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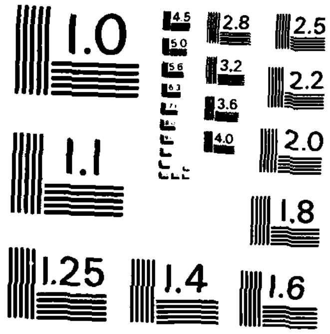

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AFGL-TR-85-0150

FABRICATE, CALIBRATE and TEST A DOSIMETER FOR INTEGRATION INTO THE CRRES SATELLITE

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March 1985

SCIENTIFIC REPORT NO. 2

(For the period 1 September 1983 - 31 August 1984)

AIR FORCE GEOPHYSICS LABORATORY
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
HANSCOM AFB, MASS 01731

"This technical report has been reviewed and is approved for publication"

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FOR THE COMMANDER

RITA C. SAGALYN, Director
Space Physics Division

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A space-radiation dosimeter is being fabricated, calibrated, tested, and integrated into the CRRES satellite. This Dosimeter is essentially identical to that previously designed, fabricated calibrated, tested and integrated into the DMSP F7 satellite. These dosimeters are primarily designed to measure the dose from electrons of greater than 1 MeV to greater than 10 MeV in four channels. Each channel has a different thickness aluminum dome.

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20. Abstract (Continued)

The solid state detector outputs are processed to provide the dose from electrons (low energy loss), the dose from protons (high energy loss), the flux of electrons, the flux of protons, and the rate of high energy loss nuclear star events. The dosimeter also has a calibration mode in which the alpha particles from a weak source behind each detector are used to check for total detector depletion and proper operation of the electronics.

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1. INTRODUCTION

The increasing use of complex solid state electronic devices in the space radiation environment makes it important to have reliable data on the radiation doses these devices will receive behind various thicknesses of shielding. As part of the effort to obtain this data a Dosimeter was designed, fabricated, calibrated, and integrated into the payload of a Defense Meteorological Satellite Program (DMSP) satellite by Panametrics, Inc., for the Air Force Geophysics Laboratory (AFGL), under contract number F19628-78-C-0247. The current contract, F19628-82-C-0090, is for the fabrication and calibration of a second, essentially identical, Dosimeter and its integration into the Combined Release and Radiation Effects Satellite (CRRES). These Dosimeters measure the accumulated radiation dose in silicon solid state detectors behind four different thicknesses of aluminum shielding. The current contract also covers the integration into the CRRES spacecraft and launch support of the Fluxmeter, a high energy electron spectrometer being built by Panametrics for AFGL under contract number F19628-79-C-1075.

The objectives of the current contract can be summarized as follows:

a. Participate in the integration and launch tests of the F7 DMSP satellite in order to determine proper interfacing, of the Dosimeter, with other satellite components, and proper operation prior to and immediately after launch.

b. Study the DMSP Dosimeter calibration and early flight data to determine the optimum method of producing omnidirectional spectra from the electron and proton data and determine the dose calibrations for small, large and very large energy deposition levels.

c. Fabricate, test, calibrate and deliver a radiation Dosimeter, essentially identical to the DMSP Dosimeter, for integration into the CRRES satellite.

d. Participate in the integration and launch tests of the CRRES satellite in order to determine proper interfacing, of the Dosimeter and Fluxmeter, with other satellite components, and proper operation prior to and immediately after launch.

e. Analyze calibration and early flight data of the CRRES Dosimeter to determine the performance of the dosimeter in space flight and the quality of flight data.

The work carried out during the first year of this contract (1 September 1982 to 31 August 1983) has been reported in Ref.1.1. This report covers the work carried out during the second year (1 September 1983 to 31 August 1984). A brief description of the Dosimeters, and a summary of their specifications, are given in Section 2. Section 2.1 deals specifically with the DMSP Dosimeter while Section 2.2 deals with the CRRES Dosimeter. The progress to date is summarized in Section 3. Section 3.1 covers the DMSP Dosimeter integration and launch support (item a, above) while Section 3.2 covers the DMSP Dosimeter calibration and flight data analysis (item b). Section 3.3 covers the CRRES Dosimeter fabrication, testing and calibration (item c) and Section 3.4 covers the CRRES Dosimeter and Fluxmeter integration and launch support (item d). No effort has yet been expended on item e, since it cannot begin until item c has been completed.

2. DOSIMETER DESCRIPTIONS AND SPECIFICATIONS

2.1 Description and Specifications of the DMSP Dosimeter

The DMSP Dosimeter was designed, fabricated, tested and calibrated by Panametrics, Inc., for the Air Force Geophysics Laboratory, under contract number F19628-78-C-0247. This instrument's specifications are outlined in Table 2.1. It should be noted that the unit was specifically designed to interface with the DMSP spacecraft and its Operational Linescan System (OLS). The DC to DC converter design, in particular, took advantage of the closely regulated DMSP power buss (28.0 ± 0.5 VDC) which eliminates the requirement for further line voltage regulation and results in reduced power consumption, weight and volume. The data registers are also optimally scaled for the approximate circular 800 km DMSP orbit. A detailed description of the DMSP Dosimeter is presented in Ref. 2.1. The design is, of course, adaptable to other spacecraft and/or orbits.

An isometric view of the DMSP Dosimeter is shown in Fig. 2.1. The 4 domes house the solid state detectors. The dome thickness increases with the size, resulting in four different incident particle energy thresholds. The instrument interfaces to the DMSP spacecraft through P1 and to the OLS through P2. J12 is a test connector which is capped during flight. A cutaway isometric view, showing the various printed circuit boards and the details of one detector, is given in Fig. 2.2. The four charge sensitive preamplifier test input connectors, shown in Fig. 2.2, are also capped for flight.

