X-564-66-101

NASA TM X-55890

DATA PROCESSING PLAN FOR ECCENTRIC ORBITING GEOPHYSICAL OBSERVATORY (OGO-B)

MARCH 1966

GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

X-564-66-101

DATA PROCESSING PLAN FOR ECCENTRIC ORBITING GEOPHYSICAL OBSERVATORY (OGO-B)

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DATA PROCESSING PLAN
FOR
ECCENTRIC ORBITING GEOPHYSICAL OBSERVATORY
(OGO-B)

SECTION I. SPACECRAFT OPERATION

THE MISSION

The OGO-B spacecraft, depicted in Figure 1, will carry into a highly eccentric orbit about the earth, a large number of varied geophysical experiments. A greater understanding of the earth, and of earth-sun relationships will be obtained from these.

As the third mission of the OGO program, the OGO-B will be launched by an Atlas-Agena B vehicle from the Atlantic Missile Range and injected into an eccentric orbit of approximately 31 degrees inclination. The spacecraft weighs about 1000 pounds, of which 150 pounds are allocated for the experiments. The orbit has a nominal perigee of 150 nautical miles, a nominal apogee of 80,000 nautical miles, and a period of 63.3 hours. The orbit allows the OGO-B to traverse the radiation belts twice during each orbit and to make geophysical measurements from the region near the earth to cislunar space. A mission lifetime of one year is expected.

THE SPACECRAFT

OGO-B is a rectangular aluminum-panelled box weighing approximately 1000 pounds, a weight which includes a minimum total experiment weight of 150 pounds. Two solar arrays and their Solar Orbital Experimental Package (SOEP), an Orbital Plane Experiment Package (OPEP), six experiment booms and three antennas constitute the major appendages of the spacecraft.

In its fully deployed and operational configuration, OGO-B will utilize reaction wheels and gas jets to maintain an attitude with respect to the sun, earth and orbital plane such that its solar paddles (Figure 4) are normal to the sun-spacecraft line, the +Z door is normal to the earth-spacecraft line, and the Orbital Plane Experiment package looks into the orbital plane in the direction of the velocity vector. The OGO Coordinate system is further illustrated in Figure 5.

