224
941	2	(2,	0)	1	8/18/1991	595.851795	595.851795	230
998	2	(2,	0)	1	9/12/1991	620.732941	620.732941	255
1021	1	(1,	0)	1	9/22/1991	630.612469	630.612469	265

Total Upsets: 31 (Soft: 31, Hard: 0)

********** Total Upsets Per Electrical Address **********

Addr	Total	(Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0)
10	1	(0	0	0	0	0	0	1	0)
18	1	(0	0	1	0	0	0	0	0)
66	1	(0	0	0	0	0	1	0	0)
149	1	(0	1	0	0	0	0	0	0)
190	1	(0	0	0	0	1	0	0	0)
239	1	(0	0	0	0	0	0	1	0)
452	1	(1	0	0	0	0	0	0	0)
474	1	(0	0	0	0	0	0	1	0)
488	1	(0	0	0	1	0	0	0	0)
643	2	(0	1	0	1	0	0	0	0)
704	1	(1	0	0	0	0	0	0	0)
870	1	(0	0	0	1	0	0	0	0)
950	1	(0	0	0	0	0	1	0	0)
1012	1	(0	0	0	0	1	0	0	0)
1128	1	(0	0	0	0	0	0	1	0)
1137	1	(0	0	0	0	0	0	0	1)
1192	1	(0	0	0	0	1	0	0	0)
1193	1	(0	0	0	0	1	0	0	0)
1245	1	(0	0	0	0	0	0	0	1)
1272	1	(0	0	0	0	0	0	0	1)
1341	1	(0	0	0	0	1	0	0	0)
1392	1	(0	0	0	0	0	0	0	1)
1495	1	(0	0	0	0	0	0	0	1)
1576	1	(0	0	0	0	0	1	0	0)
1577	1	(0	0	0	0	0	1	0	0)
1619	1	(0	0	0	0	0	1	0	0)
1680	1	(0	0	0	0	0	1	0	0)
1750	1	(0	0	0	0	0	0	1	0)
1933	1	(0	0	0	0	0	1	0	0)
2016	1	(0	0	0	0	0	0	0	1)

********** SUMMARY **********

Block: 24; Side: B; Part Number: IDT6116RS; Device: 1 of 3; Board: 2; U-Number: 71
Addresses: 2048; Bits/Addr: 8; SEU File Processed: BLK_24_a.SEU; Output File Created: BLK_24_a.DV1

Total Upsets: 31 (Soft: 31, Hard: 0)

Breakdown Of The 31 Total Upsets Into Total Upsets In Each Bit Position:

Total	(Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0)
31	(2	2	1	3	5	7	5	6)

Table 3b

Block: 24; Side: B; Device: 2 of 3; Part Number: IDT6116RS; U-Number: 72
Board: 2; Addresses: 2048; Bits/Addr: 8; SEU File Processed: BLK_24_a.SEU; Output File Created: BLK_24_a.DV2

Orbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Year
22	1	(1,	0)	0	8/03/1990	216.262892	216.262892	215
83	2	(2,	0)	0	8/28/1990	240.935666	240.935666	240
186	1	(1,	0)	0	10/10/1990	283.260135	283.260135	283
225	1	(1,	0)	0	10/26/1990	299.269745	299.269745	299
245	1	(1,	0)	0	11/03/1990	307.868869	307.868869	307
265	1	(1,	0)	3	11/11/1990	315.694003	315.694003	315
311	1	(1,	0)	3	11/30/1990	334.588350	334.588350	334
320	1	(1,	0)	3	12/04/1990	338.662300	338.662300	338
331	1	(1,	0)	3	12/08/1990	342.789790	342.789790	342
347	1	(1,	0)	3	12/15/1990	349.357341	349.358337	349
382	1	(1,	0)	3	12/29/1990	363.721969	363.721969	363
427	1	(1,	0)	3	1/17/1991	382.574911	382.574911	17
461	1	(1,	0)	3	1/31/1991	396.523098	396.523098	31
545	1	(1,	0)	3	3/06/1991	430.574301	430.574301	65
637	1	(1,	0)	0	4/13/1991	468.261863	468.261958	103
640	1	(1,	0)	0	4/14/1991	469.489054	469.489054	104
656	1	(1,	0)	0	4/21/1991	476.034956	476.034956	111
680	1	(1,	0)	0	4/30/1991	486.251150	486.251150	120
841	2	(2,	0)	1	7/06/1991	553.043719	553.043719	187
881	1	(1,	0)	1	7/24/1991	570.086524	570.086524	205
901	2	(2,	0)	1	8/01/1991	578.671027	578.671027	213
955	1	(1,	0)	1	8/24/1991	602.094168	602.094168	236
972	1	(1,	0)	1	9/01/1991	609.563572	609.563572	244
982	1	(1,	0)	1	9/05/1991	613.459018	613.459018	248
986	1	(1,	0)	1	9/07/1991	615.581374	615.581374	250
1019	1	(1,	0)	1	9/21/1991	629.752555	629.752555	264
1047	2	(2,	0)	1	10/03/1991	641.359028	641.788702	276
1050	1	(1,	0)	1	10/04/1991	642.646016	643.072867	277

Total Upsets: 32 (Soft: 32, Hard: 0)

********** Total Upsets Per Electrical Address **********

Addr	Total	(Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0)
48	1	(0	0	1	0	0	0	0	0)
56	1	(0	0	0	0	0	0	0	1)
64	1	(0	0	0	0	1	0	0	0)
65	1	(0	0	0	0	1	0	0	0)
94	1	(0	0	0	0	0	1	0	0)
212	1	(0	0	0	0	0	1	0	0)
287	1	(0	0	0	1	0	0	0	0)
534	1	(0	1	0	0	0	0	0	0)
628	1	(0	0	0	0	1	0	0	0)
629	1	(0	0	0	0	1	0	0	0)
721	1	(0	0	1	0	0	0	0	0)
753	1	(0	0	0	0	0	1	0	0)
812	1	(0	0	0	0	0	0	1	0)
851	1	(0	0	1	0	0	0	0	0)
881	1	(0	0	0	0	0	0	1	0)
1125	1	(0	0	0	0	1	0	0	0)
1136	1	(0	0	0	0	0	0	1	0)
1141	1	(0	1	0	0	0	0	0	0)
1149	1	(0	0	1	0	0	0	0	0)
1153	1	(0	0	1	0	0	0	0	0)
1253	1	(0	0	0	0	0	1	0	0)
1572	1	(0	0	0	1	0	0	0	0)
1645	1	(0	0	1	0	0	0	0	0)
1653	1	(0	1	0	0	0	0	0	0)
1702	1	(0	0	0	0	0	0	0	1)
1703	1	(0	0	0	0	0	0	0	1)
1707	1	(0	0	0	0	1	0	0	0)
1724	1	(1	0	0	0	0	0	0	0)
1810	1	(0	1	0	0	0	0	0	0)
1828	1	(0	1	0	0	0	0	0	0)
1866	1	(0	0	0	1	0	0	0	0)
1887	1	(0	0	0	0	1	0	0	0)

********** SUMMARY **********

Block: 24; Side: B; Part Number: IDT6116RS; Device: 2 of 3; Board: 2; U-Number: 72
Addresses: 2048; Bits/Addr: 8; SEU File Processed: BLK_24_a.SEU; Output File Created: BLK_24_a.DV2

Total Upsets: 32 (Soft: 32, Hard: 0)

Breakdown Of The 32 Total Upsets Into Total Upsets In Each Bit Position:

Total	(Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0)
32	(1	5	6	3	7	4	3	3)

Table 3c

Block: 24; Side: B; Device: 3 of 3; Part Number: IDT6116RS; U-Number: 73
Board: 2; Addresses: 2048; Bits/Addr: 8; SEU File Processed: BLK_24_a.SEU; Output File Created: BLK_24_a.DV3

Orbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Year
62	1	(1,	0)	0	8/20/1990	232.319025	232.319025	232
63	1	(1,	0)	0	8/20/1990	233.112408	233.112408	232
116	1	(1,	0)	0	9/11/1990	254.883673	254.883673	254
296	1	(1,	0)	3	11/24/1990	328.422861	328.422861	328
373	1	(1,	0)	3	12/26/1990	360.029339	360.029339	360
381	1	(1,	0)	3	12/29/1990	363.696229	363.696229	363
420	1	(1,	0)	3	1/14/1991	379.317880	379.317880	14
421	1	(1,	0)	3	1/14/1991	379.722426	379.722426	14
432	1	(1,	0)	3	1/19/1991	384.631165	384.631426	19
438	1	(1,	0)	3	1/21/1991	386.696619	386.696619	21
493	1	(1,	0)	3	2/13/1991	409.263832	409.263832	44
495	1	(1,	0)	3	2/14/1991	410.462854	410.462854	45
496	1	(1,	0)	3	2/14/1991	410.492624	410.492624	45
549	1	(1,	0)	3	3/08/1991	432.598486	432.598486	67
566	1	(1,	0)	3	3/15/1991	439.566215	439.566215	74
637	1	(1,	0)	0	4/13/1991	468.261863	468.261958	103
688	1	(1,	0)	1	5/04/1991	489.519263	489.519263	124
699	1	(1,	0)	1	5/08/1991	494.025084	494.025084	128
716	1	(1,	0)	1	5/15/1991	500.596545	500.596545	135
745	2	(2,	0)	1	5/27/1991	512.466691	512.466691	147
791	1	(1,	0)	1	6/15/1991	531.807433	531.807433	166
816	1	(1,	0)	1	6/26/1991	542.645598	542.645598	177
878	1	(1,	0)	1	7/22/1991	568.811970	568.811970	203
890	1	(1,	0)	1	7/27/1991	574.348514	574.348514	208
916	1	(1,	0)	1	8/08/1991	585.506961	585.506961	220
935	1	(1,	0)	1	8/16/1991	593.678811	593.678811	228
989	1	(1,	0)	1	9/08/1991	616.798894	616.798894	251
995	2	(2,	0)	1	9/11/1991	619.109086	619.120677	254
1000	1	(1,	0)	1	9/13/1991	621.571972	621.571972	256
1001	18	(18,	0)	1	9/13/1991	621.612453	621.993632	256
1002	3	(3,	0)	1	9/14/1991	622.067062	622.343898	257
1003	9	(9,	0)	1	9/14/1991	622.511430	622.851484	257
1004	15	(15,	0)	1	9/14/1991	622.904456	623.302986	257
1005	48	(48,	0)	1	9/15/1991	623.377057	623.749818	258
1006	491	(491,	0)	1	9/15/1991	623.789683	624.123071	258
1007	9	(9,	0)	1	9/16/1991	624.185077	624.541150	259
1008	40	(40,	0)	1	9/16/1991	624.618112	625.029821	259
1009	2	(2,	0)	1	9/17/1991	625.127797	625.308514	260
1010	65	(65,	0)	1	9/17/1991	625.482468	625.879404	260
1011	119	(119,	0)	1	9/17/1991	625.918558	626.322582	260
1012	601	(601,	0)	1	9/18/1991	626.344028	626.758867	261
1013	726	(726,	0)	1	9/18/1991	626.758774	627.190300	261
1014	492	(492,	0)	1	9/19/1991	627.190302	627.609525	262
1015	82	(82,	0)	1	9/19/1991	627.650433	628.032086	262
1016	61	(61,	0)	1	9/20/1991	628.054601	628.477404	263
1017	7	(7,	0)	1	9/20/1991	628.477402	628.768365	263
1022	2	(2,	0)	1	9/22/1991	630.638872	630.984591	265
1023	1	(1,	0)	1	9/23/1991	631.174762	631.174762	266
1025	3	(3,	0)	1	9/23/1991	631.918291	632.077342	266
1029	7	(7,	0)	1	9/25/1991	633.703088	633.871503	268
1030	10	(10,	0)	1	9/26/1991	634.060796	634.488882	269
1031	12	(12,	0)	1	9/26/1991	634.488880	634.653241	269
1032	1	(1,	0)	1	9/26/1991	635.039227	635.039227	269
1034	7	(7,	0)	1	9/27/1991	635.805754	636.150611	270
1035	1	(1,	0)	1	9/28/1991	636.307764	636.307764	271
1036	19	(19,	0)	1	9/28/1991	636.667937	637.043211	271
1037	6	(6,	0)	1	9/29/1991	637.100312	637.326608	272
1038	47	(47,	0)	1	9/29/1991	637.511325	637.897902	272
1039	138	(138,	0)	1	9/29/1991	637.949548	638.339803	272
1040	128	(128,	0)	1	9/30/1991	638.359210	638.770777	273
1041	44	(44,	0)	1	9/30/1991	638.795362	639.188322	273
1042	24	(24,	0)	1	10/01/1991	639.322624	639.637003	274
1043	48	(48,	0)	1	10/01/1991	639.653024	640.018440	274
1044	43	(43,	0)	1	10/02/1991	640.086607	640.496346	275
1045	148	(148,	0)	1	10/02/1991	640.509616	640.930212	275
1046	179	(179,	0)	1	10/02/1991	640.928738	641.359407	275
1047	924	(924,	0)	1	10/03/1991	641.359028	641.788702	276
1048	374	(374,	0)	1	10/03/1991	641.786921	642.212000	276
1049	165	(165,	0)	1	10/04/1991	642.241205	642.646870	277
1050	1135	(1135,	0)	1	10/04/1991	642.646016	643.072867	277
1051	127	(127,	0)	1	10/05/1991	643.083150	643.498364	278
1052	182	(182,	0)	1	10/05/1991	643.516907	643.934021	278
1053	176	(176,	0)	1	10/05/1991	643.933987	644.346765	278
1054	17	(17,	0)	1	10/06/1991	644.400094	644.648272	279
1055	32	(32,	0)	1	10/06/1991	644.814356	645.196317	279
1056	85	(85,	0)	1	10/07/1991	645.241968	645.652394	280
1057	392	(392,	0)	1	10/07/1991	645.652396	646.073537	280
1058	436	(436,	0)	1	10/08/1991	646.083038	646.511764	281
1059	486	(486,	0)	1	10/08/1991	646.509840	646.940749	281
1060	113	(113,	0)	1	10/08/1991	646.940245	647.364349	281

Table 3c (cont.)

Orbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Year
1061	227	(227,	0)	1	10/09/1991	647.373851	647.799072	282
1062	653	(653,	0)	1	10/09/1991	647.798736	648.229074	282
1063	597	(597,	0)	1	10/10/1991	648.227681	648.632703	283
1064	685	(685,	0)	1	10/10/1991	648.681670	649.080600	283
1065	611	(611,	0)	1	10/11/1991	649.088632	649.517337	284
1066	517	(517,	0)	1	10/11/1991	649.516289	649.943012	284
1067	78	(78,	0)	1	10/11/1991	649.959423	650.023802	284

Total Upsets: 11699 (Soft: 11699, Hard: 0)

********** Total Upsets Per Electrical Address **********

Addr	Total	(Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0)
116	1	(0	0	0	0	0	0	1	)
141	1	(0	0	1	0	0	0	0	)
299	1	(0	1	0	0	0	0	0	)
300	1	(0	0	0	0	0	0	1	)
311	1	(0	0	0	0	1	0	0	)
357	1	(0	0	0	0	0	1	0	)
479	1	(0	0	0	0	0	1	0	)
565	1	(1	0	0	0	0	0	0	)
574	1	(0	0	0	0	0	1	0	)
588	1	(0	0	1	0	0	0	0	)
689	1	(0	0	0	1	0	0	0	)
722	1	(0	0	0	1	0	0	0	)
787	1	(1	0	0	0	0	0	0	)
855	1	(0	0	0	0	0	0	1	)
863	1	(0	1	0	0	0	0	0	)
962	1	(0	0	0	0	1	0	0	)
963	1	(0	0	0	0	1	0	0	)
969	1	(0	0	0	0	0	1	0	)
977	11670	(0	0	11670	0	0	0	0	)
1099	1	(0	0	1	0	0	0	0	)
1118	1	(0	1	0	0	0	0	0	)
1263	1	(0	0	1	0	0	0	0	)
1656	1	(0	0	0	0	0	0	1	)
1742	1	(0	1	0	0	0	0	0	)
1780	1	(0	0	1	0	0	0	0	)
1809	1	(0	0	0	0	1	0	0	)
1931	1	(0	1	0	0	0	0	0	)
1954	1	(0	0	0	0	1	0	0	)
2010	1	(0	0	0	1	0	0	0	)
2016	1	(0	1	0	0	0	0	0	)

********** SUMMARY **********

Block: 24; Side: B; Part Number: IDT6116RS; Device: 3 of 3; Board: 2; U-Number: 73
Addresses: 2048; Bits/Addr: 8; SEU File Processed: BLK_24_a.SEU; Output File Created: BLK_24_a.DV3

Total Upsets: 11699 (Soft: 11699, Hard: 0)

Breakdown Of The 11699 Total Upsets Into Total Upsets In Each Bit Position:

Total	(Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0)
11699	(2	6	11675	3	5	2	2	4)

Table 4a

Block: 06; Side: B; Device: 1 of 3; Part Number: XTA12702A; U-Number: 56
Board: 1; Addresses: 16384; Bits/Addr: 1; SEU File Processed: BLK_06_a.SEU; Output File Created: BLK_06_a.DV1

Orbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Year
7	2	(0,	2)	0	7/28/1990	209.928995	210.069653	209
65	1	(0,	1)	0	8/21/1990	233.907151	233.907151	233
72	1	(0,	1)	0	8/24/1990	236.499754	236.499754	236
113	1	(0,	1)	0	9/10/1990	253.287855	253.287855	253
540	2	(2,	0)	3	3/04/1991	428.696797	428.702248	63
687	7	(7,	0)	1	5/03/1991	488.759942	489.118006	123
688	11	(11,	0)	1	5/04/1991	489.372252	489.469719	124
689	70	(70,	0)	1	5/04/1991	489.537557	489.907714	124
690	292	(292,	0)	1	5/04/1991	489.950994	490.344309	124
694	1	(1,	0)	1	5/06/1991	491.639538	491.639538	126
703	5	(5,	0)	1	5/10/1991	495.522934	495.665413	130
704	4	(4,	0)	1	5/10/1991	495.677289	495.762717	130
712	4	(4,	0)	1	5/13/1991	499.162011	499.323409	133
713	135	(135,	0)	1	5/14/1991	499.436401	499.767139	134
714	219	(219,	0)	1	5/14/1991	499.767135	500.176664	134
715	418	(418,	0)	1	5/15/1991	500.176661	500.586282	135
716	719	(719,	0)	1	5/15/1991	500.584764	500.992892	135
717	1408	(1408,	0)	1	5/15/1991	500.999931	501.362879	135
718	8	(8,	0)	1	5/16/1991	501.452857	501.607784	136
719	26	(26,	0)	1	5/16/1991	501.922945	502.183283	136
720	97	(97,	0)	1	5/17/1991	502.281025	502.627336	137
721	338	(338,	0)	1	5/17/1991	502.648182	502.861160	137
725	12	(12,	0)	1	5/19/1991	504.322507	504.591164	139
726	128	(128,	0)	1	5/19/1991	504.699463	505.088675	139
727	2111	(2111,	0)	1	5/20/1991	505.088674	505.497892	140
728	970	(970,	0)	1	5/20/1991	505.495874	505.897957	140
729	42	(42,	0)	1	5/20/1991	505.956103	506.309591	140
730	7	(7,	0)	1	5/21/1991	506.330639	506.437068	141
736	81	(81,	0)	1	5/23/1991	508.874854	509.132842	143
737	79	(79,	0)	1	5/24/1991	509.186837	509.586861	144
738	32	(32,	0)	1	5/24/1991	509.590768	509.706988	144
739	1	(1,	0)	1	5/24/1991	510.101911	510.101911	144
747	2	(2,	0)	1	5/28/1991	513.349210	513.420125	148
750	2	(2,	0)	1	5/29/1991	514.595420	514.814324	149
751	3	(3,	0)	1	5/29/1991	515.025359	515.127380	149
753	2	(2,	0)	1	5/30/1991	516.016195	516.097285	150
754	193	(193,	0)	1	5/31/1991	516.164221	516.469786	151
755	18	(18,	0)	1	5/31/1991	516.731116	516.864165	151
756	1	(1,	0)	1	5/31/1991	517.177429	517.177429	151
757	1	(1,	0)	1	6/01/1991	517.425177	517.425177	152
759	46	(46,	0)	1	6/02/1991	518.186723	518.563538	153
760	2	(2,	0)	1	6/02/1991	518.601226	518.857886	153
765	29	(29,	0)	1	6/04/1991	520.660870	520.986393	155
766	90	(90,	0)	1	6/05/1991	521.235825	521.471555	156
767	225	(225,	0)	1	6/05/1991	521.478856	521.886248	156
768	286	(286,	0)	1	6/05/1991	521.886248	522.251045	156
769	108	(108,	0)	1	6/06/1991	522.305372	522.715677	157
770	127	(127,	0)	1	6/06/1991	522.714822	522.856334	157
771	166	(166,	0)	1	6/07/1991	523.154148	523.511478	158
772	491	(491,	0)	1	6/07/1991	523.637862	523.968315	158
773	1636	(1636,	0)	1	6/07/1991	523.967914	524.388910	158
774	3772	(3772,	0)	1	6/08/1991	524.386845	524.765840	159
775	93	(93,	0)	1	6/08/1991	524.942003	525.199046	159
776	79	(79,	0)	1	6/09/1991	525.236549	525.615728	160
777	42	(42,	0)	1	6/09/1991	525.647085	526.065117	160
778	114	(114,	0)	1	6/10/1991	526.065124	526.461159	161
779	1	(1,	0)	1	6/10/1991	526.753255	526.753255	161
782	11	(11,	0)	1	6/11/1991	527.840031	528.170793	162
783	843	(843,	0)	1	6/12/1991	528.189842	528.599993	163
784	1382	(1382,	0)	1	6/12/1991	528.598308	529.005582	163
793	5	(5,	0)	1	6/16/1991	532.460433	532.511017	167
809	2	(2,	0)	1	6/23/1991	539.584268	539.584860	174
810	1	(1,	0)	1	6/23/1991	540.002071	540.002071	174
811	1	(1,	0)	1	6/24/1991	540.522092	540.522092	175
812	37	(37,	0)	1	6/24/1991	540.522091	540.776076	175
813	59	(59,	0)	1	6/24/1991	541.282315	541.358499	175
814	78	(78,	0)	1	6/25/1991	541.379192	541.803268	176
815	105	(105,	0)	1	6/25/1991	541.802482	542.228959	176
816	20	(20,	0)	1	6/26/1991	542.231708	542.573539	177
818	3	(3,	0)	1	6/27/1991	543.400211	543.430836	178
819	118	(118,	0)	1	6/27/1991	543.528911	543.940381	178
820	206	(206,	0)	1	6/27/1991	543.940394	544.367549	178
821	609	(609,	0)	1	6/28/1991	544.366013	544.764327	179
822	16	(16,	0)	1	6/28/1991	544.799525	544.925629	179
825	25	(25,	0)	1	6/30/1991	546.111963	546.498115	181
826	253	(253,	0)	1	6/30/1991	546.509184	546.898636	181
827	269	(269,	0)	1	6/30/1991	546.932673	547.359405	181
828	61	(61,	0)	1	7/01/1991	547.359405	547.679287	182
829	7	(7,	0)	1	7/01/1991	547.875691	547.998879	182

Table 4a (cont.)

rbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Year
830	12	(12,	0)	1	7/02/1991	548.389890	548.643990	183
831	20	(20,	0)	1	7/02/1991	548.643989	549.073710	183
832	14	(14,	0)	1	7/03/1991	549.073710	549.219156	184
836	9	(9,	0)	1	7/04/1991	550.938009	551.160160	185
842	1	(1,	0)	1	7/07/1991	553.465294	553.465294	188
843	16	(16,	0)	1	7/07/1991	553.896388	553.971126	188
845	1	(1,	0)	1	7/08/1991	554.854885	554.854885	189
850	5	(5,	0)	1	7/10/1991	556.824834	557.153314	191
851	9	(9,	0)	1	7/11/1991	557.248271	557.630751	192
852	11	(11,	0)	1	7/11/1991	557.651300	557.773161	192
863	1	(1,	0)	1	7/16/1991	562.738736	562.738736	197
866	96	(96,	0)	1	7/17/1991	563.654686	564.075521	198
867	222	(222,	0)	1	7/18/1991	564.074435	564.503743	199
868	823	(823,	0)	1	7/18/1991	564.502485	564.930304	199
869	205	(205,	0)	1	7/18/1991	564.934029	565.353839	199
870	74	(74,	0)	1	7/19/1991	565.369733	565.768778	200
871	337	(337,	0)	1	7/19/1991	565.827703	566.218077	200
872	92	(92,	0)	1	7/20/1991	566.217721	566.645944	201
873	545	(545,	0)	1	7/20/1991	566.645942	567.020546	201
876	1	(1,	0)	1	7/21/1991	568.160289	568.160289	202
877	2	(2,	0)	1	7/22/1991	568.711539	568.720878	203
878	34	(34,	0)	1	7/22/1991	568.847786	569.078234	203
879	6	(6,	0)	1	7/23/1991	569.589129	569.621200	204
880	1	(1,	0)	1	7/23/1991	570.059622	570.059622	204
881	7	(7,	0)	1	7/24/1991	570.283810	570.431602	205
883	12	(12,	0)	1	7/24/1991	570.967942	571.345542	205
884	8	(8,	0)	1	7/25/1991	571.369320	571.726360	206
885	30	(30,	0)	1	7/25/1991	571.852341	572.208723	206
886	97	(97,	0)	1	7/26/1991	572.273153	572.641935	207
887	86	(86,	0)	1	7/26/1991	572.651982	572.942424	207
888	1	(1,	0)	1	7/27/1991	573.294883	573.294883	208
891	7	(7,	0)	1	7/28/1991	574.596309	574.658484	209
892	2	(2,	0)	1	7/28/1991	574.847563	574.864156	209
893	27	(27,	0)	1	7/29/1991	575.233953	575.537998	210
894	5	(5,	0)	1	7/29/1991	575.702335	575.996640	210
895	26	(26,	0)	1	7/30/1991	576.117218	576.492539	211
896	50	(50,	0)	1	7/30/1991	576.592401	576.898815	211
897	20	(20,	0)	1	7/30/1991	576.954945	577.174109	211
898	9	(9,	0)	1	7/31/1991	577.391823	577.782006	212
899	51	(51,	0)	1	7/31/1991	577.806728	578.212248	212
900	47	(47,	0)	1	8/01/1991	578.228319	578.632132	213
901	15	(15,	0)	1	8/01/1991	578.730287	578.963555	213
902	1	(1,	0)	1	8/02/1991	579.278549	579.278549	214
904	2	(2,	0)	1	8/02/1991	580.200302	580.236261	214
910	1	(1,	0)	1	8/05/1991	582.877204	582.877204	217
911	5	(5,	0)	1	8/05/1991	583.085439	583.113385	217
922	1	(1,	0)	1	8/10/1991	587.818618	587.818618	222
923	3	(3,	0)	1	8/11/1991	588.261827	588.534962	223
924	352	(352,	0)	1	8/11/1991	588.534960	588.801363	223
925	1	(1,	0)	1	8/11/1991	589.357353	589.357353	223
926	42	(42,	0)	1	8/12/1991	589.480997	589.625136	224
927	1	(1,	0)	1	8/12/1991	590.009534	590.009534	224
928	236	(236,	0)	1	8/13/1991	590.310520	590.683922	225
929	2051	(2051,	0)	1	8/13/1991	590.682072	591.112348	225
930	1190	(1190,	0)	1	8/14/1991	591.112573	591.542173	226
931	131	(131,	0)	1	8/14/1991	591.541390	591.649218	226
936	1	(1,	0)	1	8/16/1991	593.783221	593.783221	228
939	1	(1,	0)	1	8/17/1991	595.397083	595.397083	229
940	1	(1,	0)	1	8/18/1991	595.414395	595.414395	230
943	1	(1,	0)	1	8/19/1991	596.932651	596.932651	231
944	56	(56,	0)	1	8/20/1991	597.141950	597.555528	232
945	96	(96,	0)	1	8/20/1991	597.555527	597.982855	232
946	27	(27,	0)	1	8/20/1991	597.991482	598.268578	232
996	9	(9,	0)	1	9/11/1991	619.469663	619.624330	254
997	1	(1,	0)	1	9/11/1991	620.275910	620.275910	254
998	4	(4,	0)	1	9/12/1991	620.359916	620.488698	255
1002	7	(7,	0)	1	9/14/1991	622.312846	622.345604	257
1005	1	(1,	0)	1	9/15/1991	623.655522	623.655522	258
1006	7	(7,	0)	1	9/15/1991	624.050964	624.170692	258
1007	30	(30,	0)	1	9/16/1991	624.202309	624.610362	259
1008	61	(61,	0)	1	9/16/1991	624.622118	625.027261	259
1009	89	(89,	0)	1	9/17/1991	625.056045	625.465521	260
1010	59	(59,	0)	1	9/17/1991	625.486190	625.897774	260
1011	198	(198,	0)	1	9/17/1991	625.902439	626.327522	260
1012	1589	(1589,	0)	1	9/18/1991	626.336775	626.760384	261
1013	1058	(1058,	0)	1	9/18/1991	626.758371	626.976635	261
1014	8	(8,	0)	1	9/19/1991	627.343570	627.538364	262
1015	2	(2,	0)	1	9/19/1991	627.976975	627.987334	262
1016	4	(4,	0)	1	9/20/1991	628.340562	628.478044	263
1017	79	(79,	0)	1	9/20/1991	628.478042	628.896789	263
1018	40	(40,	0)	1	9/20/1991	628.916082	629.183317	263
1019	3	(3,	0)	1	9/21/1991	629.442514	629.540102	264
1020	1	(1,	0)	1	9/21/1991	629.951450	629.951450	264

Table 4a (cont.)

Orbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Year
1021	5	(5,	0)	1	9/22/1991	630.480746	630.604100	265
1022	34	(34,	0)	1	9/22/1991	630.640508	631.033677	265
1023	8	(8,	0)	1	9/23/1991	631.062288	631.298136	266
1025	29	(29,	0)	1	9/23/1991	631.924454	632.336919	266
1026	30	(30,	0)	1	9/24/1991	632.362115	632.712784	267
1029	1	(1,	0)	1	9/25/1991	633.642881	633.642881	268
1030	1	(1,	0)	1	9/26/1991	634.397266	634.397266	269
1031	145	(145,	0)	1	9/26/1991	634.654497	634.918814	269
1032	253	(253,	0)	1	9/26/1991	634.917461	635.347585	269
1033	148	(148,	0)	1	9/27/1991	635.347591	635.765380	270
1034	50	(50,	0)	1	9/27/1991	635.780033	636.176163	270
1035	8	(8,	0)	1	9/28/1991	636.273012	636.622615	271
1036	57	(57,	0)	1	9/28/1991	636.709914	637.023203	271
1037	1	(1,	0)	1	9/29/1991	637.181258	637.181258	272
1040	2	(2,	0)	1	9/30/1991	638.372579	638.382961	273
1041	18	(18,	0)	1	9/30/1991	639.141910	639.210793	273
1042	69	(69,	0)	1	10/01/1991	639.213516	639.612167	274
1043	21	(21,	0)	1	10/01/1991	639.805652	640.041571	274
1045	2	(2,	0)	1	10/02/1991	640.500917	640.655844	275
1046	2	(2,	0)	1	10/02/1991	641.069822	641.096536	275
1047	8	(8,	0)	1	10/03/1991	641.525807	641.616379	276
1048	10	(10,	0)	1	10/03/1991	641.798560	642.033938	276
1049	1	(1,	0)	1	10/04/1991	642.643528	642.643528	277
1050	81	(81,	0)	1	10/04/1991	642.715563	643.076822	277
1051	229	(229,	0)	1	10/05/1991	643.075044	643.462048	278
1052	87	(87,	0)	1	10/05/1991	643.531579	643.898844	278
1053	23	(23,	0)	1	10/05/1991	643.937946	644.348423	278
1058	2	(2,	0)	1	10/08/1991	646.183802	646.186172	281

Total Upsets: 30684 (Soft: 30679, Hard: 5)

********** Total Upsets Per Electrical Address **********

Addr	Total	(Bit 0)
1871	2	(2)
3643	5	(5)
7294	30677	(30677)

********** SUMMARY **********

Block: 06; Side: B; Part Number: XTA12702A; Device: 1 of 3; Board: 1; U-Number: 56
Addresses: 16384; Bits/Addr: 1; SEU File Processed: BLK_06_a.SEU; Output File Created: BLK_06_a.DV1

Total Upsets: 30684 (Soft: 30679, Hard: 5)

Breakdown Of The 30684 Total Upsets Into Total Upsets In Each Bit Position:

Total	(Bit 0)
30684	(30684)

Table 4b

Block: 06; Side: B; Device: 2 of 3; Part Number: XTA12702A; U-Number: 57
Board: 1; Addresses: 16384; Bits/Addr: 1; SEU File Processed: BLK_06_a.SEU; Output File Created: BLK_06_a.DV2

Orbit	Upsets	(Soft, Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Year
794	1	(1, 0)	1	6/16/1991	532.951073	532.951073	167
816	1	(1, 0)	1	6/26/1991	542.231708	542.573539	177

Total Upsets: 2 (Soft: 2, Hard: 0)

********** Total Upsets Per Electrical Address **********

Addr	Total	(Bit 0)
10312	1	(1)
10922	1	(1)

********** SUMMARY **********

Block: 06; Side: B; Part Number: XTA12702A; Device: 2 of 3; Board: 1; U-Number: 57
Addresses: 16384; Bits/Addr: 1; SEU File Processed: BLK_06_a.SEU; Output File Created: BLK_06_a.DV2

Total Upsets: 2 (Soft: 2, Hard: 0)

Breakdown Of The 2 Total Upsets Into Total Upsets In Each Bit Position:

Total	(Bit 0)
2	(2)

Table 4c

Block: 06; Side: B; Device: 3 of 3; Part Number: XTA12702A; U-Number: 58
Board: 1; Addresses: 16384; Bits/Addr: 1; SEU File Processed: BLK_06_a.SEU; Output File Created: BLK_06_a.DV3

Orbit	Upsets	(Soft, Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Yea

Total Upsets: 0 (Soft: 0, Hard: 0)

********** SUMMARY **********

Block: 06; Side: B; Part Number: XTA12702A; Device: 3 of 3; Board: 1; U-Number: 58
Addresses: 16384; Bits/Addr: 1; SEU File Processed: BLK_06_a.SEU; Output File Created: BLK_06_a.DV3

Total Upsets: 0 (Soft: 0, Hard: 0)

Breakdown Of The 0 Total Upsets Into Total Upsets In Each Bit Position:

Total	(Bit 0)
0	(0)

Table 5a

lock: 03; Side: B; Device: 1 of 2; Part Number: 30283-1K; U-Number: 30
oard: 1; Addresses: 1024; Bits/Addr: 1; SEU File Processed: BLK_03_a.SEU; Output File Created: BLK_03_a.DV1

rbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Year
116	1	(1,	0)	0	9/11/1990	254.879525	254.886067	254
117	6	(6,	0)	0	9/11/1990	254.905435	255.298818	254
118	1	(1,	0)	0	9/12/1990	255.321359	255.707588	255
119	4	(4,	0)	0	9/12/1990	255.732568	256.121828	255
120	4	(4,	0)	0	9/13/1990	256.526424	256.529790	256
121	1	(1,	0)	0	9/13/1990	256.553871	256.553871	256
123	3	(3,	0)	0	9/14/1990	257.377664	257.762846	257
124	5	(5,	0)	0	9/14/1990	257.786857	258.171446	257
125	5	(5,	0)	0	9/15/1990	258.196430	258.585310	258
126	4	(4,	0)	0	9/15/1990	258.610695	258.993771	258
127	6	(6,	0)	0	9/16/1990	259.018444	259.405735	259
128	1	(1,	0)	0	9/16/1990	259.431241	259.433042	259
129	5	(5,	0)	0	9/16/1990	259.838585	260.227491	259
130	2	(2,	0)	0	9/17/1990	260.250198	260.640453	260
131	4	(4,	0)	0	9/17/1990	260.663705	261.045960	260
132	5	(5,	0)	0	9/18/1990	261.068443	261.461095	261
133	1	(1,	0)	0	9/18/1990	261.482479	261.489139	261
134	4	(4,	0)	0	9/18/1990	262.272256	262.277850	261
135	13	(13,	0)	0	9/19/1990	262.304540	262.696955	262
137	2	(2,	0)	0	9/20/1990	263.508174	263.513958	263
138	3	(3,	0)	0	9/20/1990	263.915671	263.930198	263
139	4	(4,	0)	0	9/20/1990	263.941859	264.333184	263
140	2	(2,	0)	0	9/21/1990	264.358544	264.744179	264
141	2	(2,	0)	0	9/21/1990	265.148888	265.156118	264
142	5	(5,	0)	0	9/22/1990	265.178163	265.567209	265
143	6	(6,	0)	0	9/22/1990	265.590245	265.978539	265
144	10	(10,	0)	0	9/22/1990	265.998307	266.388922	265
145	6	(6,	0)	0	9/23/1990	266.411980	266.801317	266
146	7	(7,	0)	0	9/23/1990	266.817842	267.206728	266
147	12	(12,	0)	0	9/24/1990	267.233061	267.622338	267
148	5	(5,	0)	0	9/24/1990	268.025632	268.030515	267
149	8	(8,	0)	0	9/25/1990	268.051753	268.441130	268
150	7	(7,	0)	0	9/25/1990	268.466847	268.856204	268
151	9	(9,	0)	0	9/25/1990	268.875094	269.264024	268
152	9	(9,	0)	0	9/26/1990	269.287688	269.673087	269
153	5	(5,	0)	0	9/26/1990	269.697544	270.084578	269
154	14	(14,	0)	0	9/27/1990	270.105075	270.494894	270
155	8	(8,	0)	0	9/27/1990	270.517902	270.908701	270
156	2	(2,	0)	0	9/27/1990	270.925600	271.317849	270
157	2	(2,	0)	0	9/28/1990	271.342947	271.731351	271
158	10	(10,	0)	0	9/28/1990	271.747781	272.138437	271
159	7	(7,	0)	0	9/29/1990	272.162045	272.553128	272
160	2	(2,	0)	0	9/29/1990	272.575585	272.960709	272
161	10	(10,	0)	0	9/29/1990	272.983637	273.373434	272
162	2	(2,	0)	0	9/30/1990	273.397138	273.789763	273
163	5	(5,	0)	0	9/30/1990	273.807161	274.189237	273
164	6	(6,	0)	0	10/01/1990	274.218795	274.605904	274
165	5	(5,	0)	0	10/01/1990	274.628652	275.015781	274
166	2	(2,	0)	0	10/02/1990	275.034981	275.423452	275
167	3	(3,	0)	0	10/02/1990	275.448512	275.836247	275
168	5	(5,	0)	0	10/02/1990	275.860075	276.244122	275
169	6	(6,	0)	0	10/03/1990	276.269007	276.661347	276
170	3	(3,	0)	0	10/03/1990	276.682918	277.066844	276
171	5	(5,	0)	0	10/04/1990	277.089930	277.480626	277
172	5	(5,	0)	0	10/04/1990	277.501779	277.891607	277
173	9	(9,	0)	0	10/04/1990	277.915003	278.303954	277
174	10	(10,	0)	0	10/05/1990	278.325405	278.715046	278
175	5	(5,	0)	0	10/05/1990	278.732940	279.122388	278
176	5	(5,	0)	0	10/06/1990	279.144007	279.532284	279
177	1	(1,	0)	0	10/06/1990	279.560571	279.562705	279
178	2	(2,	0)	0	10/06/1990	280.347578	280.356325	279
179	4	(4,	0)	0	10/07/1990	280.376187	280.767616	280
180	5	(5,	0)	0	10/07/1990	280.793604	281.176395	280
181	5	(5,	0)	0	10/08/1990	281.201400	281.589569	281
182	3	(3,	0)	0	10/08/1990	281.609739	281.998017	281
183	7	(7,	0)	0	10/09/1990	282.016254	282.408503	282
184	2	(2,	0)	0	10/09/1990	282.433130	282.816424	282
185	2	(2,	0)	0	10/09/1990	282.851456	283.226928	282
186	3	(3,	0)	0	10/10/1990	283.252621	283.641485	283
187	6	(6,	0)	0	10/10/1990	283.665803	284.050135	283
188	8	(8,	0)	0	10/11/1990	284.072793	284.460819	284
189	4	(4,	0)	0	10/11/1990	284.485674	284.873876	284
190	13	(13,	0)	0	10/11/1990	284.887787	285.282909	284
191	5	(5,	0)	0	10/12/1990	285.306943	285.698383	285
192	1	(1,	0)	0	10/12/1990	285.717425	286.102923	285
193	6	(6,	0)	0	10/13/1990	286.125559	286.518540	286
194	1	(1,	0)	0	10/13/1990	286.543333	286.543333	286
195	2	(2,	0)	0	10/13/1990	287.327427	287.339560	286
196	8	(8,	0)	0	10/14/1990	287.363079	287.746808	287
197	3	(3,	0)	0	10/14/1990	287.772457	288.157231	287

Table 5a (cont.)

Orbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Yea
198	10	(10,	0)	0	10/15/1990	288.182900	288.571633	288
199	8	(8,	0)	0	10/15/1990	288.592488	288.981703	288
200	5	(5,	0)	0	10/15/1990	288.998355	289.392544	288
201	2	(2,	0)	0	10/16/1990	289.416887	289.798861	289
202	7	(7,	0)	0	10/16/1990	289.822856	290.210673	289
203	6	(6,	0)	0	10/17/1990	290.235239	290.622608	290
204	5	(5,	0)	0	10/17/1990	290.643218	291.033331	290
205	3	(3,	0)	0	10/18/1990	291.054299	291.442091	291
206	10	(10,	0)	0	10/18/1990	291.469134	291.853964	291
207	6	(6,	0)	0	10/18/1990	291.873584	292.262762	291
208	9	(9,	0)	0	10/19/1990	292.287515	292.683217	292
209	3	(3,	0)	0	10/19/1990	292.700990	293.084640	292
210	4	(4,	0)	0	10/20/1990	293.109264	293.500418	293
211	2	(2,	0)	0	10/20/1990	293.522387	293.908022	293
212	6	(6,	0)	0	10/20/1990	293.930196	294.318898	293
213	3	(3,	0)	0	10/21/1990	294.344297	294.733059	294
214	4	(4,	0)	0	10/21/1990	294.748252	295.138957	294
215	6	(6,	0)	0	10/22/1990	295.163324	295.552157	295
216	2	(2,	0)	0	10/22/1990	295.577519	295.960950	295
217	11	(11,	0)	0	10/22/1990	295.982399	296.370002	295
218	5	(5,	0)	0	10/23/1990	296.396081	296.787516	296
220	10	(10,	0)	0	10/24/1990	297.214863	297.609527	297
221	5	(5,	0)	0	10/24/1990	297.629129	298.011822	297
222	2	(2,	0)	0	10/25/1990	298.036071	298.427985	298
223	6	(6,	0)	0	10/25/1990	298.453537	298.837726	298
224	5	(5,	0)	0	10/25/1990	298.860669	299.245495	298
225	5	(5,	0)	0	10/26/1990	299.269650	299.661227	299
226	3	(3,	0)	0	10/26/1990	299.682493	300.066335	299
227	12	(12,	0)	0	10/27/1990	300.090265	300.484526	300
228	3	(3,	0)	0	10/27/1990	300.505478	300.892323	300
229	7	(7,	0)	0	10/27/1990	300.912373	301.297725	300
230	6	(6,	0)	0	10/28/1990	301.325122	301.713744	301
231	1	(1,	0)	0	10/28/1990	301.734932	302.121930	301
232	6	(6,	0)	0	10/29/1990	302.146259	302.538860	302
233	4	(4,	0)	0	10/29/1990	302.554267	302.942151	302
234	7	(7,	0)	0	10/29/1990	302.964669	303.356346	302
235	6	(6,	0)	0	10/30/1990	303.375877	303.766108	303
236	6	(6,	0)	0	10/30/1990	303.785544	304.173313	303
237	4	(4,	0)	0	10/31/1990	304.197417	304.587861	304
238	6	(6,	0)	0	10/31/1990	304.610262	304.997506	304
239	13	(13,	0)	0	11/01/1990	305.018933	305.408077	305
240	11	(11,	0)	0	11/01/1990	305.427961	305.823150	305
241	8	(8,	0)	0	11/01/1990	305.836137	306.225351	305
242	3	(3,	0)	0	11/02/1990	306.251492	306.638384	306
243	2	(2,	0)	0	11/02/1990	306.662441	307.048882	306
244	6	(6,	0)	0	11/03/1990	307.072962	307.461297	307
245	4	(4,	0)	0	11/03/1990	307.487276	307.872840	307
246	10	(10,	0)	0	11/03/1990	307.891587	308.281039	307
247	5	(5,	0)	0	11/04/1990	308.305688	308.696183	308
248	6	(6,	0)	0	11/04/1990	308.712160	309.100697	308
251	1	(1,	0)	0	11/05/1990	309.945012	310.334191	309
252	2	(2,	0)	0	11/06/1990	310.362255	310.750684	310
253	4	(4,	0)	0	11/06/1990	310.765737	311.154738	310
254	5	(5,	0)	0	11/07/1990	311.177988	311.567649	311
255	9	(9,	0)	0	11/07/1990	311.590555	311.976057	311
256	5	(5,	0)	0	11/07/1990	312.001730	312.387031	311
257	6	(6,	0)	0	11/08/1990	312.412940	312.801389	312
258	3	(3,	0)	0	11/08/1990	312.819075	313.206958	312
259	10	(10,	0)	0	11/09/1990	313.233791	313.624682	313
260	3	(3,	0)	0	11/09/1990	313.645332	314.026934	313
261	6	(6,	0)	0	11/10/1990	314.050069	314.441461	314
262	6	(6,	0)	0	11/10/1990	314.467678	314.852148	314
263	5	(5,	0)	0	11/10/1990	314.871657	315.260939	314
264	5	(5,	0)	0	11/11/1990	315.284121	315.674850	315
265	8	(8,	0)	0	11/11/1990	315.693553	316.079682	315
266	4	(4,	0)	0	11/12/1990	316.106137	316.495276	316
267	6	(6,	0)	0	11/12/1990	316.520450	316.901795	316
268	8	(8,	0)	0	11/12/1990	316.927203	317.317860	316
269	9	(9,	0)	0	11/13/1990	317.340568	317.725489	317
270	8	(8,	0)	0	11/13/1990	317.748268	318.137641	317
271	7	(7,	0)	0	11/14/1990	318.161800	318.550679	318
272	4	(4,	0)	0	11/14/1990	318.572131	318.955654	318
273	3	(3,	0)	0	11/14/1990	318.977698	319.369422	318
274	6	(6,	0)	0	11/15/1990	319.388334	319.776957	319
275	3	(3,	0)	0	11/15/1990	319.801968	320.182238	319
276	6	(6,	0)	0	11/16/1990	320.213667	320.602902	320
277	4	(4,	0)	0	11/16/1990	320.625586	320.629141	320
278	3	(3,	0)	0	11/17/1990	321.032574	321.420628	321
279	4	(4,	0)	0	11/17/1990	321.447124	321.831335	321
280	3	(3,	0)	0	11/17/1990	321.853496	322.217870	321
281	6	(6,	0)	0	11/18/1990	322.263710	322.653206	322
282	4	(4,	0)	0	11/18/1990	322.677217	323.062879	322
283	1	(1,	0)	0	11/19/1990	323.086125	323.086125	323

Table 5a (cont.)

Orbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Year
286	5	(5,	0)	0	11/20/1990	324.697451	324.705652	324
287	3	(3,	0)	0	11/20/1990	324.724377	325.112360	324
288	5	(5,	0)	0	11/21/1990	325.138194	325.530915	325
289	4	(4,	0)	0	11/21/1990	325.551630	325.933899	325
290	3	(3,	0)	0	11/21/1990	325.960942	326.349659	325
291	9	(9,	0)	0	11/22/1990	326.371891	326.761505	326
292	4	(4,	0)	0	11/22/1990	326.783573	326.790802	326
293	8	(8,	0)	0	11/23/1990	327.375521	327.585086	327
294	7	(7,	0)	0	11/23/1990	327.601794	327.988496	327
295	3	(3,	0)	0	11/24/1990	328.010964	328.401385	328
296	9	(9,	0)	0	11/24/1990	328.424141	328.811860	328
297	3	(3,	0)	0	11/24/1990	328.832196	329.220981	328
298	8	(8,	0)	0	11/25/1990	329.245016	329.633659	329
299	4	(4,	0)	0	11/25/1990	329.658404	330.043471	329
300	3	(3,	0)	0	11/26/1990	330.066129	330.458398	330
301	1	(1,	0)	0	11/26/1990	330.479494	330.866122	330
302	5	(5,	0)	0	11/26/1990	330.885273	331.277756	330
303	4	(4,	0)	0	11/27/1990	331.297951	331.684863	331
304	8	(8,	0)	0	11/27/1990	331.709158	331.718664	331
305	4	(4,	0)	0	11/28/1990	332.500740	332.508207	332
306	2	(2,	0)	0	11/28/1990	332.527782	332.915513	332
307	3	(3,	0)	0	11/28/1990	332.938421	333.325713	332
308	6	(6,	0)	0	11/29/1990	333.351715	333.738248	333
309	3	(3,	0)	0	11/29/1990	333.762638	334.148366	333
310	10	(10,	0)	0	11/30/1990	334.172614	334.561900	334
311	4	(4,	0)	0	11/30/1990	334.579675	334.588753	334
312	1	(1,	0)	0	11/30/1990	334.991536	335.381093	334
313	5	(5,	0)	0	12/01/1990	335.403491	335.794434	335
314	2	(2,	0)	0	12/01/1990	335.812923	336.200608	335
315	5	(5,	0)	0	12/02/1990	336.225885	336.617182	336
316	5	(5,	0)	0	12/02/1990	336.636892	336.643777	336
317	5	(5,	0)	0	12/03/1990	337.045315	337.433105	337
318	6	(6,	0)	0	12/03/1990	337.456370	337.841258	337
319	4	(4,	0)	0	12/03/1990	337.866831	338.251989	337
320	10	(10,	0)	0	12/04/1990	338.278229	338.666069	338
321	4	(4,	0)	0	12/04/1990	338.687992	339.072501	338
322	3	(3,	0)	0	12/05/1990	339.098751	339.487918	339
323	5	(5,	0)	0	12/05/1990	339.505991	339.892308	339
325	6	(6,	0)	0	12/06/1990	340.330677	340.717420	340
326	5	(5,	0)	0	12/06/1990	340.742073	341.123886	340
327	7	(7,	0)	0	12/07/1990	341.149485	341.542536	341
328	7	(7,	0)	0	12/07/1990	341.560788	341.568444	341
329	1	(1,	0)	0	12/07/1990	341.969603	342.355855	341
330	4	(4,	0)	0	12/08/1990	342.383750	342.773198	342
331	4	(4,	0)	0	12/08/1990	342.792635	342.797636	342
332	6	(6,	0)	0	12/09/1990	343.203465	343.595424	343
333	6	(6,	0)	0	12/09/1990	343.613772	343.628918	343
334	3	(3,	0)	0	12/10/1990	344.022823	344.411797	344
335	4	(4,	0)	0	12/10/1990	344.437538	344.823028	344
336	2	(2,	0)	0	12/10/1990	344.845926	345.231035	344
337	4	(4,	0)	0	12/11/1990	345.257796	345.646368	345
338	1	(1,	0)	0	12/11/1990	345.663694	346.050254	345
339	8	(8,	0)	0	12/12/1990	346.076467	346.465371	346
340	6	(6,	0)	0	12/12/1990	346.486371	346.877764	346
341	2	(2,	0)	0	12/12/1990	346.893717	347.283735	346
342	7	(7,	0)	0	12/13/1990	347.306276	347.692928	347
343	4	(4,	0)	0	12/13/1990	347.717318	348.103759	347
344	2	(2,	0)	0	12/14/1990	348.128930	348.519422	348
345	1	(1,	0)	0	12/14/1990	348.540803	348.925179	348
346	4	(4,	0)	0	12/14/1990	348.948882	349.336837	348
347	5	(5,	0)	0	12/15/1990	349.360921	349.750091	349
348	3	(3,	0)	0	12/15/1990	349.766771	349.773479	349
349	7	(7,	0)	0	12/16/1990	350.183314	350.572075	350
350	4	(4,	0)	0	12/16/1990	350.591701	350.974611	350
351	2	(2,	0)	0	12/16/1990	350.999567	351.389540	350
352	12	(12,	0)	0	12/17/1990	351.410087	351.796146	351
353	6	(6,	0)	0	12/17/1990	351.815535	351.826083	351
354	3	(3,	0)	0	12/18/1990	352.232884	352.622425	352
355	1	(1,	0)	0	12/18/1990	352.644375	352.653051	352
357	6	(6,	0)	0	12/19/1990	353.466222	353.848255	353
358	3	(3,	0)	0	12/19/1990	353.875344	354.263940	353
359	1	(1,	0)	0	12/20/1990	354.665598	354.670623	354
360	6	(6,	0)	0	12/20/1990	354.692356	354.700415	354
361	6	(6,	0)	0	12/21/1990	355.106621	355.497444	355
362	6	(6,	0)	0	12/21/1990	355.518184	355.901802	355
363	1	(1,	0)	0	12/21/1990	355.927426	356.315974	355
364	8	(8,	0)	0	12/22/1990	356.337709	356.726139	356
365	3	(3,	0)	0	12/22/1990	356.747779	357.136733	356
366	6	(6,	0)	0	12/23/1990	357.157139	357.546947	357
368	1	(1,	0)	0	12/23/1990	357.977519	358.365102	357
369	4	(4,	0)	0	12/24/1990	358.389581	358.774671	358
370	2	(2,	0)	0	12/24/1990	358.799344	359.081205	358
371	5	(5,	0)	0	12/25/1990	359.213255	359.599669	359

Table 5a (cont.)

Orbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Yea
372	4	(4,	0)	0	12/25/1990	359.617943	359.861783	359
373	2	(2,	0)	0	12/26/1990	360.026495	360.420233	360
374	4	(4,	0)	0	12/26/1990	360.444054	360.450027	360
375	1	(1,	0)	0	12/26/1990	361.236753	361.236753	360
376	2	(2,	0)	0	12/27/1990	361.263727	361.648862	361
377	4	(4,	0)	0	12/27/1990	361.669388	361.678775	361
378	3	(3,	0)	0	12/28/1990	362.466438	362.474094	362
379	1	(1,	0)	0	12/28/1990	362.496498	362.506928	362
381	5	(5,	0)	0	12/29/1990	363.314695	363.704144	363
383	3	(3,	0)	0	12/30/1990	364.135927	364.524592	364
384	3	(3,	0)	0	12/30/1990	364.544052	364.933666	364
386	4	(4,	0)	0	12/31/1990	365.365568	365.750417	365
387	3	(3,	0)	0	12/31/1990	365.775733	365.860189	365
388	5	(5,	0)	0	1/01/1991	366.189133	366.574637	1
389	2	(2,	0)	0	1/01/1991	366.598279	366.602119	1
391	2	(2,	0)	0	1/02/1991	367.420863	367.806997	2
392	1	(1,	0)	0	1/02/1991	367.827995	368.214548	2
393	2	(2,	0)	0	1/03/1991	368.240219	368.623885	3
394	7	(7,	0)	0	1/03/1991	368.646427	369.032466	3
395	2	(2,	0)	0	1/04/1991	369.439907	369.445663	4
396	3	(3,	0)	0	1/04/1991	369.467446	369.854907	4
397	2	(2,	0)	0	1/04/1991	369.877259	370.269172	4
398	5	(5,	0)	0	1/05/1991	370.287398	370.677205	5
399	4	(4,	0)	0	1/05/1991	370.696901	370.705837	5
400	4	(4,	0)	0	1/06/1991	371.107754	371.502800	6
401	4	(4,	0)	0	1/06/1991	371.520483	371.716987	6
403	4	(4,	0)	0	1/07/1991	372.339867	372.727266	7
404	2	(2,	0)	0	1/07/1991	372.752805	372.757404	7
405	4	(4,	0)	0	1/08/1991	373.164230	373.553583	8
406	6	(6,	0)	0	1/08/1991	373.572640	373.957280	8
407	2	(2,	0)	0	1/08/1991	374.359316	374.370291	8
408	7	(7,	0)	0	1/09/1991	374.394252	374.778476	9
409	2	(2,	0)	0	1/09/1991	374.799582	374.806859	9
410	2	(2,	0)	0	1/10/1991	375.212522	375.596685	10
411	3	(3,	0)	0	1/10/1991	375.622617	375.627547	10
412	3	(3,	0)	0	1/11/1991	376.416047	376.423348	11
413	1	(1,	0)	0	1/11/1991	376.446764	376.831226	11
414	1	(1,	0)	0	1/11/1991	376.854062	376.857286	11
415	5	(5,	0)	0	1/12/1991	377.262427	377.653230	12
416	3	(3,	0)	0	1/12/1991	377.671834	377.681932	12
417	5	(5,	0)	0	1/13/1991	378.090510	378.473535	13
418	2	(2,	0)	0	1/13/1991	378.499207	378.503402	13
419	1	(1,	0)	0	1/13/1991	379.295551	379.295551	13
420	2	(2,	0)	0	1/14/1991	379.320179	379.704932	14
421	1	(1,	0)	0	1/14/1991	379.723895	379.729489	14
422	8	(8,	0)	0	1/15/1991	380.136712	380.524808	15
423	1	(1,	0)	0	1/15/1991	380.548061	380.935207	15
424	2	(2,	0)	0	1/15/1991	380.952559	381.341247	15
425	3	(3,	0)	0	1/16/1991	381.369032	381.750472	16
427	5	(5,	0)	0	1/17/1991	382.187522	382.577065	17
428	2	(2,	0)	0	1/17/1991	382.600507	382.987254	17
429	1	(1,	0)	0	1/17/1991	383.391386	383.398521	17
430	4	(4,	0)	0	1/18/1991	383.420033	383.429017	18
432	3	(3,	0)	0	1/19/1991	384.240528	384.624765	19
433	2	(2,	0)	0	1/19/1991	384.651262	384.653633	19
434	2	(2,	0)	0	1/20/1991	385.058921	385.447069	20
435	2	(2,	0)	0	1/20/1991	385.472802	385.479700	20
436	2	(2,	0)	0	1/20/1991	385.879957	386.270428	20
437	5	(5,	0)	0	1/21/1991	386.292660	386.677866	21
438	2	(2,	0)	0	1/21/1991	386.701428	386.705600	21
439	5	(5,	0)	0	1/22/1991	387.109175	387.498437	22
442	2	(2,	0)	0	1/23/1991	388.342355	388.346930	23
443	2	(2,	0)	0	1/23/1991	388.749673	388.756523	23
444	3	(3,	0)	0	1/24/1991	389.161689	389.551397	24
445	4	(4,	0)	0	1/24/1991	389.572541	389.958647	24
447	2	(2,	0)	0	1/25/1991	390.394956	390.401167	25
448	3	(3,	0)	0	1/25/1991	390.800902	391.189379	25
449	4	(4,	0)	0	1/26/1991	391.213295	391.602199	26
451	1	(1,	0)	0	1/27/1991	392.034859	392.426843	27
452	3	(3,	0)	0	1/27/1991	392.447891	392.450711	27
454	3	(3,	0)	0	1/28/1991	393.265663	393.650182	28
455	2	(2,	0)	0	1/28/1991	393.676207	393.681256	28
456	1	(1,	0)	0	1/29/1991	394.088743	394.473833	29
457	7	(7,	0)	0	1/29/1991	394.496917	394.503601	29
458	1	(1,	0)	0	1/29/1991	395.291581	395.291581	29
459	1	(1,	0)	0	1/30/1991	395.318078	395.704614	30
460	2	(2,	0)	0	1/30/1991	395.724143	395.727628	30
461	9	(9,	0)	0	1/31/1991	396.132176	396.526199	31
462	5	(5,	0)	0	1/31/1991	396.545968	396.932433	31
463	1	(1,	0)	0	1/31/1991	396.954902	397.346768	31
464	6	(6,	0)	0	2/01/1991	397.366016	397.754895	32
465	1	(1,	0)	0	2/01/1991	397.773124	397.780140	32
466	4	(4,	0)	0	2/02/1991	398.184449	398.576271	33

