

## The Impact of the Space Environment on Space Systems

20 July 1999

Prepared by

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Col. Hal Hagemeyer, Chief  
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## **1. Introduction**

We have undertaken a study to determine the impact of the space environment on space systems. We have included all types of spacecraft for which we have been able to find data. These include commercial, scientific, and military—both US domestic and foreign.

Known impacts include service outages, mission degradation and mission failure, data loss, sensor degradation, subsystem failure, launch delays, redesign and retest, anomaly analyses, and the ultimate cost for each of the preceding. We have attempted to quantify these impacts whenever possible. This task is made difficult because impacts are rarely formally documented.

## 2. Sources of Data

A variety of databases were used to determine those spacecraft anomalies that have been attributed to the space environment. The following comprehensive databases were utilized:

- (1) Spacecraft Anomaly Manager (SAM). This database was maintained until recently by NOAA/NGDC in Boulder, Colorado. This database primarily contains anomalies that are believed to have been caused by the space environment.
- (2) The Orbital Data Acquisition Program (ODAP). This database was developed by The Aerospace Corporation. It is no longer maintained. It contains anomaly information on 15 US Air Force and 91 non-Air Force programs. It was primarily developed to identify hardware reliability problems.
- (3) NASA Anomaly Reports [*Bedingfield et al.*, 1996; *Leach and Alexander*, 1997].
- (4) The anomaly database maintained by the US Air Force 55<sup>th</sup> Space Weather Squadron.

There are a number of serious difficulties with these existing anomaly databases. The databases were designed to determine the extent of spacecraft problems from the standpoint of the spacecraft designer. One of their main uses has been to identify unreliable parts across a variety of different spacecraft and manufacturers. Although in some cases they identify the environment as the cause of an anomaly, the spacecraft generally lack sensors to determine the state of the environment at the location of the spacecraft at the time of an anomaly. Since the appropriate environmental data were not available at the spacecraft, it was often difficult to make a diagnosis with high confidence that an anomaly was caused by the space environment. The assessments that have been incorporated into the data records have been made by a large number of people, some of whom are experts in environmental anomaly diagnosis, and some of whom have little knowledge or training in this area. Thus, there is a great deal of variability in the quality of the assessments that have been made.

The databases are also poorly maintained. There is no formal mechanism for collecting or submitting data to the organizations that maintain the databases. Often after an anomaly is understood it is no longer considered an anomaly and may no longer be recorded in the database. In the case of ODAP, later instances of an anomaly type on the same vehicle were often listed in the comment field of the first instance. Thus, there is no way to accurately count or even estimate the number of occurrences of a given type of anomaly on even a single spacecraft from the existing databases.

Finally, the databases were found to be completely inadequate to perform this study because they contain virtually no information on the impact of the anomalies in the sense that we are studying them. For both technical and insurance reasons the problems and impacts associated with anomalies are often closely held by the responsible organizations and are not normally released to the public.

A new database, known as the Space Systems Engineering Database (SSED), is being developed by The Aerospace Corporation. It is essentially a modern replacement for ODAP and addresses many of the problems found in the earlier databases. It currently contains data for several hundred vehicles.



### 3. Approach Used for this Study

We have augmented the databases above with a number of other sources for this study. We have reviewed the anomaly reports from the archives of the Space Sciences Department of The Aerospace Corporation to summarize the anomaly investigations that have been undertaken by the members of the department. In some cases, the original source material mentions the impacts the anomalies have had, especially if they have led to a redesign of a spacecraft subsystem. We have also contacted people whom we have worked with on anomaly analyses to obtain written and oral information regarding those studies. Contractor reports, published journal articles, newspaper articles, and memos have also been reviewed to identify anomaly investigations and impacts. We also visited NOAA/NGDC and reviewed their anomaly files for anomaly impacts.

We have summarized the data collected for this study in a Space Environment Impact Database. Each record contains the information for one class of anomalies for one vehicle. An anomaly class is a set of anomalies with essentially similar observables. This data collection can not and should not be used as an anomaly database for counting the individual occurrences of anomalies because each anomaly is not documented in a unique record. One record may document one anomaly or, in the extreme case, 617 anomalies for the main-bus, under-voltage, and phantom commands caused by surface electrostatic discharges on the MARECS-A spacecraft. The Space Environment Impact Database contains a description of the anomaly class, the diagnosis (i.e., the environmental cause), an indication as to whether or not the diagnosis was supported by the material in the references (on a scale from 3 meaning the diagnosis was well supported to 0 meaning there was no information to support the diagnosis), a description of the impact, any relevant comments from the references or the compiler, and a list of the references from which the information was obtained. The data have been entered into a Microsoft Access database to facilitate gathering statistics for this report. The complete database is included in Appendix A. The references for the source material for the database are given in Appendix B.

## 4. Results

The Space Environment Impact Database for this study contains 326 records. The number of records by spacecraft affiliation is given in Table 1. The total count in that table is greater than 326 because some of the spacecraft fall under more than one affiliation, such as foreign, commercial, communication satellites. 299 of the records contain anomalies that have the cause diagnosed as the space environment. Of these 299, only 155 have impacts obtained from the referenced documents.

Virtually none of the impacts are quantified in terms of their cost. Nor are their descriptions of the effects on the ultimate user of the space system. This is understandable because none of the information was provided by the ultimate user. Most of the information in the available sources was provided by the operators and the vehicle manufacturers. Hence, it tends to be related to operator impacts such as time required to restore the vehicle to normal operation or to technical impacts such as the testing and redesign required to "fix" the next generation of vehicles.

Table 1. Distribution of Records in the Space Environment Impact Database by Affiliation

Affiliation	Number of Records
DoD	87
Foreign	63
NASA, NOAA	58
Scientific	57
Classified/Other	52
Commercial	51

### 4.1 Anomaly Diagnosis

The distribution of records by anomaly diagnosis is given in Table 2. The first group is electrostatic discharges (ESD) and charging. The ESD anomalies group contains the largest number of records: 162. Virtually all of the anomalies in this area result from discharges. Only one was caused by the voltage changes on the surface of the vehicle. The uncategorized ESD anomalies refer to those that were not identified as either internal discharges or surface discharges in the references.

The second largest number of records, 85, falls in the Single-Event Upsets (SEU) group, also shown in Table 2. It contains less than half the number of records as the ESD group. The uncategorized SEU anomalies refer to those that were not related to cosmic rays, solar proton events, or the South Atlantic Anomaly in the references. Of these, the largest class is probably due to cosmic rays, and the smallest to solar proton events.

A distant third, with 16 records, is the radiation damage group. The largest member of this group is solar-array degradation, which is only reported as an anomaly when an unusually large degradation occurs during a solar proton event. Total radiation dose anomalies are surprisingly infrequent, repre-

Table 2. Distribution of Records by Anomaly Diagnosis

Diagnosis	Number of Records
ESD - Internal Charging	74
ESD - Surface Charging	59
ESD - Uncategorized	28
Surface Charging	1
Total ESD & Charging	162
SEU - Cosmic Ray	15
SEU - Solar Particle Event	9
SEU - South Atlantic Anomaly	20
SEU - Uncategorized	41
Total SEU	85
Solar Array—Solar Proton Event	9
Total Radiation Dose	3
Materials Damage	3
South Atlantic Anomaly	1
Total Radiation Damage	16
Micrometeoroid/Debris Impact	10
Solar Proton Event—Uncategorized	9
Magnetic Field Variability	5
Plasma Effects	4
Atomic Oxygen Erosion	1
Atmospheric Drag	1
Sunlight	1
IR background	1
Ionospheric Scintillation	1
Energetic Electrons	1
Other	2
Total Miscellaneous	36

senting only 1% of the records. This probably reflects the conservative limits defined in the radiation models and the conservative approach applied by designers when specifying shielding limits for electronic components.

Twelve other miscellaneous causes amounted to only 36 records.

#### 4.2 Impacts

The only impact that could be readily quantified is the time required for the operators to recover from an anomaly. This may be taken as the duration of the impact on the user. This impact usually represented complete loss of data or service for the duration. The durations shown in Table 3 are the lengths of time that were required to restore service to the users. It is interesting to note that it is tri-modal with peaks at *Minimal*, *One Hour to One Day*, and *More Than One Week*.

Table 3. Distribution of Records by Impact Duration

Duration of Impact	Number of Records
Minimal	13
Less than 10 min	8
10 min to 1 hr	14
1 hr to 1 day	54
1 day to 1 wk	7
More than 1 wk	68
Mission loss	9
Unknown	153

A *Minimal* duration anomaly has essentially no impact on the users. Some anomalies caused by SEUs are in this category because many spacecraft are designed to detect such anomalies and perform an automatic recovery. Anomalies in housekeeping functions, such as temperature sensors, are also in this category because they have no impact on the user.

*One hour to One day* represents the time it takes to recover, for example, when a vehicle suffers an attitude-control anomaly or enters a safe-hold condition. *More Than One Week* includes permanent damage and failures.

Table 4 lists other identifiable impacts that have happened on a number of systems. The largest number of records is 70 for *Phantom Commands*. The most serious is the *System or Part Failure* category, which occurs in 53 or 16% of the cases.

Table 4. Other Impacts

Impact	Number of Records
Phantom Command	70
Degraded Performance	55
System or Part Failure	53
Upsets	47
Other or Unknown	47
Spurious Signal	24
Solar array Degradation	14

*Solar Array Degradation* refers to the loss of solar array power capability primarily due to radiation damage of the solar arrays during a solar proton event. In most cases, the impact given in the source material was the potential loss of mission lifetime. However, there was no follow up to determine whether this shortening of the mission actually occurred. Thus, it was not possible to determine whether this impact was ultimately real or only predicted.

### 4.3 Mission Loss

Table 5 lists those missions that were listed as mission losses in the reference material and for which the diagnosis was environmental. Because of the impossibility of making a definitive diagnosis remotely and the serious repercussions of a mission loss, there is usually considerable controversy

Table 5. Missions Lost or Terminated Due to the Space Environment

Vehicle	Date	Diagnosis
DSCS II (9431)	Feb 73	Surface ESD
GOES 4	Nov 82	Surface ESD
Feng Yun 1	Jun 88	ESD
MARECS A	Mar 91	Surface ESD
MSTI	Jan 93	Single Event Effect
Hipparcos*	Aug 93	Total Radiation Dose
Olympus	Aug 93	Micrometeoroid Impact
SEDS 2*	Mar 94	Micrometeoroid Impact
MSTI 2	Mar 94	Micrometeoroid Impact
IRON 9906	1997	Single Event Effect
INSAT 2D	Oct 97	Surface ESD

\* Mission had been completed prior to termination

surrounding the cause of each mission loss. For the most part, the diagnoses listed have been identified as probable causes by experts on space environmental anomalies who have been involved in the analyses of anomalies on those vehicles.

The largest cause of mission failures related to the space environment is Surface ESD. In all cases, those vehicles were in geosynchronous orbit.

## 5. Space Weather Forecasting

Spacecraft charging ESD has caused by far the most environmentally related anomalies on spacecraft, and surface charging has caused the most serious anomalies, i.e., those that have resulted in the loss of the mission. Unfortunately, it is much more difficult to forecast the location and seriousness of spacecraft surface charging than it is to forecast the location and seriousness of internal charging.

Internal charging occurs one to a several days after a major magnetic storm. Hence, the storm itself is a warning that high levels of energetic electrons may be present in the radiation belts in the near future. Since these electrons primarily diffuse inward after the storm, their progress could be monitored, and flux levels reasonably well predicted one to two days in advance. Efforts to do this have been undertaken using linear prediction filters and neural networks [Nagai, 1988; Baker *et al.*, 1990; Koons and Gorney, 1991; 1993].

Surface charging is much more difficult to predict. It not only requires a prediction of a magnetic storm or substorm but also the electron distribution function as a function of location in the magnetosphere. Surface charging is not necessarily related to the absolute intensity of the flux of hot electrons around the spacecraft, but rather to the details of the electron distribution function. For example, the worst-case surface-charging event on the SCATHA spacecraft on 22 September 1982 occurred at a time when the electron distribution function at low energies (<1 keV) was below average, at middle energies (1 to 10 keV) was near the top of its average range, and at high energies (20 to 100 keV) was above its average range [Koons *et al.*, 1988; Roeder, 1994]. It is likely that the combination of high fluxes in the higher-energy range combined with a reduction in the secondary electrons from primaries in the low-energy range caused the extreme surface charging conditions on that day. Since surface charging occurs on a much faster time scale than internal charging, only an imminent forecast is probably possible, and it is unlikely that the location can be accurately identified without a significant number of sensors located across the tail of the magnetosphere.

Only the SEUs related to solar proton events can be forecast, and only an imminent solar proton event can be expected to be forecast in the foreseeable future. Since these SEUs represent only about 10% of the SEU Space Environment Impact Records, forecasts of solar proton events will not have a significant effect on impacts caused by SEUs.

Similarly, solar array degradation due to radiation damage of the arrays during a solar proton event will not have a significant effect on environmental impacts. This effect is further reduced because the time remaining in the mission is not necessarily related to this degradation, but is more often caused by some other failure on the vehicle.

Other causes make up a small portion of the environmentally related anomalies, and many, such as total radiation dose, atomic oxygen erosion, micrometeoroid impact, and debris impact, are inherently nonpredictable.

## **6. Recommendations**

We recommend that significant efforts be made to better specify the electron distribution functions responsible for surface charging and internal charging. It is especially important to obtain the worst-case environments in the spirit of the 100-year storm used by civil engineers to design dams and flood control systems. With such specifications and with studies of the interactions of these environments with candidate spacecraft materials, the spacecraft designer will be better able to design spacecraft that are immune to the environment.

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# Appendix A

## Space Environment Impact Database

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**Name:** A-1

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 08 Mar 94

**Description:** Burnout of circuit

**Diagnosis:** ESD      **Sure:** 2

**Impact:** Unknown      **Duration:** Unknown

**Category:** Random Part Failure

**Comments:** Satellite within Field Aligned currents combined with enhanced 51-1540 keV electrons before and during anomaly time

**References:** SWS1

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**Name:** A-2

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 03 Apr 94

**Description:** Bit flip in attitude control software

**Diagnosis:** SEU      **Sure:** 0

**Impact:** Unknown      **Duration:** Unknown

**Category:** Other

**Comments:** Strong electron and proton disturbances near anomaly time

**References:** SWS1

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**Name:** ADE0S 1  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 24 Sept 1996  
**Description:** Safehold; computer glitch  
**Diagnosis:** SEU-Cosmic Ray **Sure:** 0  
**Impact:** Based on description **Duration:** 1 hr to 1 day  
**Category:** Phantom commands  
**Comments:** None  
**References:** JEM1, JHA22

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**Name:** ALEXIS  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** ?  
**Description:** Autonomous attitude control system failed;  
**Diagnosis:** Unknown **Sure:** 0  
**Impact:** Necessitated creation of a makeshift attitude control system. s/c operators need to upload a file each time a maneuver is desired **Duration:** Unknown  
**Category:** System Failure  
**Comments:** None  
**References:** JHA23

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**Name:** AMPTE/CCE  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 11 Sep 1984 on  
**Description:** The magnetometer changed modes on 4 occasions  
**Diagnosis:** SEU **Sure:** 0  
**Impact:** Operating procedures had to be changed to remain operational **Duration:** 1 hr to 1 day  
**Category:** Phantom commands  
**Comments:** None  
**References:** RSS51

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**Name:** AMPTE/CCE  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 11 Nov 1984  
**Description:** Lost data modulation due to phantom command  
**Diagnosis:** ESD **Sure:** 0  
**Impact:** Operating procedures had to be changed to remain operational **Duration:** Unknown  
**Category:** Phantom commands  
**Comments:** None  
**References:** RSS13

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**Name:** AMPTE/CCE  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Apr 1988  
**Description:** The Command Processor system (CPS) No. 1 failed  
**Diagnosis:** Total Radiation Dose **Sure:** 0  
**Impact:** Switch to CPS No. 2 by the operators **Duration:** Unknown  
**Category:** System Failure  
**Comments:** Failure of CMOS PROM caused by cumulative radiation damage over 3.5 years in orbit  
**References:** RSS50

---

**Name:** Anik B  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 8 Feb 1986  
**Description:** Roll error, occurred twice  
**Diagnosis:** Magnetic Field Variability **Sure:** 0  
**Impact:** Roll control was maintained, using thrusters if necessary **Duration:** 1 hr to 1 day  
**Category:** Other  
**Comments:** Reaction of electromagnetic torquing control coils to a large geomagnetic disturbance  
**References:** RSS38

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**Name:** Anik B1

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** After Dec 1978

**Description:** One minor anomalous switching event.  
significant increase in operating temperature  
of various components. Thermal surfaces  
were degraded

**Diagnosis:** ESD Surface      **Sure:** 0

**Impact:** Unknown      **Duration:** Unknown

**Category:** Phantom commands

**Comments:** Localized discharges when the satellite was  
in eclipse

**References:** RSS12

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**Name:** Anik D2 (later ARABSAT 1D)

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 8 Mar 1985

**Description:** The despin control system malfunctioned and the platform on which the communications antenna was mounted began to spin, interrupting data transmission

**Diagnosis:** ESD Surface      **Sure:** 0

**Impact:** Although the satellite was eventually brought under control, fuel was used to correct the resulting wobble and a year of station keeping was lost. Also, a greater than expected degradation to mirrored surfaces was attributed to surface discharges in the thermal blanket      **Duration:** More than 1 wk

**Category:** Phantom commands

**Comments:** A large arc-discharge originating on the reflector at the back of the antenna or on the thermal shield at the front of the antenna

