UCSD-SP-68-5

ENVIRONMENTAL RESEARCH SATELLITE-18 DATA REDUCTION AND ANALYSIS

Volume I

SATELLITE DESCRIPTION AND OPERATIONS

(Terminal Flight Report)

July 1968

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Research Sponsored by
ADVANCED RESEARCH PROJECTS AGENCY
Nuclear Test Detector Office
Contract No. FO-4701-68-C-0108
Air Force Space and Missile Systems Organization
Los Angeles, California

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References

(1) "System Description Document Octahedral Research Satellites Mark III-A and B (ERS 17 and 18)" TRW Systems, Redondo Beach, Calif., Document No. 03565-6001-R005, August 1967.

(2) "Environmental Research Satellite-17, Data Reduction and Analysis" Volume 1, Satellite and Reduction Systems, University of California, San Diego, La Jolla, California, Report UCSD-SP-67-2, May 1967.

(3) "Environmental Research Satellite No. 18 (ORS - Mark III - Radiation)" Goddard Space Flight Center, Greenbelt, Maryland, Report X-513-67-127, March 1967.

Preface

This report series describes results obtained from the Environmental Research Satellite-18 (ERS-18), one of a series of small satellites developed over the past several years by TRW Systems through several Air Force programs. The Octahedral Research Satellite Mark III (ORS-III) was one of these series, designed to provide a complete monitoring of radiations in space and to study the radiation background problems associated with the nuclear test detection devices on the Vela Satellite Program. Two ORS-III satellites were developed and constructed in order to measure ionizing radiations throughout the magnetosphere to the altitudes of the present Vela satellite, approximately 18 R_E. The first one (ERS-17) which was launched on 20 July 1965, produced data for approximately 3-1/2 months. The ERS-18, with a modified payload, was launched April 28, 1967 in a orbit with a higher perigee, and has produced nearly continuous coverage for more than one year.

In accordance with procedures established under the ERS-17 data reduction contract, the results of the ERS-18 will be published as a series of reports, in addition to papers in scientific journals, where appropriate. The ERS-17 series consisted of seven volumes, containing a description of the ERS-17 and the data reduction system, five volumes containing all the data in form of machine plotted graphs, and a final report. The reports on the ERS-18 will be issued at approximately quarterly intervals, and will have a modified format because of the economic impracticality of publishing the entire mass of data. This, the First Quarterly or Terminal Flight Report, contains a description of the satellite, the data reduction procedures and a resume of the satellite's operation. The second Quarterly Report will contain selected sample data and its interpretation, the third may contain selected solar-terrestrial events, etc.

The ORS-III satellites were constructed by a group within the Solid State Physics Laboratory of TRW Systems under the direction of Dr. Joseph Denney. The work of many individuals, indicated in the previous report series, contributed to the success of these satellites. Particular mention is due Mr. Randy Martin, who was generally responsible for the construction, integration and test of the satellite system.

Dr. James Vette, formerly of the Aerospace Corporation, provided the initial impetus leading to the development of the ORS-III, and has continually provided technical and scientific oversight of these projects, in addition to direct contributions in detector design, data analysis, and interpretation of the scientific results.

The University of California group under the direction of Dr. Laurence Peterson has been principally responsible for the reduction and analysis of data received from these satellites. The computer programs were originally written by Mr. Louis Huszar for the ERS-17, and were modified by him for the ERS-18. The data playback system was designed, assembled and monitored in a most expedient manner by Mr. Paul Brissenden. Many undergraduates have contributed to the data playback and computer reduction operations.

This research at UCSD was supported through the Nuclear Test Detection Office, Advanced Research Projects Agency. Colonel R. C. Brouns of that office has been most helpful and understanding. UCSD is under contract through Air Force Space and Missile Systems Organization, Los Angeles, California. Major Julian Salas has also contributed much to the initiation and direction of this project.

Laurence E. Peterson

July 1968

Abstract

The 17.2 lb. Environmental Research Satellite-18 (ORS-III-B) carried a set of five radiation detectors designed to measure charged particles, X-rays, gamma rays, and cosmic rays in the near Earth environment. The satellite was launched on April 28, 1967 into a highly elliptical orbit whose initial apogee altitude was 111,200 kilometers and initial perigee altitude was 8,600 kilometers. Detectors sensitive to trapped particles include a solid state detector for electron fluxes above 0.4 Mev and protons 8-21 Mev, a low energy scintillation counter for electrons greater than 100 kev and protons greater than 1-8 Mev. A set of Geiger-Mueller counters detected solar X-rays in the 1-14 Å range, and electrons above 40 kev. Gamma ray counting rates between 30 kev and 10 Mev, as well as the total cosmic ray flux, were provided by the "dual-gamma" counter, a large NaI(Tl) crystal surrounded by a charged particle shield consisting of plastic scintillator connected in electrical anticoincidence with the central scintillator. Signals from most channels were converted to analog voltages by logarithmic count rate meters. Each channel was sampled about once a minute to modulate a subcarrier oscillator in the telemetry system. Several low counting rate channels were converted to a quasi-digital format before sampling.

Data has been received nearly continuously from launch until termination on June 3, 1968, and has been monitored occasionally to assess the performance of the instrumentation. Magnetic tapes are

presently being played back, decommutated and reduced in a semi-automatic system at the University of California, San Diego, where the data are also checked, edited and assembled in sequential order for analysis and plotting. Corrected counting rates from the principal channels have been hand-plotted as a function of time for satellite orbits 26, 27 and 28, which covers the period from June 18 to June 23, 1967. The remainder of the data has been periodically sampled to indicate the satellite status. Data retrieval will cover about 80% of the time during the first one year of operation. Many of the ERS-18 data will be machine-plotted against time, and selected portions will be presented in future reports in this series. The data will also be eventually available in a magnetic tape format for further analysis.

Introduction

Determination of the radiation conditions in the near Earth environment requires synoptic observation over a large region of space with detectors of considerable dynamic range and sensitive to many different ionizing species. The Octahedral Research Satellite Mark III is designed for this purpose and has an instrument complement of radiation detectors to measure charged particles, cosmic rays, X-rays, and gamma rays. Two satellites in this series have been successfully launched. The first, designated the Environmental Research Satellite-17 (ERS-17) was launched July 20, 1965 into a highly elliptical orbit of apogee 112,200 kilometers and perigee 192 kilometers altitude and produced data for over three months at a 30% coverage rate. The second (ORS-III-B) was launched as the ERS-18 into an orbit of 111,200 kilometers apogee and 8,600 kilometers perigee altitude on April 28, 1967, and has produced data at about an 80% coverage level for over a year. Both satellites traverse the outer trapped radiation zone, the outer magnetosphere, and reside in the interplanetary region for a considerable period of time; ERS-17 also swept through the inner zone. This report contains descriptions of the ERS-18 and the techniques used to reduce and analyze the data at the University of California, San Diego. Also included is an operational summary; data presentation and scientific results are the subject of further reports.

Description of ERS-18

The ERS-18 was designed and developed by a group within the Solid State Physics Laboratory of TRW Systems, Redondo Beach, California. The basic configuration of the ORS-III satellite is a regular octahedron measuring 11 inches on a side. Solar cells mounted on each of the faces provide sufficient electrical power to operate the experiments and the telemetry system when the satellite is illuminated by the sun. No internal battery or command system were provided. The satellite and its detector complement are briefly described in the ORS-III System Description Document[1], and the ORS III-A in Volume I of the ERS-17 report series[2].

The subsystems of the satellite consisted of electrical power, antenna, telemetry, experiments and mechanical structure. The electrical power system included the solar-cell arrays and a voltage regulator. A half-wave-length dipole and matching network comprised the antenna system. The telemetry system included an electronic commutator, a subcarrier oscillator, and the transmitter. The detector systems were designed to measure geomagnetically trapped radiation, cosmic rays, solar and galactic gamma rays and solar X-rays. As with the ERS-17, six instruments constituted the experiment complement: a Geiger tube array, a solid state detector, a surface barrier detector, two particle scintillation counters, and a large gamma ray scintillation counter with active anticoincidence particle shielding.

Satellite Description

Photographs of the ORS-III-B, with some of the solar panels removed, are shown in Figures 1 and 2 and an electrical block diagram in Figure 3. The basic welded aluminum structure weighed 1.9 lbs., the completed satellite as launched weighed 17.2 lbs. A thrust member coupled launching accelerations to the central deck upon which were mounted the transmitter, high voltage supply, and many of the welded electronic modules. Other electronic assemblies were mounted on sub-decks. Detectors requiring little or no shielding were arranged to view outward at the various corners of the octahedron.

Power was provided by eight panels of N-on-P 10 ohm-cm solar cells with 102 one-by-two centimeter cells on each panel, supplying about 4 watts of unregulated electrical power for the averaged projected area of the octahedron. A series voltage regulator provided electrical power at 9.0 ± 0.1 volt to the telemetry and experiment systems. About 0.6 watts was available to the experiments. The transmitter itself and the high voltage supply were supplied with unregulated power. An end-of-life timer was designed to remove transmitter power after a nominal preset interval of 16 months (that is, at the end of August, 1968).

The antenna was a conventional half-wave length dipole fabricated from half-inch wide ribbon steel, stiffened by concave forming. It self-erected from a coiled position and projected unsupported from the satellite. A matching network, consisting of a transformer with tuned

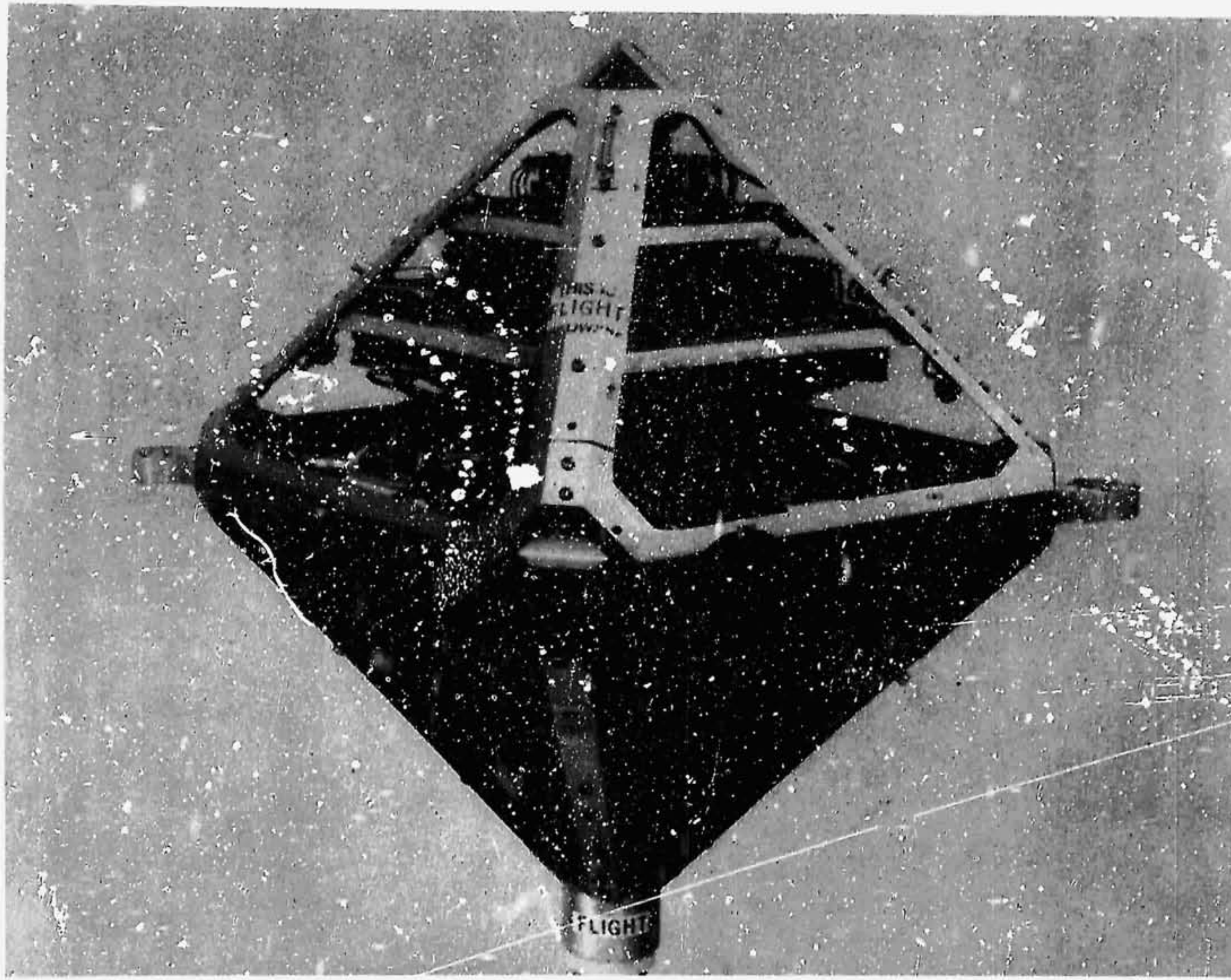


Figure 1 - A photograph of the ERS-18 with the upper solar panels removed to show the electronic construction. Visible on the outside is the G-M counter and surface barrier detector assembly, the meridian solar sensor, and several of the latitude sensors.

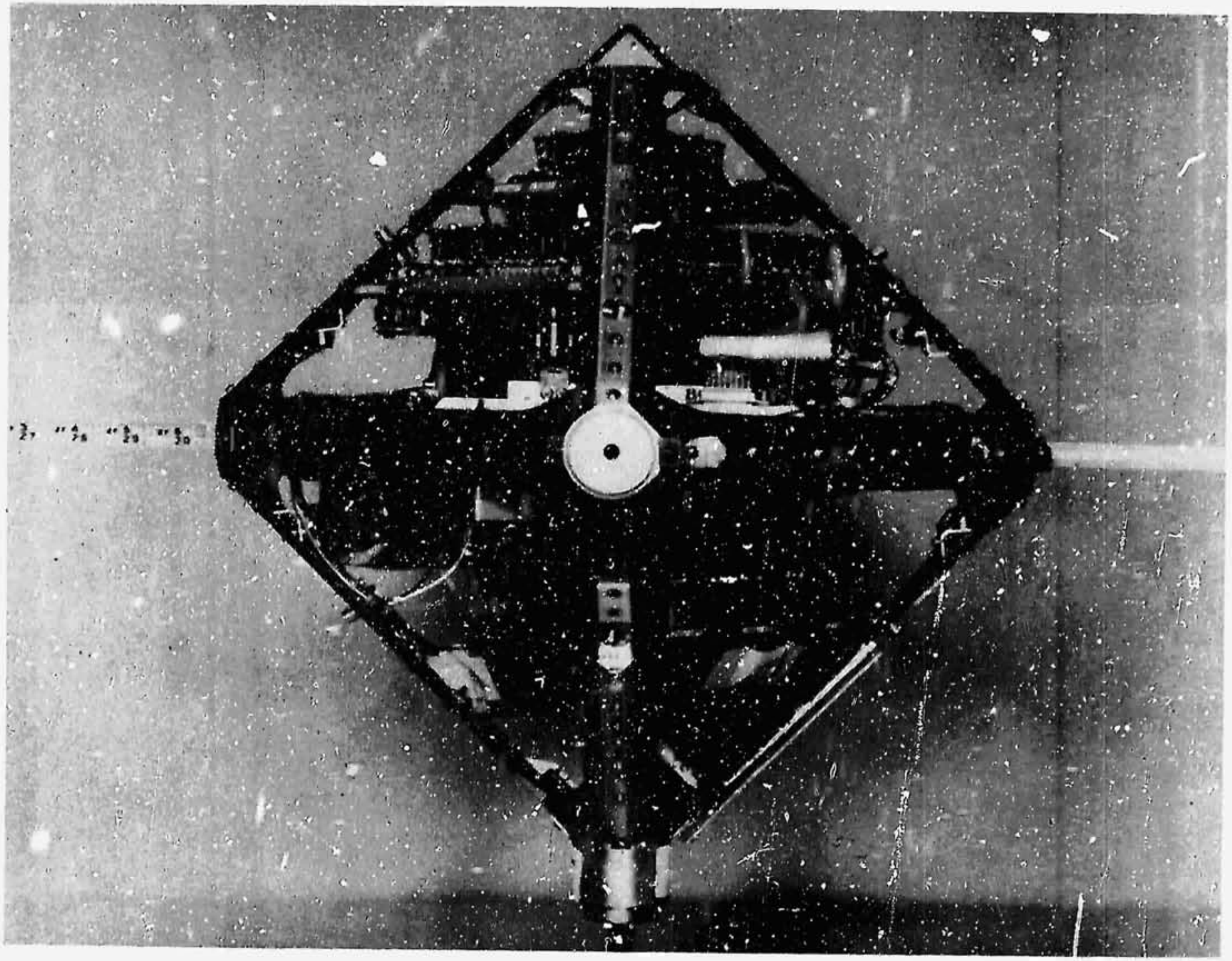


Figure 2 - The ERS-18 with all the panels removed. That large gamma-ray counter with Al foil wrap is just visible below the deck. The Li-drifted solid state detector is seen on the lower right hand panel, and the low energy scintillation particle detector is seen head-on at the center apex.

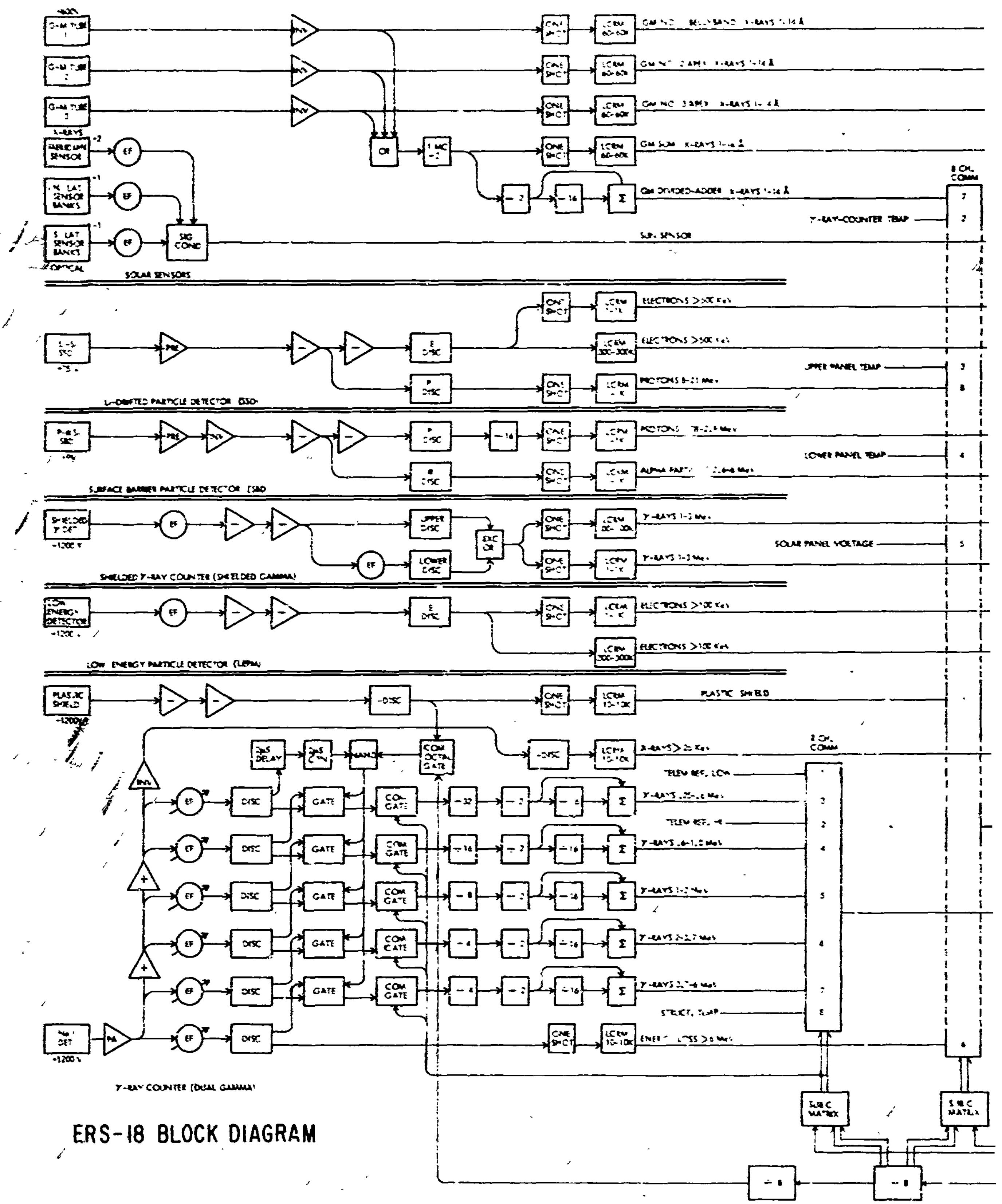


Figure 3 - A block diagram of the satellite. Counting rate
radiation detectors were converted to analog voltages with
count rate meter, or by using a quasi-digital technique. E
sampled about 5 seconds each minute and telemetered on a PA

A.