Table 5a (cont.)

rbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Year
467	2	(2,	0)	0	2/02/1991	398.595374	398.598147	33
468	3	(3,	0)	0	2/02/1991	399.386032	399.393898	33
469	1	(1,	0)	0	2/03/1991	399.417886	399.426917	34
471	2	(2,	0)	0	2/04/1991	400.238762	400.620483	35
472	1	(1,	0)	0	2/04/1991	400.646724	400.649379	35
473	7	(7,	0)	0	2/05/1991	401.054828	401.447002	36
474	3	(3,	0)	0	2/05/1991	401.469400	401.472221	36
475	1	(1,	0)	0	2/05/1991	402.268538	402.268538	36
476	2	(2,	0)	0	2/06/1991	402.288189	402.669554	37
478	3	(3,	0)	0	2/07/1991	403.107811	403.493632	38
479	4	(4,	0)	0	2/07/1991	403.518567	403.526223	38
481	1	(1,	0)	0	2/08/1991	404.342025	404.344017	39
482	2	(2,	0)	0	2/08/1991	404.743844	404.749274	39
483	4	(4,	0)	0	2/09/1991	405.159487	405.545712	40
484	2	(2,	0)	0	2/09/1991	405.570291	405.792942	40
485	2	(2,	0)	0	2/09/1991	405.997219	406.365879	40
486	1	(1,	0)	0	2/10/1991	406.389675	406.775906	41
488	2	(2,	0)	0	2/11/1991	407.209866	407.213353	42
490	4	(4,	0)	0	2/12/1991	408.036176	408.418185	43
491	2	(2,	0)	0	2/12/1991	408.439824	408.827166	43
493	4	(4,	0)	0	2/13/1991	409.260324	409.648587	44
494	2	(2,	0)	0	2/13/1991	409.668547	409.697703	44
495	8	(8,	0)	0	2/14/1991	410.080158	410.469705	45
496	6	(6,	0)	0	2/14/1991	410.486318	410.494970	45
498	2	(2,	0)	0	2/15/1991	411.310894	411.312791	46
500	2	(2,	0)	0	2/16/1991	412.129922	412.516549	47
501	1	(1,	0)	0	2/16/1991	412.541227	412.546939	47
502	1	(1,	0)	0	2/16/1991	413.329679	413.335652	47
503	1	(1,	0)	0	2/17/1991	413.359164	413.740292	48
504	2	(2,	0)	0	2/17/1991	413.768191	414.152594	48
505	4	(4,	0)	0	2/18/1991	414.179069	414.562899	49
507	1	(1,	0)	0	2/18/1991	415.382614	415.385411	49
508	1	(1,	0)	0	2/19/1991	415.410608	415.794865	50
510	3	(3,	0)	0	2/20/1991	416.229588	416.617854	51
511	3	(3,	0)	0	2/20/1991	416.634446	416.647744	51
512	2	(2,	0)	0	2/21/1991	417.432542	417.438942	52
513	3	(3,	0)	0	2/21/1991	417.456885	417.845389	52
514	1	(1,	0)	0	2/21/1991	418.253465	418.258799	52
515	3	(3,	0)	0	2/22/1991	418.279611	418.286698	53
516	1	(1,	0)	0	2/22/1991	418.687832	418.687832	53
517	4	(4,	0)	0	2/23/1991	419.099607	419.489651	54
518	1	(1,	0)	0	2/23/1991	419.506408	419.896263	54
519	1	(1,	0)	0	2/23/1991	420.299839	420.303560	54
520	2	(2,	0)	0	2/24/1991	420.333779	420.334561	55
521	1	(1,	0)	0	2/24/1991	420.738750	420.779380	55
522	2	(2,	0)	0	2/25/1991	421.147946	421.536304	56
523	3	(3,	0)	0	2/25/1991	421.560978	421.563681	56
524	2	(2,	0)	0	2/25/1991	421.969438	422.354263	56
525	7	(7,	0)	0	2/26/1991	422.380547	422.766396	57
526	1	(1,	0)	0	2/26/1991	423.177394	423.177394	57
527	5	(5,	0)	0	2/27/1991	423.198128	423.585067	58
528	3	(3,	0)	0	2/27/1991	423.606472	423.995114	58
529	3	(3,	0)	0	2/28/1991	424.396295	424.404354	59
530	1	(1,	0)	0	2/28/1991	424.429529	424.812340	59
533	3	(3,	0)	0	3/01/1991	425.653505	425.662916	60
534	6	(6,	0)	0	3/02/1991	426.063552	426.458310	61
535	2	(2,	0)	0	3/02/1991	426.474073	426.483412	61
537	2	(2,	0)	0	3/03/1991	427.675580	427.685227	62
538	1	(1,	0)	0	3/03/1991	427.707602	427.711513	62
539	4	(4,	0)	0	3/04/1991	428.497355	428.504418	63
540	1	(1,	0)	0	3/04/1991	428.526343	428.912571	63
541	3	(3,	0)	0	3/04/1991	429.315625	429.321457	63
542	2	(2,	0)	0	3/05/1991	429.348973	429.732143	64
544	5	(5,	0)	0	3/06/1991	430.167691	430.555432	65
546	4	(4,	0)	0	3/06/1991	431.366281	431.371733	65
547	2	(2,	0)	0	3/07/1991	431.392307	431.780052	66
548	1	(1,	0)	0	3/07/1991	432.188577	432.188577	66
549	2	(2,	0)	0	3/08/1991	432.214225	432.601042	67
550	2	(2,	0)	0	3/08/1991	432.624578	433.010708	67
551	3	(3,	0)	0	3/09/1991	433.032563	433.422011	68
552	2	(2,	0)	0	3/09/1991	433.445547	433.450644	68
554	3	(3,	0)	0	3/10/1991	434.265948	434.276046	69
555	4	(4,	0)	0	3/10/1991	434.672274	434.677891	69
556	1	(1,	0)	0	3/11/1991	435.152956	435.469163	70
557	2	(2,	0)	0	3/11/1991	435.494641	435.497177	70
559	3	(3,	0)	0	3/12/1991	436.313595	436.698709	71
560	2	(2,	0)	0	3/12/1991	436.719873	437.110081	71
561	5	(5,	0)	0	3/13/1991	437.129825	437.517641	72
562	1	(1,	0)	0	3/13/1991	437.541906	437.926242	72
563	2	(2,	0)	0	3/13/1991	438.333491	438.336359	72
564	3	(3,	0)	0	3/14/1991	438.360199	438.747494	73
566	5	(5,	0)	0	3/15/1991	439.182899	439.568559	74
567	4	(4,	0)	0	3/15/1991	439.589229	439.975524	74

Table 5a (cont.)

Orbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Yea
568	7	(7,	0)	0	3/15/1991	439.999391	440.385998	74
569	5	(5,	0)	0	3/16/1991	440.412238	440.793484	75
570	1	(1,	0)	0	3/16/1991	441.199907	441.206781	75
571	5	(5,	0)	0	3/17/1991	441.227376	441.617965	76
572	5	(5,	0)	0	3/17/1991	441.639935	441.644652	76
573	1	(1,	0)	0	3/18/1991	442.049839	442.437111	77
574	7	(7,	0)	0	3/18/1991	442.455738	442.844024	77
575	4	(4,	0)	0	3/18/1991	443.249570	443.258459	77
576	1	(1,	0)	0	3/19/1991	443.277750	443.658692	78
577	1	(1,	0)	0	3/19/1991	443.690594	444.073077	78
578	3	(3,	0)	0	3/20/1991	444.097701	444.482531	79
579	3	(3,	0)	0	3/20/1991	444.506446	444.889782	79
580	6	(6,	0)	0	3/20/1991	444.914146	445.305921	79
581	3	(3,	0)	0	3/21/1991	445.327250	445.711720	80
583	4	(4,	0)	0	3/22/1991	446.146037	446.530720	81
584	1	(1,	0)	0	3/22/1991	446.550038	446.938684	81
585	3	(3,	0)	0	3/22/1991	447.348063	447.350054	81
586	38	(38,	0)	0	3/23/1991	447.374469	447.722839	82
587	222	(222,	0)	0	3/23/1991	447.839744	448.169107	82
588	87	(87,	0)	0	3/24/1991	448.195697	448.579762	83
589	12	(12,	0)	0	3/24/1991	448.604602	448.951071	83
590	8	(8,	0)	0	3/24/1991	449.013813	449.397908	83
591	4	(4,	0)	0	3/25/1991	449.425148	449.679015	84
592	5	(5,	0)	0	3/25/1991	450.103851	450.217819	84
593	6	(6,	0)	0	3/26/1991	450.242140	450.625114	85
594	1	(1,	0)	0	3/26/1991	450.668865	451.038264	85
595	1	(1,	0)	0	3/27/1991	451.324270	451.444302	86
596	3	(3,	0)	0	3/27/1991	451.471464	451.854089	86
597	3	(3,	0)	0	3/27/1991	451.969521	452.270339	86
598	4	(4,	0)	0	3/28/1991	452.290207	452.673917	87
600	7	(7,	0)	0	3/29/1991	453.106566	453.497015	88
601	7	(7,	0)	0	3/29/1991	453.517021	453.524013	88
602	3	(3,	0)	0	3/29/1991	453.927802	454.313056	88
603	3	(3,	0)	0	3/30/1991	454.338607	454.719078	89
604	2	(2,	0)	0	3/30/1991	454.745254	455.132652	89
605	5	(5,	0)	0	3/31/1991	455.158329	455.540452	90
606	1	(1,	0)	0	3/31/1991	455.564202	455.949624	90
607	2	(2,	0)	0	3/31/1991	455.972602	456.358870	90
608	1	(1,	0)	0	4/01/1991	456.385349	456.403056	91
610	4	(4,	0)	0	4/02/1991	457.201926	457.586803	92
612	2	(2,	0)	0	4/03/1991	458.401446	458.409387	93
613	3	(3,	0)	0	4/03/1991	458.433703	458.817276	93
615	4	(4,	0)	0	4/04/1991	459.250551	459.632820	94
617	3	(3,	0)	0	4/05/1991	460.069388	460.458555	95
618	4	(4,	0)	0	4/05/1991	460.479103	460.763310	95
619	5	(5,	0)	0	4/05/1991	461.270472	461.275498	95
620	6	(6,	0)	0	4/06/1991	461.297902	461.684976	96
622	7	(7,	0)	0	4/07/1991	462.114362	462.505749	97
623	3	(3,	0)	0	4/07/1991	462.523977	462.542963	97
624	3	(3,	0)	0	4/07/1991	463.304358	463.325999	97
625	4	(4,	0)	0	4/08/1991	463.346521	463.733650	98
627	2	(2,	0)	0	4/09/1991	464.166323	464.548590	99
628	3	(3,	0)	0	4/09/1991	464.571605	464.577862	99
629	7	(7,	0)	0	4/09/1991	464.988007	465.369963	99
630	5	(5,	0)	0	4/10/1991	465.390750	465.777998	100
632	4	(4,	0)	0	4/11/1991	466.214020	466.599253	101
633	2	(2,	0)	0	4/11/1991	466.619398	467.007401	101
634	5	(5,	0)	0	4/12/1991	467.412023	467.418684	102
635	5	(5,	0)	0	4/12/1991	467.440772	467.822592	102
636	2	(2,	0)	0	4/12/1991	467.849681	468.237735	102
637	4	(4,	0)	0	4/13/1991	468.263072	468.643729	103
638	1	(1,	0)	0	4/13/1991	468.668094	469.055128	103
639	4	(4,	0)	0	4/14/1991	469.078026	469.462880	104
640	7	(7,	0)	0	4/14/1991	469.485380	469.871317	104
641	2	(2,	0)	0	4/14/1991	469.896323	470.282924	104
642	6	(6,	0)	0	4/15/1991	470.308329	470.692306	105
643	2	(2,	0)	0	4/15/1991	471.091828	471.104842	105
644	5	(5,	0)	0	4/16/1991	471.124062	471.509550	106
646	3	(3,	0)	0	4/16/1991	471.945077	472.329452	106
647	1	(1,	0)	0	4/17/1991	472.356591	472.371311	107
648	1	(1,	0)	0	4/17/1991	472.780147	473.151631	107
649	4	(4,	0)	0	4/18/1991	473.175909	473.559672	108
650	1	(1,	0)	0	4/18/1991	473.581642	473.964978	108
651	4	(4,	0)	0	4/18/1991	473.996548	474.380762	108
652	3	(3,	0)	0	4/19/1991	474.403348	474.786281	109
653	2	(2,	0)	0	4/19/1991	474.807778	475.194859	109
654	4	(4,	0)	0	4/20/1991	475.218939	475.606495	110
656	4	(4,	0)	0	4/21/1991	476.036686	476.425380	111
657	4	(4,	0)	0	4/21/1991	476.446164	476.829405	111
658	2	(2,	0)	0	4/21/1991	476.855169	477.242488	111
659	4	(4,	0)	0	4/22/1991	477.266994	477.648410	112
660	2	(2,	0)	0	4/22/1991	477.678060	478.063625	112
661	2	(2,	0)	0	4/23/1991	478.084219	478.470400	113

Table 5a (cont.)

Orbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Year
662	3	(3,	0)	0	4/23/1991	478.493152	478.514367	113
663	1	(1,	0)	0	4/23/1991	479.288005	479.292793	113
664	5	(5,	0)	0	4/24/1991	479.314457	479.615067	114
665	1	(1,	0)	0	4/24/1991	479.738797	480.108148	114
666	4	(4,	0)	0	4/25/1991	480.130473	480.517412	115
667	3	(3,	0)	0	4/25/1991	480.538058	480.924710	115
668	4	(4,	0)	0	4/25/1991	480.952182	481.334119	115
669	4	(4,	0)	0	4/26/1991	481.361616	481.741984	116
670	3	(3,	0)	0	4/26/1991	481.774575	482.157789	116
671	5	(5,	0)	0	4/27/1991	482.180686	482.569261	117
672	3	(3,	0)	0	4/27/1991	482.587368	482.973643	117
673	8	(8,	0)	0	4/27/1991	482.994690	483.386489	117
674	6	(6,	0)	0	4/28/1991	483.410165	483.794900	118
675	5	(5,	0)	0	4/28/1991	483.822560	484.205494	118
676	7	(7,	0)	0	4/29/1991	484.228909	484.612716	119
677	1	(1,	0)	0	4/29/1991	484.638528	485.019755	119
678	2	(2,	0)	0	4/30/1991	485.044545	485.432551	120
679	3	(3,	0)	0	4/30/1991	485.456062	485.839801	120
680	6	(6,	0)	0	4/30/1991	486.038832	486.253087	120
681	5	(5,	0)	0	5/01/1991	486.272834	486.655124	121
682	1	(1,	0)	0	5/01/1991	487.060788	487.062613	121
683	3	(3,	0)	0	5/02/1991	487.090541	487.478262	122
684	2	(2,	0)	0	5/02/1991	487.500921	487.888074	122
685	3	(3,	0)	0	5/02/1991	487.911301	488.297814	122
686	6	(6,	0)	0	5/03/1991	488.321348	488.704356	123
687	1	(1,	0)	0	5/03/1991	488.727894	489.114048	123
688	5	(5,	0)	0	5/04/1991	489.138818	489.524000	124
689	4	(4,	0)	0	5/04/1991	489.542393	489.933433	124
690	3	(3,	0)	0	5/04/1991	490.320795	490.339900	124
691	2	(2,	0)	0	5/05/1991	490.367347	490.749759	125
692	2	(2,	0)	0	5/05/1991	491.137021	491.159943	125
693	2	(2,	0)	0	5/06/1991	491.187607	491.567502	126
694	7	(7,	0)	0	5/06/1991	491.593079	491.977506	126
695	1	(1,	0)	0	5/06/1991	492.004975	492.391653	126
696	8	(8,	0)	0	5/07/1991	492.412699	492.439650	127
697	5	(5,	0)	0	5/07/1991	492.820802	493.208500	127
698	4	(4,	0)	0	5/08/1991	493.231941	493.615817	128
699	1	(1,	0)	0	5/08/1991	493.640871	494.025084	128
700	7	(7,	0)	0	5/09/1991	494.050018	494.432051	129
701	4	(4,	0)	0	5/09/1991	494.456818	494.844539	129
702	1	(1,	0)	0	5/09/1991	494.867410	495.253780	129
703	4	(4,	0)	0	5/10/1991	495.279378	495.665531	130
704	2	(2,	0)	0	5/10/1991	495.687742	496.073303	130
705	4	(4,	0)	0	5/11/1991	496.093025	496.481786	131
706	6	(6,	0)	0	5/11/1991	496.505275	496.888541	131
707	5	(5,	0)	0	5/11/1991	496.919471	497.300528	131
708	7	(7,	0)	0	5/12/1991	497.322122	497.709390	132
709	5	(5,	0)	0	5/12/1991	497.732997	498.117869	132
710	3	(3,	0)	0	5/13/1991	498.145508	498.527161	133
711	5	(5,	0)	0	5/13/1991	498.550387	498.933961	133
712	1	(1,	0)	0	5/13/1991	498.957732	499.339314	133
713	7	(7,	0)	0	5/14/1991	499.367566	499.756307	134
714	4	(4,	0)	0	5/14/1991	499.776380	500.164789	134
715	3	(3,	0)	0	5/15/1991	500.191168	500.572651	135
716	2	(2,	0)	0	5/15/1991	500.601760	500.984405	135
717	5	(5,	0)	0	5/15/1991	501.021217	501.391110	135
718	4	(4,	0)	0	5/16/1991	501.415784	501.801301	136
719	1	(1,	0)	0	5/16/1991	501.825807	501.986969	136
721	5	(5,	0)	0	5/17/1991	502.642707	503.029860	137
722	6	(6,	0)	0	5/18/1991	503.055723	503.438869	138
723	6	(6,	0)	0	5/18/1991	503.462830	503.847419	138
724	4	(4,	0)	0	5/18/1991	503.870766	504.261874	138
725	8	(8,	0)	0	5/19/1991	504.280527	504.667230	139
726	4	(4,	0)	0	5/19/1991	504.698515	505.078624	139
727	5	(5,	0)	0	5/20/1991	505.096971	505.484782	140
728	4	(4,	0)	0	5/20/1991	505.512348	505.895845	140
729	7	(7,	0)	0	5/20/1991	505.915522	506.305538	140
730	9	(9,	0)	0	5/21/1991	506.326040	506.712150	141
731	4	(4,	0)	0	5/21/1991	507.107568	507.122146	141
732	6	(6,	0)	0	5/22/1991	507.144546	507.534041	142
733	4	(4,	0)	0	5/22/1991	507.555351	507.941362	142
734	2	(2,	0)	0	5/22/1991	507.964306	508.349227	142
735	3	(3,	0)	0	5/23/1991	508.373145	508.381773	143
736	3	(3,	0)	0	5/23/1991	508.786771	509.172379	143
737	3	(3,	0)	0	5/24/1991	509.194872	509.578588	144
738	3	(3,	0)	0	5/24/1991	509.600368	509.982591	144
739	7	(7,	0)	0	5/24/1991	510.008306	510.394036	144
740	7	(7,	0)	0	5/25/1991	510.420272	510.804356	145
741	4	(4,	0)	0	5/25/1991	510.825521	511.213524	145
742	2	(2,	0)	0	5/26/1991	511.237901	511.245154	146
743	2	(2,	0)	0	5/26/1991	512.018033	512.031449	146
744	6	(6,	0)	0	5/27/1991	512.056928	512.440241	147
745	3	(3,	0)	0	5/27/1991	512.466430	512.485132	147

Table 5a (cont.)

Orbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Yea
746	4	(4,	0)	0	5/27/1991	513.246703	513.262063	147
747	5	(5,	0)	0	5/28/1991	513.286755	513.671436	148
748	7	(7,	0)	0	5/28/1991	513.696014	514.082876	148
749	6	(6,	0)	0	5/29/1991	514.101007	514.488800	149
750	3	(3,	0)	0	5/29/1991	514.510395	514.896149	149
751	6	(6,	0)	0	5/29/1991	514.920778	515.306841	149
752	5	(5,	0)	0	5/30/1991	515.331159	515.716368	150
753	2	(2,	0)	0	5/30/1991	515.738743	516.126678	150
754	3	(3,	0)	0	5/31/1991	516.150568	516.535801	151
755	6	(6,	0)	0	5/31/1991	516.557699	516.944876	151
756	8	(8,	0)	0	5/31/1991	516.968671	517.352742	151
758	3	(3,	0)	0	6/01/1991	518.156026	518.172737	152
759	7	(7,	0)	0	6/02/1991	518.195778	518.581314	153
760	6	(6,	0)	0	6/02/1991	518.606962	518.988634	153
761	5	(5,	0)	0	6/03/1991	519.013830	519.398233	154
762	6	(6,	0)	0	6/03/1991	519.418499	519.806288	154
763	7	(7,	0)	0	6/03/1991	519.827859	520.216149	154
764	2	(2,	0)	0	6/04/1991	520.241722	520.630862	155
765	1	(1,	0)	0	6/04/1991	520.654897	521.046055	155
766	3	(3,	0)	0	6/05/1991	521.070539	521.463092	156
767	8	(8,	0)	0	6/05/1991	521.483834	521.872286	156
768	9	(9,	0)	0	6/05/1991	521.900541	522.288710	156
769	10	(10,	0)	0	6/06/1991	522.310445	522.707336	157
770	8	(8,	0)	0	6/06/1991	522.743812	523.102825	157
771	12	(12,	0)	0	6/07/1991	523.139712	523.536082	158
772	8	(8,	0)	0	6/07/1991	523.561299	523.955705	158
773	7	(7,	0)	0	6/07/1991	523.982065	524.377602	158
774	12	(12,	0)	0	6/08/1991	524.399337	524.792175	159
775	11	(11,	0)	0	6/08/1991	524.821328	525.215639	159
776	3	(3,	0)	0	6/09/1991	525.240531	525.635307	160
777	5	(5,	0)	0	6/09/1991	525.654765	526.054025	160
778	5	(5,	0)	0	6/10/1991	526.074487	526.475668	161
779	5	(5,	0)	0	6/10/1991	526.497141	526.894880	161
780	8	(8,	0)	0	6/10/1991	526.923158	527.317018	161
781	63	(63,	0)	0	6/11/1991	527.345343	527.740003	162
782	10	(10,	0)	0	6/11/1991	527.763776	528.165291	162
783	11	(11,	0)	0	6/12/1991	528.189202	528.586079	163
784	7	(7,	0)	0	6/12/1991	528.610729	529.009094	163
785	9	(9,	0)	0	6/13/1991	529.033107	529.437034	164
786	6	(6,	0)	0	6/13/1991	529.457372	529.725081	164
787	5	(5,	0)	0	6/13/1991	529.886596	530.272629	164
788	11	(11,	0)	0	6/14/1991	530.308159	530.710473	165
789	2	(2,	0)	0	6/14/1991	530.737163	531.137803	165
790	10	(10,	0)	0	6/15/1991	531.165307	531.562335	166
791	32	(32,	0)	0	6/15/1991	531.584760	531.987320	166
792	13	(13,	0)	0	6/15/1991	532.013370	532.415349	166
793	16	(16,	0)	0	6/16/1991	532.437038	532.841115	167
794	349	(5,	344)	0	6/16/1991	532.862042	532.951014	167
854	58	(26,	32)	0	7/12/1991	558.838560	558.918157	193
855	316	(4,	312)	0	7/12/1991	558.940202	558.963061	193

Total Upsets: 3803 (Soft: 3115, Hard: 688)

********** SUMMARY **********

Block: 03; Side: B; Part Number: 30283-1K; Device: 1 of 2; Board: 1; U-Number: 30
Addresses: 1024; Bits/Addr: 1; SEU File Processed: BLK_03_a.SEU; Output File Created: BLK_03_a.DV1

Total Upsets: 3803 (Soft: 3115, Hard: 688)

Breakdown Of The 3803 Total Upsets Into Total Upsets In Each Bit Position:

Total	(Bit 0)
3803	(3803)

Table 5b

Block: 03; Side: B; Device: 2 of 2; Part Number: 30283-1K; U-Number: 31
Board: 1; Addresses: 1024; Bits/Addr: 1; SEU File Processed: BLK_03_a.SEU; Output File Created: BLK_03_a.DV2

Orbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Year
116	4	(4,	0)	0	9/11/1990	254.879525	254.886067	254
117	10	(10,	0)	0	9/11/1990	254.905435	255.298818	254
118	11	(11,	0)	0	9/12/1990	255.321359	255.707588	255
119	6	(6,	0)	0	9/12/1990	255.732568	256.121828	255
120	4	(4,	0)	0	9/13/1990	256.526424	256.529790	256
122	4	(4,	0)	0	9/13/1990	257.346851	257.351355	256
123	8	(8,	0)	0	9/14/1990	257.377664	257.762846	257
124	8	(8,	0)	0	9/14/1990	257.786857	258.171446	257
125	16	(16,	0)	0	9/15/1990	258.196430	258.585310	258
126	6	(6,	0)	0	9/15/1990	258.610695	258.993771	258
127	7	(7,	0)	0	9/16/1990	259.018444	259.405735	259
128	2	(2,	0)	0	9/16/1990	259.431241	259.433042	259
129	12	(12,	0)	0	9/16/1990	259.838585	260.227491	259
130	11	(11,	0)	0	9/17/1990	260.250198	260.640453	260
131	7	(7,	0)	0	9/17/1990	260.663705	261.045960	260
132	22	(22,	0)	0	9/18/1990	261.068443	261.461095	261
133	1	(1,	0)	0	9/18/1990	261.482479	261.489139	261
134	3	(3,	0)	0	9/18/1990	262.272256	262.277850	261
135	6	(6,	0)	0	9/19/1990	262.304540	262.696955	262
137	5	(5,	0)	0	9/20/1990	263.508174	263.513958	263
138	10	(10,	0)	0	9/20/1990	263.915671	263.930198	263
139	9	(9,	0)	0	9/20/1990	263.941859	264.333184	263
140	9	(9,	0)	0	9/21/1990	264.358544	264.744179	264
141	8	(8,	0)	0	9/21/1990	265.148888	265.156118	264
142	20	(20,	0)	0	9/22/1990	265.178163	265.567209	265
143	7	(7,	0)	0	9/22/1990	265.590245	265.978539	265
144	11	(11,	0)	0	9/22/1990	265.998307	266.388922	265
145	9	(9,	0)	0	9/23/1990	266.411980	266.801317	266
146	7	(7,	0)	0	9/23/1990	266.817842	267.206728	266
147	14	(14,	0)	0	9/24/1990	267.233061	267.622338	267
148	2	(2,	0)	0	9/24/1990	268.025632	268.030515	267
149	14	(14,	0)	0	9/25/1990	268.051753	268.441130	268
150	8	(8,	0)	0	9/25/1990	268.466847	268.856204	268
151	15	(15,	0)	0	9/25/1990	268.875094	269.264024	268
152	14	(14,	0)	0	9/26/1990	269.287688	269.673087	269
153	6	(6,	0)	0	9/26/1990	269.697544	270.084578	269
154	8	(8,	0)	0	9/27/1990	270.105075	270.494894	270
155	9	(9,	0)	0	9/27/1990	270.517902	270.908701	270
156	13	(13,	0)	0	9/27/1990	270.925600	271.317849	270
157	5	(5,	0)	0	9/28/1990	271.342947	271.731351	271
158	5	(5,	0)	0	9/28/1990	271.747781	272.138437	271
159	11	(11,	0)	0	9/29/1990	272.162045	272.553128	272
160	12	(12,	0)	0	9/29/1990	272.575585	272.960709	272
161	11	(11,	0)	0	9/29/1990	272.983637	273.373434	272
162	6	(6,	0)	0	9/30/1990	273.397138	273.789763	273
163	4	(4,	0)	0	9/30/1990	273.807161	274.189237	273
164	6	(6,	0)	0	10/01/1990	274.218795	274.605904	274
165	11	(11,	0)	0	10/01/1990	274.628652	275.015781	274
166	17	(17,	0)	0	10/02/1990	275.034981	275.423452	275
167	3	(3,	0)	0	10/02/1990	275.448512	275.836247	275
168	11	(11,	0)	0	10/02/1990	275.860075	276.244122	275
169	10	(10,	0)	0	10/03/1990	276.269007	276.661347	276
170	5	(5,	0)	0	10/03/1990	276.682918	277.066844	276
171	23	(23,	0)	0	10/04/1990	277.089930	277.480626	277
172	9	(9,	0)	0	10/04/1990	277.501779	277.891607	277
173	11	(11,	0)	0	10/04/1990	277.915003	278.303954	277
174	6	(6,	0)	0	10/05/1990	278.325405	278.715046	278
175	6	(6,	0)	0	10/05/1990	278.732940	279.122388	278
176	4	(4,	0)	0	10/06/1990	279.144007	279.532284	279
177	1	(1,	0)	0	10/06/1990	279.560571	279.562705	279
178	5	(5,	0)	0	10/06/1990	280.347578	280.356325	279
179	4	(4,	0)	0	10/07/1990	280.376187	280.767616	280
180	8	(8,	0)	0	10/07/1990	280.793604	281.176395	280
181	9	(9,	0)	0	10/08/1990	281.201400	281.589569	281
182	11	(11,	0)	0	10/08/1990	281.609739	281.998017	281
183	11	(11,	0)	0	10/09/1990	282.016254	282.408503	282
184	9	(9,	0)	0	10/09/1990	282.433130	282.816424	282
185	2	(2,	0)	0	10/09/1990	282.851456	283.226928	282
186	11	(11,	0)	0	10/10/1990	283.252621	283.641485	283
187	4	(4,	0)	0	10/10/1990	283.665803	284.050135	283
188	11	(11,	0)	0	10/11/1990	284.072793	284.460819	284
189	11	(11,	0)	0	10/11/1990	284.485674	284.873876	284
190	15	(15,	0)	0	10/11/1990	284.887787	285.282909	284
191	8	(8,	0)	0	10/12/1990	285.306943	285.698383	285
192	5	(5,	0)	0	10/12/1990	285.717425	286.102923	285
193	21	(21,	0)	0	10/13/1990	286.125559	286.518540	286
195	11	(11,	0)	0	10/13/1990	287.327427	287.339560	286
196	8	(8,	0)	0	10/14/1990	287.363079	287.746808	287
197	9	(9,	0)	0	10/14/1990	287.772457	288.157231	287
198	12	(12,	0)	0	10/15/1990	288.182900	288.571633	288

Table 5b (cont.)

Orbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Ye.
199	5	(5,	0)	0	10/15/1990	288.592488	288.981703	288
200	15	(15,	0)	0	10/15/1990	288.998355	289.392544	288
201	7	(7,	0)	0	10/16/1990	289.416887	289.798861	289
202	7	(7,	0)	0	10/16/1990	289.822856	290.210673	289
203	14	(14,	0)	0	10/17/1990	290.235239	290.622608	290
204	9	(9,	0)	0	10/17/1990	290.643218	291.033331	290
205	6	(6,	0)	0	10/18/1990	291.054299	291.442091	291
206	9	(9,	0)	0	10/18/1990	291.469134	291.853964	291
207	12	(12,	0)	0	10/18/1990	291.873584	292.262762	291
208	12	(12,	0)	0	10/19/1990	292.287515	292.683217	292
209	4	(4,	0)	0	10/19/1990	292.700990	293.084640	292
210	7	(7,	0)	0	10/20/1990	293.109264	293.500418	293
211	17	(17,	0)	0	10/20/1990	293.522387	293.908022	293
212	12	(12,	0)	0	10/20/1990	293.930196	294.318898	293
213	14	(14,	0)	0	10/21/1990	294.344297	294.733059	294
214	11	(11,	0)	0	10/21/1990	294.748252	295.138957	294
215	11	(11,	0)	0	10/22/1990	295.163324	295.552157	295
216	9	(9,	0)	0	10/22/1990	295.577519	295.960950	295
217	11	(11,	0)	0	10/22/1990	295.982399	296.370002	295
218	12	(12,	0)	0	10/23/1990	296.396081	296.787516	296
220	14	(14,	0)	0	10/24/1990	297.214863	297.609527	297
221	6	(6,	0)	0	10/24/1990	297.629129	298.011822	297
222	17	(17,	0)	0	10/25/1990	298.036071	298.427985	298
223	7	(7,	0)	0	10/25/1990	298.453537	298.837726	298
224	10	(10,	0)	0	10/25/1990	298.860669	299.245495	298
225	15	(15,	0)	0	10/26/1990	299.269650	299.661227	299
226	8	(8,	0)	0	10/26/1990	299.682493	300.066335	299
227	12	(12,	0)	0	10/27/1990	300.090265	300.484526	300
228	17	(17,	0)	0	10/27/1990	300.505478	300.892323	300
229	10	(10,	0)	0	10/27/1990	300.912373	301.297725	300
230	9	(9,	0)	0	10/28/1990	301.325122	301.713744	301
231	8	(8,	0)	0	10/28/1990	301.734932	302.121930	301
232	10	(10,	0)	0	10/29/1990	302.146259	302.538860	302
233	4	(4,	0)	0	10/29/1990	302.554267	302.942151	302
234	6	(6,	0)	0	10/29/1990	302.964669	303.356346	302
235	14	(14,	0)	0	10/30/1990	303.375877	303.766108	303
236	5	(5,	0)	0	10/30/1990	303.785544	304.173313	303
237	10	(10,	0)	0	10/31/1990	304.197417	304.587861	304
238	13	(13,	0)	0	10/31/1990	304.610262	304.997506	304
239	9	(9,	0)	0	11/01/1990	305.018933	305.408077	305
240	19	(19,	0)	0	11/01/1990	305.427961	305.823150	305
241	7	(7,	0)	0	11/01/1990	305.836137	306.225351	305
242	6	(6,	0)	0	11/02/1990	306.251492	306.638384	306
243	12	(12,	0)	0	11/02/1990	306.662441	307.048882	306
244	10	(10,	0)	0	11/03/1990	307.072962	307.461297	307
245	10	(10,	0)	0	11/03/1990	307.487276	307.872840	307
246	9	(9,	0)	0	11/03/1990	307.891587	308.281039	307
247	6	(6,	0)	0	11/04/1990	308.305688	308.696183	308
248	10	(10,	0)	0	11/04/1990	308.712160	309.100697	308
251	12	(12,	0)	0	11/05/1990	309.945012	310.334191	309
252	5	(5,	0)	0	11/06/1990	310.362255	310.750684	310
253	6	(6,	0)	0	11/06/1990	310.765737	311.154738	310
254	9	(9,	0)	0	11/07/1990	311.177988	311.567649	311
255	5	(5,	0)	0	11/07/1990	311.590555	311.976057	311
256	2	(2,	0)	0	11/07/1990	312.001730	312.387031	311
257	14	(14,	0)	0	11/08/1990	312.412940	312.801389	312
258	7	(7,	0)	0	11/08/1990	312.819075	313.206958	312
259	10	(10,	0)	0	11/09/1990	313.233791	313.624682	313
260	9	(9,	0)	0	11/09/1990	313.645332	314.026934	313
261	7	(7,	0)	0	11/10/1990	314.050069	314.441461	314
262	10	(10,	0)	0	11/10/1990	314.467678	314.852148	314
263	4	(4,	0)	0	11/10/1990	314.871657	315.260939	314
264	8	(8,	0)	0	11/11/1990	315.284121	315.674850	315
265	8	(8,	0)	0	11/11/1990	315.693553	316.079682	315
266	7	(7,	0)	0	11/12/1990	316.106137	316.495276	316
267	4	(4,	0)	0	11/12/1990	316.520450	316.901795	316
268	10	(10,	0)	0	11/12/1990	316.927203	317.317860	316
269	13	(13,	0)	0	11/13/1990	317.340568	317.725489	317
270	14	(14,	0)	0	11/13/1990	317.748268	318.137641	317
271	10	(10,	0)	0	11/14/1990	318.161800	318.550679	318
272	4	(4,	0)	0	11/14/1990	318.572131	318.955654	318
273	8	(8,	0)	0	11/14/1990	318.977698	319.369422	318
274	17	(17,	0)	0	11/15/1990	319.388334	319.776957	319
275	4	(4,	0)	0	11/15/1990	319.801968	320.182238	319
276	7	(7,	0)	0	11/16/1990	320.213667	320.602902	320
277	2	(2,	0)	0	11/16/1990	320.625586	320.629141	320
278	1	(1,	0)	0	11/17/1990	321.032574	321.420628	321
279	4	(4,	0)	0	11/17/1990	321.447124	321.831335	321
280	6	(6,	0)	0	11/17/1990	321.853496	322.217870	321
281	12	(12,	0)	0	11/18/1990	322.263710	322.653206	322
282	8	(8,	0)	0	11/18/1990	322.677217	323.062879	322
286	7	(7,	0)	0	11/20/1990	324.697451	324.705652	324
287	17	(17,	0)	0	11/20/1990	324.724377	325.112360	324