The Dosimeter separates the total radiation dose into that from electrons (50 keV to 1 MeV energy deposits) and protons (1 to 10 MeV energy deposits). The four aluminum shields provide energy thresholds (range thickness values) of 1, 2.5, 5, and 10 MeV for electrons, and 20, 35, 51, and 75 MeV for protons. The primary measurement, and that most accurately calibrated, is the accumulated dose. Omnidirectional electron and proton fluxes are also measured, and data on the detailed response of each channel to energy and angle for electrons and protons have been obtained. There is also a high energy loss event channel which counts the rare nuclear star events caused by high energy protons, and the low flux of high energy high-Z

Table 2.1

Specifications for the DMSP Dosimeter

Sensors	4 Planar silicon S.S.D. with aluminum shields
Field of View	2π Steradians
Data Fields	3 deposited energy ranges and 2 dose energy ranges per sensor, resulting in 5 data fields: 1 Electron Dose 1 Electron Flux 1 Proton Dose 1 Proton Flux 1 Nuclear Star Flux
Output Format	36 Bits serial, read out once per second. Each readout is internally multiplexed and must be interpreted in the context of a 64 readout data frame.
Command Requirements	On/Off, Reset, and Calibrate
Size	8" H x 4.5" W x 5.5" D excluding Domes, Connectors, and Mounting Tabs
Weight	10 lbs
Power	7 W @ 28 V $\pm$ 0.5 V DC
Temperature Range	-10^{o}C to 40^{o}C
Max Accumulated Dose before recycling	$\simeq 10^4$ rads (Si) Electrons $\simeq 10^3$ rads (Si) Protons
Max Flux before overflow	$\simeq 10^6$ Electrons/(cm^2-sec) above 1 Mev $\simeq 10^4$ Protons/(cm^2-sec) above 20 MeV
Effective Area (For omnidirectional flux)	0.013 cm^2 (Dome 1), 0.25 cm^2 (Dome 2, 3, and 4)