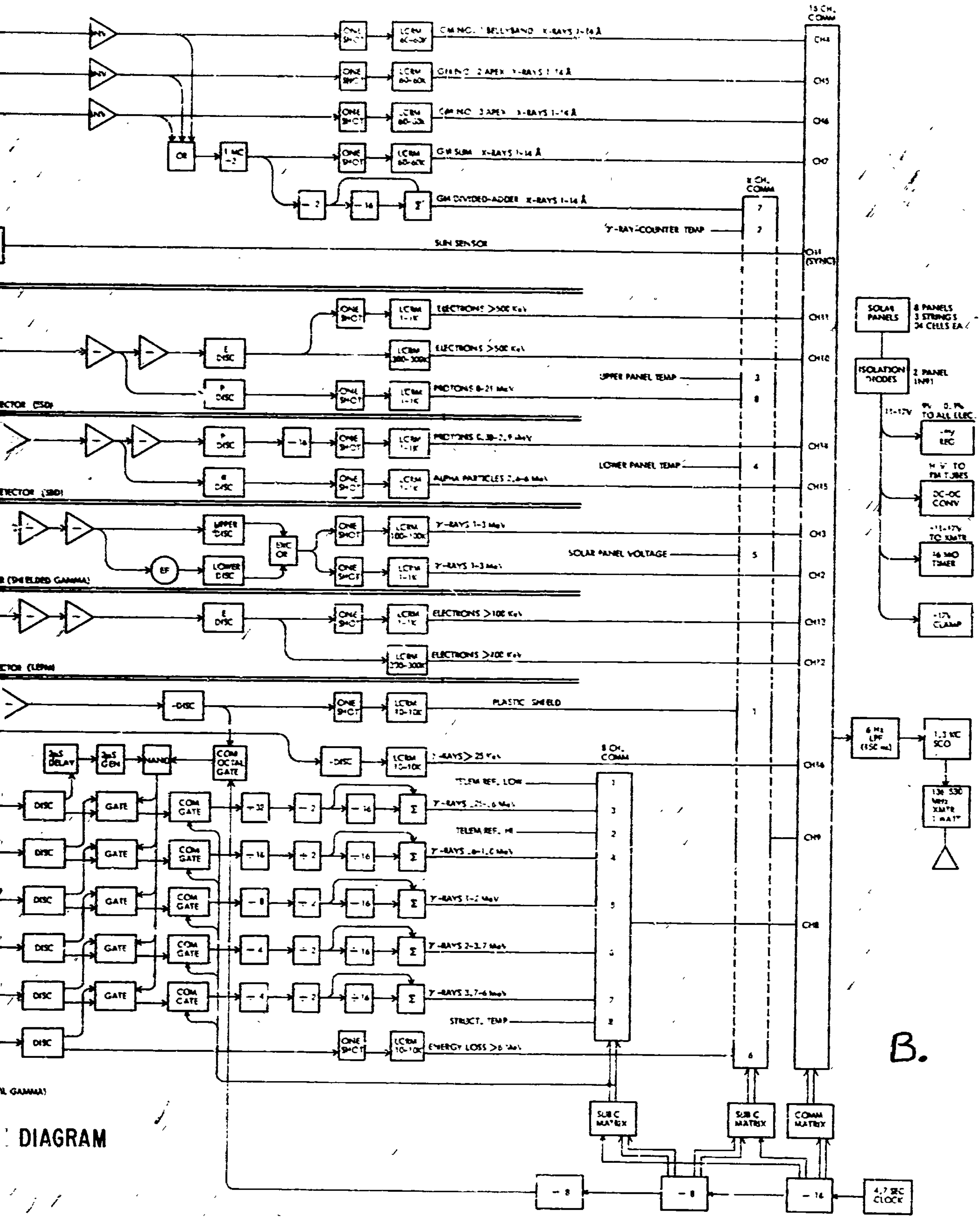


Figure 3 - A block diagram of the satellite. Counting rates from the radiation detectors were converted to analog voltages with a logarithmic count rate meter, or by using a quasi-digital technique. Each channel was sampled about 5 seconds each minute and telemetered on a PAM/FM/FM system.

primary and secondary windings, provided maximum power transfer from the transmitter to antenna.

Temperature control of the satellite was achieved by passive techniques. Good thermal coupling of all parts of the vehicle is possible because of its small size. The design operating temperature in sunlight was about $15^{\circ}C$, with excursions to nominally $0^{\circ}C$ during the short perigee eclipses (1/2 hour max.) and to $-30^{\circ}C$ during apogee eclipse (4 hours max.), which can occur only eight days per year. Temperatures measured during the satellite lifetime were within the design limits, usually being about $10^{\circ}C$ at the location of the thermisters.

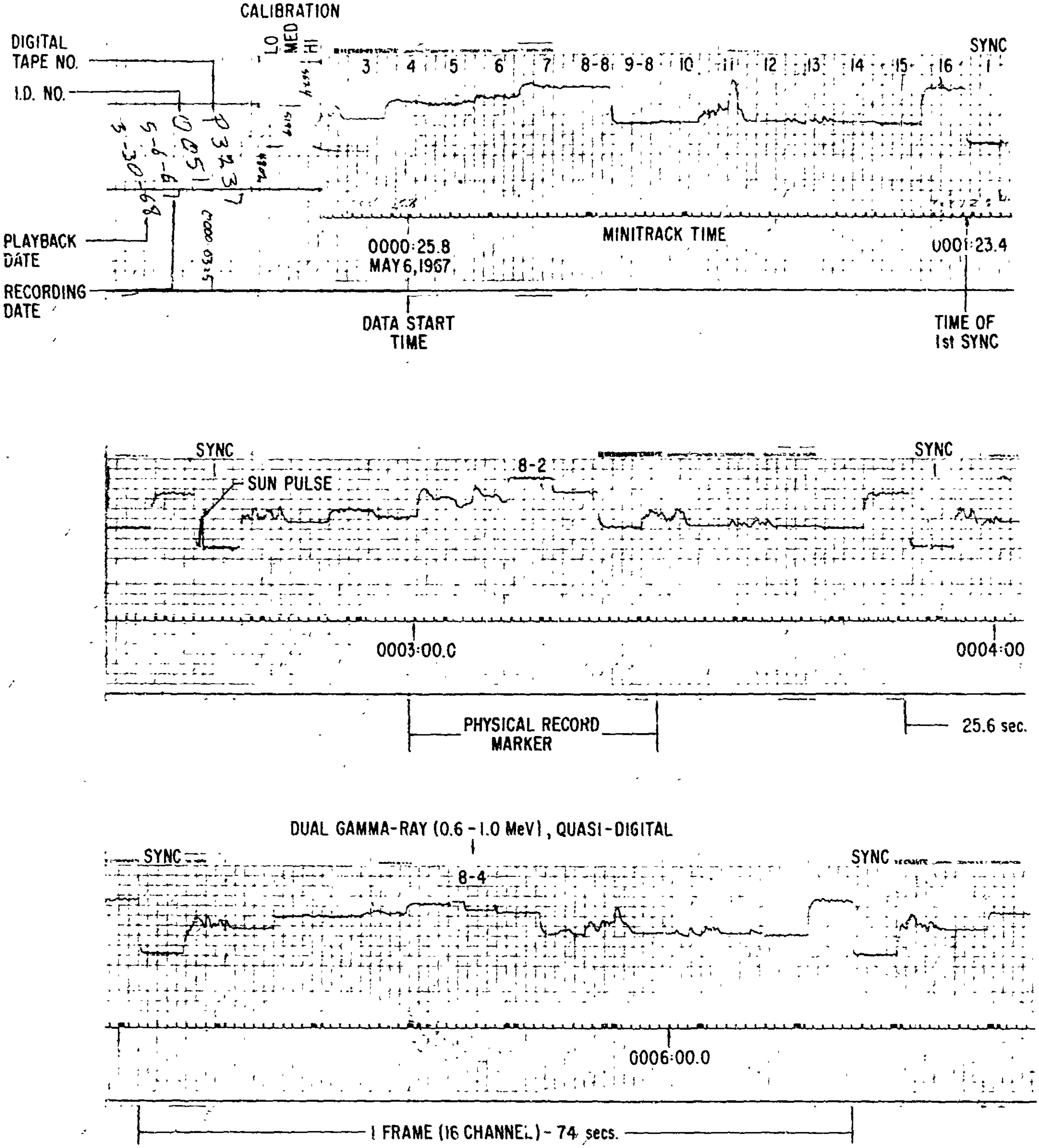
Experiment and housekeeping data was telemetered on a PAM/FM/PM system with a nominal rated power of 1000 milliwatts at 135.530 mHz. The peak modulation index is 1.0 ± 7.5% subcarrier oscillator was designed for an input range of 1.0 volt. Nominally 4.8 volts input to the commutator corresponded to a frequency of 1200 cps and 5.8 volts to 1400 cps. Subcarrier frequency was stable to within ± 0.1% over the $-25^{\circ}C$ to $+40^{\circ}C$ temperature range. Data from the 16-channel commutator was filtered by a single RC network of time constant .047 sec. This results in an information bandwidth of about 6 cps. Each commutated channel, as shown in Figure 3, was sampled for a nominal 5 seconds; two of the channels, numbers 8 and 9, were subcommutated into 8 additional channels. In orbit, the sampling time was 4.7 seconds so that about 74 seconds were required to read the entire main frame, and 592 seconds for all the subcommutator channels. Most of the data channels on the

ERS-17 and 18 consisted of analog outputs from logarithmic count rate meters, or quasi-digital data from binary scalar-adders. A typical telemetered analog chart record received from the ERS-18 is shown in Figure 4.

The channel assignments are indicated in Figure 3 and Table 1. Channels, other than the sync, were limited to a subcarrier frequency range of 1280 cps to 1400 cps, corresponding to a nominal input range of 5.2 to 5.8 volts. Channel 1 (sync) was identified by a range of 1200 cps to 1260 cps, or an input range to the commutator of 4.8 to 5.1 volts. Additionally, the information channel superimposed on the sync usually was near the 1200 cps level. Subcommutator sync (channel 8-1) was identified by sampling a low reference voltage, nominally 1233 cps, followed by a high reference voltage nominally 1379 cps on channel 8-2. Preflight temperature calibrations of the subcarrier oscillator reference frequencies are shown in Figure 5 and a typical channel in Figure 6.

Housekeeping information consisted, in addition to voltage readouts, of four temperature readouts on the subcommutated channels 8 and 9. Thermocouples were placed on the upper and lower solar panels, on the large scintillation counter, and in the central structure. A typical temperature channel calibration is shown in Figure 5; the remainder may be found included in the system description document (1).

An array of sun sensors were installed with the intent of providing a positive indication of spin axis aspect with respect to the solar direction. The meridian sun sensor, shown in Figure 7 and Figure 1,



ERS-18 ANALOG CHART -- MAY 6, 19

Figure 4 - A typi
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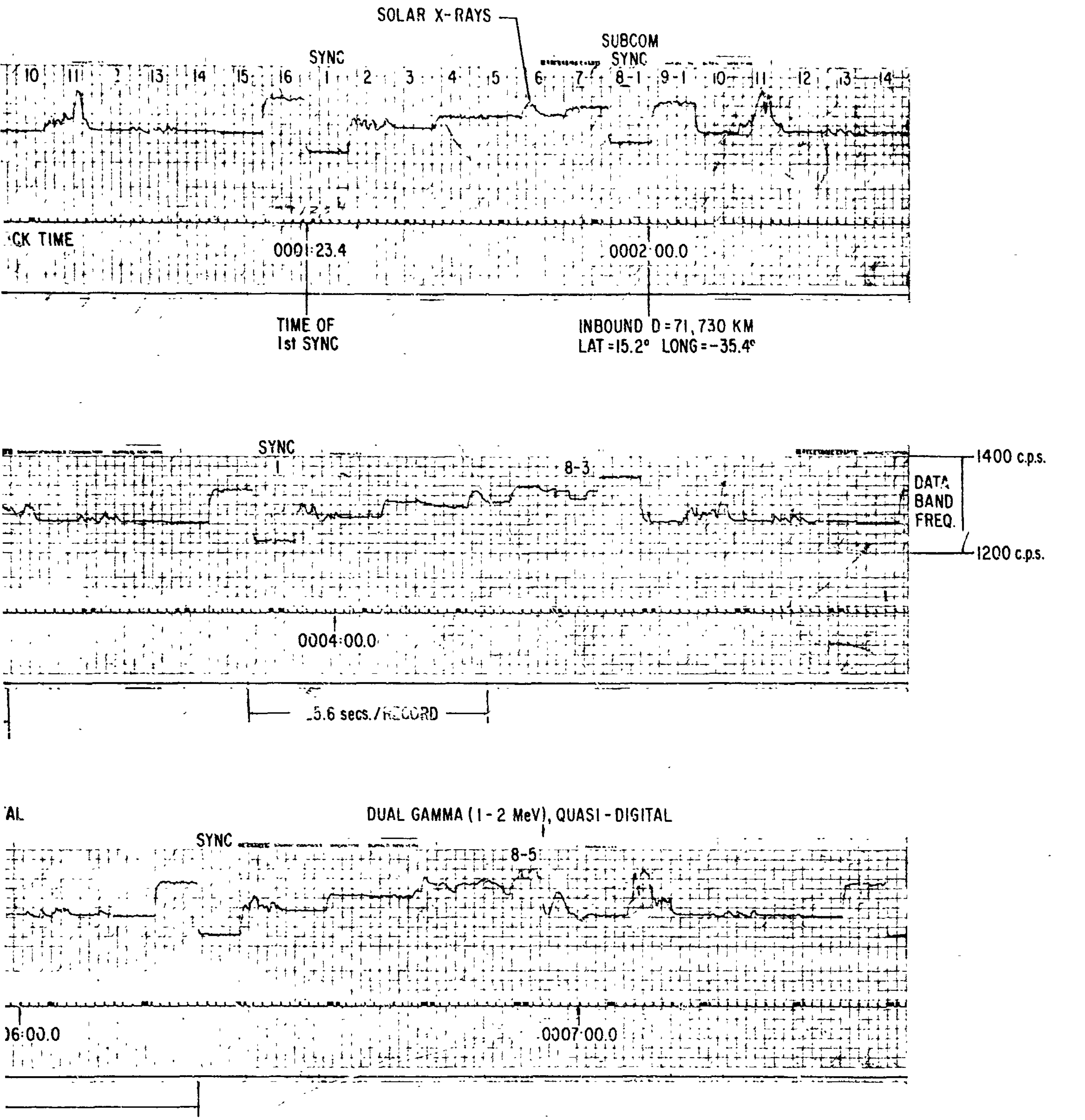
A.



-18 ANALOG CHART - MAY 6, 1967

Figure 4 - A typical record of the ERS-17 data obtained soon after launch. Each channel was sampled for about 5 seconds, and consisted of counting rate data obtained through logarithmic count rate meters, or binary scalers. Also shown are playback system calibration records used in four times real time reduction operation.

TABLE I

ERS-18 EXPERIMENT NOMINAL CHARACTERISTICS

Detector	Absorber	Measurement	Discriminator Level	Geometry Factor	Readout Type	Dynamic Range counts/sec	Scaling Factors	Channel Number
EON 6213	1.2 mg/cm^2	Electrons>40 kev	-	A=0.056 cm^2	Scaler-Adder		4 & 64	9-7
G-M Counters	Mica	Protons>750 kev X-Rays 1-14 Å	-	$\epsilon G_o = \frac{1}{56}$	LCRM	60-60,000		4,5,6
				$\Omega_t \approx 6.6$ ster	LCRM	120-120,000		7
Solid State	68.5 mg/cm^2 Aluminum	Electrons>400 kev	70 kev	$\epsilon G_o = \frac{1}{170}$	LCRM	1-1000		11
				$\Omega = 2\pi$	LCRM	300-300,000		10
		Protons 8-21 Mev	4.6 Mev	$\epsilon G_o \cong \frac{1}{125}$	LCRM	1-1000		9-8
Low Energy Photo-multiplier	8.9 mg/cm^2 Aluminum	Electrons>100 kev	75 kev	$A\Omega$ = .0142 cm^2-ster	LCRM	1-1000		13
				Ω = .045 ster	LCRM	300-300,000		12
Surface Barrier	0.3 mg/cm^2 Nickel	Protons 0.38-2.9 Mev	0.37 Mev	Ω = .045 ϵG_o = .00113 cm^2	LCRM	1-1000		14
		Alphas 2.6-6.0 Mev	2.58 Mev	$A\Omega$ = .066 cm^2-ster ϵG_o =.00526 cm^2	LCRM	1-1000		15
Shielded Gamma	4.4 gm/cm^2	γ-Rays 1-3 Mev	1 Mev	4.25 cm^2	LCR	1-1000		2
			3 Mev		LCR	100-100,000		3
Dual-Gamma Counter	~ 2 gm/cm^2	X-Rays 25-250 kev	-	69 cm^2	LCRM	10-10,000		16
		γ-Rays .25-0.6 Mev			Scaler-Adder		64&1024	8-3
		γ-Rays 0.6-1.0 Mev			" "		32&512	8-4
		γ-Rays 1-2 Mev			" "		16&256	8-5
		γ-Rays 2-3.7 Mev			" "		8&128	8-6
		γ-Rays 3.7-6.0 Mev			" "		8&128	8-7
		Cosmic Rays>43 Mev	6 Mev		LCRM	10-10,000		9-6

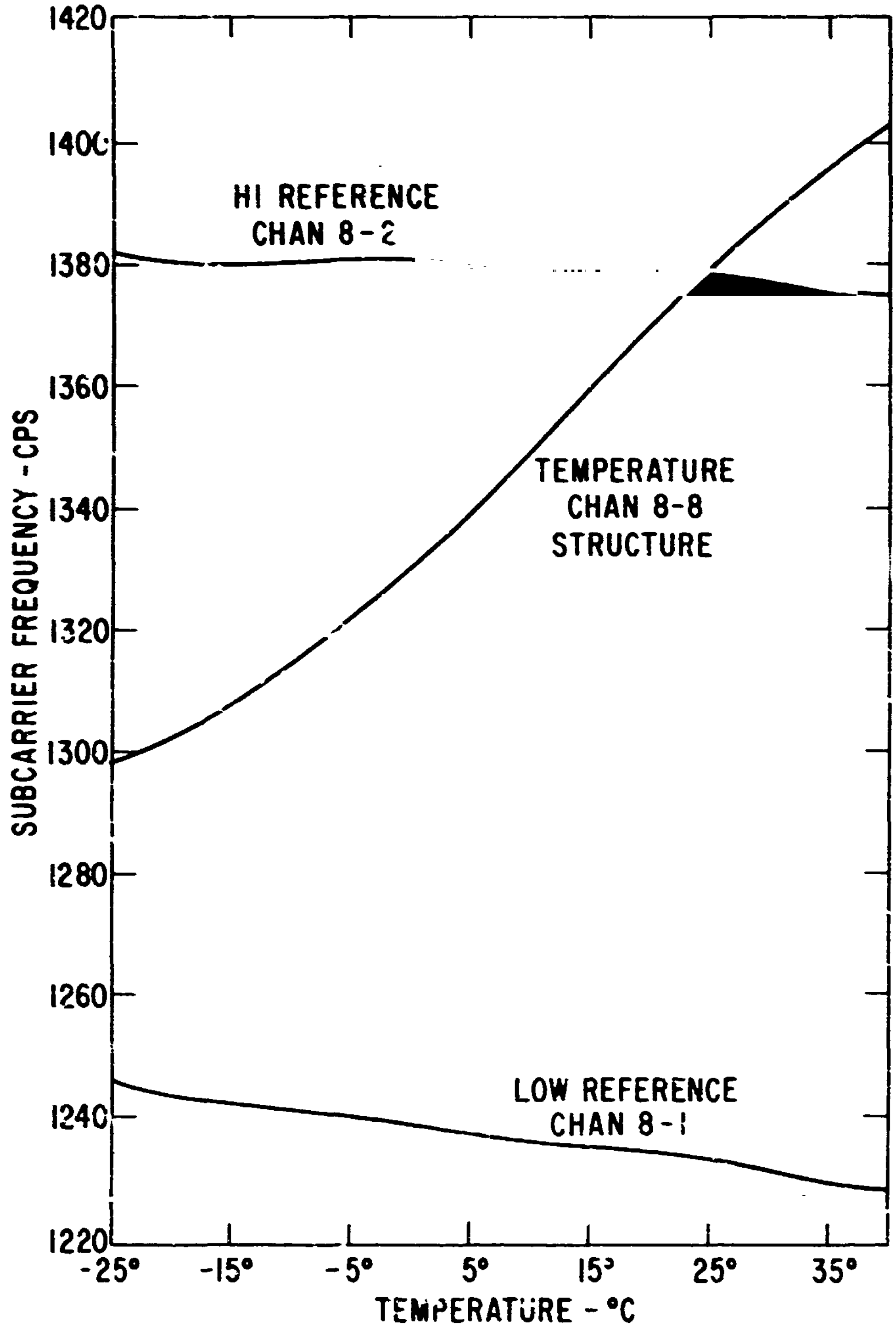


Figure 5 - Variation of subcarrier oscillator reference frequencies with temperature in a pre-launch calibration. Also shown is the calibration of a typical thermistor channel.