Table 5b (cont.)

rbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Year
288	6	(6,	0)	0	11/21/1990	325.138194	325.530915	325
289	4	(4,	0)	0	11/21/1990	325.551630	325.933899	325
290	3	(3,	0)	0	11/21/1990	325.960942	326.349659	325
291	16	(16,	0)	0	11/22/1990	326.371891	326.761505	326
292	5	(5,	0)	0	11/22/1990	326.783573	326.790802	326
293	9	(9,	0)	0	11/23/1990	327.375521	327.585086	327
294	8	(8,	0)	0	11/23/1990	327.601794	327.988496	327
295	3	(3,	0)	0	11/24/1990	328.010964	328.401385	328
296	7	(7,	0)	0	11/24/1990	328.424141	328.811860	328
297	8	(8,	0)	0	11/24/1990	328.832196	329.220981	328
298	10	(10,	0)	0	11/25/1990	329.245016	329.633659	329
299	7	(7,	0)	0	11/25/1990	329.658404	330.043471	329
300	5	(5,	0)	0	11/26/1990	330.066129	330.458398	330
301	6	(6,	0)	0	11/26/1990	330.479494	330.866122	330
302	10	(10,	0)	0	11/26/1990	330.885273	331.277756	330
303	11	(11,	0)	0	11/27/1990	331.297951	331.684863	331
304	3	(3,	0)	0	11/27/1990	331.709158	331.718664	331
305	2	(2,	0)	0	11/28/1990	332.500740	332.508207	332
306	11	(11,	0)	0	11/28/1990	332.527782	332.915513	332
307	8	(8,	0)	0	11/28/1990	332.938421	333.325713	332
308	13	(13,	0)	0	11/29/1990	333.351715	333.738248	333
309	10	(10,	0)	0	11/29/1990	333.762638	334.148366	333
310	9	(9,	0)	0	11/30/1990	334.172614	334.561900	334
311	6	(6,	0)	0	11/30/1990	334.579675	334.588753	334
312	2	(2,	0)	0	11/30/1990	334.991536	335.381093	334
313	12	(12,	0)	0	12/01/1990	335.403491	335.794434	335
314	12	(12,	0)	0	12/01/1990	335.812923	336.200608	335
315	9	(9,	0)	0	12/02/1990	336.225885	336.617182	336
316	13	(13,	0)	0	12/02/1990	336.636892	336.643777	336
317	7	(7,	0)	0	12/03/1990	337.045315	337.433105	337
318	9	(9,	0)	0	12/03/1990	337.456370	337.841258	337
319	7	(7,	0)	0	12/03/1990	337.866831	338.251989	337
320	6	(6,	0)	0	12/04/1990	338.278229	338.666069	338
321	4	(4,	0)	0	12/04/1990	338.687992	339.072501	338
322	7	(7,	0)	0	12/05/1990	339.098751	339.487918	339
323	5	(5,	0)	0	12/05/1990	339.505991	339.892308	339
324	4	(4,	0)	0	12/05/1990	339.921203	340.302923	339
325	7	(7,	0)	0	12/06/1990	340.330677	340.717420	340
326	1	(1,	0)	0	12/06/1990	340.742073	341.123886	340
327	10	(10,	0)	0	12/07/1990	341.149485	341.542536	341
328	8	(8,	0)	0	12/07/1990	341.560788	341.568444	341
329	4	(4,	0)	0	12/07/1990	341.969603	342.355855	341
330	10	(10,	0)	0	12/08/1990	342.383750	342.773198	342
331	5	(5,	0)	0	12/08/1990	342.792635	342.797636	342
332	7	(7,	0)	0	12/09/1990	343.203465	343.595424	343
333	6	(6,	0)	0	12/09/1990	343.613772	343.628918	343
334	4	(4,	0)	0	12/10/1990	344.022823	344.411797	344
335	10	(10,	0)	0	12/10/1990	344.437538	344.823028	344
336	6	(6,	0)	0	12/10/1990	344.845926	345.231035	344
337	9	(9,	0)	0	12/11/1990	345.257796	345.646368	345
338	7	(7,	0)	0	12/11/1990	345.663694	346.050254	345
339	3	(3,	0)	0	12/12/1990	346.076467	346.465371	346
340	7	(7,	0)	0	12/12/1990	346.486371	346.877764	346
341	4	(4,	0)	0	12/12/1990	346.893717	347.283735	346
342	14	(14,	0)	0	12/13/1990	347.306276	347.692928	347
343	10	(10,	0)	0	12/13/1990	347.717318	348.103759	347
344	6	(6,	0)	0	12/14/1990	348.128930	348.519422	348
345	9	(9,	0)	0	12/14/1990	348.540803	348.925179	348
346	2	(2,	0)	0	12/14/1990	348.948882	349.336837	348
347	10	(10,	0)	0	12/15/1990	349.360921	349.750091	349
348	8	(8,	0)	0	12/15/1990	349.766771	349.773479	349
349	12	(12,	0)	0	12/16/1990	350.183314	350.572075	350
350	7	(7,	0)	0	12/16/1990	350.591701	350.974611	350
351	2	(2,	0)	0	12/16/1990	350.999567	351.389540	350
352	7	(7,	0)	0	12/17/1990	351.410087	351.796146	351
353	5	(5,	0)	0	12/17/1990	351.815535	351.826083	351
354	9	(9,	0)	0	12/18/1990	352.232884	352.622425	352
355	4	(4,	0)	0	12/18/1990	352.644375	352.653051	352
356	3	(3,	0)	0	12/19/1990	353.052593	353.438256	353
357	7	(7,	0)	0	12/19/1990	353.466222	353.848255	353
358	4	(4,	0)	0	12/19/1990	353.875344	354.263940	353
359	8	(8,	0)	0	12/20/1990	354.665598	354.670623	354
360	4	(4,	0)	0	12/20/1990	354.692356	354.700415	354
361	6	(6,	0)	0	12/21/1990	355.106621	355.497444	355
362	4	(4,	0)	0	12/21/1990	355.518184	355.901802	355
363	5	(5,	0)	0	12/21/1990	355.927426	356.315974	355
364	11	(11,	0)	0	12/22/1990	356.337709	356.726139	356
365	12	(12,	0)	0	12/22/1990	356.747779	357.136733	356
366	9	(9,	0)	0	12/23/1990	357.157139	357.546947	357
367	5	(5,	0)	0	12/23/1990	357.571478	357.957727	357
368	3	(3,	0)	0	12/23/1990	357.977519	358.365102	357
369	8	(8,	0)	0	12/24/1990	358.389581	358.774671	358
370	5	(5,	0)	0	12/24/1990	358.799344	359.081205	358

Table 5b (cont.)

Orbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Ye.
371	9	(9,	0)	0	12/25/1990	359.213255	359.599669	359
372	9	(9,	0)	0	12/25/1990	359.617943	359.861783	359
373	2	(2,	0)	0	12/26/1990	360.026495	360.420233	360
374	1	(1,	0)	0	12/26/1990	360.444054	360.450027	360
376	6	(6,	0)	0	12/27/1990	361.263727	361.648862	361
377	5	(5,	0)	0	12/27/1990	361.669388	361.678775	361
378	1	(1,	0)	0	12/28/1990	362.466438	362.474094	362
379	4	(4,	0)	0	12/28/1990	362.496498	362.506928	362
380	1	(1,	0)	0	12/28/1990	362.900714	362.900714	362
381	6	(6,	0)	0	12/29/1990	363.314695	363.704144	363
382	3	(3,	0)	0	12/29/1990	363.723202	363.727421	363
383	1	(1,	0)	0	12/30/1990	364.135927	364.524592	364
384	9	(9,	0)	0	12/30/1990	364.544052	364.933666	364
386	5	(5,	0)	0	12/31/1990	365.365568	365.750417	365
387	4	(4,	0)	0	12/31/1990	365.775733	365.860189	365
388	7	(7,	0)	0	1/01/1991	366.189133	366.574637	1
389	7	(7,	0)	0	1/01/1991	366.598279	366.602119	1
390	4	(4,	0)	0	1/01/1991	367.006784	367.394029	1
391	4	(4,	0)	0	1/02/1991	367.420863	367.806997	2
392	2	(2,	0)	0	1/02/1991	367.827995	368.214548	2
393	5	(5,	0)	0	1/03/1991	368.240219	368.623885	3
394	6	(6,	0)	0	1/03/1991	368.646427	369.032466	3
395	3	(3,	0)	0	1/04/1991	369.439907	369.445663	4
396	7	(7,	0)	0	1/04/1991	369.467446	369.854907	4
397	5	(5,	0)	0	1/04/1991	369.877259	370.269172	4
398	6	(6,	0)	0	1/05/1991	370.287398	370.677205	5
399	5	(5,	0)	0	1/05/1991	370.696901	370.705837	5
400	10	(10,	0)	0	1/06/1991	371.107754	371.502800	6
401	9	(9,	0)	0	1/06/1991	371.520483	371.716987	6
402	3	(3,	0)	0	1/06/1991	371.927826	372.321592	6
403	9	(9,	0)	0	1/07/1991	372.339867	372.727266	7
404	6	(6,	0)	0	1/07/1991	372.752805	372.757404	7
405	10	(10,	0)	0	1/08/1991	373.164230	373.553583	8
406	2	(2,	0)	0	1/08/1991	373.572640	373.957280	8
407	1	(1,	0)	0	1/08/1991	374.359316	374.370291	8
408	9	(9,	0)	0	1/09/1991	374.394252	374.778476	9
409	3	(3,	0)	0	1/09/1991	374.799582	374.806859	9
410	5	(5,	0)	0	1/10/1991	375.212522	375.596685	10
411	5	(5,	0)	0	1/10/1991	375.622617	375.627547	10
412	6	(6,	0)	0	1/11/1991	376.416047	376.423348	11
413	4	(4,	0)	0	1/11/1991	376.446764	376.831226	11
414	2	(2,	0)	0	1/11/1991	376.854062	376.857286	11
415	7	(7,	0)	0	1/12/1991	377.262427	377.653230	12
416	3	(3,	0)	0	1/12/1991	377.671834	377.681932	12
417	9	(9,	0)	0	1/13/1991	378.090510	378.473535	13
418	6	(6,	0)	0	1/13/1991	378.499207	378.503402	13
420	10	(10,	0)	0	1/14/1991	379.320179	379.704932	14
421	8	(8,	0)	0	1/14/1991	379.723895	379.729489	14
422	11	(11,	0)	0	1/15/1991	380.136712	380.524808	15
423	5	(5,	0)	0	1/15/1991	380.548061	380.935207	15
424	1	(1,	0)	0	1/15/1991	380.952559	381.341247	15
425	7	(7,	0)	0	1/16/1991	381.369032	381.750472	16
426	4	(4,	0)	0	1/16/1991	381.775978	381.782899	16
427	13	(13,	0)	0	1/17/1991	382.187522	382.577065	17
428	2	(2,	0)	0	1/17/1991	382.600507	382.987254	17
429	3	(3,	0)	0	1/17/1991	383.391386	383.398521	17
430	3	(3,	0)	0	1/18/1991	383.420033	383.429017	18
431	1	(1,	0)	0	1/18/1991	384.215951	384.215951	18
432	4	(4,	0)	0	1/19/1991	384.240528	384.624765	19
433	3	(3,	0)	0	1/19/1991	384.651262	384.653633	19
434	2	(2,	0)	0	1/20/1991	385.058921	385.447069	20
435	3	(3,	0)	0	1/20/1991	385.472802	385.479700	20
436	5	(5,	0)	0	1/20/1991	385.879957	386.270428	20
437	5	(5,	0)	0	1/21/1991	386.292660	386.677866	21
438	3	(3,	0)	0	1/21/1991	386.701428	386.705600	21
439	6	(6,	0)	0	1/22/1991	387.109175	387.498437	22
442	2	(2,	0)	0	1/23/1991	388.342355	388.346930	23
443	3	(3,	0)	0	1/23/1991	388.749673	388.756523	23
444	7	(7,	0)	0	1/24/1991	389.161689	389.551397	24
445	5	(5,	0)	0	1/24/1991	389.572541	389.958647	24
447	2	(2,	0)	0	1/25/1991	390.394956	390.401167	25
448	5	(5,	0)	0	1/25/1991	390.800902	391.189379	25
449	10	(10,	0)	0	1/26/1991	391.213295	391.602199	26
450	3	(3,	0)	0	1/26/1991	391.623272	391.626258	26
451	6	(6,	0)	0	1/27/1991	392.034859	392.426843	27
452	3	(3,	0)	0	1/27/1991	392.447891	392.450711	27
453	1	(1,	0)	0	1/27/1991	393.241959	393.241959	27
454	5	(5,	0)	0	1/28/1991	393.265663	393.650182	28
455	7	(7,	0)	0	1/28/1991	393.676207	393.681256	28
456	7	(7,	0)	0	1/29/1991	394.088743	394.473833	29
457	4	(4,	0)	0	1/29/1991	394.496917	394.503601	29
459	6	(6,	0)	0	1/30/1991	395.318078	395.704614	30
460	3	(3,	0)	0	1/30/1991	395.724143	395.727628	30

Table 5b (cont.)

Orbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Year
461	8	(8,	0)	0	1/31/1991	396.132176	396.526199	31
462	8	(8,	0)	0	1/31/1991	396.545968	396.932433	31
463	2	(2,	0)	0	1/31/1991	396.954902	397.346768	31
464	7	(7,	0)	0	2/01/1991	397.366016	397.754895	32
465	5	(5,	0)	0	2/01/1991	397.773124	397.780140	32
466	9	(9,	0)	0	2/02/1991	398.184449	398.576271	33
467	2	(2,	0)	0	2/02/1991	398.595374	398.598147	33
468	4	(4,	0)	0	2/02/1991	399.386032	399.393898	33
469	4	(4,	0)	0	2/03/1991	399.417886	399.426917	34
470	2	(2,	0)	0	2/03/1991	399.830398	400.214516	34
471	3	(3,	0)	0	2/04/1991	400.238762	400.620483	35
472	1	(1,	0)	0	2/04/1991	400.646724	400.649379	35
473	5	(5,	0)	0	2/05/1991	401.054828	401.447002	36
474	3	(3,	0)	0	2/05/1991	401.469400	401.472221	36
476	6	(6,	0)	0	2/06/1991	402.288189	402.669554	37
478	4	(4,	0)	0	2/07/1991	403.107811	403.493632	38
479	5	(5,	0)	0	2/07/1991	403.518567	403.526223	38
481	1	(1,	0)	0	2/08/1991	404.342025	404.344017	39
482	1	(1,	0)	0	2/08/1991	404.743844	404.749274	39
483	9	(9,	0)	0	2/09/1991	405.159487	405.545712	40
484	2	(2,	0)	0	2/09/1991	405.570291	405.792942	40
485	3	(3,	0)	0	2/09/1991	405.997219	406.365879	40
486	8	(8,	0)	0	2/10/1991	406.389675	406.775906	41
487	1	(1,	0)	0	2/10/1991	406.798304	406.798304	41
488	2	(2,	0)	0	2/11/1991	407.209866	407.213353	42
490	7	(7,	0)	0	2/12/1991	408.036176	408.418185	43
491	10	(10,	0)	0	2/12/1991	408.439824	408.827166	43
492	3	(3,	0)	0	2/12/1991	408.846057	408.847100	43
493	9	(9,	0)	0	2/13/1991	409.260324	409.648587	44
494	4	(4,	0)	0	2/13/1991	409.668547	409.697703	44
495	7	(7,	0)	0	2/14/1991	410.080158	410.469705	45
496	4	(4,	0)	0	2/14/1991	410.486318	410.494970	45
498	3	(3,	0)	0	2/15/1991	411.310894	411.312791	46
500	9	(9,	0)	0	2/16/1991	412.129922	412.516549	47
501	5	(5,	0)	0	2/16/1991	412.541227	412.546939	47
502	4	(4,	0)	0	2/16/1991	413.329679	413.335652	47
503	5	(5,	0)	0	2/17/1991	413.359164	413.740292	48
504	1	(1,	0)	0	2/17/1991	413.768191	414.152594	48
505	7	(7,	0)	0	2/18/1991	414.179069	414.562899	49
506	4	(4,	0)	0	2/18/1991	414.586981	414.592551	49
507	2	(2,	0)	0	2/18/1991	415.382614	415.385411	49
508	4	(4,	0)	0	2/19/1991	415.410608	415.794865	50
509	2	(2,	0)	0	2/19/1991	416.204036	416.204889	50
510	8	(8,	0)	0	2/20/1991	416.229588	416.617854	51
511	2	(2,	0)	0	2/20/1991	416.634446	416.647744	51
512	2	(2,	0)	0	2/21/1991	417.432542	417.438942	52
513	7	(7,	0)	0	2/21/1991	417.456885	417.845389	52
514	2	(2,	0)	0	2/21/1991	418.253465	418.258799	52
515	2	(2,	0)	0	2/22/1991	418.279611	418.286698	53
517	8	(8,	0)	0	2/23/1991	419.099607	419.489651	54
518	2	(2,	0)	0	2/23/1991	419.506408	419.896263	54
519	1	(1,	0)	0	2/23/1991	420.299839	420.303560	54
521	1	(1,	0)	0	2/24/1991	420.738750	420.779380	55
522	6	(6,	0)	0	2/25/1991	421.147946	421.536304	56
523	2	(2,	0)	0	2/25/1991	421.560978	421.563681	56
524	3	(3,	0)	0	2/25/1991	421.969438	422.354263	56
525	5	(5,	0)	0	2/26/1991	422.380547	422.766396	57
527	6	(6,	0)	0	2/27/1991	423.198128	423.585067	58
528	6	(6,	0)	0	2/27/1991	423.606472	423.995114	58
529	6	(6,	0)	0	2/28/1991	424.396295	424.404354	59
530	8	(8,	0)	0	2/28/1991	424.429529	424.812340	59
532	3	(3,	0)	0	3/01/1991	425.251993	425.633524	60
534	9	(9,	0)	0	3/02/1991	426.063552	426.458310	61
535	4	(4,	0)	0	3/02/1991	426.474073	426.483412	61
537	4	(4,	0)	0	3/03/1991	427.675580	427.685227	62
538	3	(3,	0)	0	3/03/1991	427.707602	427.711513	62
539	5	(5,	0)	0	3/04/1991	428.497355	428.504418	63
540	6	(6,	0)	0	3/04/1991	428.526343	428.912571	63
541	4	(4,	0)	0	3/04/1991	429.315625	429.321457	63
542	3	(3,	0)	0	3/05/1991	429.348973	429.732143	64
543	1	(1,	0)	0	3/05/1991	430.143206	430.143206	64
544	7	(7,	0)	0	3/06/1991	430.167691	430.555432	65
545	6	(6,	0)	0	3/06/1991	430.575818	430.961876	65
546	3	(3,	0)	0	3/06/1991	431.366281	431.371733	65
547	5	(5,	0)	0	3/07/1991	431.392307	431.780052	66
549	3	(3,	0)	0	3/08/1991	432.214225	432.601042	67
550	3	(3,	0)	0	3/08/1991	432.624578	433.010708	67
551	6	(6,	0)	0	3/09/1991	433.032563	433.422011	68
552	3	(3,	0)	0	3/09/1991	433.445547	433.450644	68
553	1	(1,	0)	0	3/09/1991	434.240255	434.240255	68
554	1	(1,	0)	0	3/10/1991	434.265948	434.276046	69
555	1	(1,	0)	0	3/10/1991	434.672274	434.677891	69
556	7	(7,	0)	0	3/11/1991	435.152956	435.469163	70

Table 5b (cont.)

Orbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Yea
558	3	(3,	0)	0	3/11/1991	435.900611	436.289442	70
559	7	(7,	0)	0	3/12/1991	436.313595	436.698709	71
560	3	(3,	0)	0	3/12/1991	436.719873	437.110081	71
561	5	(5,	0)	0	3/13/1991	437.129825	437.517641	72
562	3	(3,	0)	0	3/13/1991	437.541906	437.926242	72
563	1	(1,	0)	0	3/13/1991	438.333491	438.336359	72
564	9	(9,	0)	0	3/14/1991	438.360199	438.747494	73
565	1	(1,	0)	0	3/14/1991	439.156545	439.156545	73
566	5	(5,	0)	0	3/15/1991	439.182899	439.568559	74
567	7	(7,	0)	0	3/15/1991	439.589229	439.975524	74
568	6	(6,	0)	0	3/15/1991	439.999391	440.385998	74
569	1	(1,	0)	0	3/16/1991	440.412238	440.793484	75
570	3	(3,	0)	0	3/16/1991	441.199907	441.206781	75
571	1	(1,	0)	0	3/17/1991	441.227376	441.617965	76
572	1	(1,	0)	0	3/17/1991	441.639935	441.644652	76
573	5	(5,	0)	0	3/18/1991	442.049839	442.437111	77
574	4	(4,	0)	0	3/18/1991	442.455738	442.844024	77
575	1	(1,	0)	0	3/18/1991	443.249570	443.258459	77
576	4	(4,	0)	0	3/19/1991	443.277750	443.658692	78
577	3	(3,	0)	0	3/19/1991	443.690594	444.073077	78
578	5	(5,	0)	0	3/20/1991	444.097701	444.482531	79
579	4	(4,	0)	0	3/20/1991	444.506446	444.889782	79
580	2	(2,	0)	0	3/20/1991	444.914146	445.305921	79
581	6	(6,	0)	0	3/21/1991	445.327250	445.711720	80
582	3	(3,	0)	0	3/21/1991	445.731298	445.735399	80
583	6	(6,	0)	0	3/22/1991	446.146037	446.530720	81
584	5	(5,	0)	0	3/22/1991	446.550038	446.938684	81
585	1	(1,	0)	0	3/22/1991	447.348063	447.350054	81
586	42	(42,	0)	0	3/23/1991	447.374469	447.722839	82
587	209	(209,	0)	0	3/23/1991	447.839744	448.169107	82
588	110	(110,	0)	0	3/24/1991	448.195697	448.579762	83
589	8	(8,	0)	0	3/24/1991	448.604602	448.951071	83
590	9	(9,	0)	0	3/24/1991	449.013813	449.397908	83
591	4	(4,	0)	0	3/25/1991	449.425148	449.679015	84
592	1	(1,	0)	0	3/25/1991	450.103851	450.217819	84
593	9	(9,	0)	0	3/26/1991	450.242140	450.625114	85
594	1	(1,	0)	0	3/26/1991	450.668865	451.038264	85
595	3	(3,	0)	0	3/27/1991	451.324270	451.444302	86
596	5	(5,	0)	0	3/27/1991	451.471464	451.854089	86
597	6	(6,	0)	0	3/27/1991	451.969521	452.270339	86
598	8	(8,	0)	0	3/28/1991	452.290207	452.673917	87
599	3	(3,	0)	0	3/28/1991	452.699705	453.083344	87
600	11	(11,	0)	0	3/29/1991	453.106566	453.497015	88
601	3	(3,	0)	0	3/29/1991	453.517021	453.524013	88
602	4	(4,	0)	0	3/29/1991	453.927802	454.313056	88
603	3	(3,	0)	0	3/30/1991	454.338607	454.719078	89
604	1	(1,	0)	0	3/30/1991	454.745254	455.132652	89
605	2	(2,	0)	0	3/31/1991	455.158329	455.540452	90
606	3	(3,	0)	0	3/31/1991	455.564202	455.949624	90
607	4	(4,	0)	0	3/31/1991	455.972602	456.358870	90
608	5	(5,	0)	0	4/01/1991	456.385349	456.403056	91
609	2	(2,	0)	0	4/01/1991	457.177870	457.182895	91
610	5	(5,	0)	0	4/02/1991	457.201926	457.586803	92
611	5	(5,	0)	0	4/02/1991	457.613183	458.000027	92
612	9	(9,	0)	0	4/03/1991	458.401446	458.409387	93
613	4	(4,	0)	0	4/03/1991	458.433703	458.817276	93
614	2	(2,	0)	0	4/03/1991	459.212248	459.227916	93
615	3	(3,	0)	0	4/04/1991	459.250551	459.632820	94
617	6	(6,	0)	0	4/05/1991	460.069388	460.458555	95
618	9	(9,	0)	0	4/05/1991	460.479103	460.763310	95
619	4	(4,	0)	0	4/05/1991	461.270472	461.275498	95
620	8	(8,	0)	0	4/06/1991	461.297902	461.684976	96
622	4	(4,	0)	0	4/07/1991	462.114362	462.505749	97
623	4	(4,	0)	0	4/07/1991	462.523977	462.542963	97
624	2	(2,	0)	0	4/07/1991	463.304358	463.325999	97
625	4	(4,	0)	0	4/08/1991	463.346521	463.733650	98
626	2	(2,	0)	0	4/08/1991	464.140323	464.142054	98
627	4	(4,	0)	0	4/09/1991	464.166323	464.548590	99
628	1	(1,	0)	0	4/09/1991	464.571605	464.577862	99
629	2	(2,	0)	0	4/09/1991	464.988007	465.369963	99
630	4	(4,	0)	0	4/10/1991	465.390750	465.777998	100
632	10	(10,	0)	0	4/11/1991	466.214020	466.599253	101
633	6	(6,	0)	0	4/11/1991	466.619398	467.007401	101
634	1	(1,	0)	0	4/12/1991	467.412023	467.418684	102
635	4	(4,	0)	0	4/12/1991	467.440772	467.822592	102
636	2	(2,	0)	0	4/12/1991	467.849681	468.237735	102
637	7	(7,	0)	0	4/13/1991	468.263072	468.643729	103
638	3	(3,	0)	0	4/13/1991	468.668094	469.055128	103
639	6	(6,	0)	0	4/14/1991	469.078026	469.462880	104
640	5	(5,	0)	0	4/14/1991	469.485380	469.871317	104
641	4	(4,	0)	0	4/14/1991	469.896323	470.282924	104
642	10	(10,	0)	0	4/15/1991	470.308329	470.692306	105
643	4	(4,	0)	0	4/15/1991	471.091828	471.104842	105

Table 5b (cont.)

rbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Year
644	4	(4,	0)	0	4/16/1991	471.124062	471.509550	106
645	9	(9,	0)	0	4/16/1991	471.533704	471.919477	106
646	6	(6,	0)	0	4/16/1991	471.945077	472.329452	106
647	3	(3,	0)	0	4/17/1991	472.356591	472.371311	107
648	1	(1,	0)	0	4/17/1991	472.780147	473.151631	107
649	7	(7,	0)	0	4/18/1991	473.175909	473.559672	108
650	3	(3,	0)	0	4/18/1991	473.581642	473.964978	108
651	7	(7,	0)	0	4/18/1991	473.996548	474.380762	108
652	6	(6,	0)	0	4/19/1991	474.403348	474.786281	109
653	5	(5,	0)	0	4/19/1991	474.807778	475.194859	109
654	10	(10,	0)	0	4/20/1991	475.218939	475.606495	110
655	5	(5,	0)	0	4/20/1991	475.628512	476.013578	110
656	7	(7,	0)	0	4/21/1991	476.036686	476.425380	111
657	4	(4,	0)	0	4/21/1991	476.446164	476.829405	111
658	5	(5,	0)	0	4/21/1991	476.855169	477.242488	111
659	3	(3,	0)	0	4/22/1991	477.266994	477.648410	112
660	2	(2,	0)	0	4/22/1991	477.678060	478.063625	112
661	16	(16,	0)	0	4/23/1991	478.084219	478.470400	113
662	3	(3,	0)	0	4/23/1991	478.493152	478.514367	113
663	7	(7,	0)	0	4/23/1991	479.288005	479.292793	113
664	3	(3,	0)	0	4/24/1991	479.314457	479.615067	114
665	2	(2,	0)	0	4/24/1991	479.738797	480.108148	114
666	10	(10,	0)	0	4/25/1991	480.130473	480.517412	115
667	8	(8,	0)	0	4/25/1991	480.538058	480.924710	115
668	3	(3,	0)	0	4/25/1991	480.952182	481.334119	115
669	6	(6,	0)	0	4/26/1991	481.361616	481.741984	116
670	6	(6,	0)	0	4/26/1991	481.774575	482.157789	116
671	7	(7,	0)	0	4/27/1991	482.180686	482.569261	117
672	6	(6,	0)	0	4/27/1991	482.587368	482.973643	117
673	7	(7,	0)	0	4/27/1991	482.994690	483.386489	117
674	11	(11,	0)	0	4/28/1991	483.410165	483.794900	118
675	5	(5,	0)	0	4/28/1991	483.822560	484.205494	118
676	8	(8,	0)	0	4/29/1991	484.228909	484.612716	119
677	7	(7,	0)	0	4/29/1991	484.638528	485.019755	119
678	7	(7,	0)	0	4/30/1991	485.044545	485.432551	120
679	4	(4,	0)	0	4/30/1991	485.456062	485.839801	120
680	2	(2,	0)	0	4/30/1991	486.038832	486.253087	120
681	7	(7,	0)	0	5/01/1991	486.272834	486.655124	121
682	1	(1,	0)	0	5/01/1991	487.060788	487.062613	121
683	10	(10,	0)	0	5/02/1991	487.090541	487.478262	122
684	5	(5,	0)	0	5/02/1991	487.500921	487.888074	122
685	7	(7,	0)	0	5/02/1991	487.911301	488.297814	122
686	6	(6,	0)	0	5/03/1991	488.321348	488.704356	123
687	4	(4,	0)	0	5/03/1991	488.727894	489.114048	123
688	5	(5,	0)	0	5/04/1991	489.138818	489.524000	124
689	6	(6,	0)	0	5/04/1991	489.542393	489.933433	124
690	2	(2,	0)	0	5/04/1991	490.320795	490.339900	124
691	7	(7,	0)	0	5/05/1991	490.367347	490.749759	125
692	4	(4,	0)	0	5/05/1991	491.137021	491.159943	125
693	6	(6,	0)	0	5/06/1991	491.187607	491.567502	126
694	6	(6,	0)	0	5/06/1991	491.593079	491.977506	126
695	9	(9,	0)	0	5/06/1991	492.004975	492.391653	126
696	2	(2,	0)	0	5/07/1991	492.412699	492.439650	127
697	6	(6,	0)	0	5/07/1991	492.820802	493.208500	127
698	8	(8,	0)	0	5/08/1991	493.231941	493.615817	128
699	2	(2,	0)	0	5/08/1991	493.640871	494.025084	128
700	11	(11,	0)	0	5/09/1991	494.050018	494.432051	129
701	14	(14,	0)	0	5/09/1991	494.456818	494.844539	129
702	6	(6,	0)	0	5/09/1991	494.867410	495.253780	129
703	3	(3,	0)	0	5/10/1991	495.279378	495.665531	130
704	4	(4,	0)	0	5/10/1991	495.687742	496.073303	130
705	7	(7,	0)	0	5/11/1991	496.093025	496.481786	131
706	2	(2,	0)	0	5/11/1991	496.505275	496.888541	131
707	4	(4,	0)	0	5/11/1991	496.919471	497.300528	131
708	6	(6,	0)	0	5/12/1991	497.322122	497.709390	132
709	1	(1,	0)	0	5/12/1991	497.732997	498.117869	132
710	14	(14,	0)	0	5/13/1991	498.145508	498.527161	133
711	8	(8,	0)	0	5/13/1991	498.550387	498.933961	133
712	7	(7,	0)	0	5/13/1991	498.957732	499.339314	133
713	9	(9,	0)	0	5/14/1991	499.367566	499.756307	134
714	4	(4,	0)	0	5/14/1991	499.776380	500.164789	134
715	6	(6,	0)	0	5/15/1991	500.191168	500.572651	135
716	8	(8,	0)	0	5/15/1991	500.601760	500.984405	135
717	6	(6,	0)	0	5/15/1991	501.021217	501.391110	135
718	9	(9,	0)	0	5/16/1991	501.415784	501.801301	136
719	2	(2,	0)	0	5/16/1991	501.825807	501.986969	136
720	3	(3,	0)	0	5/17/1991	502.616527	502.619964	137
721	6	(6,	0)	0	5/17/1991	502.642707	503.029860	137
722	10	(10,	0)	0	5/18/1991	503.055723	503.438869	138
723	5	(5,	0)	0	5/18/1991	503.462830	503.847419	138
724	3	(3,	0)	0	5/18/1991	503.870766	504.261874	138
725	6	(6,	0)	0	5/19/1991	504.280527	504.667230	139
726	7	(7,	0)	0	5/19/1991	504.698515	505.078624	139

Table 5b (cont.)

Orbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Ye
727	8	(8,	0)	0	5/20/1991	505.096971	505.484782	140
728	10	(10,	0)	0	5/20/1991	505.512348	505.895845	140
729	5	(5,	0)	0	5/20/1991	505.915522	506.305538	140
730	7	(7,	0)	0	5/21/1991	506.326040	506.712150	141
731	3	(3,	0)	0	5/21/1991	507.107568	507.122146	141
732	11	(11,	0)	0	5/22/1991	507.144546	507.534041	142
733	5	(5,	0)	0	5/22/1991	507.555351	507.941362	142
734	6	(6,	0)	0	5/22/1991	507.964306	508.349227	142
735	9	(9,	0)	0	5/23/1991	508.373145	508.381773	143
736	6	(6,	0)	0	5/23/1991	508.786771	509.172379	143
737	9	(9,	0)	0	5/24/1991	509.194872	509.578588	144
738	7	(7,	0)	0	5/24/1991	509.600368	509.982591	144
739	8	(8,	0)	0	5/24/1991	510.008306	510.394036	144
740	4	(4,	0)	0	5/25/1991	510.420272	510.804356	145
741	7	(7,	0)	0	5/25/1991	510.825521	511.213524	145
742	9	(9,	0)	0	5/26/1991	511.237901	511.245154	146
743	4	(4,	0)	0	5/26/1991	512.018033	512.031449	146
744	9	(9,	0)	0	5/27/1991	512.056928	512.440241	147
745	10	(10,	0)	0	5/27/1991	512.466430	512.485132	147
746	5	(5,	0)	0	5/27/1991	513.246703	513.262063	147
747	4	(4,	0)	0	5/28/1991	513.286755	513.671436	148
748	7	(7,	0)	0	5/28/1991	513.696014	514.082876	148
749	9	(9,	0)	0	5/29/1991	514.101007	514.488800	149
750	9	(9,	0)	0	5/29/1991	514.510395	514.896149	149
751	7	(7,	0)	0	5/29/1991	514.920778	515.306841	149
752	14	(14,	0)	0	5/30/1991	515.331159	515.716368	150
753	5	(5,	0)	0	5/30/1991	515.738743	516.126678	150
754	8	(8,	0)	0	5/31/1991	516.150568	516.535801	151
755	7	(7,	0)	0	5/31/1991	516.557699	516.944876	151
756	11	(11,	0)	0	5/31/1991	516.968671	517.352742	151
757	11	(11,	0)	0	6/01/1991	517.377177	517.763595	152
758	5	(5,	0)	0	6/01/1991	518.156026	518.172737	152
759	6	(6,	0)	0	6/02/1991	518.195778	518.581314	153
760	8	(8,	0)	0	6/02/1991	518.606962	518.988634	153
761	10	(10,	0)	0	6/03/1991	519.013830	519.398233	154
762	5	(5,	0)	0	6/03/1991	519.418499	519.806288	154
763	6	(6,	0)	0	6/03/1991	519.827859	520.216149	154
764	14	(14,	0)	0	6/04/1991	520.241722	520.630862	155
765	12	(12,	0)	0	6/04/1991	520.654897	521.046055	155
766	13	(13,	0)	0	6/05/1991	521.070539	521.463092	156
767	8	(8,	0)	0	6/05/1991	521.483834	521.872286	156
768	6	(6,	0)	0	6/05/1991	521.900541	522.288710	156
769	7	(7,	0)	0	6/06/1991	522.310445	522.707336	157
770	7	(7,	0)	0	6/06/1991	522.743812	523.102825	157
771	11	(11,	0)	0	6/07/1991	523.139712	523.536082	158
772	10	(10,	0)	0	6/07/1991	523.561299	523.955705	158
773	16	(16,	0)	0	6/07/1991	523.982065	524.377602	158
774	12	(12,	0)	0	6/08/1991	524.399337	524.792175	159
775	7	(7,	0)	0	6/08/1991	524.821328	525.215639	159
776	13	(13,	0)	0	6/09/1991	525.240531	525.635307	160
777	11	(11,	0)	0	6/09/1991	525.654765	526.054025	160
778	10	(10,	0)	0	6/10/1991	526.074487	526.475668	161
779	4	(4,	0)	0	6/10/1991	526.497141	526.894880	161
780	10	(10,	0)	0	6/10/1991	526.923158	527.317018	161
781	55	(55,	0)	0	6/11/1991	527.345343	527.740003	162
782	14	(14,	0)	0	6/11/1991	527.763776	528.165291	162
783	13	(13,	0)	0	6/12/1991	528.189202	528.586079	163
784	16	(16,	0)	0	6/12/1991	528.610729	529.009094	163
785	8	(8,	0)	0	6/13/1991	529.033107	529.437034	164
786	7	(7,	0)	0	6/13/1991	529.457372	529.725081	164
787	6	(6,	0)	0	6/13/1991	529.886596	530.272629	164
788	8	(8,	0)	0	6/14/1991	530.308159	530.710473	165
789	7	(7,	0)	0	6/14/1991	530.737163	531.137803	165
790	6	(6,	0)	0	6/15/1991	531.165307	531.562335	166
791	17	(17,	0)	0	6/15/1991	531.584760	531.987320	166
792	31	(31,	0)	0	6/15/1991	532.013370	532.415349	166
793	12	(12,	0)	0	6/16/1991	532.437038	532.841115	167
794	348	(4,	344)	0	6/16/1991	532.862042	532.951014	167
854	8	(8,	0)	0	7/12/1991	558.838560	558.918157	193
855	349	(5,	344)	0	7/12/1991	558.940202	558.963061	193