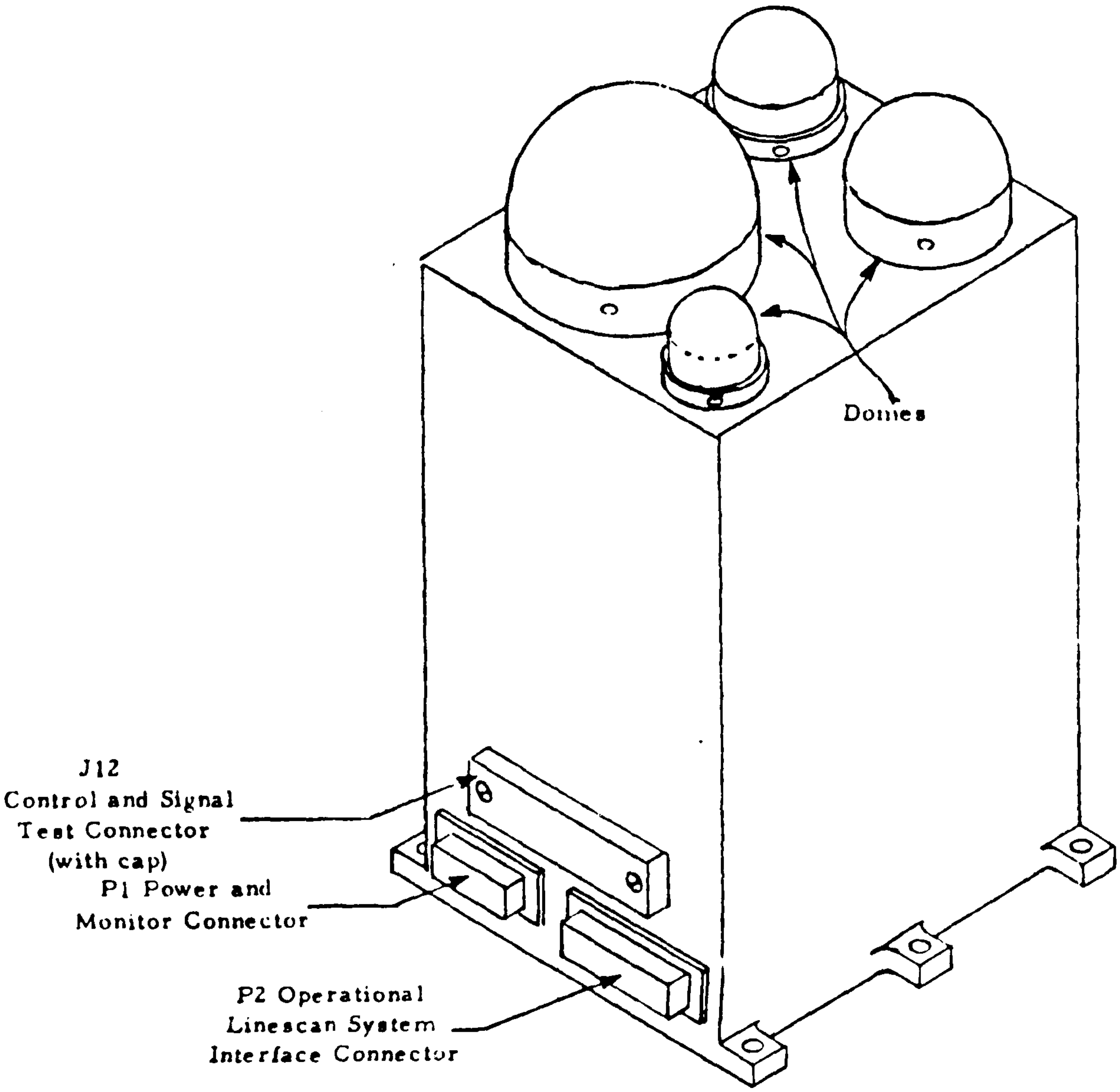

Fig. 2.1 Isometric View of the DMSP Dosimeter

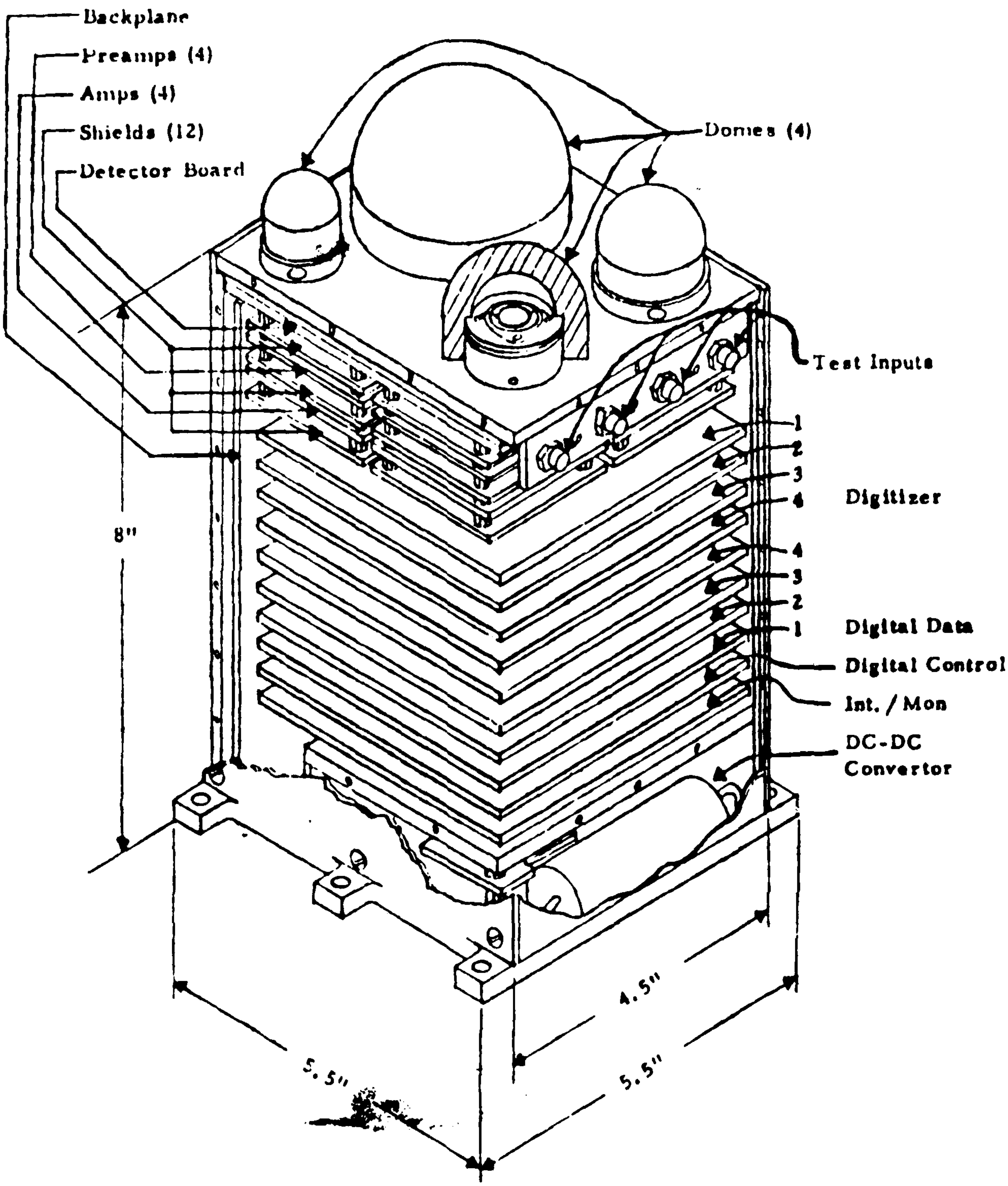

Fig. 2.2 Cutaway Isometric View of the DMSP Dosimeter

cosmic rays. Information on these high energy loss events is important, since they can cause logic upsets or memory bit loss in some types of low power micro-circuits.

The DMSP Dosimeter was extensively calibrated by use of protons from the Harvard Cyclotron, and electrons from the AFGL Linac. The 160 MeV proton beam at the Harvard cyclotron was passed through two beam-spreading absorbers to provide a maximum energy of 144 MeV at the Dosimeter. Additional absorbers were used to reduce the energy to as low as 17 MeV. Data were taken for incident directions (relative to the Dome plane normal) of from 0^{o} to 180^{o} (rear entry). The electron data taken at the AFGL linac covered the range of 0.9 to 18.4 MeV. The nominal electron energies were calibrated against known gamma-ray energies with a 1 inch thick BGO crystal, so the corrected energies should be accurate to better than 5%. The Dosimeter was also calibrated extensively using gamma-ray and beta sources, with this being the primary method of calibrating the dose channel responses. The electron and proton beam calibrations are primarily to verify proper unit operation, and to calibrate the flux channels in terms of the incident particle fluxes.

The final parameters for the four channels of the DMSP dosimeter are given in Table 2.2. These values are based on the final dose prescaler values and the calibrated detector responses. The electron channels are based on detector energy losses of 50 keV to 1 MeV, and the proton channels on 1 MeV to 10 MeV. In the calibration mode the electron channel becomes a lower loss range of 1 to 3 MeV and the proton channel an upper loss range of 3 to 10 MeV. This mode is used to check total depletion of the detectors by looking at the alpha source which irradiates the rear of the detectors.

The DMSP Dosimeter underwent a complete acceptance test sequence, in accord with a Test and Acceptance Plan approved by AFGL. Vibration testing was carried out at the AFGL test facility. Thermal and vacuum testing was done in house at Panametrics. Initial spacecraft integration tests took place at the Westinghouse (the OLS contractor) facility in Baltimore, Maryland and the Dosimeter was shipped to RCA Astroelectronics Division (the spacecraft contractor) on June 2, 1981 for integration into the DMSP F-7 spacecraft.

Table 2.2

Final Parameters for the DMSP Dosimeter

Item	Ch 1 Value	Ch 2 Value	Ch 3 Value	Ch 4 Value
Al Shield (g/cm^2)	0.55	1.55	3.05	5.91
Electron Threshold (MeV)#	1.0	2.5	5.0	10.
Proton Threshold (MeV)#	20	35	51	75
Star Threshold (MeV)#	40	40	75	40
Detector Area (cm^2)	0.051	1.00	1.00	1.00
Max elect. flux (cm^{-2} sec^{-1})*	2.41×10^6	1.23×10^5	1.23×10^5	1.23×10^5
Max proton flux (cm^{-2} sec^{-1})*	1.95×10^4	922	922	922
Elect. dose prescaler	8192	16384	4096	4096
Proton dose prescaler	64	1024	256	256
Max. elect. dose (RADS)**	1.27×10^4	1.29×10^3	323	323
Max. proton dose (RADS)**	990	808	202	202
Electron calibration constant (RADS/output dose count)	1.78×10^{-3}	1.81×10^{-4}	4.30×10^{-5}	4.85×10^{-5}
Proton calibration constant (RADS/output dose count)	1.36×10^{-4}	1.11×10^{-4}	2.90×10^{-5}	2.92×10^{-5}

*Flux value above which the flux count will overflow. Only the flux readouts are affected, as dose is still accumulated correctly.

**Dose at which the counters overflow and recycle to zero. Dose accumulation continues correctly.

#The electron and proton thresholds are the nominal particle energy to just penetrate the dome shields; the star thresholds refer to energy deposits in the detectors.