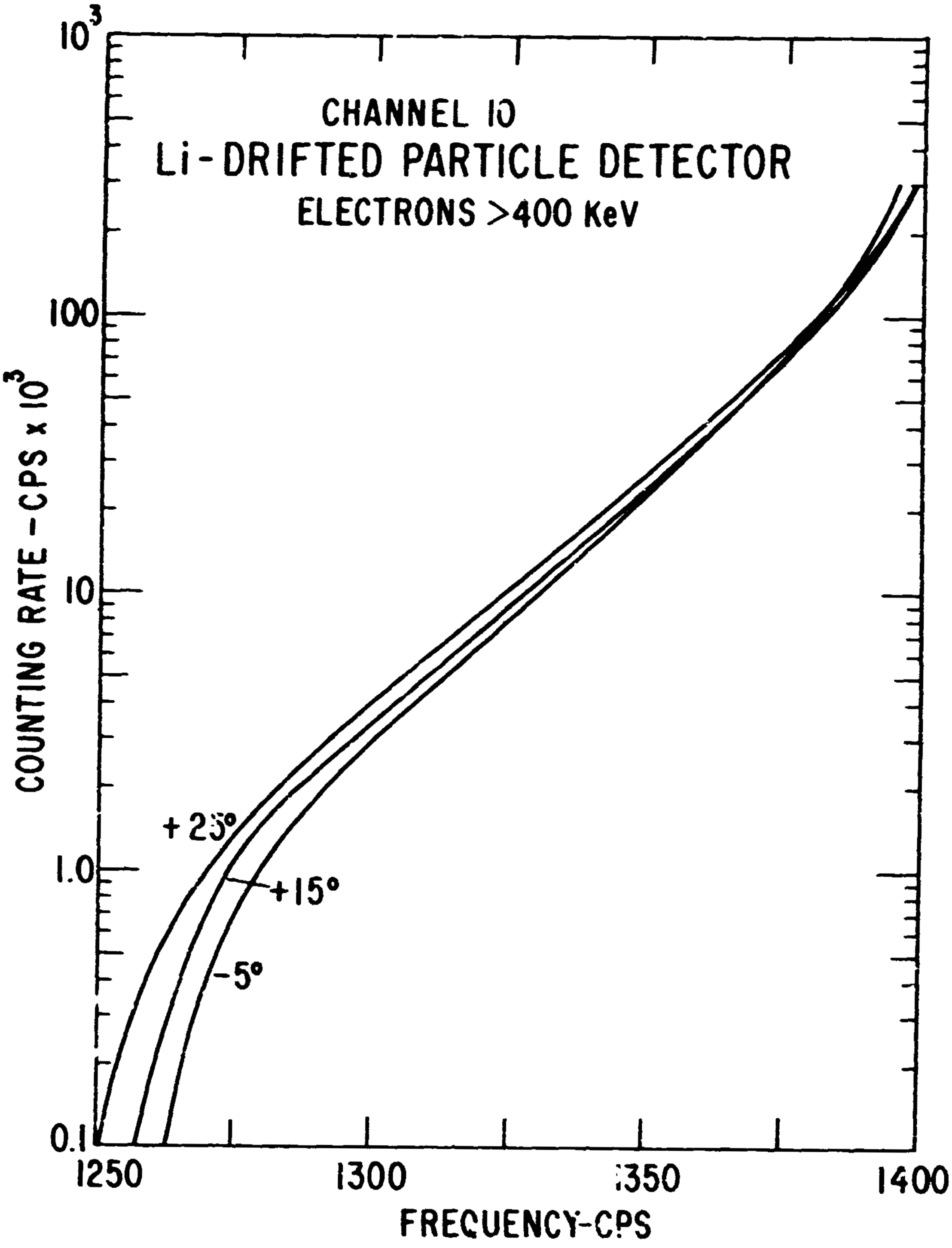


Figure 6 - Calibration of a typical logarithmic count rate meter (LCRM) at various temperatures.

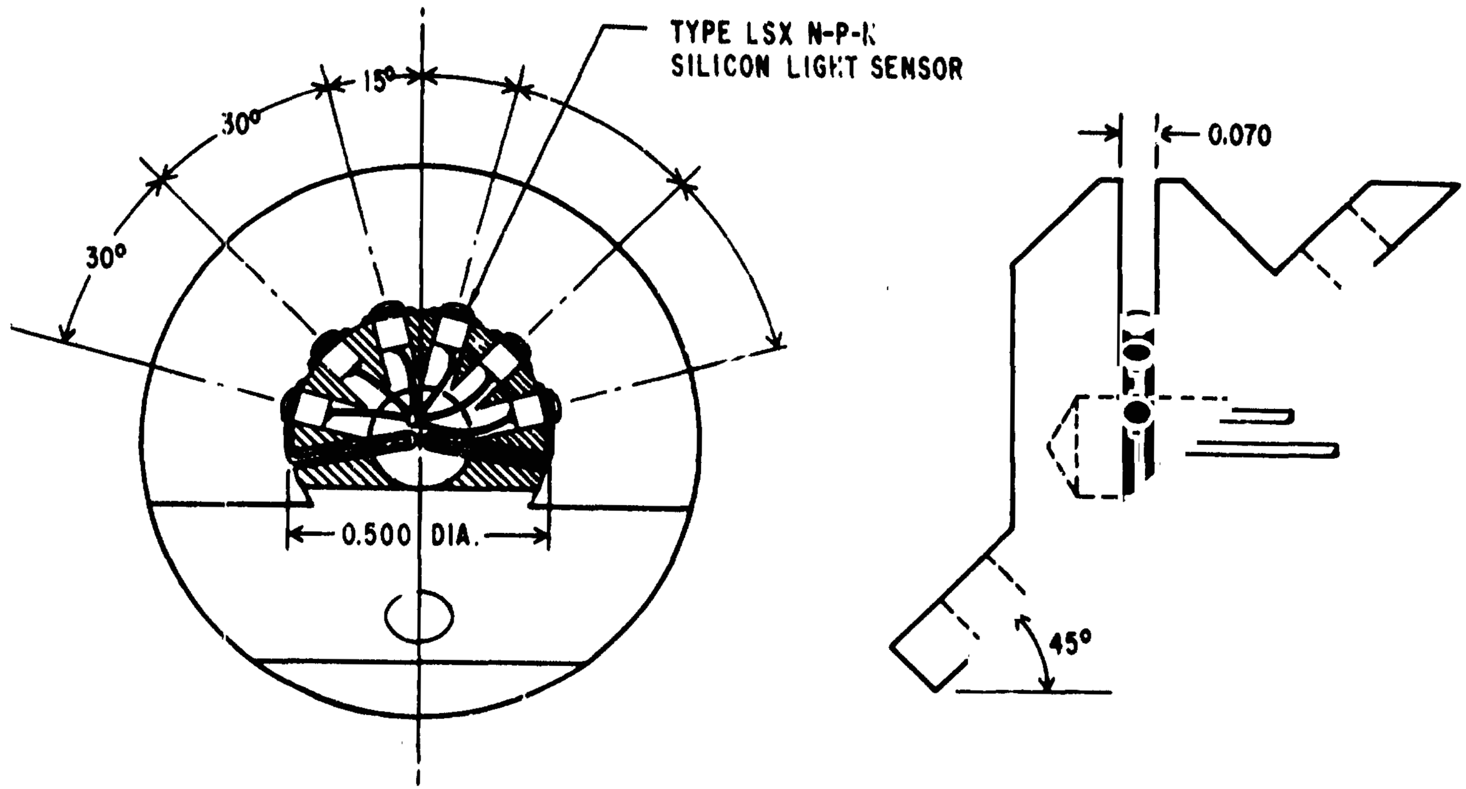
provides a pulse each rotation about the intended spin axis, which is vertical in Figure 1. The latitude sensors, Figure 8, are mounted at various locations on the spacecraft as shown in Figures 1 and 2. Only one of these sensors produces a pulse each spin rotation, the output being identified by the time and polarity of the pulses on the telemetry record, channel 1. This provides an indicator, within a 22.5° interval, of the location of the solar vector with respect to the latitude plane of the satellite. On the ERS-18, however, the interpretation of the aspect data is considerably confused because the satellite did not remain spinning about its intended axis.

The remaining 13 main frame and 9 subcommutator channels are given to data from the scientific instrumentation.

Detector Complement

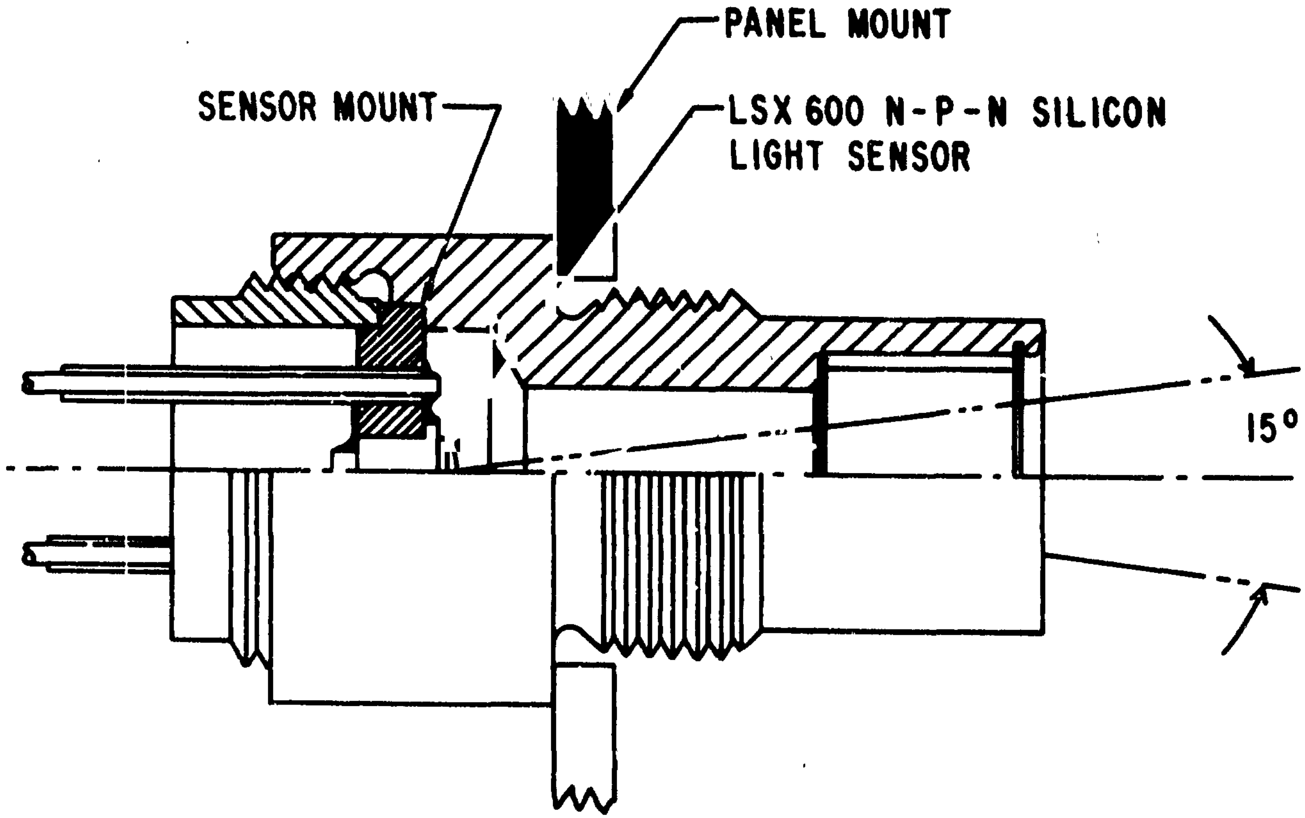
The detectors on the ORS-III-B are indicated on the block diagram, Figure 3, and many of their properties, telemetry modes, and channel assignments in Table I. Table II contains a list of all the ERS-18 sensors, a summary of terminology appearing in various documents describing the ERS project and its results, and the relationship of the detectors on the two satellites. The following sections describe each radiation counter in some detail.

A complete discussion of the response and of the detectors which are common to the ERS-17 is included in the final report of that series. Further details of the properties of the ERS-18 detectors will be included in subsequent reports.



MERIDIAN SENSOR

Figure 7 - Construction of the meridian solar sensor. This produces a single pulse each rotation about the spin axis, intended to be parallel to the slit.



SUN SENSOR ASSEMBLY TYPICAL

Figure 8 - One of the eight latitude sensors. Only one sensor produces a pulse each rotation, depending on the solar direction with respect to the spin axis.

TABLE II

SENSOR SUMMARY

Instrument	Detector Menomic	Measurement	Quantity Aboard	Relation to ERS-17 Detector
Meridian Solar Sensor	--	Spin Rate, Latitude Reference	1	Replaces Simple Solar Reference System
Latitude Sun Sensor	--	Solar Latitude W.R.T. Spin Axis	8	
Geiger-Mueller Counters	G-M	Electrons>40 kev energy X-rays 1-14 Å	3	Same, except new mount
Surface Barrier Particle Detector	SSB	Protons 0.38-2.9 Mev energy α-particles 2.6-6.0 Mev	1	New Detector
Li-drifted Particle Detector	*SSD	Electrons>0.5 Mev energy Protons 7.5-15 Mev energy	1	Same as previous SSD
Low-Energy Particle Detector	**LEPM	Electrons>100 kev energy Protons 3-27 Mev energy	1	Similar to Previous LEPM, except smaller solid angle
Shielded Gamma-Ray Counter	Shielded Gamma	Gamma rays and charged particles, 1-3 Mev energy loss	1	Similar to high energy Photo-multiplier detector (HEPM) except for passive shielding
Gamma-ray Counter	Dual Gamma	Gamma rays and charged particles, .25-6 Mev energy loss	1	Similar to Phoswich Scintillation Counter on ERS-17

* Solid State Detector
**Low Energy Photomultiplier

(A) Geiger-Mueller Counters(G-M)

The Geiger-tube detector system was designed to measure very low energy electrons and solar X-rays. The threshold sensitivity of these thin window EON 6213 Geiger tubes is determined by the window thickness which was 1.2 mg/cm^2 of mica. In order to make a measurement of the omnidirectional flux of these particles, three Geiger tubes are needed which have non-intersecting fields of view. The total solid angle is approximately 2π steradians. In this case the Geiger tubes were mounted along three mutually perpendicular axes and restricted each to a $\pm 45^{\circ}$ conical field of view by an aluminum collimator. Figure 9 is a drawing of one of the assemblies, also visible on the satellite photographs, Figures 1 and 2. The outputs of the three tubes are telemetered, both individually through logarithmic counting rate meters (LCRM) that cover the range 60-60 kc, and summed through a single binary scaler, to another 60 kc LCRM as shown in Figure 3. Thus the range covered for the summed output is 120-120 kc counts/sec. In order to measure the very lowest counting rates, the summed output is also connected to a scaler-adder circuit, which covers the range 0.5 to 100 counts/second.