**References:** RSS12

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**Name:** Anik E1

**Commercial:**  **NASA/NOAA:**  **Scientific:**

**DoD:**  **Classified/Other:**  **Foreign:**

**Dates:** 20 Jan 1994

**Description:** Momentum wheel control circuits failed causing satellite to point away from the Earth

**Diagnosis:** ESD Internal **Sure:** 3

**Impact:** Eight hour loss of service. 56 TV channels and data and telephone service in northwestern Ontario, northern Quebec, the Northwest Territories and the Yukon **Duration:** 1 hr to 1 day

**Category:** System Failure

**Comments:** Internal discharges from an ungrounded spot shield. Full service was restored about 8 hours after the failure by successfully switching the momentum wheel control circuit to a backup on-board redundant circuit

**References:** HCK11, HCK12, HCK13, HCK14, HCK18, HCK28, RSS3, RSS4

---

**Name:** Anik E1

**Commercial:**

**NASA/NOAA:**

**Scientific:**

**DoD:**

**Classified/Other:**

**Foreign:**

**Dates:** 26 March 1996

**Description:** The 'south array' of solar power panels effectively disconnected from the battery charging system

**Diagnosis:** ESD Internal

**Sure:** 1

**Impact:** Anik was reduced to half its customary power supply. This resulted in immediate loss of transponder capability which could only be partially compensated by operators after some hours. Reduction by about two-thirds of its communication throughput capacity

**Duration:** Unknown

**Category:** System Failure

**Comments:** '..., it appears very probable that the high fluence of energetic electrons was related to the failure.'

**References:** HCK9, JHA9



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**Name:** Anik E2  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 20 January 1994  
**Description:** Main momentum wheel energy transfer control circuit and secondary back-up failed during same event. Burnout of CD4047 Monostable/A stable Multivibrator from ungrounded spot shield  
**Diagnosis:** ESD Internal **Sure:** 3  
**Impact:** Canadian Press, the countries biggest news service wasn't able to transmit data for more than seven hours to more than 100 newspapers and 400 radio stations. TV and Radio relay of CBC broadcasts were eliminated by the failures. Satellite valued at US\$228.8 million **Duration** 1 hr to 1 day  
**Category:** System Failure  
**Comments:** Engineers devised a ground based control system using the satellite's thruster motors to bring the satellite under control on 21 June and restore it to useful service in August. Five month effort and \$15M loss to company. Service life of satellite shortened by 1 year  
**References:** HCK11, HCK12, HCK13, HCK14, HCK16, HCK18, RSS3, RSS4, JHA21

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**Name:** Arabsat 1A

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 15 Mar 1985, 1 Jun 1986

**Description:** On 15 March lost power, attitude control and orbit gyros. On 1 June loss of Earth lock in the attitude control system

**Diagnosis:** ESD      **Sure:** 0

**Impact:** Manual North-South station keeping,      **Duration:** 1 day to 1 wk

**Category:** Other

**Comments:** Arab league communications satellite

**References:** RSS7,RSS11

---

**Name:** ATS 6

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** After May 1974

**Description:** The heat pipe gas reservoir ran hotter than normal due to degradation of the second surface mirrors (optical solar reflectors) that cover the reservoir's radiation

**Diagnosis:** Unknown      **Sure:** 0

**Impact:** Unknown      **Duration:** Unknown

**Category:** Other

**Comments:** American Test Satellite

**References:** RSS38

---

**Name:** AUSSAT A1

**Commercial:**  **NASA/NOAA:**  **Scientific:**

**DoD:**  **Classified/Other:**  **Foreign:**

**Dates:** Jan 1986 to Jun 1989

**Description:** Anomalous phantom commands that changed modes in the telemetry system and the attitude control system. 19 such events occurred

**Diagnosis:** ESD **Sure:** 0

**Impact:** Unknown **Duration:** Unknown

**Category:** Phantom commands

**Comments:** Australian Domestic Telecommunications Satellite

**References:** RSS7

---

**Name:** AUSSAT A2

**Commercial:**  **NASA/NOAA:**  **Scientific:**

**DoD:**  **Classified/Other:**  **Foreign:**

**Dates:** May 1986 to Jun 1990

**Description:** Anomalous phantom commands that affected the telemetry subcommutator and attitude control system. 33 such events occurred

**Diagnosis:** ESD **Sure:** 0

**Impact:** Unknown **Duration:** Unknown

**Category:** Phantom commands

**Comments:** Australian Domestic Telecommunications Satellite

**References:** RSS7

---

**Name:** AUSSAT A3

**Commercial:**  **NASA/NOAA:**  **Scientific:**

**DoD:**  **Classified/Other:**  **Foreign:**

**Dates:** Oct 1987 to Oct 1990

**Description:** Anomalous phantom commands that affected the telemetry subcommutator and attitude control system. 19 such events occurred

**Diagnosis:** ESD **Sure:** 0

**Impact:** Unknown **Duration:** Unknown

**Category:** Phantom commands

**Comments:** Australian Domestic Telecommunications Satellite

**References:** RSS7

---

**Name:** AUSSAT K1

**Commercial:**  **NASA/NOAA:**  **Scientific:**

**DoD:**  **Classified/Other:**  **Foreign:**

**Dates:** 11 Nov 1985

**Description:** Bit flip in Encoder Device

**Diagnosis:** SEU **Sure:** 1

**Impact:** Loss of telemetry for a few seconds **Duration:** Minimal

**Category:** Other

**Comments:** None

**References:** DCW15, JEM3

---

**Name:** Brazilsat A1  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 13 Aug 89; 19 Oct 89; 29 Sept 89  
**Description:** Degraded solar panel power generation  
**Diagnosis:** Solar Proton Event **Sure:** 2  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Solar Array Degradati  
**Comments:** None  
**References:** DCW16, JEM4

---

**Name:** BS 3A  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 22-31 March 1991  
**Description:** Lost power panel output. One-quarter of solar cells are unavailable  
**Diagnosis:** Solar Proton Event **Sure:** 2  
**Impact:** Forced reduction in the quantity of TV signals carried. Has severe power budget. Unable to continue its three-channel broadcasting from mid-May to mid-August **Duration:** Unknown  
**Category:** Solar Array Degradati  
**Comments:** Plan to reuse old BS 2B satellite for one channel until BS 3H is launched on April 19, 1991. (Japanese TV Satellite)  
**References:** HCK33, JHA2

---

**Name:** BS 3A (Japanese Broadcasting satellite)  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 22 Feb 1994  
**Description:** 60-minute telemetry outage  
**Diagnosis:** ESD **Sure:** 0  
**Impact:** 60-minute telemetry outage **Duration:** 10 min to 1 hr  
**Category:** Degraded Performanc  
**Comments:** None  
**References:** RSS2, RSS5, RSS6

---

**Name:** CRRES  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 30 March 1991  
**Description:** DTU #1 failed during support. Switched to DTU #2 at next contact  
**Diagnosis:** ESD Internal **Sure:** 2  
**Impact:** Loss of data until next contact (~2.5 hours) **Duration:** 1 hr to 1 day  
**Category:** System Failure  
**Comments:** Period of high relativistic electron fluxes following large March 1991 magnetic storm  
**References:** HCK22

---

**Name:** CRRES  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 17 May 1991  
**Description:** Telemetry lost. Reselecting and power cycling DTU #2 did not restore telemetry. Switched back to DTU #1 and telemetry was restored  
**Diagnosis:** ESD Internal **Sure:** 2  
**Impact:** 8000 seconds of data lost **Duration:** 1 hr to 1 day  
**Category:** System Failure  
**Comments:** Reference contains interesting copies of Initial Anomaly Reports  
**References:** HCK21

---

**Name:** CRRES  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 4 May 1991  
**Description:** Telemetry lost. DTU #2 was reselected. This restored telemetry  
**Diagnosis:** Unknown **Sure:** 0  
**Impact:** Temporary loss of data **Duration:** Unknown  
**Category:** Degraded Performanc  
**Comments:** None  
**References:** HCK21

---

**Name:** CRRES

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 7 April 1991

**Description:** AFGL 701-8 was found misconfigured one time

**Diagnosis:** ESD Internal      **Sure:** 2

**Impact:** Loss of data until next contact (contacts were ~11 hours apart)      **Duration:** 1 hr to 1 day

**Category:** Phantom commands

**Comments:** Period of high relativistic electron fluxes following large March 1991 magnetic storm

**References:** HCK22

---

**Name:** CRRES

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 4 April 1991

**Description:** AFGL 701-11A High Voltage Power Supply was found at the wrong level

**Diagnosis:** ESD Internal      **Sure:** 2

**Impact:** Loss of data until next contact (contacts were ~11 hours apart)      **Duration:** 1 hr to 1 day

**Category:** Phantom commands

**Comments:** Period of high relativistic electron fluxes following large March 1991 magnetic storm

**References:** HCK22



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**Name:** CRRES  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 3 April 1991  
**Description:** AFGL 701-6 was found in wrong mode (Mode 0) one time  
**Diagnosis:** ESD Internal **Sure:** 2  
**Impact:** Loss of data until next contact (contacts were ~11 hours apart) **Duration** 1 hr to 1 day  
**Category:** Phantom commands  
**Comments:** Period of high relativistic electron fluxes following large March 1991 magnetic storm  
**References:** HCK22

---

**Name:** CRRES  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 31 March 1991  
**Description:** CMOS time off by 15 seconds  
**Diagnosis:** ESD Internal **Sure:** 2  
**Impact:** Loss of data until next contact (contacts were ~11 hours apart) **Duration** 1 hr to 1 day  
**Category:** Degraded Performanc  
**Comments:** Period of high relativistic electron fluxes following large March 1991 magnetic storm  
**References:** HCK22

---

**Name:** CRRES  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 30 March 1991  
**Description:** PCU status BAD. Sent processor reset and V/T = 6  
**Diagnosis:** ESD Internal **Sure:** 2  
**Impact:** Loss of data until next contact (contacts were ~11 hours apart) **Duration:** 1 hr to 1 day  
**Category:** Phantom commands  
**Comments:** Period of high relativistic electron fluxes following large March 1991 magnetic storm  
**References:** HCK22

---

**Name:** CRRES  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 26 March to 10 April 1991  
**Description:** AFGL 701-2 found in wrong mode (CAL MODE) three times  
**Diagnosis:** ESD Internal **Sure:** 2  
**Impact:** Loss of data until next contact (contacts were ~11 hours apart) **Duration:** 1 hr to 1 day  
**Category:** Phantom commands  
**Comments:** Period of high relativistic electron fluxes following large March 1991 magnetic storm  
**References:** HCK22

---

**Name:** CRRES  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 26 March to 10 April 1991  
**Description:** PCU Status was bad three times  
**Diagnosis:** ESD Internal **Sure:** 2  
**Impact:** Loss of data until next contact (contacts were ~11 hours apart) **Duration** 1 hr to 1 day  
**Category:** Phantom commands  
**Comments:** Period of high relativistic electron fluxes following large March 1991 magnetic storm  
**References:** HCK22

---

**Name:** CRRES  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 26 March to 10 April 1991  
**Description:** ONR 307-3 found in improper mode (Load Mode) 21 times  
**Diagnosis:** ESD Internal **Sure:** 2  
**Impact:** Loss of data until next contact (contacts were ~11 hours apart) **Duration** 1 hr to 1 day  
**Category:** Phantom commands  
**Comments:** Period of high relativistic electron fluxes following large March 1991 magnetic storm  
**References:** HCK22

---

**Name:** CRRES  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 26 March to 10 April 1991  
**Description:** AFGL 701-15 was found misconfigured two times  
**Diagnosis:** ESD Internal **Sure:** 2  
**Impact:** Loss of data until next contact (contacts were ~11 hours apart) **Duration** 1 hr to 1 day  
**Category:** Phantom commands  
**Comments:** Period of high relativistic electron fluxes following large March 1991 magnetic storm  
**References:** HCK22

---

**Name:** CRRES  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 26 March to 10 April 1991  
**Description:** AFGL 701-14 found misconfigured 17 times  
**Diagnosis:** ESD Internal **Sure:** 2  
**Impact:** Loss of data each time until next contact (contacts were ~11 hours apart) **Duration** 1 hr to 1 day  
**Category:** Phantom commands  
**Comments:** Period of high relativistic electron fluxes following large March 1991 magnetic storm  
**References:** HCK22

---

**Name:** CRRES  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 26 March to 10 April 1991  
**Description:** AFGL 701-2 was off three times  
**Diagnosis:** ESD Internal **Sure:** 2  
**Impact:** Loss of data until next contact (contacts were ~11 hours apart) **Duration:** 1 hr to 1 day  
**Category:** Phantom commands  
**Comments:** Period of high relativistic electron fluxes following large March 1991 magnetic storm  
**References:** HCK22

---

**Name:** CRRES  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Jul 1990 TO Mar 1991  
**Description:** Bit flips  
**Diagnosis:** SEU **Sure:** 3  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Other  
**Comments:** Observed in each orbit with the 93422 and 931422 bipolar random access memories (RAM) being the most sensitive  
**References:** RSS46

---

**Name:** CRRES  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 30 March 1991  
**Description:** Tape Recorder #2 status unknown and readout commands nonfunctional  
**Diagnosis:** ESD Internal **Sure:** 2  
**Impact:** ?? Loss of T/R 2 ?? **Duration:** Unknown  
**Category:** System Failure  
**Comments:** Period of high relativistic electron fluxes following large March 1991 magnetic storm  
**References:** HCK22

---

**Name:** CS 3B  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 17 Mar 1989  
**Description:** Command Circuitry failed  
**Diagnosis:** ESD Internal **Sure:** 0  
**Impact:** Permanent lost of 1/2 of command circuitry on board **Duration:** Unknown  
**Category:** System Failure  
**Comments:** None  
**References:** JHA13, JHA15

---

**Name:** CTS  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** After Nov 1977  
**Description:** A transient event counter recorded 215 transient events in the wiring harnesses in the first year. A power diode failed causing a power bus burnout  
**Diagnosis:** ESD **Sure:** 3  
**Impact:** Unknown **Duration:** More than 1 wk  
**Category:** System Failure  
**Comments:** (Hermes, Canadian-American Communications Technology Satellite  
**References:** RSS26, RSS27

---

**Name:** DE 1  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** After Aug 1981  
**Description:** Unexplained 7 to 10 watt power increase on the spacecraft bus and apparent loss of microprocessor in the command and telemetry processor  
**Diagnosis:** SEU **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** System Failure  
**Comments:** Radiation 'hits' impinging on the spacecraft clock, etc. (Dynamics Explorer)  
**References:** RSS38

---

**Name:** DE 1  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 1982  
**Description:** Failure of high voltage power supply on the High Altitude Plasma Indicator (HAPI)  
**Diagnosis:** SEU **Sure:** 0  
**Impact:** Spacecraft was operating in degraded mode **Duration:** Unknown  
**Category:** System Failure  
**Comments:** (Dynamics Explorer)  
**References:** RSS56

---

**Name:** DFS 3  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Nov 95  
**Description:** Suffered a complete breakdown and started drifting uncontrollably  
**Diagnosis:** Unknown **Sure:** 0  
**Impact:** Mission Loss. Declared a total loss and conveyed to a graveyard orbit **Duration:** Mission loss  
**Category:** Mission Loss  
**Comments:** Deutsche Telekom  
**References:** JHA 18



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**Name:** DMSP  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Mar 89  
**Description:** Had trouble unloading torque due to the large ambient magnetic field changes in orbit  
**Diagnosis:** Magnetic Field Variability **Sure:** 0  
**Impact:** Unknown **Duration:** 1 hr to 1 day  
**Category:** Other  
**Comments:** Great magnetic storm  
**References:** JHA 15

---

**Name:** DMSP  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 24 Jul 97  
**Description:** Passive microwave sensor failure  
**Diagnosis:** ESD Internal **Sure:** 0  
**Impact:** Unknown **Duration:** More than 1 wk  
**Category:** System Failure  
**Comments:** None  
**References:** SWS1

---

**Name:** DMSP F-13

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 5 May 1995

**Description:** Latch-up of microwave imaging instrument (SSM/I) microprocessor. Required reset of instrument

**Diagnosis:** ESD Surface      **Sure:** 3

**Impact:** Loss of data until spacecraft recommended      **Duration:** 1 hr to 1 day

**Category:** Degraded Performanc

**Comments:** Diagnosed from SSJ/4 particle detector and RPA plasma measurements. Occurred in an intense auroral arc

**References:** PCA2

---

**Name:** DMSP F1

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 9 Aug 1979

**Description:** OLS reset while using backup encoder pulses

**Diagnosis:** SEU-Solar Proton Event      **Sure:** 3

**Impact:** Loss of data until recommended      **Duration:** 1 hr to 1 day

**Category:** Phantom commands

**Comments:** Reset due to processor upset by proton event

**References:** PCA1

---

**Name:** DMSP F10

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 19 Apr 93

**Description:** Channel loss on the high gain analog amplifier.

**Diagnosis:** ESD Surface      **Sure:** 2

**Impact:** Unknown      **Duration:** More than 1 wk

**Category:** System Failure

**Comments:** Increase in precipitating electron fluxes as the satellite traversed the auroral zone

**References:** SWS1

---

**Name:** DMSP F2

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 1977

**Description:** SSIE data degraded due to inaccurate calibration. Caused by static buildup on spacecraft

**Diagnosis:** Surface Charging      **Sure:** 2

**Impact:** Severe degradation of sensor data      **Duration:** More than 1 wk

**Category:** Degraded Performanc

**Comments:** Fixed on F4 by isolating ion probe from ground

**References:** PCA1

---

**Name:** DMSP F2

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 29 June 1977

**Description:** Celestial sensor (CSA) experienced false transits

**Diagnosis:** SEU      **Sure:** 3

**Impact:** Loss of pointing accuracy. Important for imaging sensors. Honeywell designed CSA mod for F5      **Duration:** Unknown