2.2 Description and Specifications of the CRRES Dosimeter

The specifi`ations for the CRRES Dosimeter which is being fabricated, tested and calibrated by Panametrics, Inc. for the Air Force Geophysics Laboratory, are outlined in Table 2.3. These specifications are identical to those of the DMSP Dosimeter except for the following two items:

a) The CRRES power buss regulation is 28.0 $\pm$ 4 V DC as opposed to the 28.0 $\pm$ 0.5 V DC DMSP buss. This necessitates the addition of a line voltage regulator and results in a slight increase in the instrument's volume, weight and power requirements - all of which are reflected in Table 2.3.

b) The peak high energy proton flux at the specified CRRES orbit is about a factor of 10 higher than that at the DMSP orbit. This necessitates the addition of prescalers in the three highest energy proton flux channels to prevent counter overflow. This modification has no impact on the instrument's volume, negligible impact on power requirement and a very slight impact on its weight.

An isometric view of the CRRES Dosimeter is shown in Figure 2.3. The power buss regulator is contained in the 4" x 4" x 1" protrusion on the side of the instrument, while the proton flux prescalers are contained on a small printed circuit board within the instrument.

Table 2.3

Specifications for the CRRES Dosimeter

Sensors	4 Planar silicon S.S.D. with aluminum shields
Field of View	2π Steradians
Data Fields	3 deposited energy ranges and 2 dose energy ranges per sensor, resulting in 5 data fields: 1 Electron Dose 1 Electron Flux 1 Proton Dose 1 Proton Flux 1 Nuclear Star Flux
Output Format	36 Bits serial, read out once per second. Each readout is internally multiplexed and must be interpreted in the context of a 64 readout data frame.
Command Requirements	On/Off, Reset, and Calibrate
Size	8" H x 4.5" W x 6.5" D excluding Domes, Connectors, and Mounting Tabs
Weight	10.6 lbs
Power	7.5 W @ 28 V $\pm$ 4.0 V DC
Temperature Range	-10°C to 40°C
Max Accumulated Dose before recycling	$\simeq 10^4$ rads (Si) Electrons $\simeq 10^3$ rads (Si) Protons
Max Flux before overflow	$\simeq 10^6$ Electrons/(cm^2-sec) above 1 MeV $\simeq 10^4$ Protons/(cm^2-sec) above 20 MeV
Effective Area (For omnidirectional flux)	0.013 cm^2 (Dome 1), 0.25 cm^2 (Dome 2, 3, and 4)

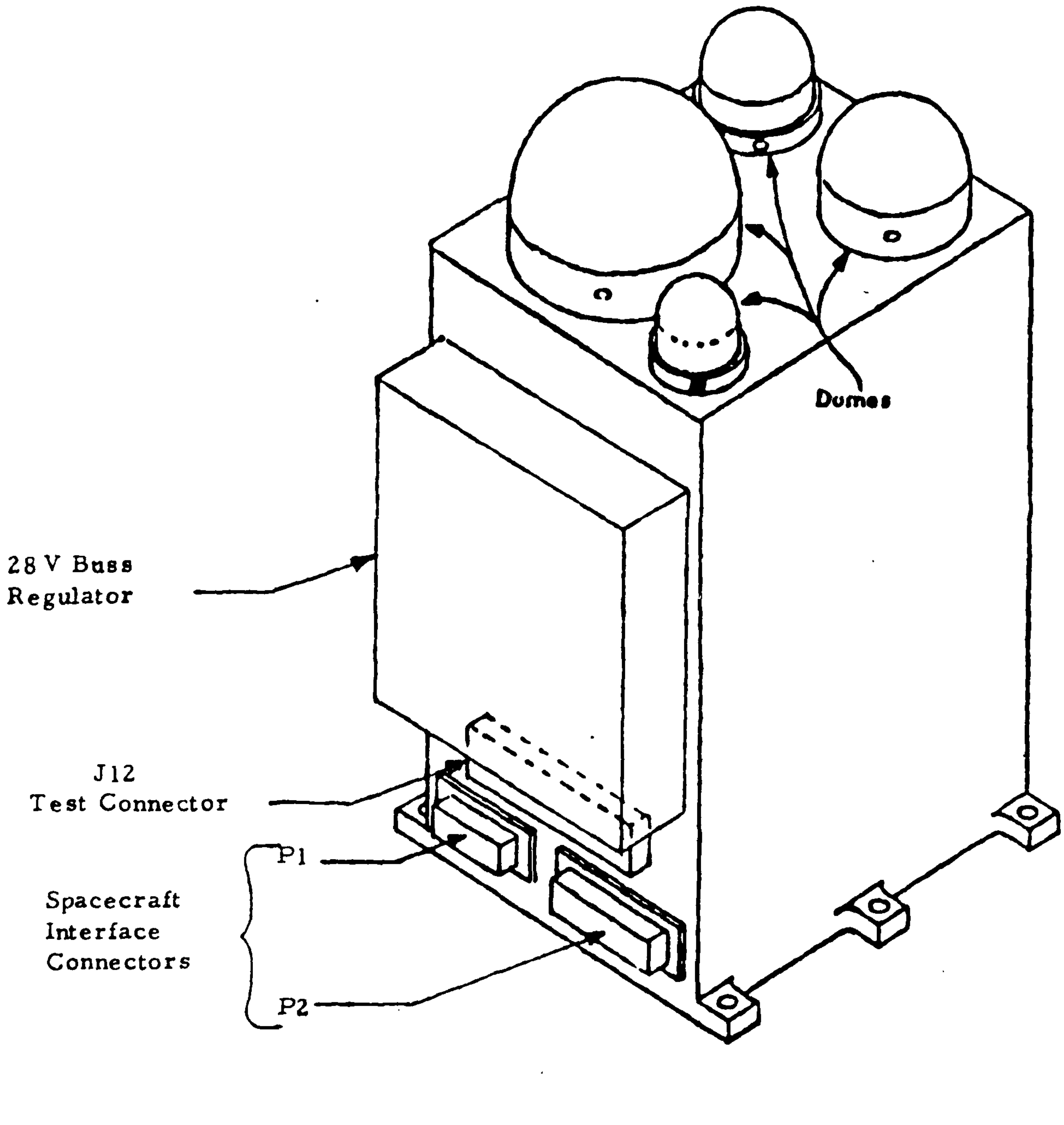

Fig. 2.3 Isometric View of the CRRES Dosimeter

3. PROGRESS TO DATE

3.1 DMSP Dosimeter Integration and Launch Support

It should be noted that the DMSP instruments are referred to as "special sensors" and that the Dosimeter is designed the "SSJ*" special sensor.