Total Upsets: 5378 (Soft: 4690, Hard: 688)

********** SUMMARY **********

Block: 03; Side: B; Part Number: 30283-1K; Device: 2 of 2; Board: 1; U-Number: 31
Addresses: 1024; Bits/Addr: 1; SEU File Processed: BLK_03_a.SEU; Output File Created: BLK_03_a.DV2

Total Upsets: 5378 (Soft: 4690, Hard: 688)

Breakdown Of The 5378 Total Upsets Into Total Upsets In Each Bit Position:

Total	(Bit 0)
5378	(5378)

Table 5c

Block: 00; Side: B; Device: 1 of 2; Part Number: 80E200001-2001; U-Number: 4
Board: 1; Addresses: 256; Bits/Addr: 1; SEU File Processed: BLK_00_a.SEU; Output File Created: BLK_00_a.DV1

Orbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Year
118	1	(1,	0)	0	9/12/1990	255.323114	255.323114	255
218	1	(1,	0)	0	10/23/1990	296.398072	296.398072	296
587	1	(1,	0)	0	3/23/1991	447.996402	448.059359	82
774	1	(1,	0)	0	6/08/1991	524.727700	524.727700	159
781	1	(1,	0)	0	6/11/1991	527.440513	527.517523	162
794	215	(0,	215)	0	6/16/1991	532.949639	532.949875	167
840	1	(1,	0)	0	7/06/1991	552.668885	552.668885	187
846	1	(1,	0)	0	7/09/1991	555.228805	555.228805	190
855	77	(1,	76)	0	7/12/1991	558.961790	558.963193	193
911	1	(1,	0)	0	8/05/1991	583.266369	583.266369	217
1028	1	(1,	0)	0	9/25/1991	633.616925	633.616925	268

Total Upsets: 301 (Soft: 10, Hard: 291)

********** SUMMARY **********

Block: 00; Side: B; Part Number: 80E200001-2001; Device: 1 of 2; Board: 1; U-Number: 4
Addresses: 256; Bits/Addr: 1; SEU File Processed: BLK_00_a.SEU; Output File Created: BLK_00_a.DV1

Total Upsets: 301 (Soft: 10, Hard: 291)

Breakdown Of The 301 Total Upsets Into Total Upsets In Each Bit Position:

Total	(Bit 0)
301	(301)

Block: 00; Side: B; Device: 2 of 2; Part Number: 80E200001-2001; U-Number: 5
Board: 1; Addresses: 256; Bits/Addr: 1; SEU File Processed: BLK_00_a.SEU; Output File Created: BLK_00_a.DV2

Orbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Year
185	1	(1,	0)	0	10/09/1990	282.927067	282.927067	282
278	1	(1,	0)	0	11/17/1990	321.032005	321.032005	321
306	1	(1,	0)	0	11/28/1990	332.536932	332.536932	332
444	1	(1,	0)	0	1/24/1991	389.377673	389.377673	24
502	1	(1,	0)	0	2/16/1991	413.328802	413.328802	47
511	1	(1,	0)	0	2/20/1991	416.641652	416.641652	51
563	1	(1,	0)	0	3/13/1991	438.336715	438.336715	72
586	1	(1,	0)	0	3/23/1991	447.614754	447.614754	82
587	1	(1,	0)	0	3/23/1991	447.996402	448.059359	82
602	7	(7,	0)	0	3/29/1991	454.325097	454.325097	88
603	7	(7,	0)	0	3/30/1991	454.325010	454.325010	89
728	1	(1,	0)	0	5/20/1991	505.895134	505.895134	140
781	1	(1,	0)	0	6/11/1991	527.440513	527.517523	162
782	2	(2,	0)	0	6/11/1991	527.892796	528.097240	162
794	215	(0,	215)	0	6/16/1991	532.949639	532.949875	167
811	1	(1,	0)	0	6/24/1991	540.106101	540.106101	175
840	1	(1,	0)	0	7/06/1991	552.668885	552.668885	187
855	77	(1,	76)	0	7/12/1991	558.961790	558.963193	193
911	1	(1,	0)	0	8/05/1991	583.266369	583.266369	217
1057	7	(7,	0)	0	10/07/1991	645.845865	645.845865	280

Total Upsets: 329 (Soft: 38, Hard: 291)

********** SUMMARY **********

Block: 00; Side: B; Part Number: 80E200001-2001; Device: 2 of 2; Board: 1; U-Number: 5
Addresses: 256; Bits/Addr: 1; SEU File Processed: BLK_00_a.SEU; Output File Created: BLK_00_a.DV2

Total Upsets: 329 (Soft: 38, Hard: 291)

Breakdown Of The 329 Total Upsets Into Total Upsets In Each Bit Position:

Total	(Bit 0)
329	(329)

Table 5d

Block: 01; Side: B; Device: 1 of 2; Part Number: 80E200002-3; U-Number: 11
Board: 1; Addresses: 1024; Bits/Addr: 1; SEU File Processed: BLK_01_a.SEU; Output File Created: BLK_01_a.DV1

Orbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Yea
252	3	(3,	0)	0	11/06/1990	310.701621	310.701621	310
294	1	(1,	0)	0	11/23/1990	327.604638	327.604638	327
423	1	(1,	0)	0	1/15/1991	380.845467	380.845467	15
587	1	(1,	0)	0	3/23/1991	447.915145	448.131868	82
593	1	(1,	0)	0	3/26/1991	450.473745	450.473745	85
597	1	(1,	0)	0	3/27/1991	452.264696	452.264696	86
652	1	(1,	0)	0	4/19/1991	474.400551	474.400551	109
723	1	(1,	0)	0	5/18/1991	503.459085	503.459085	138
732	1	(1,	0)	0	5/22/1991	507.147272	507.147272	142
741	1	(1,	0)	0	5/25/1991	511.216182	511.216182	145
783	1	(1,	0)	0	6/12/1991	528.300320	528.300320	163
790	1	(1,	0)	0	6/15/1991	531.242462	531.504165	166
794	344	(0,	344)	0	6/16/1991	532.949923	532.950397	167
855	312	(0,	312)	0	7/12/1991	558.962122	558.962501	193

Total Upsets: 670 (Soft: 14, Hard: 656)

********** SUMMARY **********

Block: 01; Side: B; Part Number: 80E200002-3; Device: 1 of 2; Board: 1; U-Number: 11
Addresses: 1024; Bits/Addr: 1; SEU File Processed: BLK_01_a.SEU; Output File Created: BLK_01_a.DV1

Total Upsets: 670 (Soft: 14, Hard: 656)

Breakdown Of The 670 Total Upsets Into Total Upsets In Each Bit Position:

Total	(Bit 0)
670	(670)

Block: 01; Side: B; Device: 2 of 2; Part Number: 80E200002-3; U-Number: 12
Board: 1; Addresses: 1024; Bits/Addr: 1; SEU File Processed: BLK_01_a.SEU; Output File Created: BLK_01_a.DV2

Orbit	Upsets	(Soft,	Hard)	Patterns	Date	Univ-Time-Begin	Univ-Time-End	Day-Of-Yea
144	1	(1,	0)	0	9/22/1990	265.997194	265.997194	265
252	3	(3,	0)	0	11/06/1990	310.701621	310.701621	310
374	1	(1,	0)	0	12/26/1990	360.449221	360.449221	360
405	1	(1,	0)	0	1/08/1991	373.161528	373.161528	8
437	2	(2,	0)	0	1/21/1991	386.432346	386.679999	21
482	1	(1,	0)	0	2/08/1991	405.025159	405.025159	39
495	1	(1,	0)	0	2/14/1991	410.465391	410.465391	45
545	1	(1,	0)	0	3/06/1991	430.572523	430.572523	65
569	1	(1,	0)	0	3/16/1991	440.411314	440.411314	75
587	7	(7,	0)	0	3/23/1991	447.915145	448.131868	82
588	2	(2,	0)	0	3/24/1991	448.250287	448.308314	83
634	1	(1,	0)	0	4/12/1991	467.416527	467.416527	102
781	1	(1,	0)	0	6/11/1991	527.571828	527.571828	162
782	1	(1,	0)	0	6/11/1991	527.849252	527.849252	162
790	1	(1,	0)	0	6/15/1991	531.242462	531.504165	166
793	1	(1,	0)	0	6/16/1991	532.496700	532.496700	167
794	344	(0,	344)	0	6/16/1991	532.949923	532.950397	167
855	312	(0,	312)	0	7/12/1991	558.962122	558.962501	193

Total Upsets: 682 (Soft: 26, Hard: 656)

********** SUMMARY **********

Block: 01; Side: B; Part Number: 80E200002-3; Device: 2 of 2; Board: 1; U-Number: 12
Addresses: 1024; Bits/Addr: 1; SEU File Processed: BLK_01_a.SEU; Output File Created: BLK_01_a.DV2

Total Upsets: 682 (Soft: 26, Hard: 656)

Breakdown Of The 682 Total Upsets Into Total Upsets In Each Bit Position:

Total	(Bit 0)
682	(682)

Table 6

10 Sep 90, Orbit: 0113, Day: 253

UT	ICU	PAT	C	BLOCK	ADDR	UPS	MASK	Altitude	Latitude	Longitude	LShell
253.265574	B	---	7	-----	----	00001	--	2554.430	-15.63	-114.55	1.4306
253.265597	B	---	7	-----	----	00000	--	2562.224	-15.61	-114.45	1.4317
253.267482	B	---	7	-----	----	00001	--	3197.968	-14.26	-107.59	1.5231
253.267505	B	---	7	-----	----	00000	--	3206.186	-14.24	-107.51	1.5244
253.269734	B	---	7	-----	----	00001	--	3988.770	-12.62	-100.75	1.6451
253.269757	B	---	7	-----	----	00000	--	3997.206	-12.61	-100.69	1.6465
253.287535	B	---	7	-----	----	00217	--	10205.212	-3.04	-73.62	2.7404
253.287547	B	---	7	-----	----	00510	--	10209.070	-3.04	-73.61	2.7412
253.287571	B	---	7	-----	----	00000	--	10216.773	-3.03	-73.59	2.7426
253.651316	B	---	7	-----	----	00001	--	3702.496	7.06	-37.77	1.7163
253.651339	B	---	7	-----	----	00000	--	3694.103	7.04	-37.71	1.7143
253.654836	B	---	7	-----	----	00001	--	2498.291	3.08	-26.37	1.4485
253.654848	B	---	7	-----	----	00000	--	2494.378	3.07	-26.33	1.4477
253.654990	B	---	7	-----	----	00001	--	2448.417	2.87	-25.79	1.4391
253.655014	B	---	7	-----	----	00000	--	2440.780	2.84	-25.70	1.4377
253.656163	B	---	7	-----	----	00001	--	2075.821	1.23	-21.19	1.3725
253.656187	B	---	7	-----	----	00000	--	2068.405	1.20	-21.09	1.3712

* 10 Sep 90, Orbit: 0114, Day: 253

UT	ICU	PAT	C	BLOCK	ADDR	UPS	MASK	Altitude	Latitude	Longitude	LShell
253.710394	B	---	7	-----	----	00510	--	13890.489	0.79	145.24	3.2204
253.710418	B	---	7	-----	----	00000	--	13897.420	0.80	145.25	3.2215
253.711734	B	---	7	-----	----	00228	--	14268.110	1.12	145.75	3.2785
253.711769	B	---	7	-----	----	00510	--	14278.123	1.12	145.76	3.2800
253.711781	B	---	7	-----	----	00000	--	14281.461	1.13	145.77	3.2806
254.064528	B	---	7	-----	----	00001	--	2879.147	4.42	-149.72	1.4117
254.064551	B	---	7	-----	----	00000	--	2871.076	4.39	-161.93	1.4104
254.065997	B	---	7	-----	----	00001	--	2392.494	2.55	-173.33	1.3392
254.066021	B	---	7	-----	----	00000	--	2384.939	2.52	-173.24	1.3381

* 11 Sep 90, Orbit: 0116, Day: 254

UT	ICU	PAT	C	BLOCK	ADDR	UPS	MASK	Altitude	Latitude	Longitude	LShell
254.497836	B	---	7	-----	----	00001	--	2473.383	-15.65	160.05	1.6025
254.497860	B	---	7	-----	----	00000	--	2481.041	-15.63	160.14	1.6032
254.557214	B	---	7	-----	----	00001	--	20207.578	5.74	-145.42	4.3476
254.557238	B	---	7	-----	----	00000	--	20212.711	5.74	-145.42	4.3485
254.788213	B	---	7	-----	----	00510	--	27232.883	17.86	-168.67	5.7212
254.788254	B	---	7	-----	----	00000	--	27227.225	17.86	-168.67	5.7203
254.791193	B	---	7	-----	----	00001	--	26811.773	17.92	-168.80	5.6501
254.791217	B	---	7	-----	----	00000	--	26808.395	17.92	-168.80	5.6495
254.885060	B	---	7	-----	----	00001	--	3267.192	5.52	-118.61	1.5742
254.885084	B	---	7	-----	----	00000	--	3258.981	5.49	-118.53	1.5728
254.886079	B	---	7	-----	----	00001	--	2917.131	4.37	-115.33	1.5125
254.886103	B	---	7	-----	----	00000	--	2909.034	4.34	-115.25	1.5110
254.887632	B	---	7	-----	----	00001	--	2402.294	2.40	-109.79	1.4225
254.887655	B	---	7	-----	----	00000	--	2394.697	2.37	-109.70	1.4212

* 20 Nov 90, Orbit: 0286, Day: 324

UT	ICU	PAT	C	BLOCK	ADDR	UPS	MASK	Altitude	Latitude	Longitude	LShell
324.431968	B	---	7	-----	----	00510	--	28114.643	18.26	-124.18	6.8977
324.431992	B	---	7	-----	----	00000	--	28117.674	18.26	-124.18	6.8983
324.699909	B	---	7	-----	----	00001	--	8005.155	-0.85	-126.62	2.2663
324.699933	B	---	7	-----	----	00000	--	7996.933	-0.86	-126.59	2.2649
324.703263	B	---	7	-----	----	00001	--	6825.125	-2.70	-122.20	2.0743
324.703299	B	---	7	-----	----	00000	--	6812.475	-2.72	-122.15	2.0723
324.705219	B	---	7	-----	----	00001	--	6125.351	-3.93	-119.12	1.9631
324.705243	B	---	7	-----	----	00000	--	6116.810	-3.94	-119.08	1.9617
324.709367	B	---	7	-----	----	00001	--	4627.024	-6.96	-110.93	1.7309
324.709379	B	---	7	-----	----	00000	--	4622.750	-6.97	-110.90	1.7303

Table 6 (cont.)

* 25 Jan 91, Orbit: 0447, Day: 025

UT	ICU	PAT	C	BLOCK	ADDR	UPS	MASK	Altitude	Latitude	Longitude	LShell
390.393652	B	---	7	-----	----	00001	--	3016.854	14.25	116.55	1.4007
390.393676	B	---	7	-----	----	00000	--	3025.022	14.27	116.63	1.4021
390.393783	B	---	7	-----	----	00001	--	3061.888	14.35	117.00	1.4085
390.393807	B	---	7	-----	----	00000	--	3070.159	14.37	117.08	1.4099
390.394387	B	---	7	-----	----	00001	--	3272.908	14.78	119.04	1.4447
390.394411	B	---	7	-----	----	00000	--	3281.195	14.79	119.12	1.4462
390.395383	B	---	7	-----	----	00001	--	3625.096	15.39	122.19	1.5053
390.395407	B	---	7	-----	----	00000	--	3633.557	15.40	122.26	1.5067
390.605599	B	---	7	-----	----	00405	--	33327.531	4.90	154.21	6.5665
390.781967	B	---	7	-----	----	00001	--	2094.689	-17.91	-154.15	1.4391
390.781990	B	---	7	-----	----	00000	--	2087.314	-17.90	-154.04	1.4375

* 05 Aug 91, Orbit: 0911, Day: 217

UT	ICU	PAT	C	BLOCK	ADDR	UPS	MASK	Altitude	Latitude	Longitude	LShell
582.961160	B	---	7	-----	----	00001	--	2081.335	-1.82	137.72	1.3047
582.961178	B	---	7	-----	----	00000	--	2086.915	-1.84	137.79	1.3059
582.962950	B	---	7	-----	----	00001	--	2659.196	-4.20	144.60	1.4298
582.962974	B	---	7	-----	----	00000	--	2667.070	-4.23	144.69	1.4315
582.963311	B	---	7	-----	----	00001	--	2780.110	-4.64	145.89	1.4558
582.963329	B	---	7	-----	----	00000	--	2786.152	-4.66	145.95	1.4570
583.266369	B	---	7	-----	----	00190	--	28442.281	-8.94	172.53	5.8785
583.369156	B	---	7	-----	----	00001	--	3037.024	14.79	-140.02	1.5975
583.369168	B	---	7	-----	----	00000	--	3032.951	14.80	-139.97	1.5971

******************** SUMMARY FOR ORBITS 4 - 1067 ****************

Note: Only upsets >= 1 and <= 99999 per time stamp were counted.
Upsets per time-stamp outside this range were considered invalid.

Block: 3C; Side: B; Part Number: F4122120 D2164A-20; Device: ALL 5 Devices; Board: 3;
U-Number: 191,192,193,194,195; Addresses: 65536; Bits/Addr: 1;
SEU File Processed: DRAM_SB.SEU; Output File Created: DRAM_SB.DVA

Total Upsets: 9445

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	June 1993	Technical Paper

4. TITLE AND SUBTITLE

Combined Release and Radiation Effects Satellite (CRRES) Micro–Electronics Package Flight Data Analysis

5. FUNDING NUMBERS

Code 900

6. AUTHOR(S)

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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Goddard Space Flight Center
Greenbelt, Maryland 20771

8. PERFORMING ORGANIZATION REPORT NUMBER

94B00007

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

National Aeronautics and Space Administration
Washington, D.C. 20546–0001

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

NASA TP–3423

11. SUPPLEMENTARY NOTES

Document is cosponsored by the Defense Nuclear Agency, Electronic Effects Division.
G.J. Brucker: Radiation Effects Consultant, West Long Branch, NJ; C.A. Stauffer: Systems Engineering and Security, Inc., Greenbelt, MD.

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Unclassified–Unlimited
Subject Category 73
Report available from the NASA Center for AeroSpace Information, 800 Elkridge Landing Road, Linthicum Heights, MD 21090; (301) 621–0390.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

A detailed in–depth analysis was performed on the data from some of the CRRES MEP devices. These space flight measurements covered a period of about 14 months of mission lifetime. Several types of invalid data were identified and corrections were made. Other problems were noted and adjustments were applied as necessary. Particularly important and surprising were observations of abnormal device behavior in many parts that could neither be explained nor correlated to causative events. Also, contrary to prevailing theory, proton effects appeared to be far more significant and numerous than cosmic–ray effects. Another unexpected result was the realization that only nine out of 32 p–MOS dosimeters on the MEP indicated a valid operation. Comments, conclusions, and recommendations are given.

14. SUBJECT TERMS

Electronic Devices, Dosimeters, Radiation Effects, Protons, Cosmic Rays, Solar Flares, Total Ionizing Dose, Single Event Upsets, Problems, Lessons, Recommendations

15. NUMBER OF PAGES

66

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unlimited