**Category:** Phantom commands

**Comments:** Proton hits outside South Atlantic Anomaly

**References:** PCA1

---

**Name:** DMSP F2

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 22 Sept 1977

**Description:** Primary attitude sensor reset several times in South Atlantic Anomaly

**Diagnosis:** SEU-South Atlantic Anomaly      **Sure:** 3

**Impact:** Loss of pointing accuracy. Important for imaging sensors      **Duration:** Unknown

**Category:** Degraded Performanc

**Comments:** Incorporated software change to star fix

**References:** PCA1

---

**Name:** DMSP F2

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 22 Dec 1978

**Description:** Spacecraft rose with main memory off and recorders and data transmitters not operating per the stored commands

**Diagnosis:** SEU      **Sure:** 1

**Impact:** Loss of data until recommended      **Duration:** 1 hr to 1 day

**Category:** Phantom commands

**Comments:** Probably due to proton stimulated processor error

**References:** PCA1

---

**Name:** DMSP F2

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 31 May 1978

**Description:** Long OLS (Operational Linescan System) auto restart. Approx 2 min compared to normal 15 to 40 sec

**Diagnosis:** SEU      **Sure:** 1

**Impact:** Minimal      **Duration:** Less than 10 min

**Category:** Other

**Comments:** May be due to unusual pattern of proton effects. No indication of system failure

**References:** PCA1

---

**Name:** DMSP F3  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 17 Sept 1979  
**Description:** OLS soft reset  
**Diagnosis:** SEU **Sure:** 3  
**Impact:** Minimal **Duration:** Unknown  
**Category:** Other  
**Comments:** None  
**References:** PCA1

---

**Name:** DMSP F3  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 17 Sept 1979  
**Description:** OLS reset, tape recorder PR3 turned off without command  
**Diagnosis:** SEU **Sure:** 3  
**Impact:** Loss of data until recommended **Duration:** 1 hr to 1 day  
**Category:** Phantom commands  
**Comments:** None  
**References:** PCA1

---

**Name:** DMSP F6  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 12 Oct 1983  
**Description:** Spacecraft switched from PRADS to basic attitude mode  
**Diagnosis:** SEU **Sure:** 2  
**Impact:** Loss of pointing accuracy. Important for imaging sensors **Duration** 1 hr to 1 day  
**Category:** Phantom commands  
**Comments:** Proton activity  
**References:** PCA1

---

**Name:** DMSP F6  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 7 Feb 1983  
**Description:** OLS reset  
**Diagnosis:** SEU-South Atlantic Anomaly **Sure:** 3  
**Impact:** Data lost until spacecraft recomanded **Duration** 1 hr to 1 day  
**Category:** Phantom commands  
**Comments:** Consistently occurs in South Atlantic Anomaly  
**References:** PCA1

---

**Name:** DMSP F6  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 7 Feb 1983  
**Description:** OLS reset  
**Diagnosis:** SEU-South Atlantic Anomaly **Sure:** 3  
**Impact:** Data lost until spacecraft recommended **Duration:** 1 hr to 1 day  
**Category:** Degraded Performanc  
**Comments:** Consistently occurs in South Atlantic Anomaly  
**References:** PCA1

---

**Name:** DMSP F6  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 27 Dec 1982  
**Description:** Celestial sensor (CSA) producing false star transits  
**Diagnosis:** SEU **Sure:** 3  
**Impact:** Reduced pointing accuracy . Important for imaging sensors **Duration:** Unknown  
**Category:** Degraded Performanc  
**Comments:** CSA modified after similar anomalies on F2 and F3. Starfix module was enabled. Proton Activity  
**References:** PCA1



---

**Name:** DMSP FLT 13  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 14 Aug 96  
**Description:** Sensor package went off-line  
**Diagnosis:** SEU **Sure:** 2  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Phantom commands  
**Comments:** None  
**References:** SWS1

---

**Name:** DMSP FLT 13  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 02 Dec 96  
**Description:** Gyro fluctuations and erratic spinning of the SSMI microwave imager resulting in the SSMI going off line  
**Diagnosis:** ESD Surface **Sure:** 1  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Degraded Performanc  
**Comments:** None  
**References:** SWS1

---

**Name:** DMSP FLT 8  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 15 Feb 94  
**Description:** Microprocessor lock-up on the microwave imaging system  
**Diagnosis:** ESD Internal **Sure:** 2  
**Impact:** Unknown **Duration:** 1 hr to 1 day  
**Category:** Degraded Performanc  
**Comments:** Very large increase in 10-30 KeV electrons may have resulted in this anomaly  
**References:** SWS1

---

**Name:** DRA Delta  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** June 1994 to 1995  
**Description:** 120 identical status switching anomalies; phantom commands disable logic in the Attitude Measurement Equipment  
**Diagnosis:** ESD Internal **Sure:** 3  
**Impact:** Little operational impact **Duration:** Minimal  
**Category:** Phantom commands  
**Comments:** GEO s/ c of Defense Research Aging, Farnborough, England  
**References:** JEM5

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**Name:** DSCC III FLT (B-10)  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 14 Mar 94  
**Description:** Upset of attitude control system  
**Diagnosis:** ESD Internal **Sure:** 2  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Other  
**Comments:** Significantly enhanced energetic electron fluxes  
**References:** SWS1

---

**Name:** DSCS A2  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 23-25 September 1991  
**Description:** CPU Failure  
**Diagnosis:** Unknown **Sure:** 0  
**Impact:** Unknown **Duration:** More than 1 wk  
**Category:** System Failure  
**Comments:** None  
**References:** RSS7

---

**Name:** DSCS II  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 14 Sep 95  
**Description:** Command Path-Electric Interface Assembly length checks and address check areas  
**Diagnosis:** ESD Internal **Sure:** 3  
**Impact:** None **Duration:** Unknown  
**Category:** Other  
**Comments:** >2 MeV electrons enhanced  
**References:** SWS1

---

**Name:** DSCS II  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 08 Apr 95  
**Description:** Anomalous NUDET detection  
**Diagnosis:** ESD Internal **Sure:** 1  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Spurious Signal  
**Comments:** Significant >2 MeV electron enhancements  
**References:** SWS1

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**Name:** DSCS II (9431)

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 2 June 1973

**Description:** Satellite failed because power to its communications subsystem was suddenly interrupted

**Diagnosis:** ESD Surface      **Sure:** 3

**Impact:** Mission Loss. Initiated joint NASA and Air Force spacecraft charging investigation. High energy discharge caused by spacecraft charging as a result of a geomagnetic substorm      **Duration:** Mission loss

**Category:** Mission Loss

**Comments:** None

**References:** RSS31,RSS32

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**Name:** DSCS II (9438)

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** Nov and Dec 1986

**Description:** Low level logic glitches

**Diagnosis:** ESD Internal      **Sure:** 0

**Impact:** Unknown      **Duration:** Unknown

**Category:** Other

**Comments:** None

**References:** RSS7

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**Name:** DSCS II (9442)  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Nov 1986 and Mar 1987  
**Description:** Low level logic glitches  
**Diagnosis:** ESD Internal **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Other  
**Comments:** None  
**References:** RSS7

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**Name:** DSCS II (9443)  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Mar and Jul 1987  
**Description:** Low level logic glitches  
**Diagnosis:** ESD Internal **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Other  
**Comments:** None  
**References:** RSS7

---

**Name:** DSCS II B7

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 26 March 1996

**Description:** Attitude Control Electronics failed

**Diagnosis:** ESD Surface      **Sure:** 0

**Impact:** Unknown      **Duration:** More than 1 wk

**Category:** System Failure

**Comments:** Suggestive evidence that the anomaly could have been caused by surface charging. The surface of the vehicle as measured by an onboard sensor was charged to about 3 kV at the time of the anomaly

**References:** HCK3

---

**Name:** DSCS III

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 22 June 1994, 6 July 1994, 16 Oct 1994, 24

**Description:** NUDET event processing caused patch to disable

**Diagnosis:** ESD Internal      **Sure:** 3

**Impact:** 10/16/94 caused RAM patch to be disabled. RAM patch had to be restored. 10/24/94 EYC disabled. Support scheduled to execute 'EYC not -enabled' contingency      **Duration:** More than 1 wk

**Category:** Degraded Performanc

**Comments:** Possible attitude loss of yaw control due to NUDET event processing

**References:** HCK5, HCK6

---

**Name:** DSCS III  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 10 Nov 95  
**Description:** Software detected fault in the logic circuit caused shutdown of the RAM-PATCH module  
**Diagnosis:** ESD Internal **Sure:** 3  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Degraded Performanc  
**Comments:** >2 MeV electrons significantly enhanced  
**References:** SWS1

---

**Name:** DSCS III  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 09 Nov 95  
**Description:** CPU cycle time over  
**Diagnosis:** ESD Internal **Sure:** 1  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Other  
**Comments:** >2 MeV electrons elevated  
**References:** SWS1



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**Name:** DSCS III (4524 )  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Dec 1986 to Jan 1987  
**Description:** Glitches in the tachometer system (10)  
**Diagnosis:** ESD Internal **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Other  
**Comments:** None  
**References:** RSS7

---

**Name:** DSCS III (4524)  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** several from 16 Dec 1986 to 16 May 1987  
**Description:** Tachometer problem  
**Diagnosis:** Unknown **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Other  
**Comments:** None  
**References:** RSS7

---

**Name:** DSCS III B-7  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 26 Mar 96  
**Description:** CPU error and altitude control excursion  
**Diagnosis:** ESD Internal **Sure:** 3  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Degraded Performanc  
**Comments:** None  
**References:** SWS1

---

**Name:** DSCS III B-9  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 24 mar 96 & 25 Mar 96  
**Description:** Telemetry problems  
**Diagnosis:** ESD Internal **Sure:** 1  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Degraded Performanc  
**Comments:** Other satellites in close proximity experienced no injections, B-9 has been exposed to greater injections in the past with no problems experienced  
**References:** SWS1

---

**Name:** DSCS III B4 & B9

**Commercial:**  **NASA/NOAA:**  **Scientific:**

**DoD:**  **Classified/Other:**  **Foreign:**

**Dates:** 30 Mar 1994, 15 May 1994, 11 Sept 1994, 3

**Description:** KI-31 autonomously switched from using the satellites master clock to its own internal oscillator

**Diagnosis:** SEU **Sure:** 0

**Impact:** Command access to vehicle lost on 9/11/94 until the KI-31 was commanded back(?). On 10/3/94 had to use ACE mitigation plan to switch back to frequency standard **Duration** 1 hr to 1 day

**Category:** Phantom commands

**Comments:** Probably no user impact

**References:** HCK4

---

**Name:** DSCS III FLT 17

**Commercial:**  **NASA/NOAA:**  **Scientific:**

**DoD:**  **Classified/Other:**  **Foreign:**

**Dates:** 03 Oct 94

**Description:** K1-31 switch from the master clock to the internal oscillator

**Diagnosis:** ESD **Sure:** 2

**Impact:** Unknown **Duration** Unknown

**Category:** Phantom commands

**Comments:** Significantly enhanced geomagnetic and energetic particle environment

**References:** SWS1

---

**Name:** DSCS III FLT 21  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 08 Oct 96  
**Description:** RAM patch disable  
**Diagnosis:** ESD **Sure:** 3  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Degraded Performanc  
**Comments:** None  
**References:** SWS1

---

**Name:** DSCS III FLT 23  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 24 Oct 94  
**Description:** Enhanced Yaw Control Patch to Disable  
**Diagnosis:** Unknown **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Degraded Performanc  
**Comments:** Spacecraft charging or SEU  
**References:** SWS1

---

**Name:** DSCS III FLT 23  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 24 Oct 94  
**Description:** Enhanced Yaw Control Patch disabled (due to NUDET event processing)  
**Diagnosis:** ESD **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Degraded Performanc  
**Comments:** Significantly disturbed geomagnetic and energetic particle environment  
**References:** SWS1

---

**Name:** DSCS III FLT 23  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 11 May 95  
**Description:** Uncommanded internal oscillator swap  
**Diagnosis:** ESD Internal **Sure:** 1  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Phantom commands  
**Comments:** None  
**References:** SWS1

---

**Name:** DSCS-III FLT 21  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 01 Oct 97  
**Description:** Anomalous Nuclear Event Detector Trip  
**Diagnosis:** ESD Internal **Sure:** 3  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Spurious Signal  
**Comments:** Enhanced energetic particle environment. >2 MeV  
**References:** SWS1

---

**Name:** DSP F?  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** ?  
**Description:** Sensor Temp Monitor Shift in Calibration  
**Diagnosis:** ESD Surface **Sure:** 1  
**Impact:** None **Duration:** Unknown  
**Category:** Degraded Performanc  
**Comments:** Anomalies correlate with occurrence of focal plane strobes which are thought to be caused by charging  
**References:** JLR18

---

**Name:** DSP F1

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 1 July 1971

**Description:** False trigger signals in MIIIB Control Counter Monitor

**Diagnosis:** ESD Surface      **Sure:** 2

**Impact:** Only annoyance to spacecraft controllers      **Duration:** Unknown

**Category:** Spurious Signal

**Comments:** Correlation of many events with Ap index and local time occurrence in 2300-0600 sector

**References:** JLR1

---

**Name:** DSP F10

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** June 15, 1983

**Description:** Uncommanded Mode Switch

**Diagnosis:** ESD Surface      **Sure:** 2

**Impact:** None      **Duration:** Unknown

**Category:** Degraded Performanc

**Comments:** Onboard detectors saturated. Suggestive correlation of anomaly with electron data from other DSP satellites

**References:** JLR17

---

**Name:** DSP F2

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 18 & 20 May 1971

**Description:** Digital Telemetry Unit subcom B calibration change (partial short)

**Diagnosis:** ESD Surface      **Sure:** 0

**Impact:** Only annoyance to spacecraft controllers.  
Re-interpretation of housekeeping channels      **Duration** More than 1 wk

**Category:** Degraded Performanc

**Comments:** No engineering reason for short, so it must be the environment

**References:** JLR2

---

**Name:** DSP F2

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** Various

**Description:** Noise Strobes over Focal Plane

**Diagnosis:** ESD Surface      **Sure:** 1

**Impact:** Bad data removed by ground processing      **Duration** 1 hr to 1 day

**Category:** Spurious Signal

**Comments:** Local time distribution centers at midnight to dawn sector

**References:** JLR3



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**Name:** DSP F2  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** February 13-14, 1978  
**Description:** Excessive Star Sensor Output  
**Diagnosis:** Solar Proton Event **Sure:** 3  
**Impact:** Intermittent loss of data totaling 900 s **Duration:** 10 min to 1 hr  
**Category:** Spurious Signal  
**Comments:** Must use backup attitude processing algorithms instead of primary method  
**References:** JLR4

---

**Name:** DSP F3  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** March 3, 1974  
**Description:** Mission IIIB Sensor Degradation  
**Diagnosis:** Total Radiation Dose **Sure:** 0  
**Impact:** Loss of redundant sensor (one of three) **Duration:** More than 1 wk  
**Category:** Random Part Failure  
**Comments:** No coincident particle data but similar degradation observed during May and August 1972 particle events  
**References:** JLR5

---

**Name:** DSP F3  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Various  
**Description:** Noise Strobes over Focal Plane  
**Diagnosis:** ESD Surface **Sure:** 1  
**Impact:** Bad data removed by ground processing **Duration:** 1 hr to 1 day  
**Category:** Spurious Signal  
**Comments:** Local time distribution centers at midnight to dawn sector  
**References:** JLR3

---

**Name:** DSP F4  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Various  
**Description:** Noise Strobes over Focal Plane  
**Diagnosis:** ESD Surface **Sure:** 1  
**Impact:** Bad data removed by ground processing **Duration:** Unknown  
**Category:** Spurious Signal  
**Comments:** Local time distribution centers at midnight to dawn sector  
**References:** JLR3

---

**Name:** DSP F4  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** July 6, 1973 0840 UT  
**Description:** Focal Plane Heater Inadvertent Inhibit  
**Diagnosis:** ESD Surface **Sure:** 1  
**Impact:** Annoyance to ground controller **Duration:** Unknown  
**Category:** Phantom commands  
**Comments:** Poor correlation with Kp and ground magnetograms  
**References:** JLR6

---

**Name:** DSP F4  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** June 4, 1974 0107 UT  
**Description:** Star Sensor Threshold Level Uncommanded Change  
**Diagnosis:** ESD Surface **Sure:** 1  
**Impact:** None **Duration:** Unknown  
**Category:** Phantom commands  
**Comments:** No supporting particle data. Anomaly correlated with focal plane strobes thought to be caused by charging  
**References:** JLR7

---

**Name:** DSP F4  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** July 3, 1973 0125 UT  
**Description:** SRI QCM Inadvertently Turned Off  
**Diagnosis:** ESD Surface **Sure:** 0  
**Impact:** None **Duration:** Unknown  
**Category:** Phantom commands  
**Comments:** Local time occurrence of event in midnight sector  
**References:** JLR8

---

**Name:** DSP F6  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** January 30, 1977  
**Description:** IR Noise Bursts  
**Diagnosis:** ESD Surface **Sure:** 1  
**Impact:** Removed from data by ground processing **Duration:** Unknown  
**Category:** Spurious Signal  
**Comments:** Local time distribution is midnight to dawn sector  
**References:** JLR9