The last four sets of SSJ* DMSP integration test data were received from Westinghouse during September and November 1983. These were thoroughly reviewed relative to accurate baseline values recorded at Panametrics prior to delivery and showed no statistically significant change from those baselines.

Integration and testing of the DMSP F-7 spacecraft was completed in November 1983 and the spacecraft was launched, with the SSJ* Dosimeter on board, late that month. The SSJ* Dosimeter was first turned on in Rev 77 on 23 November 1983 at 1625 UT. At turn-on the temperature was +11°C, which decreased to +8°C during the first orbit cycle, but climbed to +46°C at the start of Rev 84. The dosimeter was thus turned off at 0430 UT on 24 November 1983. The dosimeter was turned on again at 0850 UT on 25 November 1983, in Rev 101. The temperature started at +17°C and increased over the next several orbits, reaching a plateau of 50°C ± 3°C by Rev 121 (1830 UT on 26 November), with the ± 3°C being the sun/shadow cycling for each orbit. The temperature variations for Revs 77 to 85 are shown in Fig. 3.1, for Revs 101 to 111 in Fig. 3.2, and for Revs 111 to 121 in Fig. 3.3.

Data for the dosimeter temperature have been obtained for February 15, 1984, and show a temperature cycle of 45.8°C to 51.4°C. This is slightly lower than at the end of November, 1983, and is a desirable trend towards lower temperature.

Analysis of Normal Mode and Calibration Mode data show completely proper operation of the dosimeter, both at the low temperature after turn-on, and at the maximum temperature of 53°C. The Am^{-241} calibration source data during periods of low ambient background indicate the detectors are still totally depleted. Thus the dose and flux data are all valid using the pre-launch calibrations.

The predicted in-orbit temperature for the dosimeter was +26°C for the minimum 30° solar zenith angle of the DMSP-F7 orbit. The originally specified operating temperature range for the SSJ* was -10°C to +40°C, so the actual operating temperature exceeds this by +13°C. Since the SSJ* dosimeter appears to be operating properly, the operating specifications given to GWC (Global Weather Central) have been changed to: 1) notify AFGL/Panametrics if the temperature exceeds +55°C; and 2) turn the SSJ* off if the temperature exceeds +60°C.

At present there is no definite answer as to why the temperature is so much higher than the prediction, but a VAR (Vehicle

Anomaly Report) has been opened by GWC to at least document the situation. The SSJ* is mounted to the DMSP satellite with electrical isolation at the base, and a thermal insulating blanket around the sides. Most of the heat radiation thus takes place through a teflon tape on the top surface around the detector domes. The high temperature could thus be the result of contamination of the tape surface reducing its emissivity, or of the tape partially pulling away from the surface. During the various integration, thermal vacuum, etc. tests at RCA, the dosimeter temperature never exceeded +30°C, although this is only for about 4 hours of operation.

A check of test records at Panametrics shows that in May, 1982, when the dosimeter was returned to Panametrics for a grounding modification and check-out, the dosimeter was given a two-week test in vacuum where it ran at about 50°C. These test data show proper dosimeter operation at that temperature, so the in-orbit 50°C ± 3°C operation has actually been tested before launch (for a relatively short-term period). The dosimeter electronics have been tested to much higher temperatures, so the detectors are the only potential problem at high temperature. The detectors are photodiodes operated as particle detectors at total depletion. At high temperatures the leakage current increases, leading to eventual partial depletion, and the noise level increases, leading to excessive noise in the electron channels. At +50°C the detectors are still totally depleted, and noise is still not noticeable at the 50 keV electron threshold.

3.2 DMSP Dosimeter Flight Data Analysis

The routine analysis of the DMSP F7 Dosimeter flight data at AFGL is basically in operation. The algorithm for obtaining the dose and flux increments from the DMSP dosimeter data were completed and have been verified with checks against actual data. The final procedure corrects the four-second dose increments for ripple counter overflow. A check against South Atlantic Anomaly data shows that the summed dose increments equal the actual dose increment between dose mantissa changes to within the beginning and ending ripple count increments, which is the maximum possible accuracy within the readout resolution. A procedure has also been developed to correct the data for dead-time effects. This is a simple calculation which can be easily added when necessary. A check of the SAA and maximum polar cap solar particle data shows that the maximum dead-time effect observed thus far is 5%.

Data from a calibration cycle for August 20, 1984 (day 233) were obtained from the AWS. These data have been checked and show no statistically significant changes from the Rev. 78 cal cycle data on November 23, 1983, shortly after turn-on. The dosimeter solid state detectors are thus still fully depleted, and the signal gains are all proper, after operation near 50°C for nine months.