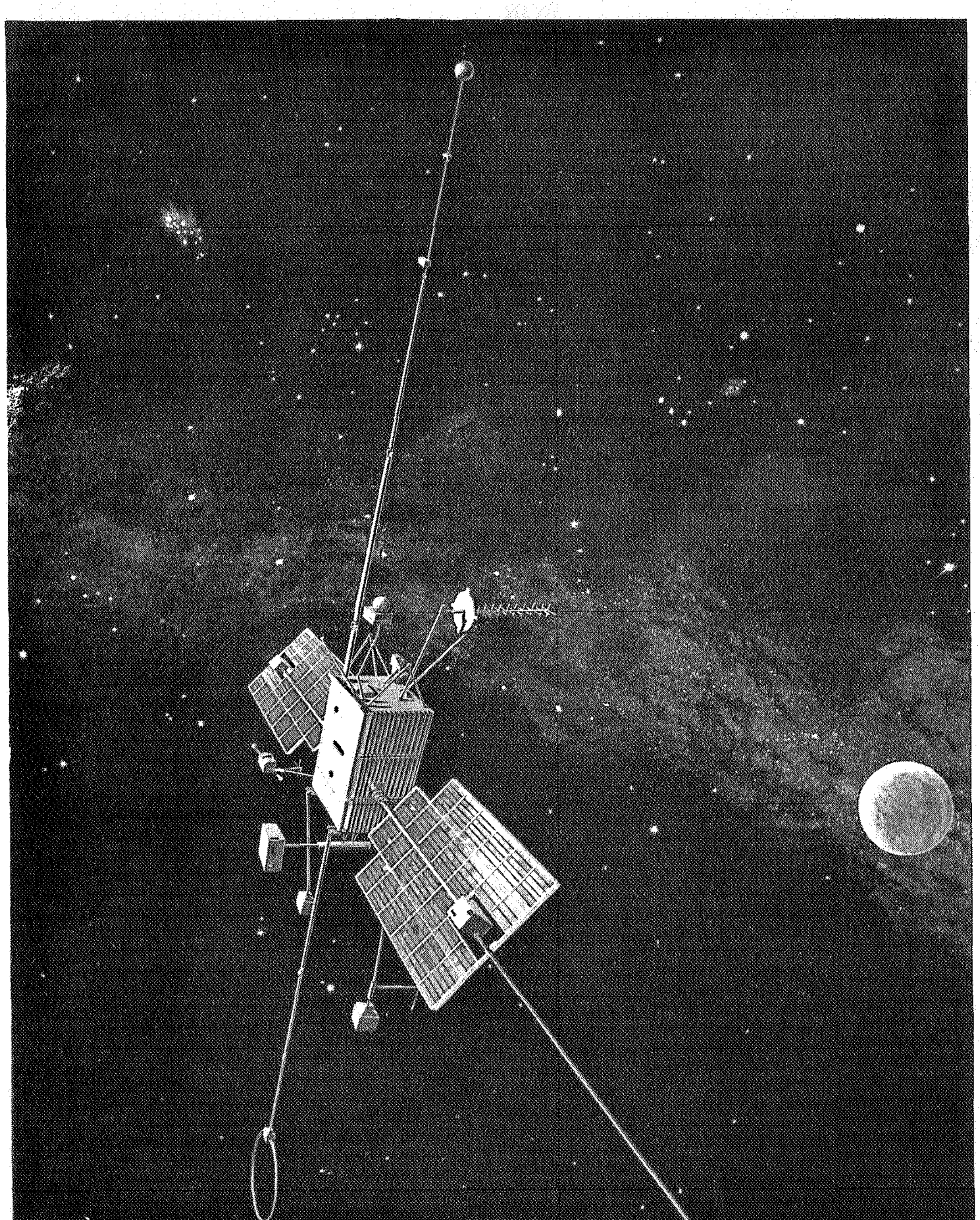


Figure 1—OGO Spacecraft

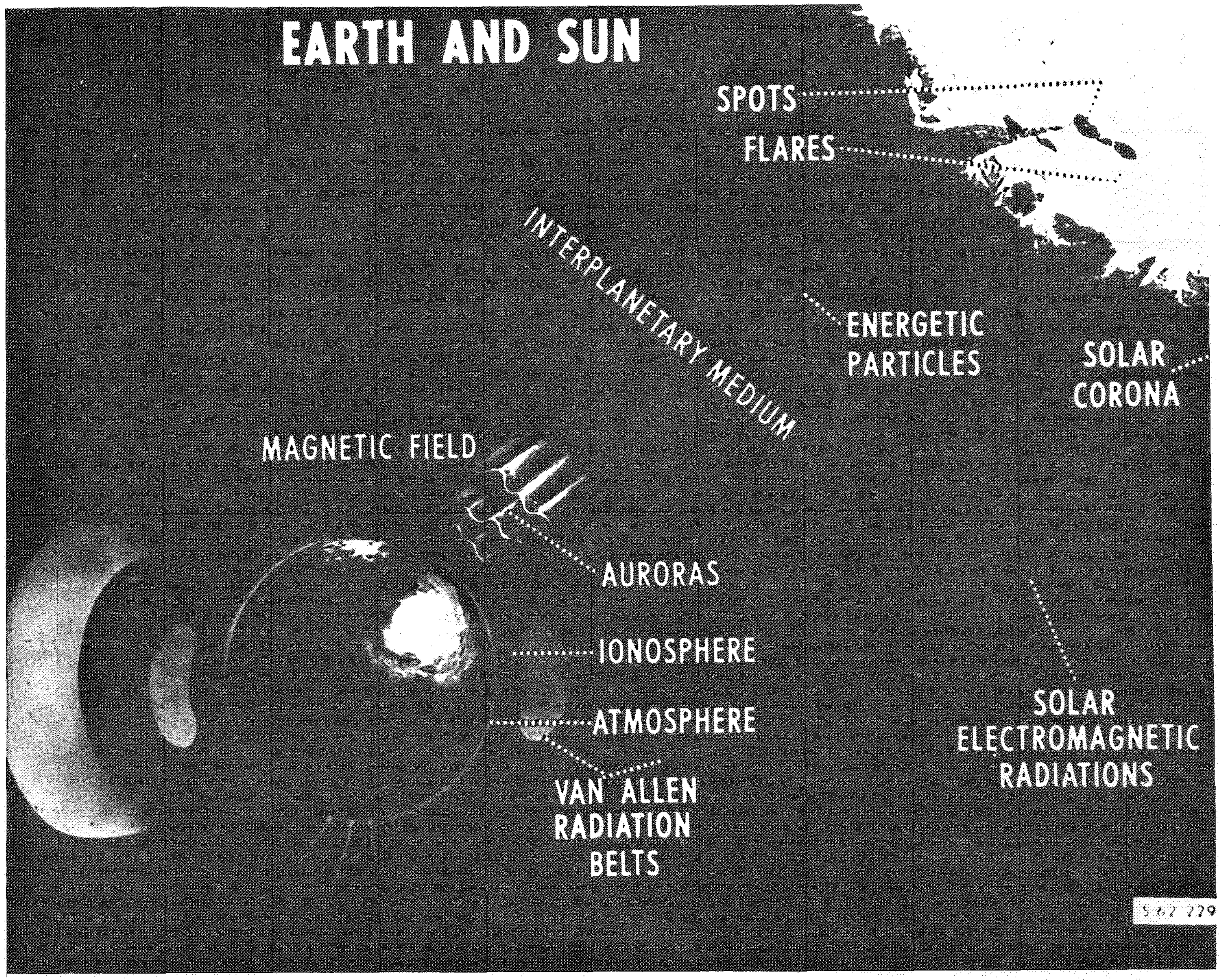