---

**Name:** DSP F6

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** March 28 , 1983

**Description:** Earth Sensor Assembly A Failure

**Diagnosis:** ESD Surface      **Sure:** 1

**Impact:** Loss of Earth lock and data for 24 h. Loss of subsystem redundancy      **Duration** 1 hr to 1 day

**Category:** System Failure

**Comments:** Coincident with end of eclipse interval.  
Weak correlation with electron data from other satellites

**References:** JLR10

---

**Name:** DSP F6

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** Jan 8, 1985 1730-2030 UT

**Description:** Earth Sensor Assembly B Failure

**Diagnosis:** ESD Surface      **Sure:** 1

**Impact:** Loss of attitude subsystem redundancy      **Duration** More than 1 wk

**Category:** System Failure

**Comments:** Anomaly time uncertain within 3 hours. Two substorm electron injections during this interval from measurements on other satellites

**References:** JLR11

---

**Name:** DSP F6  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** February 13-14, 1978  
**Description:** Excessive Star Sensor Output  
**Diagnosis:** Solar Proton Event **Sure:** 3  
**Impact:** Intermittent loss of data totaling 900 s **Duration:** 10 min to 1 hr  
**Category:** Spurious Signal  
**Comments:** Must use backup attitude processing algorithms instead of primary method  
**References:** JLR4

---

**Name:** DSP F7  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Jan 24, 1985  
**Description:** Earth Sensor Assembly B Failure  
**Diagnosis:** ESD Surface **Sure:** 0  
**Impact:** Software changes required to continue mission **Duration:** More than 1 wk  
**Category:** System Failure  
**Comments:** No supporting particle data but "similar" to previous Anomaly 1097 which was suspected as surface charging  
**References:** JLR12

---

**Name:** DSP F7  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Dec 3, 1983  
**Description:** Link 2 Quality Alarms, Intermittent Signal Strength  
**Diagnosis:** ESD Surface **Sure:** 1  
**Impact:** Degraded data quality for several hours **Duration:** 1 hr to 1 day  
**Category:** Degraded Performanc  
**Comments:** Correlation between alarms and electron flux from onboard detector not very consistent  
**References:** JLR14

---

**Name:** DSP F7  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** February 13-14, 1978  
**Description:** Excessive Star Sensor Output  
**Diagnosis:** Solar Proton Event **Sure:** 3  
**Impact:** Intermittent loss of data totaling 900 s **Duration:** 10 min to 1 hr  
**Category:** Spurious Signal  
**Comments:** Must use backup attitude processing algorithms instead of primary method  
**References:** JLR4

---

**Name:** DSP F7

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** Nov 9-10, 1983

**Description:** Earth Sensor Assembly A Failure

**Diagnosis:** ESD Surface      **Sure:** 3

**Impact:** Loss of Earth lock and data for 1800 s      **Duration** 10 min to 1 hr

**Category:** System Failure

**Comments:** Correlation of two events with peaks in electron flux from onboard detector good within several minutes

**References:** JLR13

---

**Name:** DSP F9

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** Feb 10 , 1983 1200 UT

**Description:** Crypto Power Supply KPP-29A-A Anomalous Turn-on and Failure

**Diagnosis:** ESD Surface      **Sure:** 3

**Impact:** Loss of command subsystem redundancy      **Duration** More than 1 wk

**Category:** System Failure

**Comments:** Strong correlation of two anomaly events with electron flux peak from on-board detector

**References:** JLR15



---

**Name:** DSP F9

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** October 7, 1982

**Description:** Crypto Power Supply KPP-29A-B Failure

**Diagnosis:** ESD Surface      **Sure:** 3

**Impact:** Loss of command subsystem redundancy      **Duration:** More than 1 wk

**Category:** System Failure

**Comments:** Strong correlation of failure with electron flux peak from on-board detector

**References:** JLR16

---

**Name:** DSP PAR 4

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 14 Sep 95

**Description:** Current spike on primary bus current

**Diagnosis:** ESD Internal      **Sure:** 1

**Impact:** Unknown      **Duration:** Unknown

**Category:** Spurious Signal

**Comments:** Injection 51-107 KeV and 107-315 KeV electrons

**References:** SWS1

---

**Name:** ERBS  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 1 Nov 1984  
**Description:** Bit changes in block (delta time) section of both command memories. There were 142 'hits' recorded to date  
**Diagnosis:** SEU **Sure:** 1  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Degraded Performanc  
**Comments:** Earth Radiation Budget Satellite  
**References:** RSS51

---

**Name:** ERBS  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 7 Oct 1993  
**Description:** Anomalous changes in chips located in the Command Storage Memory  
**Diagnosis:** Unknown **Sure:** 0  
**Impact:** CSM-2 unreliable and time tags changed. Stop use of CSM-2 and use only CSM-1 **Duration:** More than 1 wk  
**Category:** System Failure  
**Comments:** Noise and radiation. (Earth Radiation budget Satellite)  
**References:** RSS33

---

**Name:** ERS-1

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** After Jul 1991

**Description:** A Precision Range Rate Equipment (PRARE) instrument failed following a transient high current event

**Diagnosis:** SEU-South Atlantic Anomaly      **Sure:** 0

**Impact:** Unknown      **Duration:** More than 1 wk

**Category:** System Failure

**Comments:** (European Space Agency Remote Sensing satellite)

**References:** RSS45

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**Name:** ETS-6 (Japanese Engineering Test Satellite)

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 11 Jul 1979

**Description:** Reduced effectiveness of solar panels

**Diagnosis:** Radiation Damage      **Sure:** 3

**Impact:** Satellite lifetime reduced      **Duration:** More than 1 wk

**Category:** Solar Array Degradati

**Comments:** Satellite failed to reach geostationary orbit and high Van Allen Belt radiation levels quickly eroded the efficiency of the solar panels

**References:** RSS42

---

**Name:** EUVE  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Nov 1993  
**Description:** 'Clam-up' (all detector doors shut). Payload put into pre-launch mode  
**Diagnosis:** SEU **Sure:** 0  
**Impact:** System restored to normal on day of each anomaly with no damage **Duration:** 1 hr to 1 day  
**Category:** Phantom commands  
**Comments:** (Extreme Ultraviolet Explorer)  
**References:** RSS33

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**Name:** F2, F3, F4  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 8,9,10 September 1984  
**Description:** Observed in telemetry  
**Diagnosis:** Unknown **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Other  
**Comments:** Period of unusually high solar and geomagnetic activity  
**References:** HCK19

---

**Name:** FLTSATCOM  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 2/11/87, 3/3/87, 5/10/87, 6/12/87, 6/20/87  
**Description:** Low level logic problems  
**Diagnosis:** ESD Internal **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Spurious Signal  
**Comments:** None  
**References:** RSS7

---

**Name:** FLTSATCOM 6071  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Mar to Jun 1987  
**Description:** Low level logic anomalies  
**Diagnosis:** ESD Internal **Sure:** 0  
**Impact:** System restored to normal on day of each anomaly with no damage **Duration:** 1 hr to 1 day  
**Category:** Spurious Signal  
**Comments:** Five deep dielectric charging events  
**References:** RSS7

---

**Name:** FLTSATCOM-1  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 12 May 95  
**Description:** Relay flip switch  
**Diagnosis:** ESD Internal **Sure:** 1  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Phantom commands  
**Comments:** >2 MeV electrons enhanced for 9 days prior to anomaly  
**References:** SWS1

---

**Name:** FY-1  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 15 Oct 1988  
**Description:** Failure of attitude control system  
**Diagnosis:** ESD **Sure:** 0  
**Impact:** Mission Loss **Duration:** Mission loss  
**Category:** Mission Loss  
**Comments:** Fengyun-1, Chinese experimental weather satellite  
**References:** HCK36, RSS7

---

**Name:** GEO spacecraft (13 commercial)  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 29-30 September 1989  
**Description:** SEUs  
**Diagnosis:** SEU-Solar Proton Event **Sure:** 2  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Unknown  
**Comments:** None  
**References:** HCK33

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**Name:** GEO spacecraft (7 commercial)  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 13-14 Mar 89  
**Description:** Problems maintaining operational attitude orientation within specified ranges  
**Diagnosis:** Magnetic Field Variability **Sure:** 0  
**Impact:** Required 177 manual operator interventions to make thruster adjustments in orbit to maintain the required attitude **Duration:** 1 hr to 1 day  
**Category:** Degraded Performanc  
**Comments:** More than is normally required of controllers during a year of routine observations  
**References:** JHA15

---

**Name:** GEO spacecraft (commercial)  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 22-31 March 1991  
**Description:** L-band amplifier failed  
**Diagnosis:** Unknown **Sure:** 0  
**Impact:** Unknown **Duration:** More than 1 wk  
**Category:** System Failure  
**Comments:** None  
**References:** HCK33

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**Name:** GEO spacecraft (commercial)  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 22-30 May 1991  
**Description:** L-band amplifier loss  
**Diagnosis:** Unknown **Sure:** 0  
**Impact:** Unknown **Duration:** More than 1 wk  
**Category:** System Failure  
**Comments:** None  
**References:** JHA20



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**Name:** GEO spacecraft (various commercial)  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 19-29 October 1989  
**Description:** Pitch glitches and SEUs  
**Diagnosis:** SEU-Solar Proton Event **Sure:** 2  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Degraded Performanc  
**Comments:** None  
**References:** HCK33

---

**Name:** GMS-3  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:**  
**Description:** Severe scintillation  
**Diagnosis:** Ionospheric Scintillations **Sure:** 0  
**Impact:** Data transmissions were lost for 1 hour **Duration:** 10 min to 1 hr  
**Category:** Degraded Performanc  
**Comments:** None  
**References:** JHA15 (?)

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**Name:** GMS-3  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Sept 1984-Jan 1989  
**Description:** phantom commands  
**Diagnosis:** ESD Surface **Sure:** 1  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Phantom commands  
**Comments:** None  
**References:** JEM7

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**Name:** GMS-3  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Dec 1984 to Aug 1985  
**Description:** Multiple anomalous switching events in the accelerometer. Anomalous gain level stepping the Visible Infrared Spin Scan Radiometer  
**Diagnosis:** ESD Internal **Sure:** 2  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Phantom commands  
**Comments:** (Japanese Geostationary Meteorological Satellite , Himawari 3)  
**References:** RSS7, DCW4

---

**Name:** GMS-4

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** Jan and Jul 1991

**Description:** The Visible Infrared Spin Scan Radiometer gain setting experienced an anomalous change in state

**Diagnosis:** ESD      **Sure:** 0

**Impact:** Unknown      **Duration:** Unknown

**Category:** Phantom commands

**Comments:** (Japanese Meteorological Satellite, Himawari 4)

**References:** RSS7

---

**Name:** GOES -8

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 18 & 20 Apr 94

**Description:** Attitude orbital control system experienced uncommanded thruster burns

**Diagnosis:** ESD Internal      **Sure:** 1

**Impact:** Unknown      **Duration:** Unknown

**Category:** Phantom commands

**Comments:** Uncommanded thruster burns while in transfer orbit. C.F. Falcon AFB assessment 5/17/94 & attached reference

**References:** SWS1

---

**Name:** GOES-4  
**Commercial:**       **NASA/NOAA:**       **Scientific:**   
**DoD:**       **Classified/Other:**       **Foreign:**   
**Dates:** 29 Mar 1981 to 26 Nov 1982  
**Description:** The mirror used with the visible Spin Scan Radiometer Atmospheric Sounder, the principle (VISSR) instrument on the spacecraft, suffered phantom commands that began a sudden, undesired repositioning. Eventually it failed completely on 11/26/82  
**Diagnosis:** ESD Surface      **Sure:** 0  
**Impact:** New commands were issued by controllers on Earth. Finally taken out of service. The ungrounded radiator was redesigned on GOES-5 before its launch      **Duration** Mission loss  
**Category:** Mission Loss  
**Comments:** Mission Loss. Led to the development of the spacecraft anomaly database at NOAA. A portion of the VAS second stage radiation cooler was ungrounded and built up potential from the surrounding plasma until it discharged, creating a large electromagnetic pulse (Geostationary Operational Environmental Satellite)  
**References:** RSS20, RSS21

---

**Name:** GOES-5  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** various from 8/20/81 to 4/3/84  
**Description:** Channel 7 gain stepped from 2 to 3 (48 times)  
**Diagnosis:** ESD Surface **Sure:** 3  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Phantom commands  
**Comments:** None  
**References:** RSS7, HCK25

---

**Name:** GOES-5  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 19-22 March 1990  
**Description:** Power panel output degradation  
**Diagnosis:** Radiation Damage-Solar Proton Event **Sure:** 3  
**Impact:** Unknown **Duration:** More than 1 wk  
**Category:** Solar Array Degradati  
**Comments:** None  
**References:** HCK33

---

**Name:** GOES-5  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 19 Oct 1989  
**Description:** A major solar flare on 19 Oct degraded the solar array by about 0.5 amps  
**Diagnosis:** Radiation Damage-Solar Proton Event **Sure:** 3  
**Impact:** Unknown **Duration:** More than 1 wk  
**Category:** Solar Array Degradati  
**Comments:** None  
**References:** RSS49

---

**Name:** GOES-5  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 1989  
**Description:** The Central Telemetry Unit (CTU) experienced 4 SEUs  
**Diagnosis:** SEU-Cosmic Ray **Sure:** 2  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Unknown  
**Comments:** None  
**References:** RSS49

---

**Name:** GOES-5  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 1989  
**Description:** The Central Telemetry Unit (CTU) experienced six SEUs which were associated with solar flares  
**Diagnosis:** SEU-Solar Proton Event **Sure:** 2  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Unknown  
**Comments:** None  
**References:** RSS49

---

**Name:** GOES-5 & 6  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 19-29 October 1989  
**Description:** SEUs  
**Diagnosis:** SEU-Solar Proton Event **Sure:** 2  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Unknown  
**Comments:** Unknown  
**References:** HCK33

---

**Name:** GOES-6  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 12-21 August 1989  
**Description:** Power Panel output degradation  
**Diagnosis:** Radiation Damage-Solar Proton Event **Sure:** 3  
**Impact:** Unknown **Duration:** More than 1 wk  
**Category:** Solar Array Degradati  
**Comments:** None  
**References:** HCK33

---

**Name:** GOES-6  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 22-30 Mar 91  
**Description:** Power Panel Output Degradation  
**Diagnosis:** Radiation Damage-Solar Proton Event **Sure:** 3  
**Impact:** Equal to 3-year loss **Duration:** More than 1 wk  
**Category:** Solar Array Degradati  
**Comments:** None  
**References:** JHA20



---

**Name:** GOES-6  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 19-22 March 1990  
**Description:** Power panel output degradation  
**Diagnosis:** Radiation Damage-Solar Proton Event **Sure:** 3  
**Impact:** Equivalent to 3 years lost from end of life **Duration:** More than 1 wk  
**Category:** Solar Array Degradati  
**Comments:** None  
**References:** HCK33

---

**Name:** GOES-6  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 9 Mar 1988  
**Description:** The telemetry was permanently degraded  
**Diagnosis:** SEU **Sure:** 0  
**Impact:** Loss of several analog and digital channels **Duration:** More than 1 wk  
**Category:** System Failure  
**Comments:** None  
**References:** RSS50

---

**Name:** GOES-6  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 27 Sep 1986, 17 Mar 1986  
**Description:** Uncommanded shift in visible Infrared Spin Scan Radiometer Atmospheric sounder (VAS) Earth window. X-ray scan shifted to calibration mode  
**Diagnosis:** ESD **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Phantom commands  
**Comments:** None  
**References:** RSS7, RSS15

---

**Name:** GOES-6  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 7 Jul 1984  
**Description:** Loss of pulse code modulated telemetry  
**Diagnosis:** SEU **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** System Failure  
**Comments:** None  
**References:** RSS51

---

**Name:** GOES-6  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 12-21 August 1989  
**Description:** Lost half of telecommunications system  
**Diagnosis:** Unknown **Sure:** 0  
**Impact:** Unknown **Duration:** More than 1 wk  
**Category:** System Failure  
**Comments:** None  
**References:** HCK33, JHA20

---

**Name:** GOES-7  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 26 Feb 1989  
**Description:** The VAS digital multiplexer bit mode command failed after the satellite came out of eclipse  
**Diagnosis:** ESD Surface **Sure:** 1  
**Impact:** Unknown **Duration:** More than 1 wk  
**Category:** Random Part Failure  
**Comments:** This satellite experienced several discharge events in 1987-9 that resulted in phantom commands  
**References:** RSS7, RSS9

---

**Name:** GOES-7  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 12 Mar 89  
**Description:** Communications Circuit Anomaly  
**Diagnosis:** Unknown **Sure:** 0  
**Impact:** Lost imagery **Duration:** Unknown  
**Category:** System Failure  
**Comments:** None  
**References:** JHA15

---

**Name:** GOES-7  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 19-30 Oct 89  
**Description:** Solar Array power degradation  
**Diagnosis:** Radiation Damage-Solar Proton Event **Sure:** 3  
**Impact:** 6 year's equivalent lifetime lost **Duration:** More than 1 wk  
**Category:** Solar Array Degradati  
**Comments:** None  
**References:** JHA15

---

**Name:** GOES-7  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 19-22 March 1990  
**Description:** Power panel output degradation  
**Diagnosis:** Radiation Damage-Solar Proton Event **Sure:** 3  
**Impact:** Equal to 3-years loss **Duration:** More than 1 wk  
**Category:** Solar Array Degradati  
**Comments:** None  
**References:** HCK33, JHA20

---

**Name:** GOES-7  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 22-24 March 1991  
**Description:** Solar array power degradation  
**Diagnosis:** Radiation Damage-Solar Proton Event **Sure:** 3  
**Impact:** Decrease of 2 to 3 years in expected satellite lifetime **Duration:** More than 1 wk  
**Category:** Solar Array Degradati  
**Comments:** None  
**References:** HCK15 RSS61

---

**Name:** GOES-7

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** Jun 1988

**Description:** The REPLY BUS switch uncommanded from A to B channel in the Central Telemetry Unit (CTU-1)

**Diagnosis:** SEU      **Sure:** 0

**Impact:** Unknown      **Duration:** Unknown

**Category:** Phantom commands

**Comments:** None

**References:** JHA50

---

**Name:** GOES-8

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 19 Apr 1984 and 23 Apr 1994