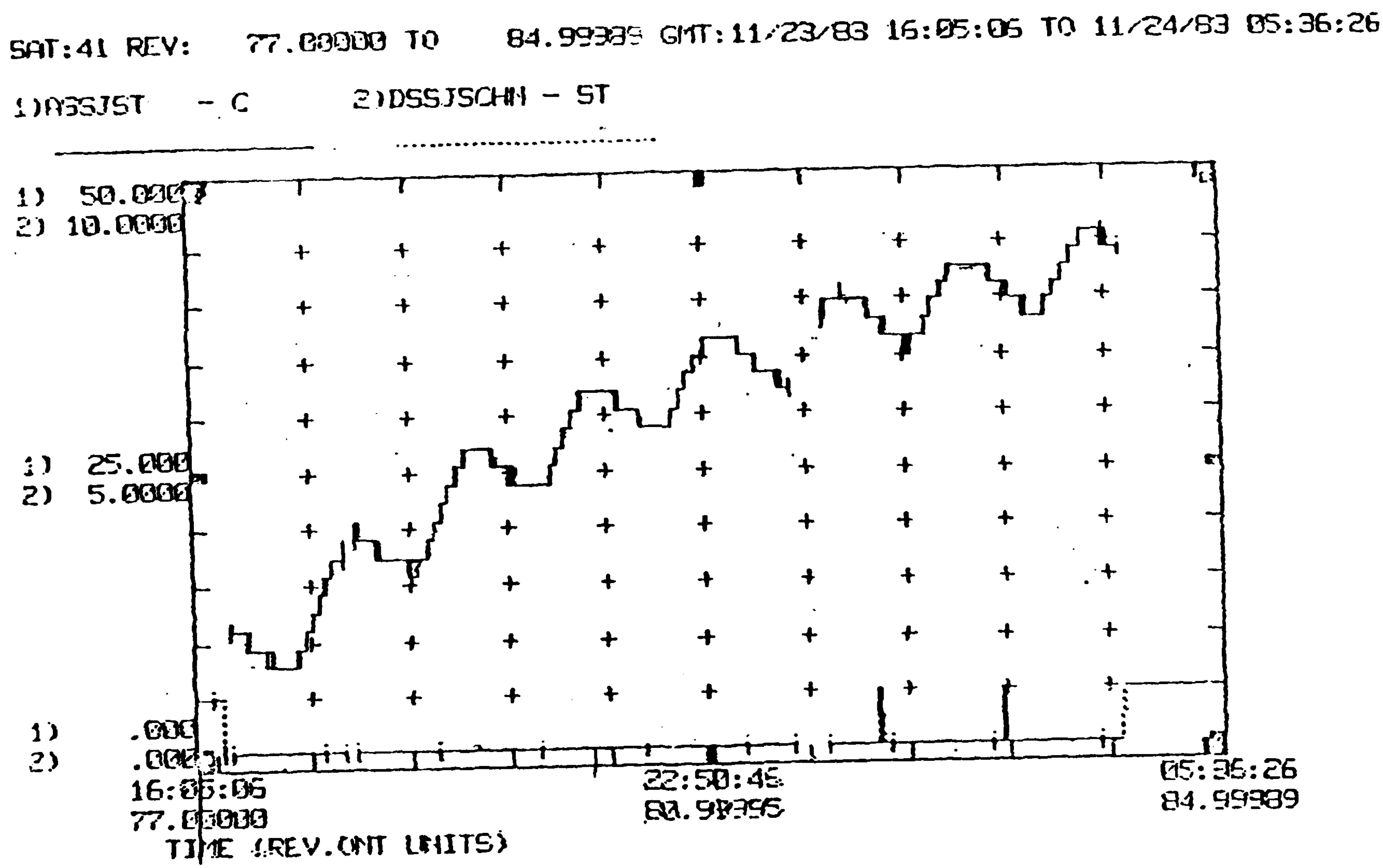

Figure 3.1 SSJ* Dosimeter Temperature Variations After First Dosimeter Turn-On.

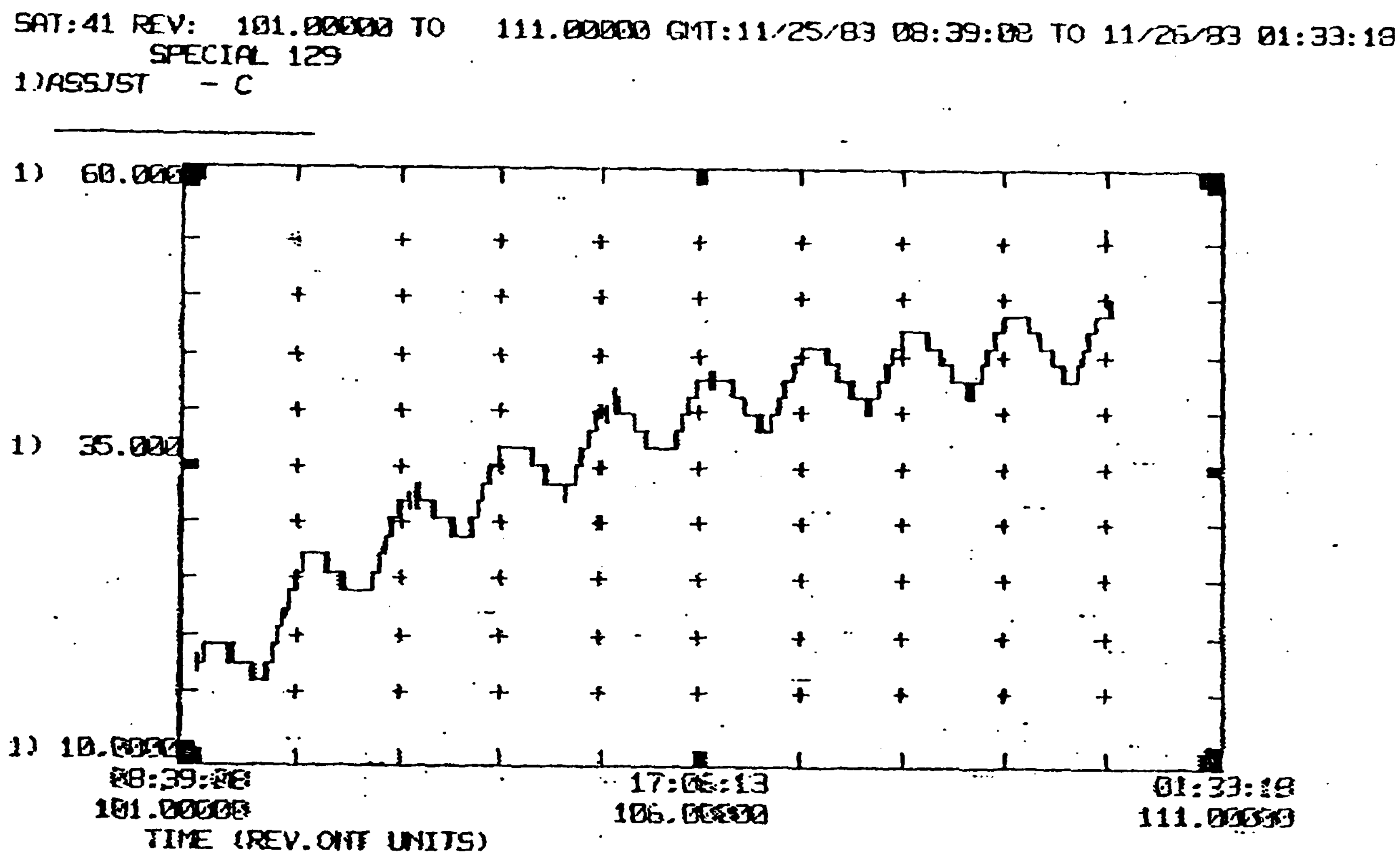

Figure 3.2 SSJ* Dosimeter Temperature Variations after Second Turn-On.