The tubes are sensitive to X-rays between about 1-14 Å and will detect solar X-rays even when the sun is quiet. Since the sun is effectively a point source in the Geiger tube apertures, and the only such strong source, the time structure of the Geiger tube responses can be used to gain an independent measure of the aspect of the spacecraft roll axis with respect to the sun. This allows a more reliable

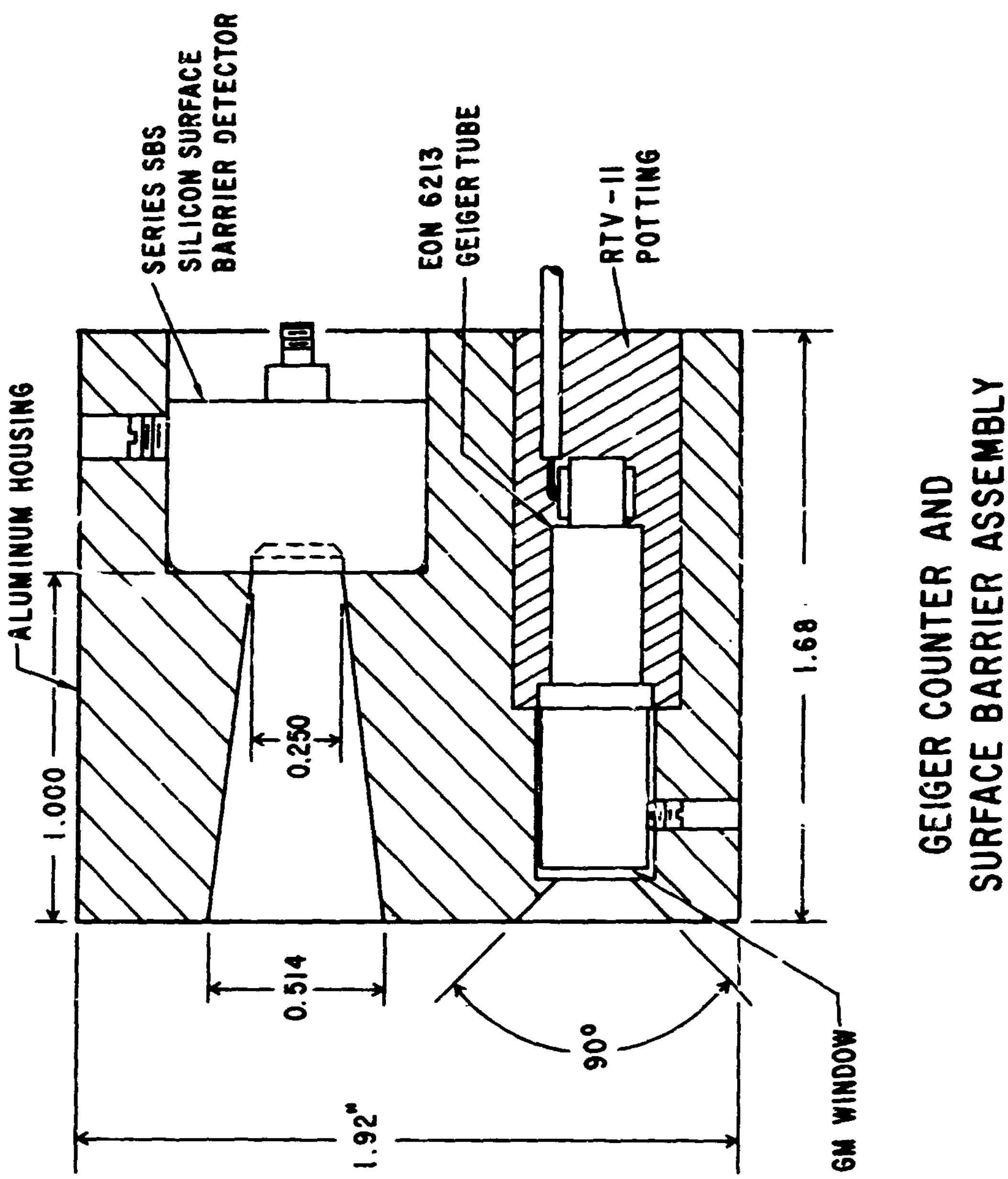


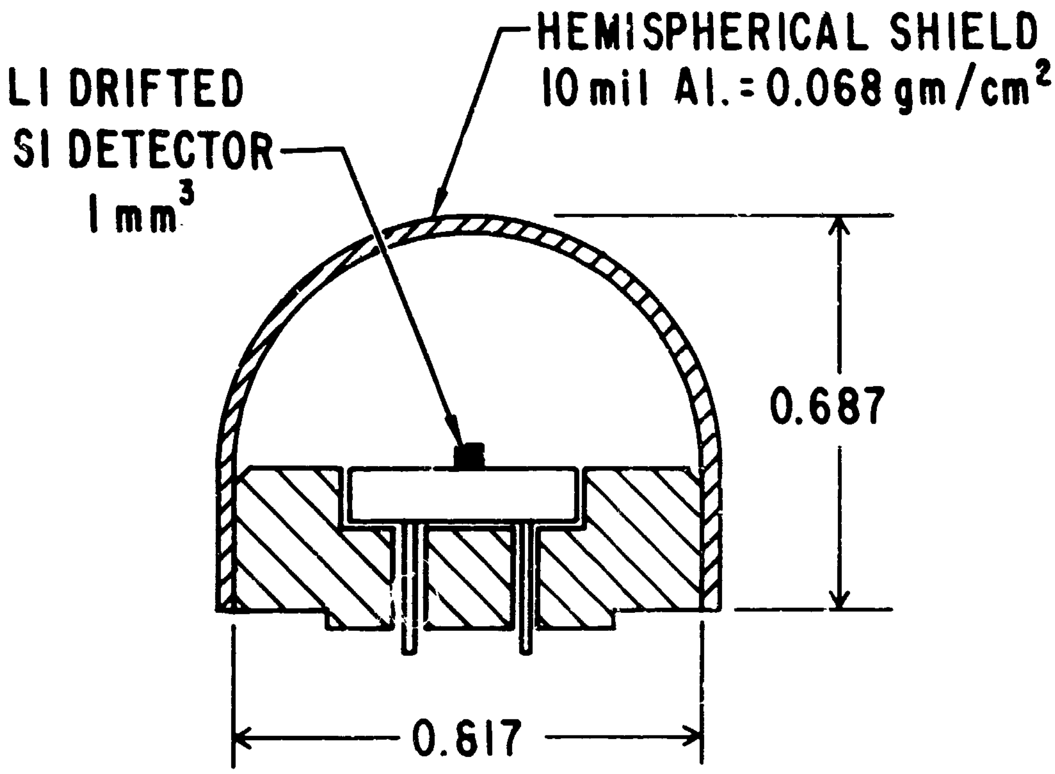
Figure 9 - The surface barrier detector for counting low energy protons and α-particles. This is included in the same mount as one of the G-M counters. The remaining two G-M counters are mounted in the assembly shown at the top apex of the tetrahedron in Figures 1 and 2.

estimate of the radiation fluxes emanating from the sun. Since the bulk of solar X-ray emission is at low energies, the Geiger tubes are the only instruments on this satellite to provide measurements of quiet solar X-ray emission. Geiger tube data also provide important complementary information to the counting rate data from the other instruments during disturbed periods of solar activity.

Because of the thin windows, the G-M counters are sensitive to low energy electrons when inside the magnetosphere. When in interplanetary space, and outside the view of the sun, the background rate is determined by galactic and solar cosmic rays.

(B) Li-drifted Particle Detector (SSD)

The silicon solid-state detector to measure low energy electrons consists of a lithium-drifted cube of silicon of dimensions 1x1x1 mm operated at a 75-volt bias. This detector, shown in Figure 10, is mounted under a hemispherical 10 mil aluminum shield on one face of the satellite (lower right hand panel of Figure 2). This design has been evaluated on the TRS-II satellite and has been shown to be almost an ideal 2π geometry. The output of this device is amplified and fed through two pulse-height discriminators, one which triggers on pulses produced by 180 kev energy losses in the detector and will be measuring mainly electrons above 0.4 Mev. The other discriminator will trigger on 2.5 Mev energy loss pulses and will be measuring protons in the energy window 8-21 Mev. The output of the electron discriminator is fed to two LCRM's, one a low-level meter with a range of 1-1000 counts



Li-DRIFTED PARTICLE DETECTOR

Figure 10 - The solid state detector assembly consists of a 1 mm^3 Si detector under a 10 mil Al hemispherical shield.

per second and the other a high-level meter with a range of 300-300 K counts per second. The low-level meter is preceded by a one-shot multivibrator, so individual counts can be observed during the sample period, if the counting rate should be less than a few per second. The output of the proton discriminator is fed to a LCRM with a range of 1-1K counts per second preceded by a one-shot multivibrator for very low count rates. The total range is then better than 1-10^3 counts/second.

(C) Surface Barrier Particle Detector (SBD)

The surface barrier detector is designed to measure very low energy protons in the outer magnetosphere and beyond. The sensing element, shown in Figure 9, has a sensitive thickness of 19 microns. The proton discriminator voltage bias level is set to measure protons in the energy range 0.38 to 2.9 Mev. However, a nickel window of .000020 inch thickness was added so that the SBD will not respond to light from the sun. The alpha-particle energy range is 2.6-6.0 Mev. A preamplifier compatible with the SBD and manufactured by Solid State Radiations, Inc. is used to drive the main amplifier. Amplified pulses passing the alpha discriminator drive a 1-1K cps LCRM which is read out in telemetry channel 15. Pulses passing the proton discriminator are scaled by a factor of 16, then read into telemetry channel 14 via a 1-1KC LCRM. The 1-1KC LCRM have the characteristic that individual counts can be seen through the telemetry which permits read out of very low counting rates.

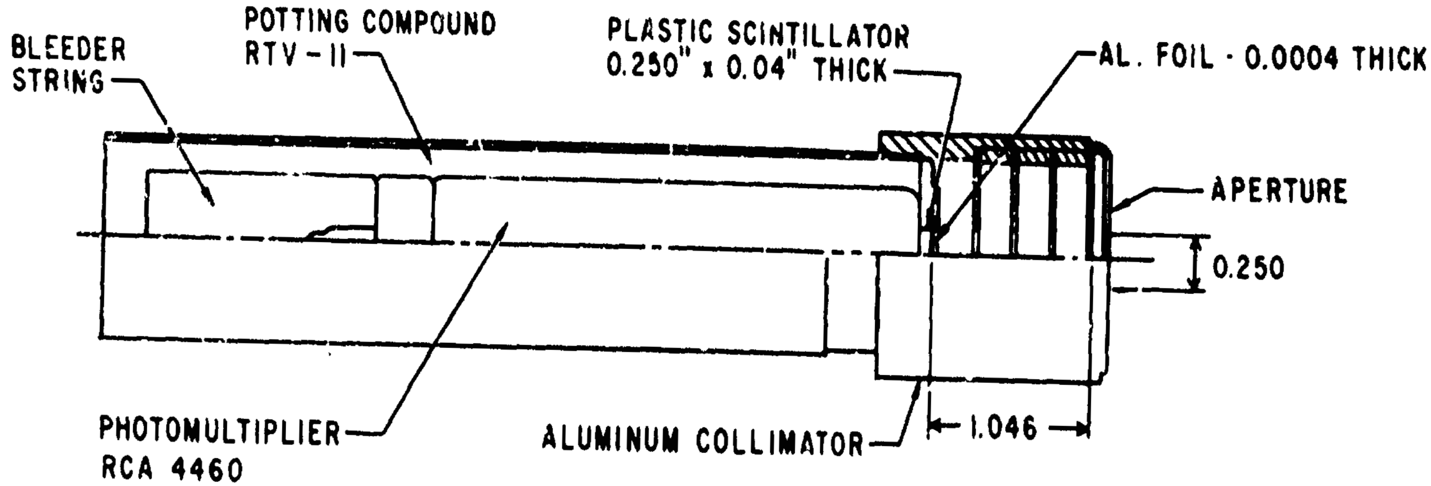
(D) Low Energy Particle Detector (LEPM)

This instrument is designed to detect low energy electrons and protons. As shown in Figure 11, it consists of a 0.1 cm thick by 1/4-inch diameter plastic crystal cemented to the face of an RCA 4460 photomultiplier tube operated at 1200 volts. A conical collimator with an exit aperture of 0.4 cm diameter and half angle 7^{o} is covered by two 0.65 mil aluminum foils. Shielding in all other directions is in excess of 2 g/cm^2. The discriminator will trigger on 75 kev energy loss pulses. This detector, therefore, measures incident electrons above 100 kev. The signal conditioning electronics are similar to the electron channels of the solid state detector. Output appears in telemetry channel 13 for the low-level LCRM, and in channel 12 for the high-level LCRM.

(E) Shielded Gamma-Ray Counter (Shielded Gamma)

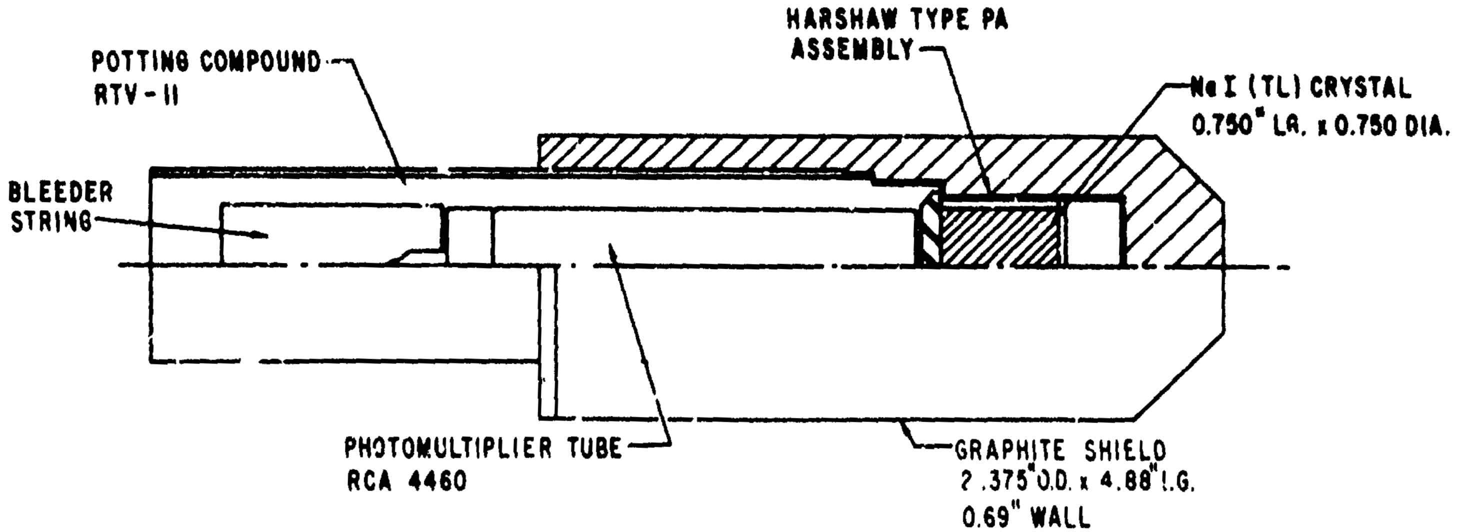
This scintillation detector is designed to measure 1-3 Mev gamma rays and charged particles producing energy losses in this range. It consists of a 1.91 cm. long by 1.91 cm. diameter NaI(Tl) scintillation crystal encased in a ruggedized mount and further shielded by a carbon cylinder 1.75 cm thick, as shown in Figure 12. The crystal is optically connected to an RCA 4460 photomultiplier operated at 1200 volts.

The output of the PM tube is fed to a single-channel analyzer. This analyzer consists of an upper and a lower discriminator which provide inputs to an exclusive OR circuit. Only those pulses which correspond to an energy loss of 1-3 Mev are counted. The output rate of the



LOW ENERGY PARTICLE DETECTOR

Figure 11 - The low-energy photomultiplier assembly provides a detector which counts electrons above 100 kev and protons in the 3-27 Mev range.



SHIELDED γ-RAY COUNTER

Figure 12 - Electrons and γ-rays producing energy losses in the 1-3 Mev range are counted with this detector. The passive shield prevents lower energy electrons and protons from reaching the counter.

analyzer is measured with two LCRM's whose ranges are 1-1K and 100-100K cps, respectively.

(F) Gamma-ray Counter (Dual Gamma)

This detector is used primarily to obtain a measurement of the cosmic gamma-ray flux with anti-coincidence rejection of charged particles. Its central part consists of a large NaI(Tl) crystal, 7.62 cm in diameter by 7.62 cm long. Surrounding it on all sides but one is a bucket-shaped shield of plastic scintillator. The two scintillators are optically separate, each is viewed by its own RCA 4461 photomultiplier tube, as shown in Figure 13. The shield is designed primarily to reject counts in the central detector caused by cosmic rays. Any charged cosmic ray traversing the central crystal must also pass through the shield, producing an anticoincidence rejection pulse. In order to determine whether the anticoincidence was functioning properly and also to increase the information yield of the instrument, it was designed to be switched on and off every four telemetry cycles by the satellite clock, giving central detector counting rates with and without charged particle background.

There are a total of eight telemetry channels associated with this detector:

Channel (16) Central detector counts with energy greater than 25 kev. Output is a 10-10 K cps LCRM without one-shot.

Channel (8-3) Central detector counts with energy between 250 and 600 kev. Output is quasi-digital* with a prescaling factor of 64.

Channel (8-4) Central detector counts with energy between 0.6 and 1 Mev. Output quasi-digital prescaled by 32.

* Quasi-digital definition follows listing.

Channel (8-5) Central detector counts with energy between 1 and 2 Mev.
Output quasi-digital, prescaled by 16.

Channel (8-6) Central detector counts with energy between 2 and 3.7 Mev.
Output quasi-digital, prescaled by 8.

Channel (8-7) Central detector counts with energy between 3.7 and 6 Mev.
Output quasi-digital, prescaled by 8.

Channel (9-6) Central detector counts with energy loss greater than 6 Mev.
Effectively all counts due to cosmic rays.
Output via 10-10 K cps LCRM with one-shot.

Channel (9-1) Shield counting rate.
Output via 10-10 K cps LCRM with one-shot.

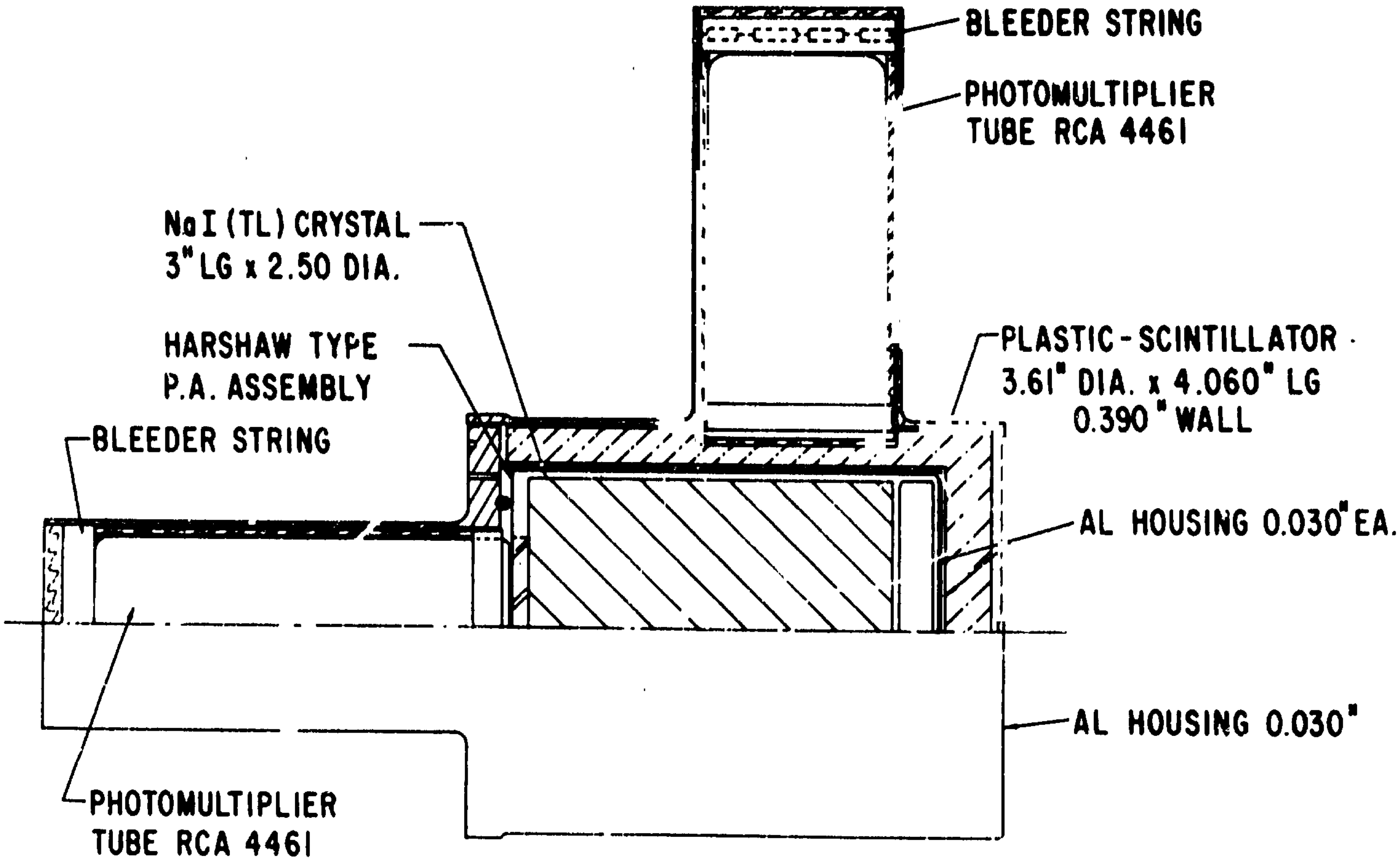
*"Quasi-digital" means the following:

The detector pulse rate is first scaled to obtain the prescaling factor indicated. Part of this output is then scaled by an additional factor of 16 and which is added in a resistance network. The resultant 4-level signal is transmitted as an analog voltage. This method increases the dynamic counting rate range by an order of magnitude.

Detector Summary

Table I contains a complete summary of the ERS-18 detectors. For each detector, the principal radiation measurement and its energy range, together with appropriate instrumental and telemetry details are listed. The absorber listed for the Geiger tubes, solid state detector, and low energy photomultiplier is in the direction of the sensitive aperture; over the remaining solid angle shielding is several gm/cm^2 for each instrument. Absorption for the higher energy detectors is an estimated average over the detector and satellite masses. The actual settings of each discriminator level, calibrated prior to flight, are also given.