**Description:** Sun-presence bit went high and latched ES

**Diagnosis:** SEU-Radiation Belts      **Sure:** 0

**Impact:** No corrective action required      **Duration:** Unknown

**Category:** Unknown

**Comments:** None

**References:** RSS68, JEM6

---

**Name:** GOES-8  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 8-10 Jan 97  
**Description:** Main power supply for the automatic on-board pointing control failed  
**Diagnosis:** ESD Internal **Sure:** 0  
**Impact:** Satellite was out of operation much of the 8th and 9th and was switched back on using the back-up supply on the 10th of January **Duration:** 1 day to 1 wk  
**Category:** System Failure  
**Comments:** None  
**References:** JHA10

---

**Name:** GOES-8  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 28 Jun 96  
**Description:** PCEM watchdog timer (WDT) timeout, resulting in a reset of the payload control electronics  
**Diagnosis:** SEU-Cosmic Ray **Sure:** 2  
**Impact:** Unknown **Duration:** Unknown  
**Category:** System Failure  
**Comments:** None  
**References:** SWS1

---

**Name:** GOES-8  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 19&21 Apr, 2 Jun, 29 Jul, 9 Aug 1996  
**Description:** Reset of Payload Control Electronics Module  
**Diagnosis:** SEU-Cosmic Ray **Sure:** 3  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Phantom commands  
**Comments:** None  
**References:** SWS1

---

**Name:** GOES-8 & 9  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** ~ 6 Nov 97  
**Description:** Star tracker problems  
**Diagnosis:** Solar Proton Event **Sure:** 2  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Degraded Performanc  
**Comments:** None  
**References:** JHA8



---

**Name:** GPS

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 10-16 April 1990

**Description:** Unknown

**Diagnosis:** ESD Internal      **Sure:** 0

**Impact:** Unknown      **Duration:** Unknown

**Category:** Other

**Comments:** 'Experienced problems that may have resulted from enhanced > 2 MeV electron flux'

**References:** HCK33

---

**Name:** GPS (FSV-1)

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 13 June 1980

**Description:** Solar array wings were misdirected and were not tracking the sun. Tracking Mode changed to HOLD. Three separate logic changes had occurred since previous contact

**Diagnosis:** ESD Internal      **Sure:** 3

**Impact:** Mistracking occurred for either 44 or 100 minutes before it was determined that the arrays were misdirected. Contingency command plans developed and added to OOH. When the anomaly was discovered all pre-planned activities were aborted and SV data monitored while a course of corrective action was planned      **Duration** 1 hr to 1 day

**Category:** Phantom commands

**Comments:** Corrective action includes modification to follow-on vehicles. (Did this occur ?)

**References:** HCK27, HCK28, HCK29

---

**Name:** GPS 1

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 2 Sep 78

**Description:** Frequency shifts in GPS clocks

**Diagnosis:** ESD Internal      **Sure:** 1

**Impact:** Loss of accuracy of the system until corrected      **Duration:** 1 day to 1 wk

**Category:** Degraded Performanc

**Comments:** While discussed, deep dielectric charging was not specifically identified as the cause. It was put forward by the contractor. Anomalies occurred during rapid rise in dose rate at mission altitude

**References:** HCK26, JFF4

---

**Name:** GPS 2

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 3 Sep 78, 4 Sep 78, 5 Sep 78, 6 Sep 78, 6 Oc

**Description:** Frequency shifts in GPS clocks

**Diagnosis:** ESD Internal      **Sure:** 1

**Impact:** Loss of accuracy of the system until corrected      **Duration:** 1 day to 1 wk

**Category:** Degraded Performanc

**Comments:** While discussed, deep dielectric charging was not specifically identified as the cause. It was put forward by the contractor. Anomalies occurred during rapid rise in dose rate at mission altitude

**References:** HCK26, JFF4

---

**Name:** GPS 2  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 8 Oct 78  
**Description:** Clock Failure  
**Diagnosis:** ESD Internal **Sure:** 1  
**Impact:** Unknown **Duration:** More than 1 wk  
**Category:** System Failure  
**Comments:** None  
**References:** HCK26, JFF4

---

**Name:** GPS 5118  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 17 JUL 1985  
**Description:** Unexpected switch settings within the motor control electronics  
**Diagnosis:** ESD **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Phantom commands  
**Comments:** None  
**References:** RSS6

---

**Name:** GPS SVN 26

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 09 OCT 95

**Description:** Software upset to the Attitude Control Subsystem processor (TI 9989)

**Diagnosis:** ESD Surface      **Sure:** 3

**Impact:** Unknown      **Duration:** Unknown

**Category:** Upset

**Comments:** Geomagnetic storming and enhanced low energy electrons could have played a role in this anomaly

**References:** SWS1

---

**Name:** GPS SVN-28

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 09 Oct 95

**Description:** Bit hit to the TI 9789 processor

**Diagnosis:** ESD Internal      **Sure:** 1

**Impact:** Unknown      **Duration:** Unknown

**Category:** Upset

**Comments:** >2 MeV electrons were above internal charging event levels

**References:** SWS1

---

**Name:** GPS- SVN-11  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 11 Feb 94  
**Description:** PCM-A and PLCM-B malfunctions  
resulting in bad telemetry data  
**Diagnosis:** ESD Surface **Sure:** 2  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Spurious Signal  
**Comments:** Enhanced levels of 100 KeV electrons  
**References:** SWS1

---

**Name:** HEO Spacecraft  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** various 1978  
**Description:** Mission data exhibited dropouts  
**Diagnosis:** Plasma Effects-Multipaction **Sure:** 3  
**Impact:** Noise in mission data. Massive effort  
troubleshooting the problem. Workarounds  
were devised leaving anomaly only a modest  
nuisance **Duration:** More than 1 wk  
**Category:** Degraded Performanc  
**Comments:** Gamma ray radioactive source could  
reproduce the dropouts in laboratory tests  
**References:** JBB1

---

**Name:** HEO spacecraft

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** Unknown

**Description:** At first turn-on the signal from four preamps were degraded by about 32 dB

**Diagnosis:** ESD Internal      **Sure:** 3

**Impact:** Massive effort to test an engineering model of the subassembly to find a fix for subsequent missions. Redesign of the payload      **Duration:** More than 1 wk

**Category:** System Failure

**Comments:** None

**References:** HCK35

---

**Name:** HEO spacecraft (several)

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** Various

**Description:** False trips of limit switch

**Diagnosis:** ESD Surface      **Sure:** 3

**Impact:** Significant effort spent troubleshooting. 'Band-aid' attempts were made to harden subsequent missions without much success. Anomaly ultimately became a minor annoyance      **Duration:** Unknown

**Category:** Phantom commands

**Comments:** None

**References:** JBB1

---

**Name:** HEO Spacecraft F3  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** July and September 1982  
**Description:** RS Uncommanded Mode Changes  
**Diagnosis:** ESD Internal **Sure:** 3  
**Impact:** No Significant Impact **Duration:** Unknown  
**Category:** Phantom commands  
**Comments:** None  
**References:** JBB1

---

**Name:** HEO Spacecraft F4  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** July and September 1982  
**Description:** RS Uncommanded Mode Changes  
**Diagnosis:** ESD Internal **Sure:** 3  
**Impact:** No significant impact **Duration:** Unknown  
**Category:** Phantom commands  
**Comments:** None  
**References:** JBB1



---

**Name:** Hipparcos  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 15 Aug 1993  
**Description:** Communication with the satellite was lost  
**Diagnosis:** Total Radiation Dose **Sure:** 0  
**Impact:** Mission Loss. Attempts to restart operations were unsuccessful and mission operations were terminated 4 years and 1 week after launch **Duration** Mission loss  
**Category:** Mission Loss  
**Comments:** ESA astronomy satellite  
**References:** RSS48

---

**Name:** HST  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 11 Apr 1994  
**Description:** SAP test failed during SADE 1 slew, S/C into SAFE MODE  
**Diagnosis:** SEU **Sure:** 0  
**Impact:** Recovered from SAFE MODE **Duration** 1 hr to 1 day  
**Category:** Upset  
**Comments:** None  
**References:** RSS68

---

**Name:** HST (STS-31)  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 9 Dec 1993  
**Description:** The Data Interface Unit-2 (DIU -2), A Side, presented faulty telemetry readings for specific HST parameters  
**Diagnosis:** Radiation Damage **Sure:** 0  
**Impact:** Negligible effect. DIU-2 switched to redundant B-side permanently and problem cleared **Duration:** Minimal  
**Category:** Spurious Signal  
**Comments:** None  
**References:** RSS33

---

**Name:** HST (STS-31)  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 4 Jul 1991  
**Description:** Six of the telescopes status monitors failed. Guide star acquisition failures  
**Diagnosis:** Radiation Damage-South Atlantic Anomaly **Sure:** 0  
**Impact:** Unknown **Duration:** More than 1 wk  
**Category:** Random Part Failure  
**Comments:** None  
**References:** RSS44

---

**Name:** HST (STS-31)  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 7 May 1990 , 20 Jun 1990  
**Description:** Bit flips occurred in the RAM of Fine Guidance Electronics. High photomultiplier tube (PMT) counts in the fine guidance system  
**Diagnosis:** SEU-South Atlantic Anomaly **Sure:** 3  
**Impact:** Could not operate in South Atlantic Anomaly **Duration:** Less than 10 min  
**Category:** Upset  
**Comments:** None  
**References:** RSS47, JHA Private Communication

---

**Name:** HST (STS-31)  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Apr 1990  
**Description:** British Aerospace inspection of the old HST array found effects ranging from slight grazing to the puncture of cells and blankets  
**Diagnosis:** Impact-Micrometeoroid **Sure:** 3  
**Impact:** No degradation in the electrical performance from the tests made before launch **Duration:** Minimal  
**Category:** Other  
**Comments:** 5000 to 6000 micrometeoroid impacts during four year life  
**References:** RSS35

---

**Name:** INSAT -1  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 13 Sep 1987 to 26 Apr 1988  
**Description:** 6 bit flip errors  
**Diagnosis:** SEU-Cosmic Ray **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Upset  
**Comments:** None  
**References:** RSS55

---

**Name:** INSAT -1B  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 18 Mar-18 Apr 84  
**Description:** Temperature Sensor Anomalies. Damaged FETs in telemetry thermal channels input circuits  
**Diagnosis:** ESD **Sure:** 1  
**Impact:** Unknown **Duration:** More than 1 wk  
**Category:** Degraded Performanc  
**Comments:** None  
**References:** DCW3

---

**Name:** INSAT -2D  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 1 Oct 97  
**Description:** Failed. Lost connection between power panels and batteries  
**Diagnosis:** ESD Surface **Sure:** 1  
**Impact:** Mission Loss. Shutdown the Indian stock exchange. Shut down communications between the central government and the provinces **Duration:** Mission loss  
**Category:** Mission Loss  
**Comments:** Major magnetic storm  
**References:** JHA6, JHA7

---

**Name:** INSAT -2D  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Mar 96  
**Description:** 10 ESD Events  
**Diagnosis:** ESD **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Unknown  
**Comments:** None  
**References:** JHA 16

---

**Name:** Intelsat 510 (International Telecommunicatio  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 15 Jan 1988  
**Description:** Affected the attitude control system and caused uncommanded status changes  
**Diagnosis:** ESD **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Phantom commands  
**Comments:** None  
**References:** RSS7

---

**Name:** Intelsat 511  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 25 Sep 86  
**Description:** A status bit change caused the thruster to switch 'ON' and stay in that setting for 3 to 4 minutes. A normal 'blast' is only 200 ms  
**Diagnosis:** Unknown **Sure:** 0  
**Impact:** Unknown **Duration:** Less than 10 min  
**Category:** Phantom commands  
**Comments:** The emergency thruster gas cut off worked after about 1 min. to stop the flow and limit the problem caused by this event  
**References:** JHA11

---

**Name:** Intelsat 511  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** August 1993  
**Description:** Disrupted attitude control system caused uncommanded status changes  
**Diagnosis:** ESD **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Phantom commands  
**Comments:** None  
**References:** RSS7

---

**Name:** Intelsat 511  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 7 Oct 1995  
**Description:** Thruster firing necessitated safe hold  
**Diagnosis:** ESD Internal **Sure:** 0  
**Impact:** Magnitude of thruster firing put satellite in safe sun acquisition mode. Anomaly at 6 pm satellite local time. Recovery from safe status at 6 pm local time requires the longest outage' **Duration:** 1 hr to 1 day  
**Category:** Phantom commands  
**Comments:** Earth acquisition regained @ 1624Z. 'some inconvenience', but no lasting damage  
**References:** JEM15

---

**Name:** Intelsat 602  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** March 1991  
**Description:** Experienced a step-like degradation [in power]  
**Diagnosis:** Radiation Damage-Solar Proton Event **Sure:** 2  
**Impact:** Unknown **Duration:** More than 1 wk  
**Category:** Solar Array Degradati  
**Comments:** None  
**References:** JHA3

---

**Name:** Intelsat K  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 20 January 1994  
**Description:** 'Minor electrical disturbance' Momentum wheel Circuit Problem  
**Diagnosis:** ESD Internal **Sure:** 2  
**Impact:** Pointing upset **Duration:** 10 min to 1 hr  
**Category:** System Failure  
**Comments:** System control was re-established by switching to backup circuitry  
**References:** HCK11, JHA20, JHA21



---

**Name:** Intelsat K  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 20 Jan 1994  
**Description:** Disabled the momentum wheel control circuitry causing it to wobble and produce fluctuations in antenna coverage  
**Diagnosis:** ESD **Sure:** 0  
**Impact:** Use of backup system **Duration:** 1 hr to 1 day  
**Category:** System Failure  
**Comments:** Full operational status was achieved on the same day after a backup system was activated  
**References:** RSS2

---

**Name:** Intelsat Satellites (five vehicles)  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** August 1993  
**Description:** Minor electrical disturbance  
**Diagnosis:** ESD Internal **Sure:** 2  
**Impact:** Unknown **Duration:** Minimal  
**Category:** Unknown  
**Comments:** During a period of elevated energetic electron fluxes  
**References:** HCK11, JEM8

---

**Name:** Iridium #11  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Unknown  
**Description:** Problems with momentum wheel  
**Diagnosis:** Unknown **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Unknown  
**Comments:** Space News article (about 12/4/97) Third Iridium Satellite that has had problems  
**References:** JHA5

---

**Name:** IRON 2102  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 03 Apr 97  
**Description:** Reset of the Command and Data Handler (CDH)  
**Diagnosis:** SEU-South Atlantic Anomaly **Sure:** 2  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Upset  
**Comments:** Spacecraft within the heart of the South Atlantic Anomaly  
**References:** SWS1

---

**Name:** IRON 2102

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 23 Oct 96

**Description:** Command and Data Handler Processor reset

**Diagnosis:** SEU-South Atlantic Anomaly      **Sure:** 2

**Impact:** Unknown      **Duration:** Unknown

**Category:** Upset

**Comments:** Spacecraft located in South Atlantic Anomaly following severe geomagnetic storming

**References:** SWS1

---

**Name:** IRON 2102

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 15 Sep 95

**Description:** Bus Interface Module (BIM) reset

**Diagnosis:** SEU-South Atlantic Anomaly      **Sure:** 2

**Impact:** Unknown      **Duration:** Unknown

**Category:** Upset

**Comments:** Enhanced Inner Van Allen Belt

**References:** SWS1

---

**Name:** IRON 2102  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 25, 27, 29, 30, 31 May 96 3, 4, 6 Sep 96 13,  
**Description:** Safehold state  
**Diagnosis:** IR-Environmental Sources **Sure:** 1  
**Impact:** Unknown **Duration:** 1 hr to 1 day  
**Category:** Other  
**Comments:** None  
**References:** SWS1

---

**Name:** IRON 2102  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 18 Mar 94  
**Description:** GPS receiver lost track and failed to reacquire  
**Diagnosis:** ESD Internal **Sure:** 2  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Degraded Performanc  
**Comments:** Good geomagnetic storming and strongly enhanced energetic electrons. Should not happen in Iron 2102 orbit  
**References:** SWS1

---

**Name:** IRON 2102  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 05 Dec 94  
**Description:** Anomalous reset of the Command and Data handling Processor #2  
**Diagnosis:** SEU-South Atlantic Anomaly **Sure:** 1  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Upset  
**Comments:** None  
**References:** SWS1

---

**Name:** IRON 2102  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 29 Jul 95  
**Description:** Radar Illumination Verification System (RIVs) processor failure  
**Diagnosis:** SEU-South Atlantic Anomaly **Sure:** 1  
**Impact:** Unknown **Duration:** More than 1 wk  
**Category:** System Failure  
**Comments:** Spacecraft within South Atlantic Anomaly  
**References:** SWS1

---

**Name:** IRON 3122

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 18 Sep 97

**Description:** Command processor reset

**Diagnosis:** ESD      **Sure:** 1

**Impact:** None      **Duration:** Unknown

**Category:** Upset

**Comments:** Spacecraft within region where Field aligned currents are located

**References:** SWS1

---

**Name:** IRON 3122

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 15 Dec 97

**Description:** Command processor reset

**Diagnosis:** SEU-South Atlantic Anomaly      **Sure:** 2

**Impact:** Unknown      **Duration:** Unknown

**Category:** Upset

**Comments:** Spacecraft ascending within the heart of the South Atlantic Anomaly

**References:** SWS1

---

**Name:** IRON 4221

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 31 May 95

**Description:** Anomalous reset of the Command and Data Handling (CDH) processor

**Diagnosis:** SEU-South Atlantic Anomaly      **Sure:** 1

**Impact:** Unknown      **Duration:** Unknown

**Category:** Upset

**Comments:** Spacecraft within the heart of the South Atlantic Anomaly

**References:** SWS1

---

**Name:** IRON 4221

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 23 Nov 95

**Description:** Anomalous reset of the Command and Data Handling (CDH) processor

**Diagnosis:** SEU      **Sure:** 1

**Impact:** Unknown      **Duration:** Unknown

**Category:** Upset

**Comments:** None

**References:** SWS1

---

**Name:** IRON 4221  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 17 Jul 95  
**Description:** Anomalous reset of the Attitude Control system (ACS) processor  
**Diagnosis:** Unknown **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Upset  
**Comments:** Disturbed geomagnetic and energetic particle environment  
**References:** SWS1