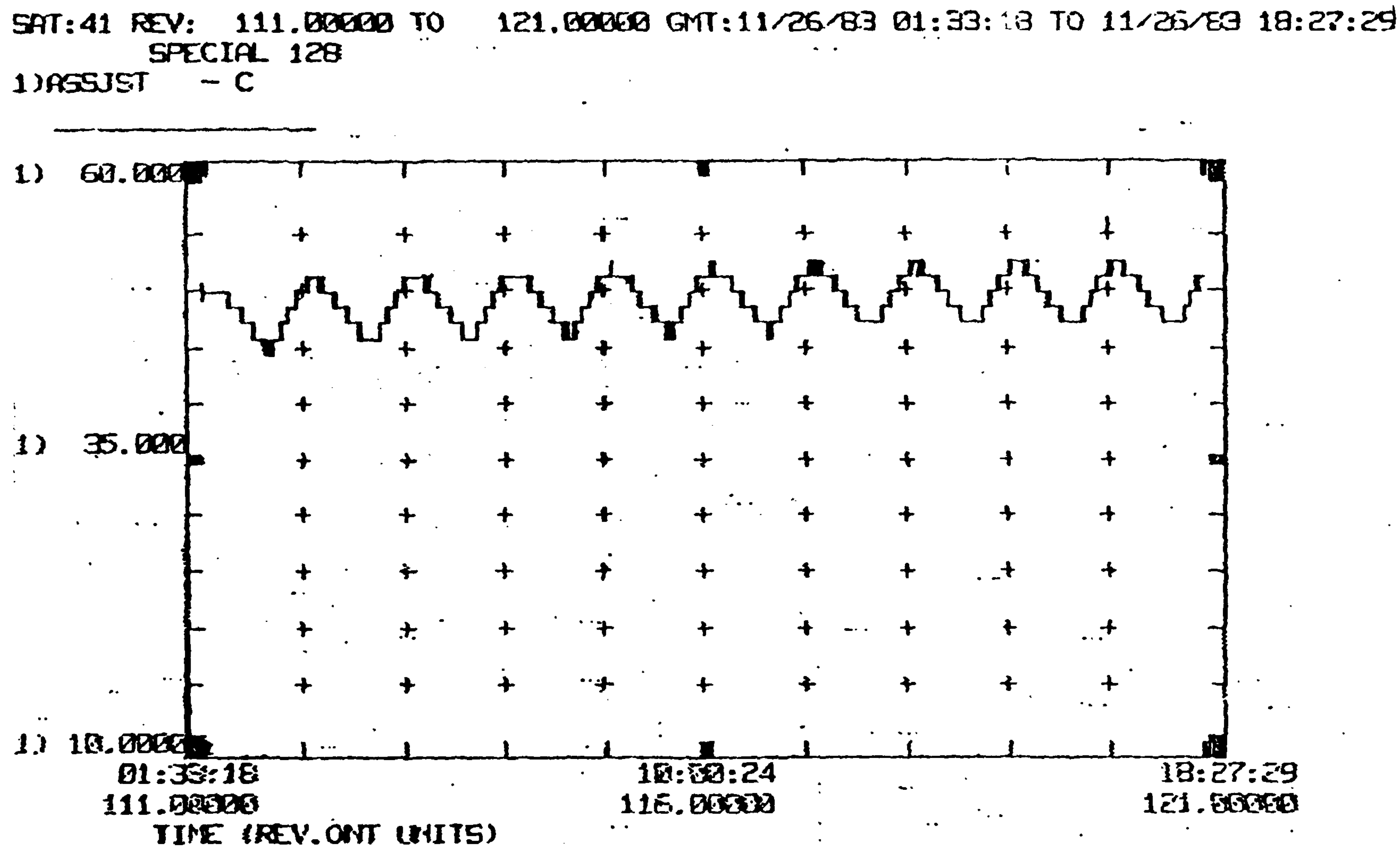

Figure 3.3 SSJ* Dosimeter Temperature Variations as Equilibrium is Achieved.

A number of abstracts for presentation at the December 1984 AGU meeting have been prepared with AFGL personnel. These presentations of the DMSP dosimeter data include: 1) a description of the dosimeter design and operation; 2) dose data comparisons for the February and April 1984 solar flare events and the South Atlantic Anomaly; 3) comparison of model calculations and dosimeter measurement of nuclear star events; and 4) use of the channel 1 nuclear star counts in solar flare events to estimate the alpha particle flux.

The data from passes through the South Atlantic Anomaly have been checked in detail. Data from the peak flux and dose periods, taken from Day 47, 1984 (16 February 1984), are shown in Table 3.1. The data show that the flux counts for channels 2P, 3P and 4P are near to the overflow count of 4096, and all proton dose channels have ripple counter overflows of 1-3. However, the ripple counter overflow can be extracted by using the ratio of 3.5 input dose counts/flux count and the flux count to correct for ripple counter overflow. This method will work for all near-equatorial data (mostly SAA data) reviewed so far.

Data from the peak counts for a solar particle event on Day 117 (26 April 1984) for a North Pole pass near 1320 UT are summarized in Table 3.2. The major change in Table 3.2 is the change in input dose cnts/flux cnt ratio for the proton channels from about 3.5 for the SAA to near 5.0. This requires that the ratio of input dose cnts/flux cnt be allowed to vary over the DMSP orbit, and for different events. An algorithm to do this was developed and tested on the dosimeter data. It is incorporated into the routine data analysis procedure at AFGL.

The electron channel flux counts overflow at 524288, so since the maximum observed count is about 8700 there is a large allowable increase in the electron channel (low energy loss range) flux before flux counter overflow would occur. This is not true for the proton flux counts, since the maximum count of 3900 is about 5% below overflow at 4096. Note that this requires some modification if the Dosimeter is to be used in the higher flux environment of the CRRES satellite. This is discussed in more detail in the next Section. Note also that the dose counters have prescalers before the ripple counters which are set by wire jumpers, so the dose counters can be readily adjusted for any desired flux.