Each Geiger counter selected for the ERS-18 has been carefully calibrated; the effective forward area is about 0.056 cm. The approxi-



γ-RAY COUNTER

Figure 13 - This Gamma-Ray counter with geometry factor for an isotropic flux of 69.5 cm^2 operates over the 25 kev to 6 Mev range. Direct particle effects are rejected by the anti-coincidence shield.

mate solid angle is given for each detector as determined by measurement or calculation. Efficiency-geometry factors, ϵG_0, for an incident flux isotropic over 4π solid angle are also given for the directional detectors. These have also been obtained by measurement and calculation, and may be energy dependent in some cases. For the higher energy scintillation counters, G_0 is obtained from the formula

$$G_0 = \frac{\pi}{4} LD \left(1 + \frac{D}{2L}\right),$$

where D is the diameter and L the length of the right cylindrical sensitive volume.

Satellite Operations

Launch and Orbit

The ERS-18 was launched on April 28, 1967 along with the 4A and 4B Vela Satellites into a highly elliptical orbit. The initial orbital parameters were 117,600 kilometers apogee and 15,000 kilometers perigee from the Earth center; this resulted in a period of 47 hours. The semi-major axis was inclined about 12.5° southward from the ecliptic plane and was about 120° from the earth-sun line. Inclination of the orbit plane was 34.4° to the earth's equatorial plane. Figures 14 and 15 show projections of the orbit on June 20, 1967.

Spin-up was obtained from a coiled spring separation mechanism located in the shroud of the missile system. Initial spin rate was close to 6 rpm, as determined from the receiving station AGC records, and the periodicity of the geiger counter rates as they swept by the sun.

Although the satellite was dynamically spin balanced it did not spin about the intended axis. In balancing the satellite the additional weights were not placed correctly to maintain the intended spin axis as the principal axis of inertia. Consequently, immediately after ejection the tip off errors caused a precessional motion about the original spin axis which did not damp out until a new spin axis about the principal moment of inertia was established; this occurred by mid-June 1967 when a pure rotational motion was observed. This final spin orientation, as well as that during the transition period, have not yet been determined.

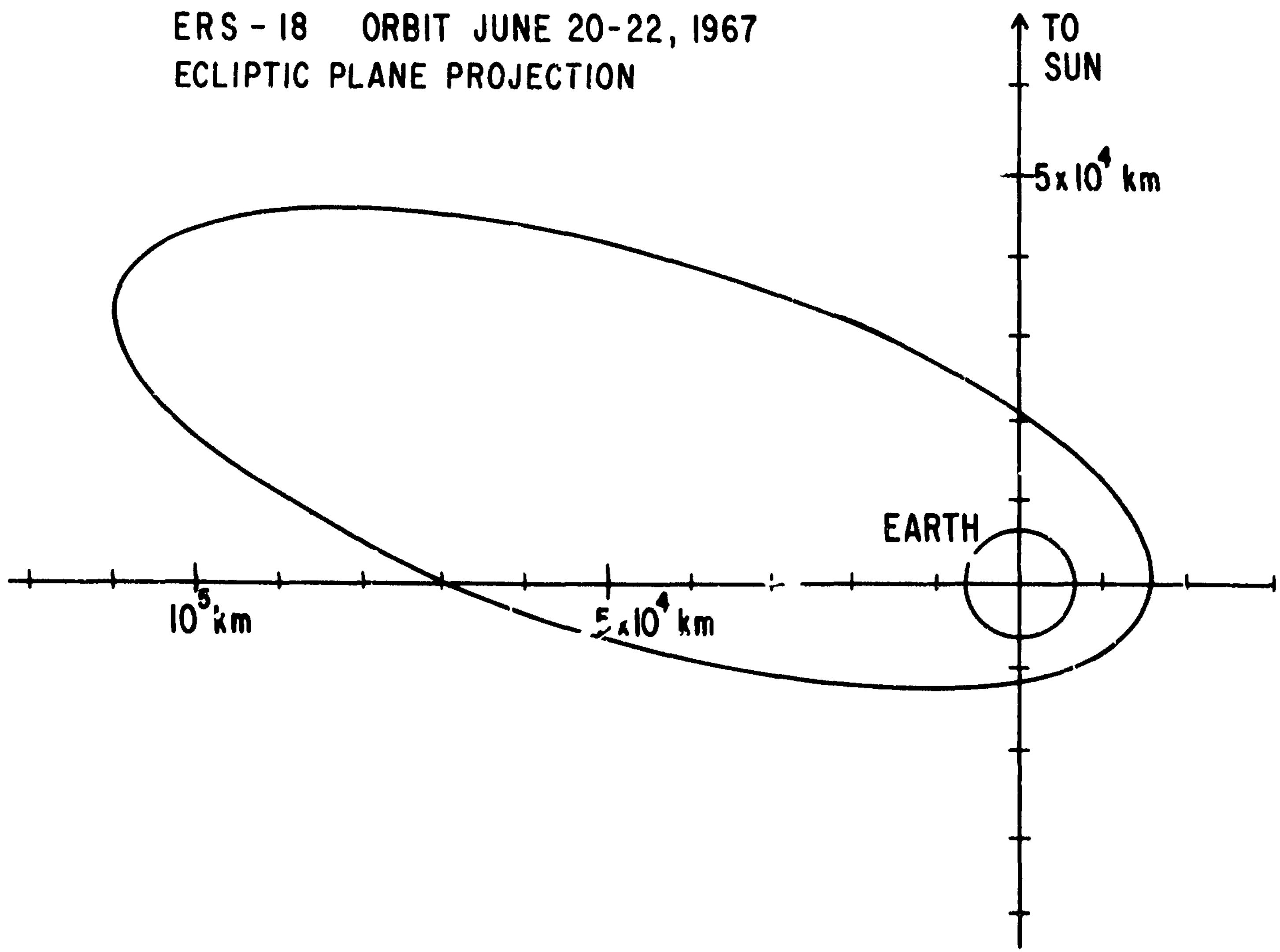


Figure 14 - The June 20-22, 1967 orbit of the ERS-18 projected on to the Ecliptic plane on this date is shown because extensive reduction for this period was performed initially.

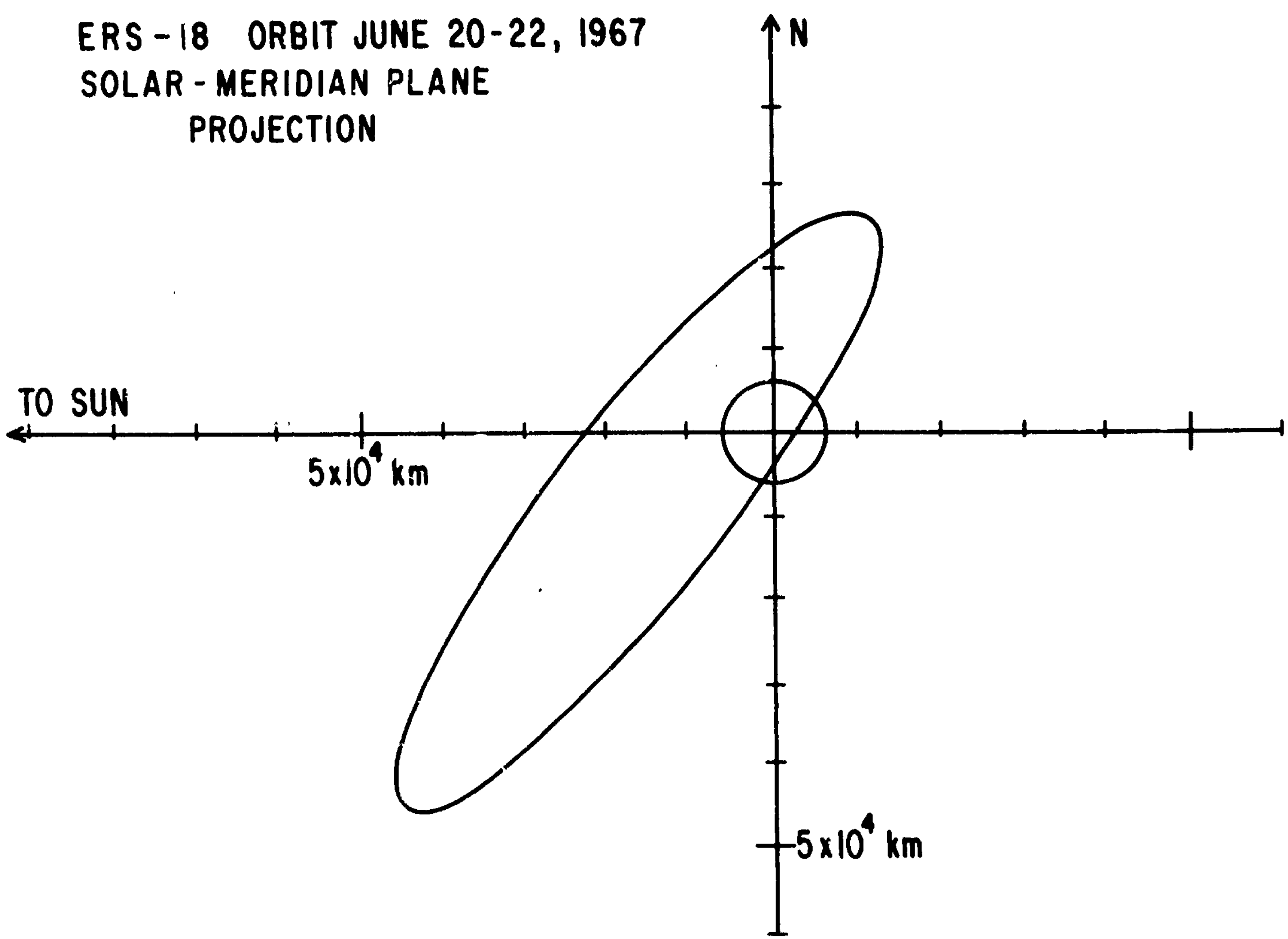


Figure 15 - The June 20-22, 1967 orbit projected onto the X-Z plane in Solar Ecliptic coordinates

Tracking and data recovery for the ERS satellites are performed by the STADAN System of the National Aeronautics and Space Administration. Data was acquired at 1423 soon after launch on April 28 from the station at Johannesburg. Analog magnetic tapes recorded at the various STADAN stations are first sent to Goddard Space Flight Center (GSFC) for quality control and evaluation and then to UCSD for processing and reduction. In addition, real time quick-look Sanborn charts recorded at various stations permit GSFC and TRW personnel to evaluate satellite operation on an up-to-date basis. The tracking and data acquisition plan is described in the ERS-18 operations plan dated March 1967 [3]. Refined Ephemeris magnetic tapes are also provided to UCSD from GSFC.

Data Reduction System

The reduction system at UCSD is nearly identical to that used for the ERS-17 satellite, with minor modifications for the ERS-18 format. Analog tapes recorded at 7.5 ips are played back at 30 ips through the system shown in Figure 16. The voltage output of the subcarrier discriminator produces the Sanborn chart, shown in Figure 4, which also has timing and control indicators. The output voltage is sampled at a high rate with an 11-bit analog-to-digital converter, whose output is accumulated in a magnetic core memory. This is dumped in record format onto a computer-compatible magnetic tape for automatic reduction and analysis. Timing and tape speed compensated for the entire system is obtained from reference channels recorded at the STADAN stations. Further details and operational procedures of the system may be obtained from the earlier report [2].

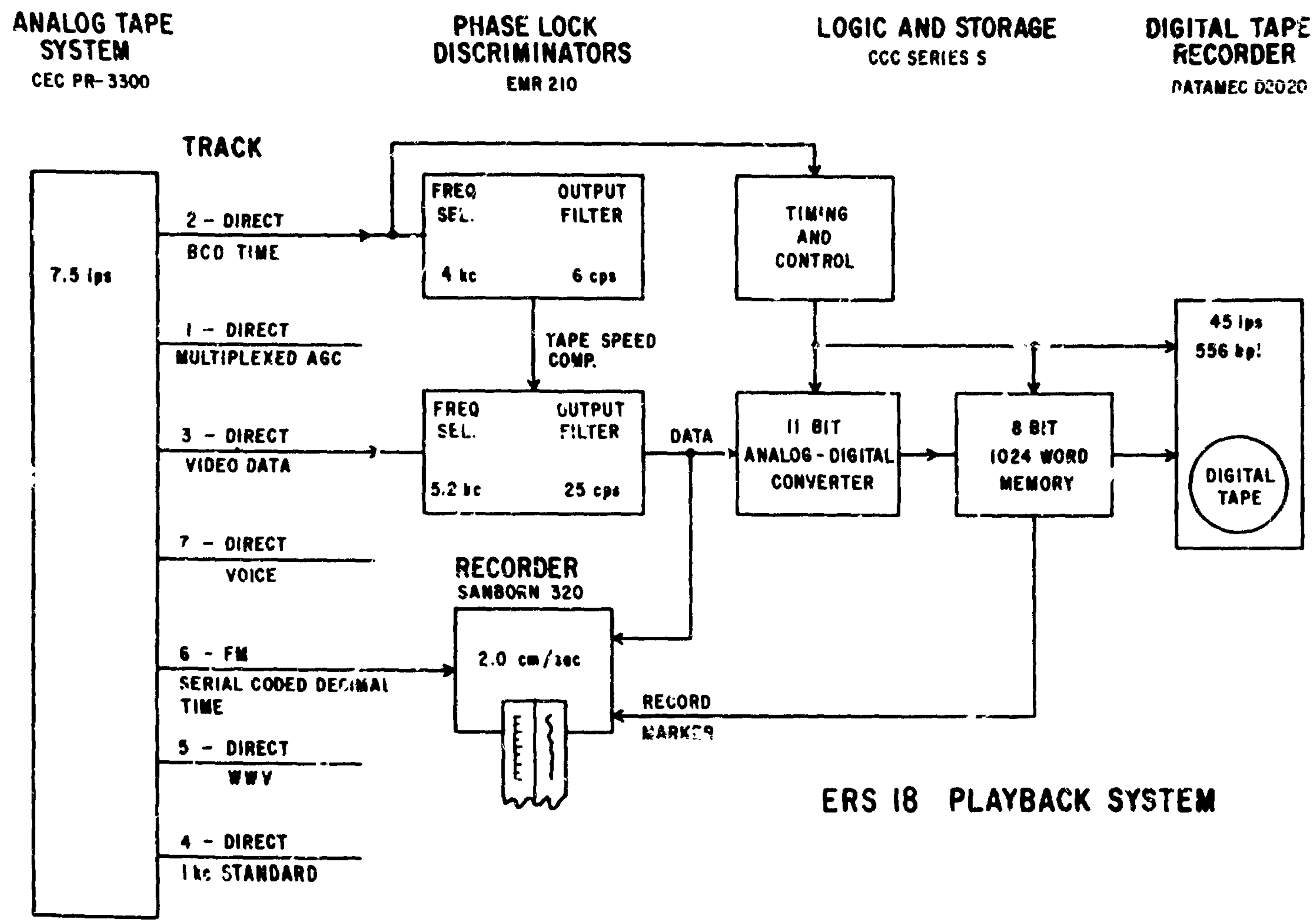


Figure 16 - A block diagram of the playback system used at UCSD to reduce satellite data. The analog information from the subcarrier discriminator was sampled 20 times per second, digitized and read onto magnetic tape for computer reduction.

A control or I.D. card is punched for each continuous recorded data length which constitutes a file on the initial computer tape. This card contains an I.D. number for the file, acquisition and playback dates, data start and stop times obtained from the Sanborn chart system, calibration data, etc. These cards are continually checked, corrected and updated; a listing forms a master record of the data. These cards are also issued at various stages in the computer reduction.

The flow of data through the entire reduction system is shown in Figure 17. This has also been described in detail earlier. Digital tapes are first edited to detect obvious errors, remove faulty playbacks, etc., and then are stacked in general chronological order on a cleaned up binary tape for the first decommutation. This decommutation operation recognizes main frame and subcommutator sync, separates out the various channels, reduces each sample to an equivalent subcarrier frequency, and produces a new magnetic tape with the data in a simplified format. This tape is then precisely ordered and edited to eliminate overlaps, and is used to obtain quantities such as counting rates, temperatures, voltages, etc. They are fitted to polynomials in subcarrier frequency at each temperature calibration of each channel as indicated in the Appendix. This data may then be plotted channel-by-channel vs. time, or may be merged with orbital data for a more complex analysis procedure.

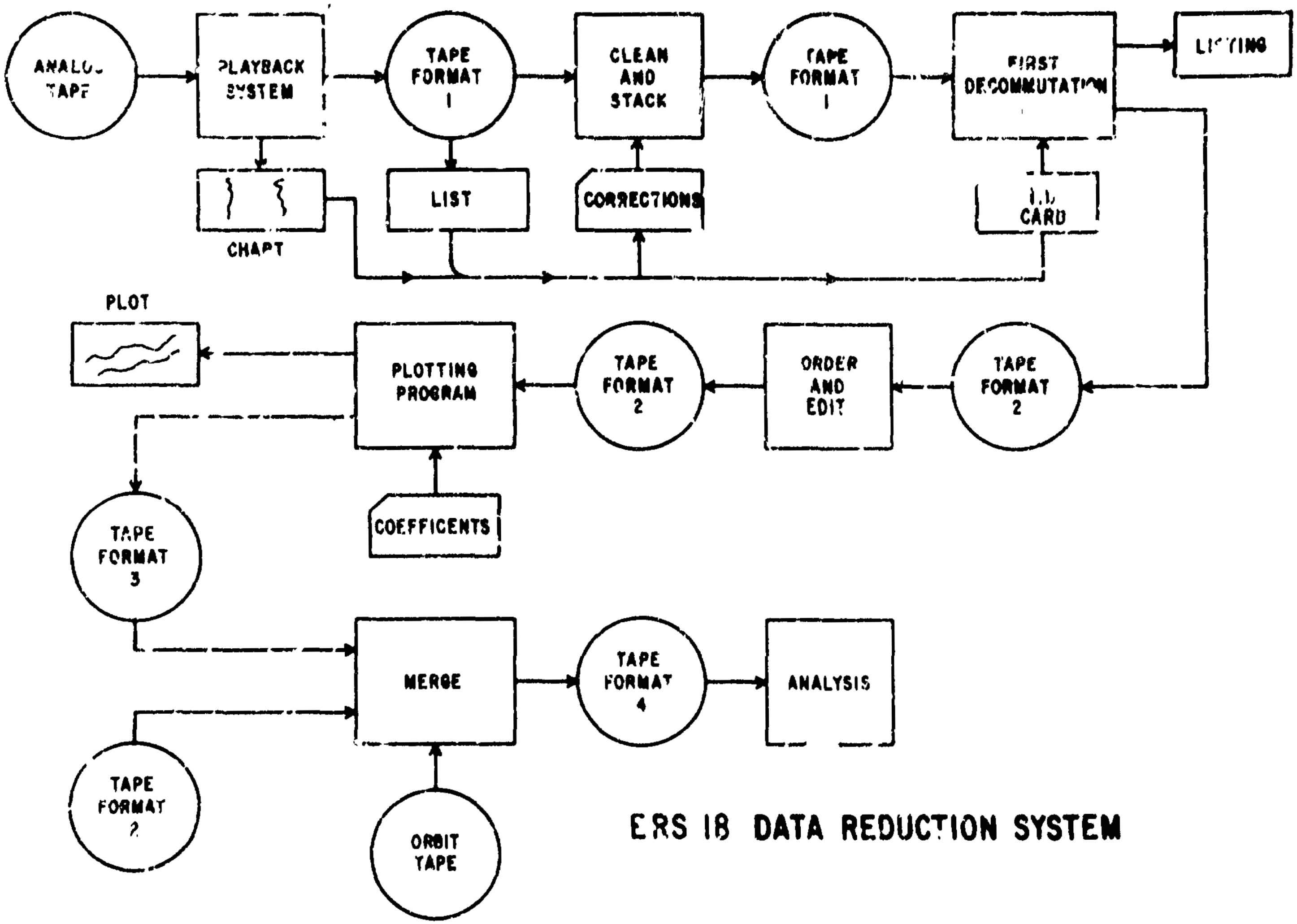


Figure 17 · Data flow through the computerized reduction system at UCSD. Each step in the initial phases, through the first decommutation, was carefully checked and reworked if needed. This assured nearly error-free data going into the final plotting and analysis stages.