---

**Name:** IRON 4221  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 26 Jun 95  
**Description:** Anomalous reset of the Attitude control system (ACS) processor  
**Diagnosis:** ESD **Sure:** 1  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Upset  
**Comments:** Disturbed geomagnetic and particle environments  
**References:** SWS1



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**Name:** IRON 4221

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 06 Jul 95

**Description:** Anomalous soft reset of the Command and Data Handling (CDH) microprocessor

**Diagnosis:** SEU-South Atlantic Anomaly      **Sure:** 1

**Impact:** Unknown      **Duration:** Unknown

**Category:** Upset

**Comments:** Portions of the inner Van Allen Belt and the South Atlantic Anomaly in which this spacecraft was located are somewhat enhanced during solar minimum

**References:** SWS1

---

**Name:** IRON 4524

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 15 May 94

**Description:** Communications system hardware to switch oscillators

**Diagnosis:** ESD Internal      **Sure:** 2

**Impact:** Unknown      **Duration:** Unknown

**Category:** Phantom commands

**Comments:** >2 MeV electrons enhanced

**References:** SWS1

---

**Name:** IRON 7092

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 15 Dec 94

**Description:** Communication interruption between the Battery Charge Regulator (BCR) and the Spacecraft Control Module (SCM)

**Diagnosis:** Unknown      **Sure:** 0

**Impact:** Unknown      **Duration:** Unknown

**Category:** Unknown

**Comments:** Spacecraft descending through the heart of the Van Allen Belt

**References:** SWS1

---

**Name:** IRON 7092

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 08 Dec 95

**Description:** Anomalous loss of telemetry

**Diagnosis:** SEU      **Sure:** 1

**Impact:** Unknown      **Duration:** Unknown

**Category:** Upset

**Comments:** Spacecraft transited the inner Van Allen Belt and the South Atlantic Anomaly

**References:** SWS1

---

**Name:** IRON 7092

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 01 Apr 95

**Description:** Battery Charge Regulator (BCR) reset causing the payloads to be turned off

**Diagnosis:** ESD Internal      **Sure:** 1

**Impact:** Unknown      **Duration:** 1 hr to 1 day

**Category:** Upset

**Comments:** Spacecraft within the horns of the outer Van Allen Belt

**References:** SWS1

---

**Name:** IRON 7092

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 06 Nov 94

**Description:** Attitude Control Subsystem declared contingency mode and cycled to initialization routines

**Diagnosis:** Unknown      **Sure:** 0

**Impact:** Unknown      **Duration:** Unknown

**Category:** Phantom commands

**Comments:** Moderately disturbed geomagnetic and energetic particle environments at the time of the anomaly

**References:** SWS1

---

**Name:** IRON 7092

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 10 Dec 94

**Description:** Communication interruption between the Housekeeping Interface Unit (HIU) and the Payload Services Module (PSM)

**Diagnosis:** SEU      **Sure:** 1

**Impact:** Unknown      **Duration:** Unknown

**Category:** Upset

**Comments:** Spacecraft ascending through the heart of the Van Allen Belt

**References:** SWS1

---

**Name:** IRON 7092

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 13 Dec 94

**Description:** Battery Charge Regulator (BCR) timer working double time

**Diagnosis:** SEU      **Sure:** 1

**Impact:** Unknown      **Duration:** Unknown

**Category:** Upset

**Comments:** Spacecraft descending through the heart of the Van Allen Belt

**References:** SWS1

---

**Name:** IRON 7092

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 29 Sep 94

**Description:** Anomalous reset of the Payload Services Module (PSM) clock

**Diagnosis:** SEU-South Atlantic Anomaly      **Sure:** 1

**Impact:** Unknown      **Duration:** Unknown

**Category:** Upset

**Comments:** Spacecraft within the South Atlantic Anomaly

**References:** SWS1

---

**Name:** IRON 7092

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 04 Nov 94

**Description:** Communication interruption between the spacecraft Control Module (SCM) and Battery Charge Regulator (BCR)

**Diagnosis:** SEU      **Sure:** 1

**Impact:** Unknown      **Duration:** Unknown

**Category:** Upset

**Comments:** Spacecraft within the heart of the Inner Van Allen Belt

**References:** SWS1

---

**Name:** IRON 7092

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 26 Mar 95

**Description:** Battery Charge Regulator (BCR) reset causing the payloads to be turned off

**Diagnosis:** ESD Surface      **Sure:** 0

**Impact:** Unknown      **Duration:** 1 hr to 1 day

**Category:** Upset

**Comments:** Spacecraft located in the auroral zone that was observed to be intensified with enhanced precipitating energetic particle fluxes

**References:** SWS1

---

**Name:** IRON 7092

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 18 Dec 94

**Description:** Corruption of the Battery Charge Regulator (BCR) software

**Diagnosis:** SEU      **Sure:** 1

**Impact:** Unknown      **Duration:** Unknown

**Category:** Upset

**Comments:** Spacecraft descending through the heart of the Van Allen Belt

**References:** SWS1

---

**Name:** IRON 7092

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 04-05 Nov 94

**Description:** 18 anomalous periods of noise spikes that appeared within the multiple electrical power system telemetry points

**Diagnosis:** SEU      **Sure:** 2

**Impact:** Unknown      **Duration:** Unknown

**Category:** Spurious Signal

**Comments:** All of the anomalies were recorded while the spacecraft was within one of the following environments-the inner Van Allen Belt, South Atlantic Anomaly, and in or just below the 'horn region' of the outer Van Allen Belt

**References:** SWS1

---

**Name:** IRON 7092

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 17 Feb 95

**Description:** Communication interruption between the Spacecraft Computer and the Housekeeping interface unit (HIU) along with an associated Electrical Power System (EPS) battery charge code error

**Diagnosis:** SEU      **Sure:** 1

**Impact:** Unknown      **Duration:** Unknown

**Category:** Upset

**Comments:** Spacecraft located within the Inner Van Allen belt

**References:** SWS1

---

**Name:** IRON 9364

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 16 Oct 92 19 Oct 92

**Description:** Glitch in earth sensor

**Diagnosis:** ESD Surface      **Sure:** 2

**Impact:** Unknown      **Duration:** Unknown

**Category:** Unknown

**Comments:** None

**References:** SWS1



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**Name:** IRON 9364  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 27 Oct 92 and 30 Oct 92  
**Description:** Glitch in earth sensor reference  
**Diagnosis:** ESD **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Unknown  
**Comments:** None  
**References:** SWS1

---

**Name:** IRON 9443  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 18 Oct 92  
**Description:** Command check read malfunction  
**Diagnosis:** ESD Surface **Sure:** 2  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Spurious Signal  
**Comments:** Spacecraft experienced a marked increase of energetic electron fluxes while traversing the local midnight sector  
**References:** SWS1

---

**Name:** IRON 9445  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 06 Oct 95  
**Description:** Electrical Integration Assembly (EIA)  
command processing  
**Diagnosis:** ESD Internal **Sure:** 1  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Unknown  
**Comments:** None  
**References:** SWS1

---

**Name:** IRON 9445  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 08 Oct 95  
**Description:** Electrical Integration Assembly (EIA)  
command processing anomaly  
**Diagnosis:** ESD Internal **Sure:** 3  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Unknown  
**Comments:** None  
**References:** SWS1

---

**Name:** IRON-9906

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 1992 to 1997

**Description:** The payload control electronics module (PCEM) suffered a watchdog timer(WDT) time-out which caused a payload reset. Occurred numerous times over spacecraft lifetime

**Diagnosis:** SEU-South Atlantic Anomaly      **Sure:** 3

**Impact:** All stored data lost      **Duration** 1 hr to 1 day

**Category:** Upset

**Comments:** None

**References:** SWS1

---

**Name:** IRON-9906

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 1997

**Description:** The payload control electronics module (PCEM) suffered a watchdog timer(WDT) time-out which caused a payload reset.. After last latch-up, spacecraft lost

**Diagnosis:** SEU      **Sure:** 3

**Impact:** Mission Loss      **Duration** Mission loss

**Category:** Mission Loss

**Comments:** None

**References:** SWS1

---

**Name:** ISEE-1  
**Commercial:**       **NASA/NOAA:**       **Scientific:**   
**DoD:**       **Classified/Other:**       **Foreign:**   
**Dates:** 7 August 1978  
**Description:** The ULEWAT instrument on ISEE-1 lost all isobutane gas over a 7 day period ~ 1 year after launch. Gas supply was intended to last for at least 5 years  
**Diagnosis:** Impact-Micrometeoroid      **Sure:** 2  
**Impact:** Instrument returned useful low-energy particle data for ~ 1 years out of a potential of at least ~5 years (~20% science return from this instrument)      **Duration** More than 1 wk  
**Category:** System Failure  
**Comments:** Micrometeoroid impact likely but not conclusively proven. ISEE-1 was ~15 Re from Earth at the time the ULEWAT gas pressure began to decrease. The gas leak was small enough that the regulation system compensated for the loss for ~7 days, after which the supply ran out  
**References:** RSS2

---

**Name:** ISEE-1 (International Sun-Earth Explorer)  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** After Oct 1977  
**Description:** Detector window punctured  
**Diagnosis:** Impact-Micrometeoroid **Sure:** 0  
**Impact:** 25% data loss **Duration:** More than 1 wk  
**Category:** Degraded Performanc  
**Comments:** None  
**References:** RSS38

---

**Name:** Kosmos -1275  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 24 Jul 1981  
**Description:** Broke up into over 200 trackable fragments while at an altitude of 977 km  
**Diagnosis:** Impact-Hypervelocity collision with a piece **Sure:** 0  
**Impact:** Unknown **Duration:** Mission loss  
**Category:** Mission Loss  
**Comments:** None  
**References:** RSS37

---

**Name:** Landsat-3  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** After May 1978  
**Description:** The multispectral scanner on board the Landsat-3 satellite experienced extra scan monitor pulses that caused early line starts or extra end of line codes  
**Diagnosis:** Unknown **Sure:** 0  
**Impact:** Loss of data **Duration:** More than 1 wk  
**Category:** Degraded Performanc  
**Comments:** These events occurred over magnetic anomalies ??  
**References:** RSS38

---

**Name:** LDEF (STS-41C)  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** After Mar 1984  
**Description:** An aluminized-polyimide Kapton multilayer insulation sample located on the leading edge of the Long Duration Exposure Facility was eroded over the mission lifetime  
**Diagnosis:** Atomic-oxygen Erosion **Sure:** 3  
**Impact:** None **Duration:** More than 1 wk  
**Category:** Other  
**Comments:** This experimental study showed much wider and shallower undercut cavities than predicted, with implications for future low Earth orbit missions  
**References:** RSS40

---

**Name:** LEO spacecraft

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** Unknown

**Description:** Problems in power system soon after launch.  
Bus load increased substantially.  
Concurrently problems were seen in RAM  
memory system

**Diagnosis:** SEU      **Sure:** 3

**Impact:** Mission ops procedures were modified to  
include frequent power cycling of the RAMs  
to unlatch them. RAMs were turned off  
between ops. Required more complex ops  
planning. Some RAMs were permanently  
damaged      **Duration:** More than 1 wk

**Category:** Degraded Performanc

**Comments:** Single Event Latchup occurring in RAMs.  
RAMs extremely susceptible to latchup  
were drawing greatly excessive current

**References:** JBB1

---

**Name:** LEO spacecraft

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** Unknown

**Description:** Uncommanded shutdowns of TWT HV supply

**Diagnosis:** Plasma Effects      **Sure:** 3

**Impact:** Vehicle operations were modified to keep the pumpout holes out of the RAM direction. Required more complex OPS planning for life of vehicle. Threat of permanent failure      **Duration:** More than 1 wk

**Category:** Phantom commands

**Comments:** Interaction between the ionospheric plasma coming through pumpout holes and the HV caused the TWT shutdowns. Shutdown occurred when pumpout holes were in the RAM direction

**References:** JBB1

---

**Name:** LEO spacecraft

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 19-29 October 1989

**Description:** Multiple switching off of microwave transmitter unit

**Diagnosis:** Solar Proton Event      **Sure:** 0

**Impact:** Unknown      **Duration:** 1 hr to 1 day

**Category:** Phantom commands

**Comments:** None

**References:** HCK33



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**Name:** Magsat  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** After Oct 1979  
**Description:** Loss of star camera data  
**Diagnosis:** Sunlight **Sure:** 2  
**Impact:** Loss of data for 30-40 minutes **Duration:** More than 1 wk  
**Category:** Degraded Performanc  
**Comments:** Direct sunlight on the sides of the sunshades that penetrated their black plastic skin  
**References:** RSS38

---

**Name:** MARECS-A  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 31 August 85  
**Description:** One section of a solar array panel failed while entering eclipse  
**Diagnosis:** ESD Surface **Sure:** 0  
**Impact:** Unknown **Duration:** More than 1 wk  
**Category:** System Failure  
**Comments:** ESD Event which resulted in a short circuit through the cell to the back structure of the solar array panel'  
**References:** DCW13

---

**Name:** MARECS-A

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 3, 17, 29 Mar 89

**Description:** 50 switching events

**Diagnosis:** ESD Surface      **Sure:** 0

**Impact:** Unknown      **Duration:** 10 min to 1 hr

**Category:** Phantom commands

**Comments:** Great magnetic storm

**References:** DCW11

---

**Name:** MARECS-A

**Commercial:**  **NASA/NOAA:**  **Scientific:**

**DoD:**  **Classified/Other:**  **Foreign:**

**Dates:** Feb 82 to Mar 91

**Description:** Spurious anomalies in the telemetry system requiring onboard processors to be manually reset. Pointing system suddenly went into an energy conserving 'safeing' mode shutting down all communications subsystems. Solar panel surfaces degraded to the point that power output dropped to unacceptable operating levels

**Diagnosis:** ESD Surface **Score:** 3

**Impact:** Eventually taken out of service. The charging study improved the design of future satellites in the series **Duration:** 10 min to 1 hr

**Category:** Phantom commands

**Comments:** Electrostatic discharges due to spacecraft charging. Localized arcing caused by surface charging while the satellite was in eclipse

**References:** RSS18, RSS19

---

**Name:** MARECS-A  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Feb 82 to Dec 84  
**Description:** 617 Phantom commands indicating that a main bus under-voltage had occurred  
**Diagnosis:** ESD Surface **Sure:** 3  
**Impact:** Required 3 telecommands to reset the telemetry latch **Duration:** Less than 10 min  
**Category:** Spurious Signal  
**Comments:** None  
**References:** DCW13

---

**Name:** MARECS-A  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Feb 82to Dec 84  
**Description:** Part of the AOCS autonomous protection logic disabled 157 times  
**Diagnosis:** ESD Surface **Sure:** 3  
**Impact:** Immediately re-enabled by telecommand **Duration:** Less than 10 min  
**Category:** Phantom commands  
**Comments:** None  
**References:** DCW13

---

**Name:** MARECS-A  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Feb 82 to Dec 84  
**Description:** ESD-Coupled stimuli into onboard logic.  
(205 events)  
**Diagnosis:** ESD Surface **Sure:** 3  
**Impact:** Some impact on mission when logic was enabled **Duration:** Less than 10 min  
**Category:** Phantom commands  
**Comments:** None  
**References:** DCW13

---

**Name:** MARECS-A  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 25 March 1991  
**Description:** Complete failure  
**Diagnosis:** ESD Internal **Sure:** 2  
**Impact:** Mission Loss. Traffic switched to Intelsat commercial telecommunication satellite **Duration:** Mission loss  
**Category:** Mission Loss  
**Comments:** Period of high energetic electron fluxes following an solar proton event. It was being employed as a backup communications satellite at the time. Had a history of space-environment induced anomalies  
**References:** HCK15, HCK33, JHA20, JHA4

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**Name:** METEOSAT 2  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 8/10/86- 10/22/86  
**Description:** Single Parameter Switchings  
**Diagnosis:** ESD Internal **Sure:** 0  
**Impact:** Did not effect operations **Duration** Minimal  
**Category:** Phantom commands  
**Comments:** None  
**References:** DCW12

---

**Name:** METEOSAT 3  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 12-22 JAN 1994  
**Description:** Arcing Problems  
**Diagnosis:** ESD Internal **Sure:** 0  
**Impact:** Images Lost **Duration** Unknown  
**Category:** Degraded Performanc  
**Comments:** None  
**References:** JHA 20

---

**Name:** Meteosat F-1

**Commercial:**  **NASA/NOAA:**  **Scientific:**

**DoD:**  **Classified/Other:**  **Foreign:**

**Dates:** Various from 12 Dec 77 to 3 Mar 78

**Description:** Large number of spurious switching events

**Diagnosis:** ESD Surface **Sure:** 3

**Impact:** None of the switching events caused a serious interruption to the METEOSAT mission but The inconvenience to the Space Operations Teams was considerable. Led to study by the Project Team and by Industry to determine the probable cause of these events and more importantly to determine if corrective action could be designed into future versions of METEOSAT. A series of current-injection tests and electron-radiation tests were carried out during 1978/79 on METEOSAT P1 spacecraft **Duration** 10 min to 1 hr