Table 3.1

Dosimeter Data at SAA Peak ~ 0020 UT, Day 47, 1984

Channel	≈ Max. Flux cnt	≈ Max. Ripple cnt/overflows	Input Dose cnts/ Flux cnt (Range)
1P	280	17/1	3.6 (3.5 - 6.4)
2P	3900	14/0-1	3.6 (3.5 - 4.6)
3P	3100	42/2-3	3.5 (3.4 - 4.1)
4P	2500	35/2	3.5 (3.4 - 4.5)
1E	930	1/0	6.4 (6.0 - 7.6)
2E	8700	4/0	6.8 (6.8 - 7.9)
3E	7900	13/0	7.0 (6.7 - 7.6)
4E	6400	12/0	7.4 (7.0 - 8.3)

Table 3.2

Dosimeter Data For North Pole Peak of Solar Flux Event ~ 1320 UT, Day 117, 1984

Channel	≈ Max. Flux cnt	≈ Max. Ripple cnt/overflows	Input Dose cnts/ Flux cnt (Range)
1P	330	33/1-2	5.3 (5.2 - 5.5)
2P	1100	6/0	5.2 (5.1 - 5.2)
3P	330	6/0	4.6 (4.5 - 4.6)
4P	100	2/0	4.6 (4.6 - 4.7)
1E	1200	< 1/0	6.0 (6.0 - 6.1)
2E	1300	< 1/0	7.5 (7.5 - 7.6)
3E	370	< 1/0	6.4 (5.4 - 7.3)
4E	180	< 1/0	5.7 (5.3 - 6.1)

3.3 CRRES Dosimeter Fabrication, Calibration and Testing

Fabrication and testing of the CRRES Dosimeter, which is identical to the DMSP Dosimeter with the addition of a 28V power buss line voltage regulator and proton flux prescalers, is essentially complete - except for the line voltage regulator and prescalers.

The Dosimeter contains 23 printed circuit boards (not including the line voltage regulator or prescalers). The charge sensitive preamplifiers (4 identical boards) have been completely fabricated and tested, as have the shaping and star amplifiers (also 4 identical boards). These 8 boards have been assembled to their mother board, and that sub-assembly has been tested. The 4 identical digital data boards and 4 identical digitizer boards have also been completely fabricated and tested. The 3 printed circuit boards which comprise the DC to DC converter have also been fabricated and that sub-assembly has been completed and tested. The remaining 3 boards (digital control, interface/monitor and backplane) have been completely fabricated and are currently being tested.

The design of the line voltage regulator is currently in process. The design and breadboard testing of this unit, as well as the required printed circuit board layout and housing modifications, should be completed shortly.

As discussed in Section 3.2, the proton fluxes in channels 2, 3, and 4 on the DMSP Dosimeter are all within a factor of 2 of overflow at 4096 counts. The maximum SAA L-shell for DMSP is about 1.2 while the maximum trapped flux occurs at L = 1.4 - 1.5 and is about a factor of 5 larger. The CRRES Dosimeter would thus have proton flux counter overflows for these three channels unless some prescaling is done. This situation is being investigated, and it appears that a prescale of 8 can be used for the proton flux counters in channels 2, 3, and 4. The prescaler would not be reset, so no counts are lost at low flux levels. The proton flux counters would simply be 8 times the DMSP unit input counts. It presently appears that this can be implemented within the present contract scope with no increase in cost.

3.4 CRRES Integration and Launch Support

3.4.1 Ball Aerospace Corporation Preliminary Design Review

The Preliminary Design Review was held on October 11-14, 1983 at Ball Aerospace Systems Division (BASD) in Boulder, Colorado, and was attended by Panametrics' Paul Morel. The first 2-3 days were devoted to a detailed description of the spacecraft by BASD personnel, while the latter part of the week was devoted to a thorough review of the preliminary experimenter Interface Control Documents (ICDs.)

3.4.2 Ball Aerospace Corporation Critical Design Review

The Critical Design Review (CDR) was held on July 16-20, in Longmont, Colorado, and was attended by Panametrics' Paul Morel. The first 2-3 days were devoted to a detailed description of the spacecraft by BASD personnel, while the latter part of the week was devoted to a thorough review of the experimenter ICDs.

The only problem uncovered at CDR (as far as the Dosimeter and Fluxmeter are concerned) was that BASD wanted larger mounting holes in the Dosimeter and Fluxmeter Sensor and Electronics - units which were already fabricated. Also, for some reason, BASD did not have the latest copies of our Interface Control Drawings - which we had previously provided to both BASD and AFGL. Additional copies were forwarded to BASD's Carl Holmes on August 1, 1984. After several subsequent telephone conversations between Panametrics, AFGL and BASD, it was finally determined that only the Fluxmeter Sensor and Electronics need be modified. Red lined interface control drawings and baseplate manufacturing drawings, indicating the proposed modifications, were forwarded to Carl Holmes on August 15, 1984. We have also obtained price and delivery quotations for the manufacturing of new baseplates. It should be noted that the procurement and installation of these new baseplates will be carried out under the Fluxmeter fabrication contract (F19628-79-C-0175).

3.4.3 Wooden Mockups

Wooden mockups of the Dosimeter and Fluxmeter were fabricated by AFGL and delivered to Panametrics where connectors (non-flight) were mounted. These units were then returned to AFGL and have subsequently been delivered to BASD.

3.4.4 Parts Lists

Parts lists for the Dosimeter and Fluxmeter, which had been requested by BASD, were submitted to AFGL on February 8, 1984.

3.4.5 Orbital Requirements Document

Responses to a preliminary Orbital Requirements Document (ORD) inputs questionnaire were submitted to AFGL, for both the Dosimeter and Fluxmeter, on February 24, 1984.

3.4.6 Interface Control Document

A preliminary copy of the Interface Control Document (ICD) was distributed by BASD prior to PDR and was reviewed, in great detail, at PDR (October 11-14, 1983). A draft copy of the ICD containing the modifications identified at PDR was distributed by BASD during a meeting at AFGL on December 21, 1983. This was thoroughly reviewed, marked up as required and returned to BASD. The ICD was also thoroughly reviewed, and marked up as required, during CDR (July 16-20, 1984).

REFERENCES

1.1 P. R. Morel, F. A. Hanser and B. Sellers, "Fabricate, Calibrate and Test a Dosimeter for Integration into the CRRES Satellite," report AFGL-TR-84-0150, (October 1983). Scientific Report No. 1 for Contract No. F19628-82-C-0090. ADA150683

2.1 B. Sellers, R. Kelliher, F. A. Hanser, and P. R. Morel, "Design, Fabrication, Calibration, Testing and Satellite Integration of a Space-Radiation Dosimeter," report AFGL-TR-81-0354 AD A113085, (December 1981). Final Report for Contract No. F19628-78-C-0247.

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