Satellite Operation

No indication of a major satellite fault has been indicated from the GSFC quick-look data, therefore tracking and data acquisition continued at a high level of coverage throughout the operating lifetime of the satellite which ended on 3 June 1968 when the timer caused termination of the radio transmitter. Magnetic tapes are received in shipments from GSFC at a one to two month lag after recording. A log book entry is made for each tape from which selections of data to be reduced can be made, and the related control I.D. card generated. About 2300 analog tapes have been listed in this log. This represents about 6000 I.D.'s, some 7200 hours of data and 132 nearly complete satellite orbits. The useable coverage obtained on an orbital basis is about 75% and is shown for each orbit through March 26 in Figure 18. Complete data has now been obtained through orbit 192 on 8 May; the latest tape is from orbit 200 on May 25.

The satellite is near apogee most of the time, hence at large distances, $\sim 18\ R_e$ stations with antennas having gains greater than about 19 dB acquire the majority of the data. For example, Johannesburg, with an 85' dish, has obtained over 500 analog tapes.

In order to evaluate the satellite instrument performance in advance of full playback operations, selected portions of the data have been played back and reduced through the first decommutation. This included 78 I.D.'s, representing over 140 hours of data from every second pass and scattered over most portions of the orbit. This evaluation

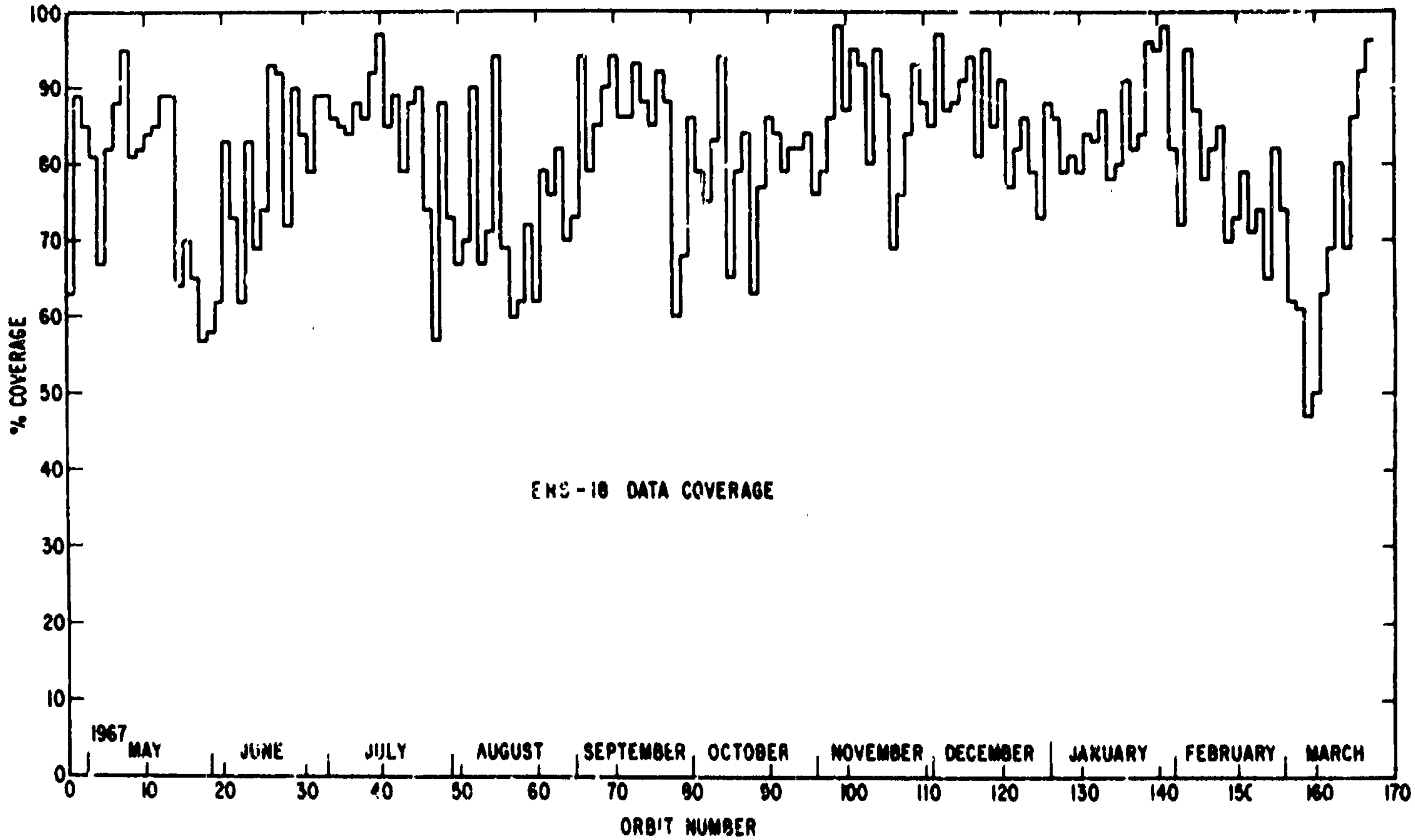


Figure 18 - Data coverage for the ERS-18 through March 1968. This remained at about the 75% level until the satellite ceased transmitting on June 3, 1968.

included the first 8 months of operation, through orbit 116 on December 14, 1967. In addition, orbits 26, 27 and 28 have been completely reduced in order to provide an assessment of instrument operation under all radiation environments normally encountered by the satellite in its orbit.

Based on an evaluation of the sample playbacks, the operation of the scientific instruments was about as expected. As of December 14, 1967, anomalies and failures have been noted only in the operation of the Geiger Counters. Two of the G-M counters had failed by the beginning of November 1967, based on their lack of response to either solar X-radiation or trapped electrons near perigee. G-M No. 2 showed a reduced response on October 6, and by November 9 it no longer registered counting. G-M No. 3 was last observed counting on August 20; by September 26 it had become inoperative. G-M No. 1, however, was still operating at full or nearly full efficiency on December 11, 1967, based on quick-look data decommutated at UCSD. Data received from the Rosman Tracking Station showed it in operation until the end of the satellite's telemetry lifetime on June 3, 1969. Failure of these instruments is almost certainly due to loss of the tubes' gas fill.

The solid state detector proton channel (8-21 Mev) has so far counted definite rates only during the solar proton events of May 23-30, 1967. This is probably not anomalous behavior since under normal conditions the satellite never encounters protons of this energy. The relatively high perigee of 2.5 R_e is outside the inner radiation belts.

All the remaining radiation detectors appear to have operated properly and showed no indication of failure, or altered response through the entire time span covered by the quick-look checks.

The temperature of the satellite structure was ordinarily 8° C and had not changed by more than 4° C during the first 8 months of operation.

Preliminary decommutation indicates that the reference frequencies in channels 8-1 and 8-2 have not changed by more than ± 1 hz between May 3 and October 10, 1967.

As already indicated, the satellite is spinning about some unexpected axis. Preliminary evaluation indicates that this axis can be located and its direction in space inferred with enough accuracy to permit interpretation of counting rates from the directional detectors.

Based on the results of the spot analysis, the satellite and its instruments have performed remarkably well. The few non-catastropic anomalies can be compensated for in the data analysis. The satellite clearly produced significant new data on the trapped radiation, magnetospheric particles, solar and cosmic X-ray and gamma rays, and galactic cosmic-rays. Therefore reduction of significant portions of the entire mass of data is proceeding.

Status of Reduction and Analysis

As part of the initial evaluation, orbits 25, 26 and 27 have been completely played back, edited, ordered, decommutated and instrument counting rates obtained from the transmitted subcarrier frequencies.

These rates have been hand-plotted resulting in a set of some 70 graphs on a 1"/hr. basis covering the interval from 1800 17 June to 1800 23 June. This set includes orbital plots and much of the quasi-digital data from the anticoincidence gamma ray counter. The presentation and discussion of this data will form the substance of the second report in this series.

Most of the data from launch until orbit 17 on May 31 has also been played back, and is presently undergoing editing, ordering, and decommutation in preparation for automatic plotting. This interval includes the May 23-2[illegible], 1967 series of solar events, whose solar X-rays and near-earth particle effects were extensively observed by the ERS-18. Data playback on selected portions of the remaining data will resume soon.

Technical reports and published results may be expected on the following topics:

(1) Presentation and discussion of the data from the orbital series 25, 26 and 27, as indicated above.

(2) Analysis and Publication of the May 1967 series.

(3) Presentation of data obtained in the first month of satellite operation.

(4) Analysis and Publication of results on cosmic gamma rays obtained from the ERS-17 and 18.

(5) Presentation of data obtained during solar proton and X-ray events.

(6) Additional results on cosmic X-rays, trapped radiation, magnetospheric and boundary phenomena.

APPENDIX I

CALIBRATION COEFFICIENTS

This appendix contains the coefficients from a least squares polynomial fit of the counting rate vs. frequency curve for the ERS-18 instruments at eight different instrument temperatures[1]. The coefficients actually represent the logarithm of the counting rate as a function of the actual subcarrier frequency minus 1200 cps, the IRIG channel 5 lower band edge. ERS-18 Channels 2, 3, 4, 5, 6, 7, 9-6, 9-8, 10, 11, 12, 13, 14, 15, 16 have a set of coefficients for temperatures -25, -15, -5, 15, 25, 35, 40° C. Channel 9-1 has coefficients for temperatures 5, 15 and 25° C.

This appendix is organized by telemetry channels. The channel number, a short description of the detector, and the dynamic counting rate ran[illegible] of the channel head [illegible]ch page. The different temperatures are shown in the column marked "TEMP". The coefficients are in floating point decimal format, with the power of 10 following the letter "E". The column headed "code" is a repetition of channel number and temperature, and contains some data used for editing. The entries of the form "DATA (CF(N) = " are FORTRAN statements used for computer calculation of counting rates.

A counting rate is calculated as a polynomial function of frequency, the coefficients for which are specified by the channel number and temperature. Actual telemetered frequencies lie between 1200 and 1400 cps, but the input frequencies used in evaluating counting rates lie between 0 and 200 cps. The result of this operation is the natural logarithm of the counting rate. The general equation is:

$$c = \exp\left(b_0 + b_1 f + b_2 f^2 + \cdots + b_n f^n\right)$$

where c is the counting rate

b_n is a coefficient

f^n is a frequency between 0 and 200 cps

n is the number of terms in the expansion

Typical satellite operating temperatures do not remain obligingly at one of the eight calibration temperatures. Accordingly, the reported counting rate from a detector is interpolated linearly from the counting rates calculated at the two nearest calibration temperatures.

CHANNEL 2   SHD GAMMA (1-1KC)

```
TEMP                         COEFFICIENTS                                  CODE

 40
       DATA(CF(1)=
      1             -1.04914434272E 01, 6.65180706596E-01,-1.36783380786E-0202 40113
      2            , 1.94825714239E-04,-1.78439946205E-06, 1.02225088858E-0802 40123
      3            ,-3.29930358706E-11, 4.55116536794E-14)                  02 40133
 35
       DATA(CF(9)=
      1             -1.13745957182E 01, 5.99677839829E-01,-1.33463930670E-0202 35113
      2            , 1.95334235699E-04,-1.87150040930E-06, 1.10591140226E-0802 35123
      3            ,-3.61477335042E-11, 4.96811837947E-14)                  02 35133
 25
       DATA(CF(17)=
      1             -7.89853564953F 01, 6.44999922335F 00,-2.40700079582E-0102 25114
      2            , 5.28018880682E-03,-7.34665671107E-05, 6.67290091130E-0702 25124
      3            ,-3.94603983773E-09, 1.46472348890E-11,-3.09977133025E-1402 25134
      4            , 2.85399800929E-17)                                     02 25144
 15
       DATA(CF(27)=
      1             -3.77717331343F 02, 2.99345417932E 01,-1.05326947794E 0002 15114
      2            , 2.15011396585E-02,-2.79078615707E-04, 2.38175154926E-0602 15124
      3            ,-1.33437001146E-08, 4.72894456505E-11,-9.61890212027E-1402 15134
      4            , 8.55878061382E-17)                                     02 15144
  5
       DATA(CF(37)=
      1              1.57693596612E 01,-1.37123029443E 00, 3.98417528789E-0202  5113
      2            ,-5.50700820854E-04, 4.17483727343F-06,-1.75779219301F-0802  5123
      3            , 3.78759400133E-11,-3.13520351029E-14)                  02  5133
 -5
       DATA(CF(45)=
      1              3.36155487655E 01,-2.44807713939E 00, 6.59541935252E-0202 -5113
      2            ,-8.88377897628F-04, 6.72926348634E-06,-2.90053821018E-0802 -5123
      3            , 6.60675382498E-11,-6.10371979349E-14)                  02 -5133
-15
       DATA(CF(53)=
      1              8.79833830683E 01,-5.85513875226E 00, 1.54031565765E-0102-15113
      2            ,-2.11579317495E-03, 1.67315223799E-05,-7.67981831974E-0802-15123
      3            , 1.90280256208E-10,-1.96665620382E-13)                  02-15133
-25
       DATA(CF(61)=
      1              2.52419214637E 02,-1.96965518864E 01, 6.30510824989E-0102-25113
      2            ,-1.10166752330E-02, 1.[illegible]5400110134E-04,-7.66577837197E-0702-25123
      3            , 3.08630578697E-09,-6.96700725635E-12, 6.76833087462E-1502-25133
      4)
```

CHANNEL 3   SHD GAMMA (100-100KC)

```
TEMP                          COEFFICIENTS                                    CODE

 40
      DATA(CF(70)=
     1            -1.01249857078E 03, 8.50687984517E 01,-3.12339654402E 0003 40114
     2           , 6.61039459088E-02,-8.87993410090E-06, 7.85321228155E-0603 40124
     3           ,-4.57175449177E-08, 1.69060512114E-10,-3.60456999514E-1303 40134
     4           , 3.37764656177E-16)                                    03 40144
 35
      DATA(CF(80)=
     1            -2.65219970822E 03, 2.18754327507E 02,-7.91456056305E 0003 35114
     2           , 1.65140382425E-01,-2.18920910702E-03, 1.91225381137E-0503 35124
     3           ,-1.10076318102E-07, 4.02744332550E-10,-8.50089196768E-1303 35134
     4           , 7.88903832634E-16)                                    03 35144
 25
      DATA(CF(90)=
     1            -2.93247172277E 03, 2.26879701350E 02,-7.73014250107E 0003 25114
     2           , 1.52291308809E-01,-1.90965472980E-03, 1.57968790719E-0503 25124
     3           ,-8.61773520662E-08, 2.98939047375E-10,-5.98364864243E-1303 25134
     4           , 5.26646534214E-16)                                    03 25144
 15
      DATA(CF(100)=
     1            -9.26029429212E 03, 6.89697988390E 02,-2.26237398450E 0103 15114
     2           , 4.29096045671E-01,-5.18490210385E-03, 4.13917485380E-0503 15124
     3           ,-2.18327120034E-07, 7.33815525321E-10,-1.42636640804E-1203 15134
     4           , 1.22188998057E-15)                                    03 15144
  5
      DATA(CF(110)=
     1            -1.19446322773E 04, 8.72268688399E 02,-2.80820108659E 0103  5114
     2           , 5.23221431894E-01,-6.21645155363E-03, 4.88404937554E-0503  5124
     3           ,-2.53755030525E-07, 8.40800259262E-10,-1.61241706819E-1203  5134
     4           , 1.36378309317E-15)                                    03  5144
 -5
      DATA(CF(120)=
     1            -6.61612521054E 03, 4.24818256020E 02,-1.18289367275E 0103 -5113
     2           , 1.86657075491E-01,-1.82517474500E-03, 1.13241629495E-0503 -5123
     3           ,-4.35371950956E-08, 9.48378425930E-11,-8.96261977707E-1403 -5133
     4)
-15
      DATA(CF(129)=
     1            -6.19697421324E 03, 3.92735897406E 02,-1.08219667198E 0103-15113
     2           , 1.69406753642E-01,-1.64686953227E-03, 1.01777018388E-0503-15123
     3           ,-3.90385342587E-08, 8.49561178219E-11,-8.03012227197E-1403-15133
     4)
-25
      DA   CF(138)=
     1            -2.94544160122E 04, 2.11260038026E 03,-6.68958864233E 0103-25114
     2           , 1.22726071309E 00,-1.43738001180E-02, 1.11444133066E-0403-25124
     3           ,-5.72030455933E-07, 1.87461330276E-09,-3.55966304307E-1203-25134
     4           , 2.98469598905E-15)                                    03-25144
```

CHANNEL 4   GM NO. 1 BELLYBAND

```
TEMP                          COEFFICIENTS                              CODE

 40
      DATA(CF(148)=
     1          1.12713045653E 01,-1.26975217508E 00, 6.35724482976E-0204 40113
     2         ,-1.51512501080E-03, 2.06652810780E-05,-1.69719850158E-0704 40123
     3         , 8.31374519155E-10,-2.24077716249E-12, 2.56055325648E-1504 40133
     4)
 35
      DATA(CF(157)=
     1          -2.13321189949E 02, 1.93335342314E 01,-7.56349485252E-0104 35114
     2         , 1.69991774138E-02,-2.40614660422E-04, 2.22126953444E-0604 35124
     3         ,-1.33717757746E-08, 5.06427018461E-11,-1.09595763445E-1304 35134
     4         , 1.03379887302E-16)                                      04 35144
 25
      DATA(CF(167)=
     1          -6.50479339040E 01, 4.32466976903E 00,-1.19001342962E-0104 25113
     2         , 1.88053556799E-03,-1.83555966555E-05, 1.12780445939E-0704 25123
     3         ,-4.24631036085E-10, 8.92794306530E-13,-7.98788427748E-1604 25133
     4)
 15
      DATA(CF(176)=
     1          -2.64945243119E 02, 2.19438957243E 01,-8.04278467200E-0104 15114
     2         , 1.71471208578E-02,-2.31879336230E-04, 2.05344520730E-0604 15124
     3         ,-1.18862369645E-08, 4.33477739140E-11,-9.04119840008E-1404 15134
     4         , 8.22443979024E-17)                                      04 15144
  5
      DATA(CF(186)=
     1          -4.80997859663E 02, 3.76563490275E 01,-1.29772909507E 0004  5114
     2         , 2.59205190162E-02,-3.29125754873E-04, 2.74990142410E-0604  5124
     3         ,-1.51[illegible]030856E-08, 5.26260647282E-11,-1.05519025712E-1304  5134
     4         , 9.28[illegible]993876E-17)                                      04  5144
 -5
      DATA(CF(196)=
     1          -8.42233558907E 02, 6.59377321857E 01,-2.28461942880E 0004 -5114
     2         , 4.59827703319E-02,-5.90122571529E-04, 4.99709414539E-0604 -5124
     3         ,-2.78835238056E-08, 9.87911927374E-11,-2.01605287590E-1304 -5134
     4         , 1.80556[illegible]1635E-16)                                      04 -5144
-15
      DATA(CF(206)=
     1           6.11266643251E 02,-4.68872830027E 01, 1.51619951642E 0004-15113
     2         ,-2.70581054303E-02, 2.93432960362E-04,-1.98784245909E-0604-15123
     3         , 8.23873450165E-09,-1.91433749042E-11, 1.91296292655E-1404-15133
     4)
-25
      DATA(CF(215)=
     1          -3.46461958595E 02, 1.95201462283E 01,-4.63085758[illegible]3E-0104-25113
     2         , 6.10608397855E-03,-4.78739270486E-05, 2.23434891028E-0704-25123
     3         ,-5.74663173605E-10, 6.28469244763E-13)                   04-25133
```