**Category:** Phantom commands

**Comments:** Extensive Modifications and Improvements incorporated into future spacecraft and resolved previous problems

**References:** DCW13

---

**Name:** Meteosat-F1

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** Various from Sept. 1981 to March 1982

**Description:** Only the occurrence of 'problems' were noted, no specific problem identified

**Diagnosis:** ESD Surface      **Sure:** 0

**Impact:** Unknown in any detail      **Duration:** Unknown

**Category:** Unknown

**Comments:** Based on hearsay. Anomaly list gives 13 dates and times but no specific effect

**References:** JFF ??

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**Name:** Meteosat-F1 (European Space Agency Mete

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** After Nov 1977

**Description:** 150 anomalies in first 3 years

**Diagnosis:** ESD Surface      **Sure:** 3

**Impact:** Meteosat F-2 was modified prior to launch in June 1994 to eliminate some of the problems that F-1 experienced, and equipped with instrumentation to measure electrons in the energy range that could cause spacecraft charging      **Duration:** 10 min to 1 hr

**Category:** Phantom commands

**Comments:** None

**References:** RSS23, RSS24, RSS25



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**Name:** MILSTAR DFS-1

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 3/94-9/97

**Description:** Processor Upsets (142) with automatic reboot

**Diagnosis:** SEU-Cosmic Ray      **Sure:** 3

**Impact:** Minimal operational impact. Some ground terminals that have just logged in have to reboot. Cost to study upsets in the range from \$200K to \$500K      **Duration:** Minimal

**Category:** Upset

**Comments:** Reboot takes 1-2 sec. Restores state from 30-60 sec ago

**References:** HCK34

---

**Name:** MILSTAR DFS-2

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 11/95-9/97

**Description:** 75 Processor Upsets with automatic reboot

**Diagnosis:** SEU-Cosmic Ray      **Sure:** 2

**Impact:** Minimal operational impact. Some ground terminals that have just logged in have to reboot. Cost to study upsets in the range from \$200K to \$500K      **Duration:** Minimal

**Category:** Upset

**Comments:** Reboot takes 1-2 sec. Restores state from 30-60 sec ago

**References:** HCK34

---

**Name:** MILSTAR-DFS 1

**Commercial:**  **NASA/NOAA:**  **Scientific:**

**DoD:**  **Classified/Other:**  **Foreign:**

**Dates:** 19 April 94, 26 April 94, 15 June 94

**Description:** Processor Upsets that have required manual resets

**Diagnosis:** SEU-Cosmic Ray **Sure:** 3

**Impact:** 2-3 hr required to regain operational status **Duration:** 1 hr to 1 day

**Category:** Upset

**Comments:** Problem related to software errors that precluded automatic reboot. Software errors that produced these reboots have been fixed

**References:** HCK34

---

**Name:** Mir SS

**Commercial:**  **NASA/NOAA:**  **Scientific:**

**DoD:**  **Classified/Other:**  **Foreign:**

**Dates:** After Feb 1986

**Description:** Chronic power shortages

**Diagnosis:** Impact-Debris **Sure:** 0

**Impact:** Unknown **Duration:** More than 1 wk

**Category:** Solar Array Degradati

**Comments:** Solar panels have been battered by tiny meteorites, space debris, and atomic oxygen

**References:** RSS36

---

**Name:** MSTI  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 04 Jan 93  
**Description:** TCM relay or PCM decoder malfunction, or encryption device malfunction (Bit Hit) lost all telemetry contact  
**Diagnosis:** SEU **Sure:** 0  
**Impact:** Mission Loss **Duration:** Mission loss  
**Category:** Mission Loss  
**Comments:** None  
**References:** SWS1

---

**Name:** MSTI 2  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 5 Sep 1994  
**Description:** Contact with satellite was lost  
**Diagnosis:** Impact-Micrometeoroid **Sure:** 0  
**Impact:** Mission Loss **Duration:** Mission loss  
**Category:** Mission Loss  
**Comments:** Orbital debris impact to a wire bundle causing an electrical short and/or spacecraft charging  
**References:** RSS67

---

**Name:** MSTI-2  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 14 Aug 94  
**Description:** CPU reset resulting in loss of attitude control  
**Diagnosis:** SEU-South Atlantic Anomaly **Sure:** 1  
**Impact:** Loss of data **Duration:** 1 hr to 1 day  
**Category:** Upset  
**Comments:** Spacecraft was descending into the outer edge of the South Atlantic Anomaly  
**References:** SWS1

---

**Name:** MSTI-2  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 18 JUN 94  
**Description:** CPU reset  
**Diagnosis:** SEU **Sure:** 1  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Upset  
**Comments:** None  
**References:** SWS1

---

**Name:** NATO 3A  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Multiple in 1978  
**Description:** Attitude determination errors  
**Diagnosis:** ESD Surface **Sure:** 2  
**Impact:** Improper narrow beam antenna pointing **Duration:** Unknown  
**Category:** Spurious Signal  
**Comments:** Times of errors were not all well known, but all overlapped local midnight. The most accurately timed events occurred in the pre to just post midnight regions. Surface charging/discharging suspected to have caused erroneous attitude data from earth sensors  
**References:** JFF8

---

**Name:** NATO 3A  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 11 Jan 1987  
**Description:** Attitude control problems  
**Diagnosis:** ESD Internal **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Other  
**Comments:** None  
**References:** RSS7

---

**Name:** NATO 3B  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 11 Jan 1987, Aug and Sep 1987  
**Description:** Three attitude control anomalies, three phantom command anomalies  
**Diagnosis:** ESD Internal **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Phantom commands  
**Comments:** None  
**References:** RSS7

---

**Name:** NATO 3B  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Multiple in 1978  
**Description:** Attitude determination errors  
**Diagnosis:** ESD Surface **Sure:** 2  
**Impact:** Improper narrow beam antenna pointing **Duration:** Unknown  
**Category:** Spurious Signal  
**Comments:** Times of errors were not all well known, but all overlapped local midnight. The most accurately timed events occurred in the pre to just post midnight regions. Surface charging/discharging suspected to have caused erroneous attitude data from earth sensors  
**References:** JFF8

---

**Name:** NATO 3C  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Dec 1986 to Sep 1987  
**Description:** Five attitude control anomalies  
**Diagnosis:** ESD Internal **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Unknown  
**Comments:** None  
**References:** RSS7

---

**Name:** NIMBUS 7  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** After Oct 1978  
**Description:**  
**Diagnosis:** Unknown **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Unknown  
**Comments:** High energy particles caused electrical component damage ??  
**References:** RSS54

---

**Name:** NOAA 10  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 13 Mar 89  
**Description:** Excessive x-axis gyro speed after magnetic moment unloading causing the roll/yaw coil to switch to backup mode  
**Diagnosis:** Unknown **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Degraded Performanc  
**Comments:** High Solar activity  
**References:** RSS49

---

**Name:** NOAA 10  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 1 Oct 89  
**Description:** The SCU 28 volt switch power indicated an 'on' reading  
**Diagnosis:** Unknown **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Phantom commands  
**Comments:** Command line glitch or solar influence  
**References:** RSS49



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**Name:** NOAA 11  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 11-20 March 1989  
**Description:** ??  
**Diagnosis:** ESD Internal **Sure:** 2  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Unknown  
**Comments:** Anomalies occur within trapped radiation regions  
**References:** HCK33

---

**Name:** NOAA 11  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 10 April 1990  
**Description:** Experienced pitch reaction wheel glitches. Usual process of transferring spin to the momentum wheel was reversed and the wheel 'spun-up' the satellite  
**Diagnosis:** Magnetic Field Variability **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Degraded Performanc  
**Comments:** Major magnetic storm on 10-11 April 1990  
**References:** HCK33

---

**Name:** NOAA 11  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 22-24 March 1991  
**Description:** Loss of automatic attitude control  
**Diagnosis:** Solar Proton Event **Sure:** 2  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Degraded Performanc  
**Comments:** Command line glitch or solar influence ??  
**References:** HCK15, JHA 20

---

**Name:** NOAA 7  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** After Jun 1981  
**Description:** Magnetic coil unloadings were not completely effective  
**Diagnosis:** Higher than expected torque from solar press **Sure:** 0  
**Impact:** Unknown **Duration:** 1 hr to 1 day  
**Category:** Degraded Performanc  
**Comments:** None  
**References:** RSS38

---

**Name:** NOAA 8  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** July 1984 ?  
**Description:** sudden failure  
**Diagnosis:** Unknown **Sure:** 0  
**Impact:** Loss of S/C **Duration:** Unknown  
**Category:** Mission Loss  
**Comments:** Computer problems that became acute early on 12 June 1984-JHA  
**References:** JEM9

---

**Name:** NOAA 9  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Mar 89  
**Description:** Unusual momentum wheel activity that resulted in roll/yaw coil switching to its backup mode. Proper attitude control was maintained through the event  
**Diagnosis:** Unknown **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Degraded Performanc  
**Comments:** High Solar Activity  
**References:** RSS49

---

**Name:** NOAA-? Three satellites  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Mar 89  
**Description:** Had trouble unloading torque due to the large ambient magnetic field charges in orbit  
**Diagnosis:** Magnetic Field Variability **Sure:** 2  
**Impact:** Unknown **Duration:** 1 hr to 1 day  
**Category:** Degraded Performanc  
**Comments:** Great Magnetic Storm  
**References:** JHA15

---

**Name:** NOAA-10  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 29-30 Sept 1989  
**Description:** Phantom Command  
**Diagnosis:** Solar Proton Event **Sure:** 3  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Phantom commands  
**Comments:** Rare 'Phantom Command'  
**References:** HCK33, JHA20

---

**Name:** Olympus  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 11-12 August 1993  
**Description:** Service interrupted, began to spin slowly  
**Diagnosis:** Unknown **Sure:** 0  
**Impact:** Satellite retired from service because it was low on fuel for attitude control and station keeping **Duration** Mission loss  
**Category:** Mission Loss  
**Comments:** At the time of the Perseid meteor shower  
**References:** JEM10

---

**Name:** ROSAT  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 26 January 1991  
**Description:** CPU for attitude control had an upset  
**Diagnosis:** SEU **Sure:** 1  
**Impact:** Lost control for 14 hours **Duration** 1 hr to 1 day  
**Category:** Upset  
**Comments:** (Roentgen Satellite)  
**References:** JHA 13

---

**Name:** SAMPEX  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 20 JULY 1992-present  
**Description:** Dual high voltage supplies in LICA instrument move to maximum ~4KV output level while control voltages remain nominal; most likely to occur in auroral zone & while S/C is at 0-8 local time  
**Diagnosis:** ESD Surface **Sure:** 2  
**Impact:** Premature aging of micro-channel plates due to hv spikes. Instrument off-line for ~3 months in 1992 during anomaly investigation. Instrument powered off 15 min/day from on-board HV monitor. Lost ~5% of science data from this instrument **Duration** More than 1 wk  
**Category:** Degraded Performanc  
**Comments:** Correlation with s/c shadowing and auroral zone precipitation suggest surface charging plays a role in the anomaly  
**References:** JEM11

---

**Name:** SBS 1

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** After 1981

**Description:** Hundreds of events over an eight year period affecting the attitude control system

**Diagnosis:** ESD      **Sure:** 0

**Impact:** Unknown      **Duration:** Unknown

**Category:** Phantom commands

**Comments:** (Satellite Business Systems telecommunications satellite)

**References:** RSS7

---

**Name:** SCATHA

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** After 1981

**Description:** Hundreds of events over an eight year period affecting the attitude control system

**Diagnosis:** ESD Surface      **Sure:** 1

**Impact:** Minimal      **Duration:** Minimal

**Category:** Phantom commands

**Comments:** (Spacecraft Charging at High Altitude satellite, P78-2)

**References:** RSS7

---

**Name:** SCATHA (Spacecraft Charging at High Altit  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 22 Sep 1982  
**Description:** A filter change of state in one of the magnetic field monitors, timing errors in the Plasma Wave Analyzer  
**Diagnosis:** ESD Surface **Sure:** 3  
**Impact:** A 2-minute loss of data **Duration:** Less than 10 min  
**Category:** Phantom commands  
**Comments:** A particularly large number of arcing events  
**References:** RSS22

---

**Name:** SEDS-2  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 14 Mar 1994  
**Description:** 20 km tether was severed  
**Diagnosis:** Impact-Micrometeoroid **Sure:** 2  
**Impact:** Experiment ended prematurely **Duration:** Mission loss  
**Category:** Mission Loss  
**Comments:** (Small Expendable Deploy Satellite)  
**References:** RSS62



---

**Name:** Skylab  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 11 Jul 1979  
**Description:** Prematurely re-entered the Earth's atmosphere  
**Diagnosis:** Atmospheric drag **Sure:** 2  
**Impact:** None **Duration:** More than 1 wk  
**Category:** Other  
**Comments:** None  
**References:** RSS41

---

**Name:** Skynet 2B  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 1975 to 1976  
**Description:** Anomalies in timing circuits of the telemetry and command subsystem. 300 were investigated  
**Diagnosis:** ESD Surface **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Degraded Performanc  
**Comments:** (UK defense communications satellite)  
**References:** RSS30

---

**Name:** SMM  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** After Feb 1980  
**Description:** The C Gyro failed  
**Diagnosis:** Unknown **Sure:** 0  
**Impact:** Control was regained and the B Gyro was used **Duration:** 1 day to 1 wk  
**Category:** Random Part Failure  
**Comments:** Transient radiation susceptibility of complementary MOS semi-conductors in the electronics. (Solar Maximum Mission)  
**References:** RSS38

---

**Name:** SMM  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 1985  
**Description:** Anomaly in the onboard computer placed the spacecraft in 'safe hold' condition  
**Diagnosis:** SEU **Sure:** 0  
**Impact:** Science data interrupted for 8 days **Duration:** More than 1 wk  
**Category:** Upset  
**Comments:** (Solar Maximum Mission)  
**References:** RSS57

---

**Name:** SMM  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Jan 1986  
**Description:** Some 'safe holds' during spacecraft operation due to problems in the on board computer  
**Diagnosis:** SEU-Cosmic Ray **Sure:** 0  
**Impact:** 8K of memory (out of 48K total) was lost. Loss of data during safe hold recovery **Duration:** More than 1 wk  
**Category:** Random Part Failure  
**Comments:** (Solar Maximum Mission)  
**References:** RSS58

---

**Name:** Solar-A  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** After Aug 1991  
**Description:** 0.05 mm hole in the thin film membrane covering the optical system  
**Diagnosis:** Impact-Micrometeoroid **Sure:** 0  
**Impact:** Loss of the visual portion of the telescope **Duration:** More than 1 wk  
**Category:** System Failure  
**Comments:** (Yohkoh)  
**References:** RSS63

---

**Name:** SPOT-3  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 10 Jan 95  
**Description:** Transmitter / Downlink problems  
**Diagnosis:** SEU-South Atlantic Anomaly **Sure:** 1  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Degraded Performanc  
**Comments:** Spacecraft within the heart of the South Atlantic Anomaly  
**References:** SWS1

---

**Name:** STRV 1A  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** June 1994  
**Description:** Background increases in MCP detectors  
**Diagnosis:** Energetic electrons **Sure:** 0  
**Impact:** Unknown **Duration:** More than 1 wk  
**Category:** Degraded Performanc  
**Comments:** None  
**References:** JEM5

---

**Name:** STS-45

**Commercial:**  **NASA/NOAA:**  **Scientific:**

**DoD:**  **Classified/Other:**  **Foreign:**

**Dates:** Mar 1992

**Description:** The space shuttle Atlantis suffered two gouges (1.9x1.6 in. and 0.4x1 in.) on the upper portion of the right wing leading edge

**Diagnosis:** Impact-Micrometeoroid **Sure:** 3

**Impact:** None **Duration:** Minimal

**Category:** Other

**Comments:** Low relative velocity debris impact on-orbit or during re-entry, or prelaunch or ascent debris. Raised concern about the consequences of a higher energy impact to the integrity of the space craft

**References:** RSS64

---

**Name:** STS-49

**Commercial:**  **NASA/NOAA:**  **Scientific:**

**DoD:**  **Classified/Other:**  **Foreign:**

**Dates:** May 1992

**Description:** Chip in upper right hand corner of the thermal window pane

**Diagnosis:** Impact-Debris or Micrometeoroid **Sure:** 0

**Impact:** Unknown **Duration:** Minimal

**Category:** Other

**Comments:** Impact occurring on or around flight day 8

**References:** RSS34

---

**Name:** STS-61  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 6 Dec 1993  
**Description:** Star tracker failed  
**Diagnosis:** SEU-South Atlantic Anomaly **Sure:** 0  
**Impact:** Following a power cycle the star tracker passed a self test and functioned nominally for the rest of the mission The Y star tracker failed to acquire navigation stars for approximately 5 hours **Duration** 1 day to 1 wk  
**Category:** System Failure  
**Comments:** Single event upset in the South Atlantic Anomaly. The high altitude flown on STS-61 resulted in increased radiation exposure  
**References:** RSS43

---

**Name:** Symphonie A  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** After Nov 1974  
**Description:** History of non-critical anomalies (i.e. modulation losses and logic upsets)  
**Diagnosis:** ESD Surface **Sure:** 2  
**Impact:** A reset command is sent from the control center if necessary **Duration** 10 min to 1 hr  
**Category:** Upset  
**Comments:** (French-German experimental communications satellite)  
**References:** RSS29

---

**Name:** Symphonie B  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** After Aug 1975  
**Description:** History of non-critical anomalies (i.e. modulation losses and logic upsets)  
**Diagnosis:** ESD Surface **Sure:** 2  
**Impact:** A reset command is sent from the control center if necessary **Duration:** 10 min to 1 hr  
**Category:** Upset  
**Comments:** (French-German experimental communications satellite)  
**References:** RSS29

---

**Name:** TDRS 1  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 1984-1990  
**Description:** Anomalous responses in the Attitude Control System (ARCS) traced to state changes in the Random Access Memory (RAM) in the ACS  
**Diagnosis:** SEU-Cosmic Ray **Sure:** 0  
**Impact:** Ground control was required to maintain the satellite's proper attitude. Had to change TDRS 2 parts before launch **Duration:** More than 1 wk  
**Category:** Degraded Performanc  
**Comments:** Same chip used in HST  
**References:** RSS53, JHA23

---

**Name:** TDRS 1  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 1984 to 1990  
**Description:** Anomalous responses in the Attitude Control System (ACS) traced to state changes in the Random Access Memory (RAM) in the ACS  
**Diagnosis:** SEU-Cosmic Ray **Sure:** 3  
**Impact:** Ground control was required to maintain the satellite's proper attitude. Prompted changes in the ACS design of future TDRS missions **Duration:** More than 1 wk  
**Category:** Degraded Performanc  
**Comments:** None  
**References:** RSS53

---

**Name:** TDRS 1  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 1984-1990  
**Description:** Anomalous responses in the Attitude Control System (ARCS) traced to state changes in the Random Access Memory (RAM) in the ACS  
**Diagnosis:** SEU-Cosmic Ray **Sure:** 0  
**Impact:** Temporary loss of attitude control **Duration:** More than 1 wk  
**Category:** Degraded Performanc  
**Comments:** None  
**References:** RSS49



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**Name:** TDRS 2  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 19-29 October 1989  
**Description:** SEUs  
**Diagnosis:** SEU-Solar Proton Event **Sure:** 1  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Upset  
**Comments:** 'Even the hardened TDRS-2 and -3 experienced SEUs'  
**References:** HCK33

---

**Name:** TDRS 3  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 19-29 October 1989  
**Description:** SEUs  
**Diagnosis:** SEU-Solar Proton Event **Sure:** 2  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Upset  
**Comments:** 'Even the hardened TDRS-2 and -3 experienced SEUs'  
**References:** HCK33

---

**Name:** TDRS 4  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 8 May 1989  
**Description:** Earth Sensor Assembly (ESA) roll output alarm  
**Diagnosis:** SEU-Solar Proton Event **Sure:** 0  
**Impact:** Temporary loss of attitude control **Duration:** Unknown  
**Category:** Spurious Signal  
**Comments:** None  
**References:** RSS49

---

**Name:** TDRS 4  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 1 Aug 1993  
**Description:** Erratic ACS data and the spacecraft slowly started to diverge from Earth pointing  
**Diagnosis:** SEU **Sure:** 2  
**Impact:** User services out for 8 hours before CTE and CPE units re-enabled **Duration:** 1 hr to 1 day  
**Category:** Upset  
**Comments:** None  
**References:** RSS33

---

**Name:** TDRS 4  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 26 Aug 1993  
**Description:** An Earth sensor assembly roll and pitch 'glitch' lasted 2 seconds causing ESA 'fail-safe' to occur  
**Diagnosis:** SEU **Sure:** 0  
**Impact:** Reaction wheels run down to zero, re-enabled by ground command, S/C recovery in 5 minutes **Duration:** Less than 10 min  
**Category:** Upset  
**Comments:** None  
**References:** RSS33

---

**Name:** TDRS 5  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 10 Aug 1991  
**Description:** A control sensor parameter momentarily exceeded its caution limit  
**Diagnosis:** SEU **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Upset  
**Comments:** None  
**References:** RSS44

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**Name:** TDRS 5

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 12 Dec 93

**Description:** Normal mode outputs from the Control Processing Electronics (CPE) went into a disabled state, with numerous attitude control system (ACS) parameters out of limits. S/C started to lose its attitude reference

**Diagnosis:** SEU      **Sure:** 0

**Impact:** CPE re-initialized and reloaded. no loss of user data      **Duration:** Minimal

**Category:** Upset

**Comments:** None

**References:** RSS33

---

**Name:** TDRS 6

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 10 Jul 93

**Description:** Earth Sensor Assembly A Pitch Channel output cautioned at 0/.3199 deg for one update period

**Diagnosis:** SEU      **Sure:** 1

**Impact:** None      **Duration:** Minimal

**Category:** Upset

**Comments:** Single Event Upset in the Command and Telemetry electronics (CTE) buffer. Self-healing

**References:** RSS33

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**Name:** TDRS 6  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 4 Jun 1994  
**Description:** Control processor initialized itself, causing attitude divergence  
**Diagnosis:** ESD Surface **Sure:** 0  
**Impact:** Loss of data until reinitialized **Duration:** Unknown  
**Category:** Upset  
**Comments:** Control processing electronics reinitialized from ground station  
**References:** RSS68

---

**Name:** TDRS-1  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 1 Apr 1992  
**Description:** The Control Processing Electronics stopped running due to CPE/CTE sync failure  
**Diagnosis:** SEU-Cosmic Ray **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** System Failure  
**Comments:** None  
**References:** RSS54

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**Name:** TDRS-1  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 2 Nov 1989  
**Description:** Upset in command processor electronics  
**Diagnosis:** SEU-Cosmic Ray **Sure:** 0  
**Impact:** Temporary loss of attitude control **Duration:** Unknown  
**Category:** Upset  
**Comments:** None  
**References:** RSS49

---

**Name:** TDRS-1  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 19-20 October 1989  
**Description:** 50 SEUs in radiation susceptible memory chips  
**Diagnosis:** SEU-Solar Proton Event **Sure:** 3  
**Impact:** Unknown **Duration:** 1 day to 1 wk  
**Category:** Degraded Performanc  
**Comments:** Unhardened RAM  
**References:** HCK33

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**Name:** TDRS-7  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 6 Dec 1995  
**Description:** Loss of attitude control  
**Diagnosis:** SEU-Cosmic Ray **Sure:** 0  
**Impact:** Unknown **Duration:** 1 hr to 1 day  
**Category:** Upset  
**Comments:** SEU in the control processing or command and telemetry electronics. An emergency RAM reload did not help and the S/C started to pitch and tumble very quickly as the reaction wheel speeds started dropping  
**References:** RS69

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**Name:** TDRSS  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** After April 1983  
**Description:** Arcing anomalies in several different subsystems over their operating lifetimes, most seriously in the attitude control system processor electronics  
**Diagnosis:** ESD Surface **Sure:** 0  
**Impact:** Rapid manual intervention was required to prevent loss of control of the satellites **Duration:** 1 hr to 1 day  
**Category:** Phantom commands  
**Comments:** None  
**References:** RSS16, RSS17

---

**Name:** Telecom 1A  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** After 4 Aug 1984  
**Description:** Interrupted data transmissions  
**Diagnosis:** ESD **Sure:** 0  
**Impact:** Mission Loss **Duration:** Mission loss  
**Category:** Mission Loss  
**Comments:** Was removed from service and used as a backup  
**References:** RSS10, RSS14

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**Name:** Telecom 1A  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** Various  
**Description:** Switch-off problems in its Syracuse [military communications] payload  
**Diagnosis:** ESD Surface **Sure:** 0  
**Impact:** Intermittent loss of communications **Duration:** 1 hr to 1 day  
**Category:** Degraded Performanc  
**Comments:** Electrostatic charge buildup on the satellite's thermal shielding related to an underground metalized dielectric covering that was added at the last minute to cover a fiberglass area of the satellite  
**References:** HCK31



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**Name:** Telecom 1B

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 15 January 1988

**Description:** Suffered a failure of both its normal and backup attitude control systems

**Diagnosis:** ESD Surface      **Sure:** 2

**Impact:** Mission Loss. Relay traffic switched to Telecom 1A. Two of three French TV channels were switched to Telecom 1A      **Duration:** Mission loss

**Category:** Mission Loss

**Comments:** Electrostatic discharges coupling with exposed electrical wiring. At the time of the loss it was the prime platform for the Syracuse military communications relay which was switched to Telecom 1A. Severe magnetic storm on 15 January 1988 with peak Kp of 7.3

**References:** HCK31, RSS10

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**Name:** Telstar 401

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 9 Oct 1994

**Description:** Satellite stabilization briefly lost

**Diagnosis:** ESD Surface      **Sure:** 0

**Impact:** 1-hour disruption in service      **Duration:** 1 hr to 1 day

**Category:** Phantom commands

**Comments:** None

**References:** RSS1

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**Name:** TEMPO  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 3/25/97  
**Description:** Loss of 2.7 A of Solar Array Current multiple times  
**Diagnosis:** ESD Surface **Sure:** 3  
**Impact:** The problems will result in reduced power toward the end of the satellites projected lifetime **Duration:** More than 1 wk  
**Category:** Solar Array Degradati  
**Comments:** The anomalies on 4/11/97 occurred during a large magnetic storm  
**References:** HCK7, HCK8

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**Name:** TOPEX  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 7 NOV 1993  
**Description:** Failure of the ASTRA 1B star tracker  
**Diagnosis:** ESD Internal **Sure:** 1  
**Impact:** Unknown **Duration:** More than 1 wk  
**Category:** System Failure  
**Comments:** None  
**References:** JEM12

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**Name:** TOPEX  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 7 Nov 1993  
**Description:** ASTRA 1A TEC off  
**Diagnosis:** ESD Internal **Sure:** 1  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Unknown  
**Comments:** None  
**References:** JEM12

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**Name:** TOPEX  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 13 May 1994  
**Description:** EU anomaly  
**Diagnosis:** ESD Internal **Sure:** 1  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Unknown  
**Comments:** None  
**References:** JEM12

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**Name:** TOPEX  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 25 May 1994  
**Description:** ASTRA 1B star tracker flatline  
**Diagnosis:** ESD Internal **Sure:** 1  
**Impact:** Unknown **Duration:** More than 1 wk  
**Category:** System Failure  
**Comments:** None  
**References:** JEM12

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**Name:** TOPEX  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 4 June 1994  
**Description:** RIU 6A anomaly  
**Diagnosis:** ESD Internal **Sure:** 1  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Unknown  
**Comments:** None  
**References:** JEM12

---

**Name:** Unknown

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** 6 October 1981

**Description:** Premature ignition of a random number of ordnance devices caused subsequent damage to payload during BECO, SECO, MECO1 and MECO2. There was shorting of numerous circuits

**Diagnosis:** Triboelectric charging of PLF      **Sure:** 2

**Impact:** Damage to solar arrays and payload      **Duration:** More than 1 wk

**Category:** Other

**Comments:** Charging of fairing surfaces during accent with discharges onto payload causing circuit shorts and premature ordnance ignition on fairing and payload. No direct evidence but scenario could explain the fact that damage did occur to antenna, array and payload with several circuits shorted

**References:** JFF1

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**Name:** Unknown or Classified

**Commercial:**                       **NASA/NOAA:**                       **Scientific:**

**DoD:**                       **Classified/Other:**                       **Foreign:**

**Dates:** Multiple-Dates unknown

**Description:** Loss of link and noisy data

**Diagnosis:** Plasma Effects-Multipaction                      **Sure:** 3

**Impact:** Cause loss of data and useless noisy data.                      **Duration** 10 min to 1 hr  
Duration of losses were unpredictable but could last minutes. There were many occurrences. Result was degraded system performance. Design was changed to eliminate problem for follow-on satellites

**Category:** Degraded Performanc

**Comments:** Multipaction in classic parallel plate high voltage capacitor in T/M subsystem. Multipaction onset cause by environmental radiation generating free electrons inside the capacitor. Multipaction was duplicated on the ground using a radioactive source to initiate the process.

**References:** JFF9

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**Name:** Unknown or Classified

**Commercial:**                       **NASA/NOAA:**                       **Scientific:**

**DoD:**                       **Classified/Other:**                       **Foreign:**

**Dates:** Multiple in 1980

**Description:** 'Broadband dropout'

**Diagnosis:** Plasma Effects-Breakdown                      **Sure:** 2

**Impact:** Loss of data during dropouts. Operational                      **Duration** Unknown  
workaround required. Vents were  
redesigned to fix problem on later S/C

**Category:** Degraded Performanc

**Comments:** Ion ingestion caused sputtering of High  
Voltage terminals and subsequent  
breakdown with loss of output from TWTs.  
Subsequent operations were designed to  
minimize ram ion ingestion with good  
success. References discuss problem and not  
actual anomaly

**References:** JFF5, JFF6, JFF7

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**Name:** Unknown spacecraft

**Commercial:**                       **NASA/NOAA:**                       **Scientific:**

**DoD:**                       **Classified/Other:**                       **Foreign:**

**Dates:** 6, 8, 9, 14th Mar 89

**Description:** Episodes of uncontrolled tumbling

**Diagnosis:** Unknown                      **Sure:** 0

**Impact:** Interfered with operational functions                      **Duration** Unknown

**Category:** Unknown

**Comments:** Great Storm Period

**References:** JHA15

---

**Name:** Unknown. Identified as F3

**Commercial:**  **NASA/NOAA:**  **Scientific:**

**DoD:**  **Classified/Other:**  **Foreign:**

**Dates:** 8-10 September 1982

**Description:** Telemetry anomalies near perigee on 4 occasions

**Diagnosis:** ESD Internal **Sure:** 2

**Impact:** Unknown **Duration:** Unknown

**Category:** Spurious Signal

**Comments:** Report covers multiple satellites in the same HEO orbit with 'telemetry' anomalies. Same as Unknowns F2 and F4. Multiple satellites had anomalies on same days

**References:** JFF3

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**Name:** Unknown. Identified as F4

**Commercial:**  **NASA/NOAA:**  **Scientific:**

**DoD:**  **Classified/Other:**  **Foreign:**

**Dates:** 8-10 September 1982

**Description:** Telemetry anomalies on 3 occasions

**Diagnosis:** ESD Internal **Sure:** 2

**Impact:** Unknown **Duration:** Unknown

**Category:** Spurious Signal

**Comments:** Report covers multiple satellites in the same HEO orbit with 'telemetry' anomalies. Same as Unknowns F2 and F3. Multiple satellites had anomalies on same days

**References:** JFF3



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**Name:** Unknown. or Classified Identified as F2

**Commercial:**  **NASA/NOAA:**  **Scientific:**

**DoD:**  **Classified/Other:**  **Foreign:**

**Dates:** 10 September 1982

**Description:** Telemetry anomalies near perigee

**Diagnosis:** ESD Internal **Sure:** 2

**Impact:** Unknown **Duration:** Unknown

**Category:** Spurious Signal

**Comments:** Report covers multiple satellites in the same HEO orbit with 'telemetry' anomalies. Same as Unknowns F3 and F4. Multiple satellites had anomalies on same days

**References:** JFF3

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**Name:** UOSAT 2

**Commercial:**  **NASA/NOAA:**  **Scientific:**

**DoD:**  **Classified/Other:**  **Foreign:**

**Dates:** After Feb 1984

**Description:** Upsets in large dynamic NMOS and static CMOS memories

**Diagnosis:** SEU-South Atlantic Anomaly **Sure:** 3

**Impact:** Unknown **Duration:** Unknown

**Category:** Upset

**Comments:** Upsets in large dynamic NMOS and static CMOS memories, strongly localized to the South Atlantic region

**References:** RSS52

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**Name:** UOSAT 2  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 19-29 October 1989  
**Description:** Many SEUs particularly in the South Atlantic Anomaly Region  
**Diagnosis:** SEU-South Atlantic Anomaly **Sure:** 0  
**Impact:** Unknown **Duration:** Unknown  
**Category:** Upset  
**Comments:** None  
**References:** HCK33

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**Name:** Vehicle 4487  
**Commercial:**  **NASA/NOAA:**  **Scientific:**   
**DoD:**  **Classified/Other:**  **Foreign:**   
**Dates:** 08 Aug 95  
**Description:** Redundant attitude control system (ACS) failed to acquire the sun  
**Diagnosis:** ESD **Sure:** 2  
**Impact:** Unknown **Duration:** More than 1 wk  
**Category:** System Failure  
**Comments:** None  
**References:** SWS1

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**Name:** Viking Lander 1

**Commercial:**

**NASA/NOAA:**

**Scientific:**

**DoD:**

**Classified/Other:**

**Foreign:**

**Dates:** After Aug 1975

**Description:** Variations in Gas Chromatograph Mass Spectrometer Ion Pump current

**Diagnosis:** ESD

**Sure:** 0

**Impact:** Operations with a degrading high voltage source

**Duration** More than 1 wk

**Category:** Degraded Performanc

**Comments:** Arcing/corona

**References:** RSS28

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**Name:** Voyager 1

**Commercial:**

**NASA/NOAA:**

**Scientific:**

**DoD:**

**Classified/Other:**

**Foreign:**

**Dates:** 1979

**Description:** An on-board clock lost 8 seconds due to 40 spurious power-on reset signals

**Diagnosis:** ESD

**Sure:** 0

**Impact:** Unknown

**Duration** Unknown

**Category:** Degraded Performanc

**Comments:** Jovian Radiation

**References:** RSS38

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**Name:** Voyager 1

**Commercial:**       **NASA/NOAA:**       **Scientific:**

**DoD:**       **Classified/Other:**       **Foreign:**

**Dates:** After Sep 1977

**Description:** Star tracker number 2 could not be commanded into cone angle settings 2, 4, or 5

**Diagnosis:** Radiation Damage      **Sure:** 0

**Impact:** Unknown      **Duration:** More than 1 wk

**Category:** Random Part Failure

**Comments:** Transistor leakage caused by 2 or more Delrin insulating sleeves decomposing due to high intensity radiation

**References:** RSS38

## Appendix B

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