CHANNEL 5   GM NO. 2 APEX

```
TEMP                         COEFFICIENTS                                    CODE

 40
        DATA(CF(223)=
     1           -1.08524467651E 02, 1.000 7977454E 01,-3.97395303776E-0105 40114
     2          , 9.22419921495E-03,-1.36539319955E-04, 1.33325578933E-0605 40124
     3          ,-8.58046968328E-09, 3.50890659267E-11,-8.27430474828E-1405 40134
     4          , 8.57384482585E-17)                                   05 40144
 35
        DATA(CF(233)=
     1           -3.15622245579E 02, 2.83625169517E 01,-1.10901034663E 0005 35114
     2          , 2.49271703541E-02,-3.54527009511E-04, 3.30247328058E-0605 35124
     3          ,-2.01461103838E-08, 7.76383555389E-11,-1.71630408603E-1305 35134
     4          , 1.65968916094E-16)                                   05 35144
 25
        DATA(CF(243)=
     1           -7.01194693485E 02, 5.63882625999E 01,-1.98606366568E 0005 25114
     2          , 4.05620571169E-02,-5.20804867381E-04, 4.42394856829E-0605 25124
     3          ,-2.47433113510E-08, 8.78895544191E-11,-1.79963346545E-1305 25134
     4          , 1.61904485809E-16)                                   05 25144
 15
        DATA(CF(253)=
     1           -1.24826146243E 03, 9.25601626583E 01,-3.01733001686E 0005 15114
     2          , 5.68926735653E-02,-6.83328322822E-04, 5.42245667276E-0605 15124
     3          ,-2.84381603671E-08, 9.50902303704E-11,-1.84036912702E-1305 15134
     4          , 1.57153958100E-16)                                   05 15144
  5
        DATA(CF(263)=
     1           -2.08880556753E 03, 1.54644213488E 02,-5.01997839636E 0005  5114
     2          , 9.38623954938E-02,-1.11313175599E-03, 8.68109206110E-0605  5124
     3          ,-4.45259257529E-08, 1.44896515011E-10,-2.71606117499E-1305  5134
     4          , 2.23620276293E-16)                                   05  5144
 -5
        DATA(CF(273)=
     1           -1.50817889202E 03, 1.10864060343E 02,-3.58777096437E 0005 -5114
     2          , 6.71311306744E-02,-7.99243872496E-04, 6.27693722257E-0605 -5124
     3          ,-3.25255341613E-08, 1.07297495785E-10,-2.04672730347E-1305 -5134
     4          , 1.72209711000E-16)                                   05 -5144
-15
        DATA(CF(283)=
     1           -4.03259729850E 03, 3.08514415387E 02,-1.04076551427E 0105-15114
     2          , 2.03100069991E-01,-2.52436249359E-03, 2.07158112164E-0505-15124
     3          ,-1.12185896770E-07, 3.86697323155E-10,-7.69850433384E-1305-15134
     4          , 6.74506555882E-16)                                   05-15144
-25
        DATA(CF(293)=
     1           -4.38867525978E 03, 3.16084160708E 02,-1.00624650295E 0105-25114
     2          , 1.85897920025E-01,-2.19580020575E-03, 1.71984721298E-0505-25124
     3          ,-8.93396131485E-08, 2.96858526842E-10,-5.72650842974E-1305-25134
     4          , 4.08689887803E-16)                                   05-25144
```

CHANNEL 6   GM NO. 3 APEX

```
TEMP                          COEFFICIENTS                                          CODE

 40
      DATA(CF(309)=
     1          -1.08795483195E 02, 1.00541830456E 01,-3.94316905976E-0106 40114
     2          , 8.91031277156E-03,-1.26913562443E-04, 1.18045321089E-0606 40124
     3          ,-7.17187534261E-09, 2.74697992479E-11,-6.02641508658E-1406 40134
     4          , 5.77788329533E-17)                                       06 40144
 35
      DATA(CF(313)=
     1          -3.31001826711E 01, 2.21848975873E 00,-5.64402442635E-0206 35113
     2          , 8.11809051712E-04,-6.97808890138E-06, 3.57059367668E-0806 35123
     3          ,-1.01367117179E-10, 1.22349283634E-13)                    06 35133
 25
      DATA(CF(321)=
     1          -4.24505169930E 01, 2.53336507565E 00,-5.99521262362E-0206 25113
     2          , 8.05265594414E-04,-6.47565321834E-06, 3.30470134742E-0806 25123
     3          ,-8.20869935025E-11, 9.23847282375E-14)                    06 25133
 15
      DATA(CF(329)=
     1          -4.24497393193E 01, 2.22605402849E 00,-4.61535937876E-0206 15113
     2          , 5.49386227119E-04,-3.99183402455E-06, 1.77654665927E-0806 15123
     3          ,-4.49736453382E-11, 4.99756019830E-14)                    06 15133
  5
      DATA(CF(337)=
     1          -6.12276996556E 02, 4.63174920913E 01,-1.54016933178E 0006  5114
     2          , 2.96671696557E-02,-3.63195114728E-04, 2.93441433163E-0606  5124
     3          ,-1.56311155934E-08, 5.29309605213E-11,-1.03398732690E-1306  5134
     4          , 8.87968630483E-17)                                       06  5144
 -5
      DATA(CF(347)=
     1          -1.41172478476E 02, 8.05525259022E 00,-1.92950498068E-0106 -5113
     2          , 2.58089579851E-03,-2.06292631186E-05, 9.82955339058E-0806 -5123
     3          ,-2.58233129448E-10, 2.88358695951E-13)                    06 -5133
-15
      DATA(CF(355)=
     1          -1.69384603892E 01, 3.32832679589E-01, 6.94574071933E-0306-15113
     2          ,-2.23737756757E-04, 2.45777329867E-06,-1.34066698313E-0806-15123
     3          , 3.63805602893E-11,-3.98136490621E-14)                    06-15133
-25
      DATA(CF(363)=
     1           2.89139939764E 02,-2.12112436170E 01, 6.57967268559E-0106-25113
     2          ,-1.12666173512E-02, 1.17504575694E-04,-7.67907095309E-0706-25123
     3          , 3.07498180325E-09,-6.92515196779E-12, 6.72369432808E-1506-25133
     4)
```

CHANNEL 7 GM SUM

```
TEMP                          COEFFICIENTS                                   CODE

 40
      DATA(CF(372)=
     1            -1.16551402031E 02, 1.04412891673E 01,-4.01597089998E-0107 40114
     2            , 8.99975664238E-03,-1.25433260514E-04, 1.70589679552E-0607 40124
     3            ,-7.43753300572E-09, 2.90319109836E-11,-6.50548599567E-1407 40134
     4            , 6.37539208389E-17)                                     07 40144
 35
      DATA(CF(382)=
     1            -2.18708448636E 02, 1.79199005710E 01,-6.34314136102E-0107 35114
     2            , 1.29874141081E-02,-1.68863965957E-04, 1.44518398558E-0607 35124
     3            ,-8.14094204688E-09, 2.91101573221E-11,-5.99647206580E-1407 35134
     4            , 5.42262351641E-17)                                     07 35144
 25
      DATA(CF(392)=
     1            -5.80177742208E 02, 4.43891538272E 01,-1.48168065757E 0007 25114
     2            , 2.84841989219E-02,-3.46793220442E-04, 2.77155608998E-0607 25124
     3            ,-1.45410210380E-08, 4.83128379798E-11,-9.23015933367E-1407 25134
     4            , 7.73217975837E-17)                                     07 25144
 15
      DATA(CF(402)=
     1            -1.53436244428E 02, 8.75298803929E 00,-2.07095184934E-0107 15113
     2            , 2.71369195957E-03,-2.11079719302E-05, 9.73026018147E-0807 15123
     3            ,-2.46043587028E-10, 2.63371435553E-13)                  07 15133
  5
      DATA(CF(410)=
     1            -2.03637724509E 02, 1.17038588798E 01,-2.80567447114E-0107  5113
     2            , 3.71407084586E-03,-2.91378686967E-05, 1.35289241953E-0707  5123
     3            ,-3.44161562040E-10, 3.70242195163E-13)                  07  5133
 -5
      DATA(CF(418)=
     1            -2.72765562154E 03, 2.01650117099E 02,-6.55495204194E 0007 -5114
     2            , 1.22998584004E-01,-1.46668878727E-03, 1.15210559507E-0507 -5124
     3            ,-5.96068733814E-08, 1.95872093199E-10,-3.71025492990E-1307 -5134
     4            , 3.08761099260E-16)                                     07 -5144
-15
      DATA(CF(428)=
     1            -3.24684132804E 03, 2.39160863875E 02,-7.76104331331E 0007-15114
     2            , 1.45663276259E-01,-1.74100399294E-03, 1.37374966306E-0507-15124
     3            ,-7.15[illegible]2161504E-08, 2.37216867963E-10,-4.54315161787E-1307-15134
     4            , 3.33048410120E-16)                                     07-15144
-25
      DATA(CF(438)=
     1            -2.97891646111E 02, 1.53812133858E 01,-3.36540420115E-0107-25113
     2            , 4.11558887386E-03,-3.03018442198E-05, 1.34397959668E-0707-25123
     3            ,-3.32751115813E-10, 3.55048978678E-13)                  07-25133
```

CHANNEL 9-1 DUAL GAMMA XTAL

```
TEMP                          COEFFICIENTS                                       CODE

 25
      DATA(NCF(1)=
    1            1.79077279643E 01,-4.33131937613E 00, 1.56   924503E-0191 25113
    2           ,-2.49292549858E-03, 2.13776435796E-05,-1.02968551972E-0791 25123
    3           , 2.62508327799E-10,-2.75538554771E-13)                    91 25133
 15
      DATA(NCF(9)=
    1           -5.57384696056E 06, 3.50851727527E 03,-9.74698953447E 0191 15114
    2           , 1.56837512707E 00,-1.61075934515E-02, 1.09497790132E-0491 15124
    3           ,-4.92706403555E-07, 1.41517867800E-09,-2.35458090866E-1291 15134
    4           , 1.72918919419E-15)                                       91 15144
  5
      DATA(NCF(19)=
    1           -3.29185953934F 03, 1.59774597856E 02,-3.30433272524E 0091  5113
    2           , 3.77338499256E-02,-2.56760830226E-04, 1.04085300237E-0691  5123
    3           ,-2.32765905361E-09, 2.21586473536E-12)                    91  5133
```

CHANNEL 9-6 DUAL GAMMA COSMIC RAY

```
TEMP                         COEFFICIENTS                                   CODE
 40
       DATA(CF(446)=
      1         -4.09557011275E 01, 2.96400825714E 00,-8.61863115570E-0296 40113
      2        , 1.39232245035E-03,-1.32679207873E-05, 7.41855045198E-0896 40123
      3        ,-2.24705756549E-10, 2.84420052357E-13)                    96 40133
 35
       DATA(CF(454)=
      1         -4.70287514394E 02, 4.53255838680E 01,-1.92803600460E 0096 35114
      2        , 4.77817251196E-02,-7.62376630260E-04, 8.17754136981E-0696 35124
      3        ,-5.97016236919E-08, 2.92887339019E-10,-9.23984928802E-1396 35134
      4        , 1.69271082606E-15,-1.36765057282E-18)                    96 35144
 25
       DATA(CF(465)=
      1         -1.00634699201E 02, 6.18889875838E 00,-1.58640047073E-0196 25113
      2        , 2.24992990715E-03,-1.59012608971E-05, 9.37669863715E-0896 25123
      3        ,-2.53921683331E-10, 2.89589564548E-13)                    96 25133
 15
       DATA(CF(473)=
      1         -1.57272635071E 02, 9.45229352056E 00,-2.38594229583E-0196 15113
      2        , 3.32312998001E-03,-2.73999744141E  , 1.33405889737E-0796 15123
      3        ,-3.5466141775 E-10, .97171373433  )                      96 15133
  5
       DATA(CF(481)=
      1          2.36408969678E 02,-1.77354444930E 01, 5.61854430556E-0196  5113
      2        ,-9.83296221914E-03, 1.04886859318E-04,-7.01259504072E-0796  5123
      3        , 2.87709176255E-09,-6.63274275327E-12, 5.58593349904E-1596  5133
      4)
 -5
       DATA(CF(490)=
      1         -1.26227194731E 02, 6.95549823123E 00,-1.62857202310E-0196 -5113
      2        , 2.13566631224E-03,-1.67631751884E-05, 7.83208276541E-0896 -5123
      3        ,-2.00937656366E-10, 2.18163820030E-13)                    96 -5133
-15
       DATA(CF(498)=
      1         -2.16957420483E 03, 1.65421699928E 02,-5.54959630733E 0096-15114
      2        , 1.07507204622E-01,-1.12449633733E-03, 1.07621076753E-0596-15124
      3        ,-5.76869090775E-08, 1.96758578811E-10,-3.87623372069E-1396-15134
      4        , 3.36158864509E-16)                                       96-15144
-25
       DATA(CF(508)=
      1         -4.16728951805E 02, 2.44673809066E 01,-6.08866010688E-0196-25113
      2        , 8.34718580358E-03,-6.78294406063E-05, 3.26202265470E-0796-25123
      3        ,-8.59090935113E-10, 9.56017277529E-13)                    96-25133
```

CHANNEL 9-3 SSD. PROTON

```
TEMP                          COEFFICIENTS                                   CODE

 40
      DATA(CF(516)=
     1            -3.72260842007E-01,-2.02726464835E-01, 1.1[illegible]212525846E-0298 40113
     2            ,-2.29229139013E-04, 2.46717336023E-06,-1.48852787769E-0898 40123
     3            , 4.72981724225E-11,-6.13808886404E-14)                     96 40133
 35
      DATA(CF(524)=
     1            -1.29890179425E 01, 8.23415500368E-01,-2.29520504846E-0298 35113
     2            , 3.74027113308E-04,-3.56084901321E-06, 1.96723081070E-0898 35123
     3            ,-5.85965798295E-11, 7.30255381833E-14)                     98 35133
 25
      DATA(CF(532)=
     1            -7.28877460281E 01, 5.60258271266E 00,-1.84334683354E-0198 25113
     2            , 3.35223582719E-03,-3.64615362854E-05, 2.43430441979E-0798 25123
     3            ,-9.78087655618E-10, 2.17046587419E-12,-2.04244697321E-1598 25133
     4)
 15
      DATA(CF(541)=
     1            -2.07971432152E 02, 2.56388570723E 01,-9.94729326293E-0198 15114
     2            , 2.19476612366E-02,-3.02673316683E-04, 2.70781836298E-0698 15124
     3            ,-1.57397899928E-08, 5.74213234428E-11,-1.19509279507E-1398 15134
     4            , 1.08297868512E-16)                                        98 15144
  5
      DATA(CF(551)=
     1            -2.45372748998E 02, 2.16105579765E 01,-8.36419699434E-0198  5114
     2            , 1.85067739958E-02,-2.56[illegible]14579684E-04, 2.31430506014E-0698  5124
     3            ,-1.35700106065E-08, 4.99653983722E-11,-1.04978589114E-1398  5134
     4            , 9.60315458826E-17)                                        98  5144
 -5
      DATA(CF(561)=
     1             4.65515121922E 02,-4.67209945410E 01, 2.06289863848E 0098 -5114
     2            ,-5.29465988767E-02, 8.74934018[illegible]92E-04,-9.71545012482E-0698 -5124
     3            , 7.33717886440E-08,-3.7213540[illegible]98E-10, 1.21379789751E-1298 -5134
     4            ,-2.30109328736E-15, 1.9274428[illegible]942E-18)                     98 -5144
-15
      DATA(CF(572)=
     1            -5.82422047644E 01, 3.6457397[illegible]28E 00,-1.0191[illegible]23425E-0198-15113
     2            , 1.60894695259E-03,-1.503954[illegible]759E-05, 8.25474107475E-0898-15123
     3            ,-2.45733390213E-10, 3.06168171280E-13)                     98-15133
-25
      DATA(CF(580)=
     1             4.57116005896E 03,-4.30005069356E 02, 1.79601775849E 0198-25114
     2            ,-4.38912221696E-01, 6.95155679877E-03,-7.45564379951E-0598-25124
     3            , 5.48366313789E-07,-2.73126304458E-09, 8.81750195939E-1298-25134
     4            ,-1.66646364389E-14, 1.40053506434E-17)                     98-25144
```

CHANNEL 10 SSD. ELECTRON (300-300KC)

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TEMP                              COEFFICIENTS                                  CODE

 40
      DATA(CF(591)=
     1          -5.46997397579E 00, 6.79621137679E-02, 3.88089302654E-0210 40114
     2          ,-1.55291544211E-03, 2.37134986974E-05,-3.38448228250E-0710 40124
     3          , 2.37434783211E-09,-1.01062265935E-11, 2.39597598900E-1410 40134
     4          ,-2.42776031425E-17)                                     10 40144
 35
      DATA(CF(601)=
     1          -1.80975949136E 01, 1.29468072479E 00,-2.95010139071E-0210 35113
     2          , 3.87586228098E-04,-3.09230918903E-06, 1.50372469772E-0810 35123
     3          ,-4.11948087998E-11, 4.88939569599E-14)                  10 35133
 25
      DATA(CF(609)=
     1          -6.38720821158E 01, 3.83309187257E 00,-8.99219719181E-0210 25113
     2          , 1.17722632876E-03,-9.18548329663E-06, 4.26766323205E-0810 25123
     3          ,-1.09260757174E-10, 1.18910972145E-13)                  10 25133
 15
      DATA(CF(617)=
     1          -1.36131810951E 02, 7.67097213771E 00,-1.76105469844E-0110 15113
     2          , 2.23648165172E-03,-1.68915414618E-05, 7.59127191117E-0810 15123
     3          ,-1.88057304086E-10, 1.98207653908E-13)                  10 15133
  5
      DATA(CF(625)=
     1          -1.01186264519E 03, 7.67992766760E 01,-2.55524799862E 0010  5114
     2          , 4.90817504039E-02,-5.98693920264E-04, 4.80589663435E-0610  5124
     3          ,-2.53821022628E-08, 8.50573273771E-11,-1.64158825364E-1310  5134
     4          , 1.39084980365E-16)                                     10  5144
 -5
      DATA(CF(635)=
     1          -3.71599646611E 02, 2.37568937562E 01,-6.53019383317E-0110 -5113
     2          , 1.01970766968E-02,-9.84263137938E-05, 5.99773221009E-0710 -5123
     3          ,-2.24906015303E-09, 4.73919739365E-12,-4.29288124433E-1510 -5133
     4)
-15
      DATA(CF(644)=
     1          -2 55466193456E 02, 1.39360204458E 01,-3.17792179901E-0110-15113
     2          , 4.01982331288E-03,-3.03650284396E-05, 1.36941367629E-0710-15123
     3          ,-3.41290686995E-10, 3.62512758110E-13)                  10-15133
-25
      DATA(CF(652)=
     1          -3.05945641146E 02, 1.58598575964E 01,-3.43001242983E-0110-25113
     2          , 4.09039251530E-03,-2.89683243429E-05, 1.21849990159E-0710-25123
     3          ,-2.81981822092E-10, 2.77195158601E-13)                  10-25133
```

CHANNEL 11 SSD. ELECTRON (1-1KC)

```
TEMP                         COEFFICIENTS                                    CODE

 40
      DATA(CF(660)=
     1          -6.04173096223E 00, 2.81872435211E-01,-5.61599542061E-0311 40113
     2          , 9.58609539480E-05,-1.11614716073E-06, 7.770487594?7E-0911 40123
     3          ,-2.87901795498E-11, 4.36541554355E-14)                  11 40133
 35
      DATA(CF(668)=
     1          -1.11534105963E 01, 5.90605309489E-01,-1.41704679586E-0211 35113
     2          , 2.21588525578E-04,-2.15129914664E-06, 1.?4970840773E-0811 35123
     3          ,-3.96723580017E-11, 5.29315334500E-14)                  11 35133
 25
      DATA(CF(676)=
     1          -2.64318054408E 02, 2.28153788694E 01,-8.59363437397E-0111 25114
     2          , 1.84220469539E-02,-2.46943506936E-04, 2.14941436594E-0611 25124
     3          ,-1.21770458011E-08, 4.34008606570E-11,-8.84945805091E-1411 25134
     4          , 7.87763948119E-17)                                     11 25144
 15
      DATA(CF(686)=
     1           4.16192600674E 01,-2.76278736268E 00, 7.07954270334E-0211 15113
     2          ,-9.25447051856E-04, 6.88201465167E-06,-2.93691668176E-0811 15123
     3          , 6.67327104625E-11,-6.20397350634E-14)                  11 15133
  5
      DATA(CF(694)=
     1          -1.60993265524E 01, 4.22737294249E-01,-2.13993573445E-0311  5113
     2          ,-2.75555837183E-05, 4.64483007905E-07,-2.75650930777E-0911  5123
     3          , 7.54378200509E-12,-7.75495671318E-15)                  11  5133
 -5
      DATA(CF(702)=
     1           1.67604232352E 02,-1.23464729014E 01, 3.74829451262E-0111 -5113
     2          ,-6.22461267619E-03, 6.25643468987E-05,-3.93856918038E-0711 -5123
     3          , 1.51473953511E-09,-3.26809131861E-12, 3.03607107198E-1511 -5133
     4)
-15
      DATA(CF(711)=
     1          -5.10125969874E 01, 2.57484744587E 00,-5.90729319386E-0211-15113
     2          , 7.98301793565E-04,-6.60033573059E-06, 3.28669541306E-0811-15123
     3          ,-9.05665986915E-11, 1.06240856531E-13)                  11-15133
-25
      DATA(CF(719)=
     1          -3.33320167736E 01, 2.03898004815E 00,-6.00548173755E-0211-25113
     2          , 1.01283016463E-03,-9.91568040010E-06, 5.58088481100E-0811-25123
     3          ,-1.67565330470E-10, 2.08114322785E-13)                  11-25133
```

CHANNEL 12 LOW ENERGY ELECTRON (300-300KC)

```
TEMP                        COEFFICIENTS                                   CODE

 40
      DATA(CF(727)=
     1          -6.45436083619E 01, 5.11249961739E 00,-1.60877616899E-0112 40113
     2          ,-2.87822568719E-03,-3.15345986292E-05, 2.15463766585E-0712 40123
     3          ,-8.94334758655E-10, 2.06082143012E-12,-2.01909813739E-1512 40133
     4)
 35
      DATA(CF(736)=
     1          -2.89392863069E 02, 2.48312184238E 01,-9.19391166582E-0112 35114
     2          , 1.96163736022E-02,-2.64656750095E-04, 2.33848959912E-0612 35124
     3          ,-1.35295943054E-08, 4.94420128129E-11,-1.03622412955E-1312 35134
     4          , 9.49733522553E-17)                                      12 35144
 25
      DATA(CF(746)=
     1          -1.18201394702E 03, 9.64129989059E 01,-3.47172562539E 0012 25114
     2          , 7.29061834840E-02,-9.87237944803E-04, 9.00209898152E-0612 25124
     3          ,-5.59697987477E-08, 2.34303555085E-10,-6.32119603315E-1312 25134
     4          , 9.92536743288E-16,-6.88771952677E-19)                   12 25144
 15
      DATA(CF(757)=
     1          -2.82995889394E 02, 1.85624130405E 01,-5.19064055127E-0112 15113
     2          , 8.23711836524E-03,-8.06931044629E-05, 4.93604104423E-0712 15123
     3          ,-1.89513770313E-09, 4.04950667371E-12,-3.72423869558E-1512 15133
     4)
  5
      DATA(CF(766)=
     1          -4.19528394565E 02, 2.71682651772E 01,-7.50058370805E-0112  5113
     2          , 1.16891931160E-02,-1.12121815374E-04, 6.77075746539E-0712  5123
     3          ,-2.51248815215E-09, 5.23716315559E-12,-4.69465718674E-1512  5133
     4)
 -5
      DATA(CF(775)=
     1           3.36610162508E 03,-3.19184946106E 02, 1.32062156306E 0112 -5114
     2          ,-3.14808764326E-01, 4.80312463699E-03,-4.91177738179E-0512 -5124
     3          , 3.41545487469E-07,-1.59701849913E-09, 4.81200663093E-1212 -5134
     4          ,-8.44710619119E-15, 6.56739521422E-18)                   12 -5144
-15
      DATA(CF(786)=
     1          -5.62790227064E 03, 4.37022749032E 02,-1.48904758986E 0112-15114
     2          , 2.92446868127E-01,-3.64763314411E-03, 2.99652644229E-0512-15124
     3          ,-1.62162504482E-07, 5.57614622312E-10,-1.10590345957E-1212-15134
     4          , 9.64193130354E-16)                                      12-15144
-25
      DATA(CF(796)=
     1          -2.93341429258E 03, 2.00750220107E 02,-5.93742440129E 0012-25113
     2          , 9.93469832512E-02,-1.02817970261E-03, 6.73985626071E-0612-25123
     3          ,-2.73322004377E-08, 6.27088987653E-11,-6.23373309080E-1412-25133
     4)
```

CHANNEL 13 LOW ENERGY ELECTRON (1-1KC)

```
TEMP                          COEFFICIENTS                                    CODE

 40
      DATA(CF(805)=
     1         2.20982973336E 01,-2.49461730302E 00, 1.09463000299E-0113 40113
     2        ,-2.49914231006E-03, 3.35807691285E-05,-2.77219382928E-0713 40123
     3        , 1.36732274882E-09,-3.71592120541E-12, 4.27633206185E-1513 40133
     4)
 35
      DATA(CF(814)=
     1        -2.40544758347E 01, 1.52118271333E 00,-4.12442033505E-0213 35113
     2        , 6.40976442629E-04,-5.91234733711E-06, 3.21043136634E-0813 35123
     3        ,-9.48928432107E-11, 1.17957714433E-13)                  13 35133
 25
      DATA(CF(822)=
     1         5.50573398557E 01,-4.41201607103E 00, 1.43228501460E-0213 25113
     2        ,-2.51607537974E-03, 2.68292283948E-05,-1.79329296682E-0713 25123
     3        , 7.36938089959E-10,-1.70683413310E-12, 1.70951260327E-1513 25133
     4)
 15
      DATA(CF(831)=
     1         5.80354169222E 01,-5.12445281958E 00, 1.79851977169E-0113 15113
     2        ,-3.39070475707E-03, 3.84583776848E-05,-2.71476688812E-0713 15123
     3        , 1.16652729595E-09,-2.79883718793E-12, 2.87668577029E-1513 15133
     4)
  5
      DATA(CF(840)=
     1        -4.99052083713E 01, 2.65811973956E 00,-6.20640707354E-0213  5113
     2        , 8.30800776393E-04,-6.70312512235E-06, 3.23278210731E-0813  5123
     3        ,-8.[illegible]3337623405F-11, 9.69751218869E-14)                  13  5133
  5
      DATA(CF(848)=
     1        -1.19861242615E 02, 8.37764241686E 00,-2.54633813334E-0113 -5113
     2        , 4.32980957034E-03,-4.44916030532E-05, 2.82330832363E-0713 -5123
     3        ,-1.08054864057E-09, 2.28090075270E-12,-2.03160342906E-1513 -5133
     4)
-15
      DATA(CF(857)=
     1        -9.79898591596E 02, 8.05131162540E 01,-2.90533363860E 0013-15114
     2        , 6.02031546109E-02,-7.87858038163E-04, 6.75068826543E-0613-15124
     3        ,-3.78833116061E-08, 1.34339064945E-10,-2.73353426059E-1313-15134
     4        , 2.43367134326E-16)                                     13-15144
-25
      DATA(CF(867)=
     1         1.75270771139E 02,-1.57709794067E 01, 5.53839964501E-0113-25113
     2        ,-1.03773600672E-02, 1.16046924115E-04,-8.01476105233E-0713-25123
     3        , 3.36009341467E-09,-7.85295491223E-12, 7.85995243781E-1513-25133
     4)
```

CHANNEL 14 SRD. PROTON

```
TEMP                              COEFFICIENTS                                    CODE

 40
      DATA(CF(376)=
      1          -6.25276005489E 03, 7.94902875589E 02,-4.52914976573E 01 4 40113
      2          , 1.52993033032E 00,-3.41? 72239612E-02, 1.30122328782E-0414 40123
      3          ,-5.88116523111E-06, 4.69430312806E-08,-2.68624908110E-1014 40133
      4          , 1.07216029218E-12,-2.83848986332E-15, 4.47902426170E-1814 40143
      5          ,-3.18820492894E-21)                                        14 40153
 35
      DATA(CF(889)=
      1          -3.35737945704E 03, 3.59607589105E 02,-1.717768354?2E 0114 35114
      2          , 4.83159805043E-01,-6.88988890150E-03, 1.12382645337E-0414 35124
      3          ,-9.96522888704E-07, 6.20188929967E-09,-2.65561529463E-1114 35134
      4          , 7.46485005505E-14,-1.23925089964E-16, 9.21470372917E-2014 35144
      5)
 25
      DATA(CF(901)=
      1          -1.61978846198E 04, 1.59684243452E 03,-7.04019383842E 0114 25114
      2          , 1.83254908709E 00,-3.12964425149E-02, 3.68319767516E-0414 25124
      3          ,-3.04925152258E-06, 1.77666928394E-08,-7.14329618774E-1114 25134
      4          , 1.88855813317E-13,-2.95653184748E-16, 2.07743590750E-1914 25144
      5)
 15
      DATA(CF(91?)=
      1          -4.65213045815E 02, 3.00032793538E 01,-8.28208997613E-0114 15113
      2          , 1.28420215013E-02,-1.22029957807E-04, 7.27421799136E-0714 15123
      3          ,-2.65673432540E-09, 5.43682781963E-12,-4.77381847939E-1514 15133
      4)
  5
      DATA(CF(922)=
      1          -4.20025081246E 04, 4.33203419950E 03,-2.02004439913E 0214  5115
      2          , 5.63068237739E 00,-1.04492560338E-01, 1.36029958312E-0314  5125
      3          ,-1.27409961095E-05, 8.65371648828E-08,-4.23157056464E-1014  5135
      4          , 1.45331313151E-12,-3.32923886657E 15, 4.56884034607E-1814  5145
      5          ,-2.84178287454E-21)                                        14  5155
 -5
      DATA(CF(935)=
      1          -2.85029145642E 04, 2.56381270?    03,-1.01667936?0E 0??4 -5114
      2          , 2.41017077526E 00,-3.76541808?   -02, 4.07096223684E ?414 -5124
      3          ,-3.10836611688E-06, 1.67449?287 ?E-0?,-6.26089629787E-?014 -5134
      4          , 1.54228921383E-13,-2.2561324923?E-16, 1.48525329420?-1914 -5144
      5)
-15
      DATA(CF(947)=
      1          -9.15826908080E 04, 8.17020221637E 03,-3.27748842956E 0214-15114
      2          , 7.00450980586E 00,-1.22589700914E-01, 1.33592018854E-0314-15124
      3          ,-1.02621119475E-05, 5.58310283??0E-08,-2.05627?0969E-1014-15134
      4          , 5.26420417065E-13,-7.76480503??1E-16, 5.17941636689E-1914-15144
      5)
-25
      DATA(CF(959)=
      1          -1.29196511404E 05, 1.11912251898E 0?,-4.36079378775E 0214-25114
      2          , 1.00906575381E 01,-1.56079976337E-01, 1.63044787047E-0314-25124
      3          ,-1.22029079989E-05, 6.46123362891E-08,-2.37245750476E-1014-25134
      4          , 3.75491265184E-13,-8.30231073336E-16, 5.39794088190E-1914-25144
      5)
```

CHANNEL 15 SRD. ALPHA

```
TEMP                         COEFFICIENTS                                        CODE

 40
      DATA(CF(971)=
     1          -9.20614869543E 00, 4.11455145746E-01,-5.93990307651E-0315 40113
     2          , 4.16834417463E-05,-6.41389231593E-08,-8.43939686893E-1015 40123
     3          , 4.77379550925E-12,-7.26912028529E-15)                   15 40133
 35
      DATA(CF(979)=
     1          -1.86095077521E 01, 1.00014636494E 00,-2.26702495175E-0215 35113
     2          , 3.08331978525E-04,-2.60017844010E-06, 1.34285097197E-0815 35123
     3          ,-3.90023810387E-11, 4.89633392438E-14)                   15 35133
 25
      DATA(CF(987)=
     1          -4.19328175742E 01, 2.35896228551E 00,-5.70320840064E-0215 25113
     2          , 7.85603978939E-04,-6.49964009447E-06, 3.20989540895E-0815 25123
     3          ,-8.74222260923E-11, 1.01347595500E-13)                   15 25133
 15
      DATA(CF(995)=
     1          [illegible].69569753186E 01,-2.36854563397E 00, 1.01188558084E-0115 15113
     2          ,-2.11668918602E-03, 2.56576760678E-05,-1.89438023671E-0715 15123
     3          , 8.02545426288E-10,-2.07900198764E-12, 2.19024193968E-1515 15133
     4)
  5
      DATA(CF(1004)=
     1          -7.62268446072E 02, 5.98365416285E 01,-2.06489889370E 0015  5114
     2          , 4.10646030807E-02,-5.17629123025E-04, 4.28691552090E-0615  5124
     3          ,-2.33275037206E-08, 8.04493413997E-11,-1.59627420883E-1315  5134
                , 1.38915463307E-16)                                      15  5144
 -5
      DATA(CF(1014)=
     1          -1.70251016339E 04, 1.64092456023E 03,-7.08392246836E 0115 -5114
     2          , 1.80784298328E 00,-3.03050661256E-02, 3.50441525428E-0415 -5124
     3          ,-2.85347733082E-06, 1.63668820664E-08,-6.48358473496E-1115 -5134
     4          , 1.69024076030E-13,-2.61116709898E-16, 1.81188694172E-1915 -5144
     5)
-15
      DATA(CF(1026)=
     1          -2.12573504273E 04, 2.08152721019E 03,-9.14743539543E 0115-15114
     2          , 2.38163467869E 00,-4.08264034207E-02, 4.83960948174E-0415-15124
     3          ,-4.04948867694E-06, 2.39257351065E-08,-9.78570263786E-1115-15134
     4          , 2.63969713356E-13,-4.22822426364E-16, 3.04785093915E-1915-15144
     5)
-25
      DATA(CF(1038)=
     1          -1.39163171480E 04, 1.34426722818E 03,-5.86504651814E 0115-25114
     2          , 1.50964309846E 00,-2.57290906791E-02, 3.03821954963E-0415-25124
     3          ,-2.53664790757E-06, 1.49761772164E-08,-6.12830605451E-1115-25134
     4          , 1.67568349586E-13,-2.65860518819E-16, 1.92267142609E-1915-25144
     5)
```

CHANNEL 16 DUAL GAMMA BREMSSTRAHLEN

```
MP                          COEFFICIENTS                                 CODE

 DATA(CF(1050)=
1          -1.91857305559E 01, 1.15776636111E 00,-2.62605214202E-0216 40113
2          , 3.40896961448E-04,-2.62059774832E-06, 1.18813755113E-0816 40123
3          ,-2.95062745520E-11, 3.13319846650E-14)                 16 40133

 DATA(CF(1058)=
1          -5.51811888104E 01, 3.39989669831E 00,-8.66171082039E-0216 35113
2          , 1.23616322421E-03,-1.04734752883E-05, 5.24618624034E-0816 35123
3          ,-1.43642483169E-10, 1.65936502704E-13)                 16 35133

 DATA(CF(1066)=
1          -1.53432066963E 02, 8.96549339546E 00,-2.20401131065E-0116 25113
2          , 2.99445112050E-03,-2.40988820099E-05, 1.14673004462E-0716 25123
3          ,-2.98538014345E-10, 3.28109693911E-13)                 16 25133

 DATA(CF(1074)=
1           4.76646999887E 01,-3.37215742271E 00, 9.53602952254E-0216 15113
2          ,-1.38868690951E-03, 1.15946049089E-05,-5.60524121427E-0816 15123
3          , 1.46083708806E-10,-1.58805259821E-13)                 16 15133

 DATA(CF(1082)=
1          -8.75413865782E 00,-5.33807052881E-01, 3.57633534877E-0216  5113
2          ,-7.17538324604E-04, 7.24169231381E-06,-3.98872684786E-0816  5123
3          , 1.14524713563E-10,-1.34204357257E-13)                 16  5133

 DATA(CF(1090)=
1          -8.07766180602E 01, 4.05809074140E 00,-8.85836831969E-0216 -5113
2          , 1.12131913929E-03,-8.73023230513E-06, 4.14253797522E-0816 -5123
3          ,-1.10000790303E-10, 1.25318790003E-13)                 16 -5133

 DATA(CF(1098)=
1          -2.77962446748E 02, 1.43073932664E 01,-3.13676596340E-0116-15113
2          , 3.82913517358E-03,-2.80134686123E-05, 1.22786456355E-0716-15123
3          ,-2.98496623244E-10, 3.10473046382E-13)                 16-15133

 DATA(CF(1106)=
1          -1.92703226703E 02, 9.88812562940E 00,-2.19800901954E-0116-25113
2          , 2.76241769892E-03,-2.09885873715E-05, 9.59337433288E-0816-25123
3          ,-2.43309929245E-10, 2.63465236471E-13)                 16-25133
                                                                          812 CARDS
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UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)
University of California, San Diego
La Jolla, California 92037

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP

3. REPORT TITLE
Environmental Research Satellite-18
Data Reduction and Analysis

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Terminal Flight Report

5. AUTHOR(S) (First name, middle initial, last name)
Laurence E. Peterson
Duane Gruber
Stephen J. Lewis
Michael R. Stone

6. REPORT DATE
July 1968

7a. TOTAL NO. OF PAGES
65

7b. NO. OF REFS
3

8a. CONTRACT OR GRANT NO.
FO-4701-68-C-0108

b. PROJECT NO. VELA

c. Order No. ARPA - 102

d.

9a. ORIGINATOR'S REPORT NUMBER(S)
UCSD-SP-68-5

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

10. DISTRIBUTION STATEMENT
Qualified requesters may obtain copies of this report from DDC

11. SUPPLEMENTARY NOTES

12. SPONSORING MILITARY ACTIVITY
Department of Defense
Advanced Research Projects Agency
Nuclear Detection Branch
Washington, D.C. 20333

13. ABSTRACT

The 17.2 lb. Environmental Research Satellite-18 (ORS-III-B) carried a set of five radiation detectors designed to measure charged particles, X-rays, gamma rays, and cosmic rays in the near Earth environment. The satellite was launched on April 28, 1967 into a highly elliptical orbit whose initial apogee altitude was 111,200 kilometers and initial perigee altitude was 8,600 kilometers. Detectors sensitive to trapped particles include a solid state detector for electron fluxes above 0.4 Mev and protons 8-21 Mev, a low energy scintillation counter for electrons greater than 100 kev and protons greater than 1-8 Mev. A set of Geiger-Mueller counters detected solar X-rays in the 1-14 Å range, and electrons above 40 kev. Gamma ray counting rates between 30 kev and 10 Mev, as well as the total cosmic ray flux, were provided by the "dual-gamma" counter, a large NaI(Tl) crystal surrounded by a charged particle shield consisting of plastic scintillator connected in electrical anticoincidence with the central scintillator. Signals from most channels were converted to analog voltages by logarithmic count rate meters. Each channel was sampled about once a minute to modulate a subcarrier oscillator in the telemetry system. Several low counting rate channels were converted to a quasi-digital format before sampling. Data has been received nearly continuously from launch until termination on June 3, 1968, and has been monitored occasionally to assess the performance of the instrumentation.

DD FORM 1 NOV 65 1473

Unclassified
Security Classification

Unclassified
Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Radiation						
Satellite						
Solar Terrestrial Relations						
Trapped Particles						
Gamma Rays						
X-Rays						

Unclassified
Security Classification