Figure 2–Earth Sun Relationship

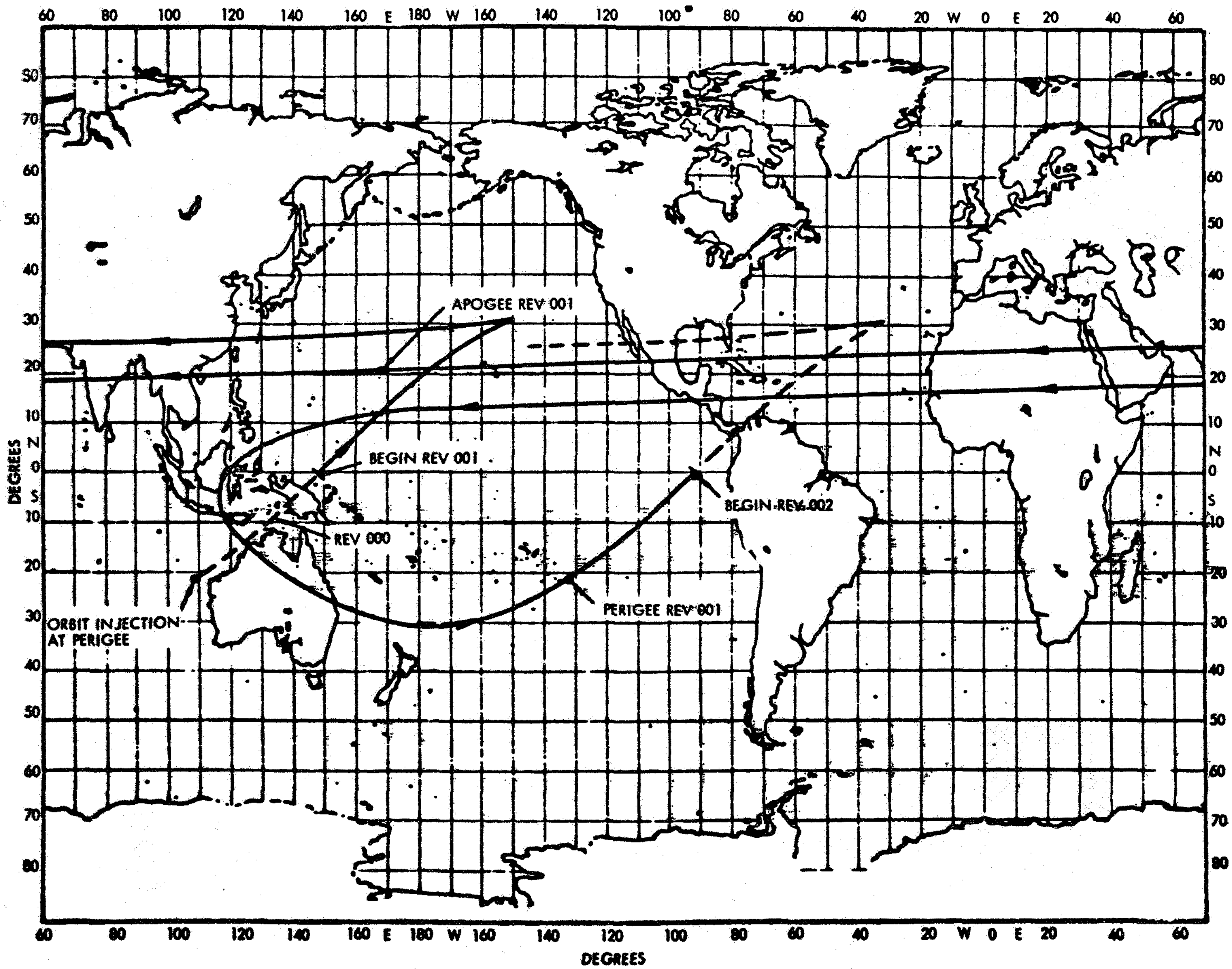
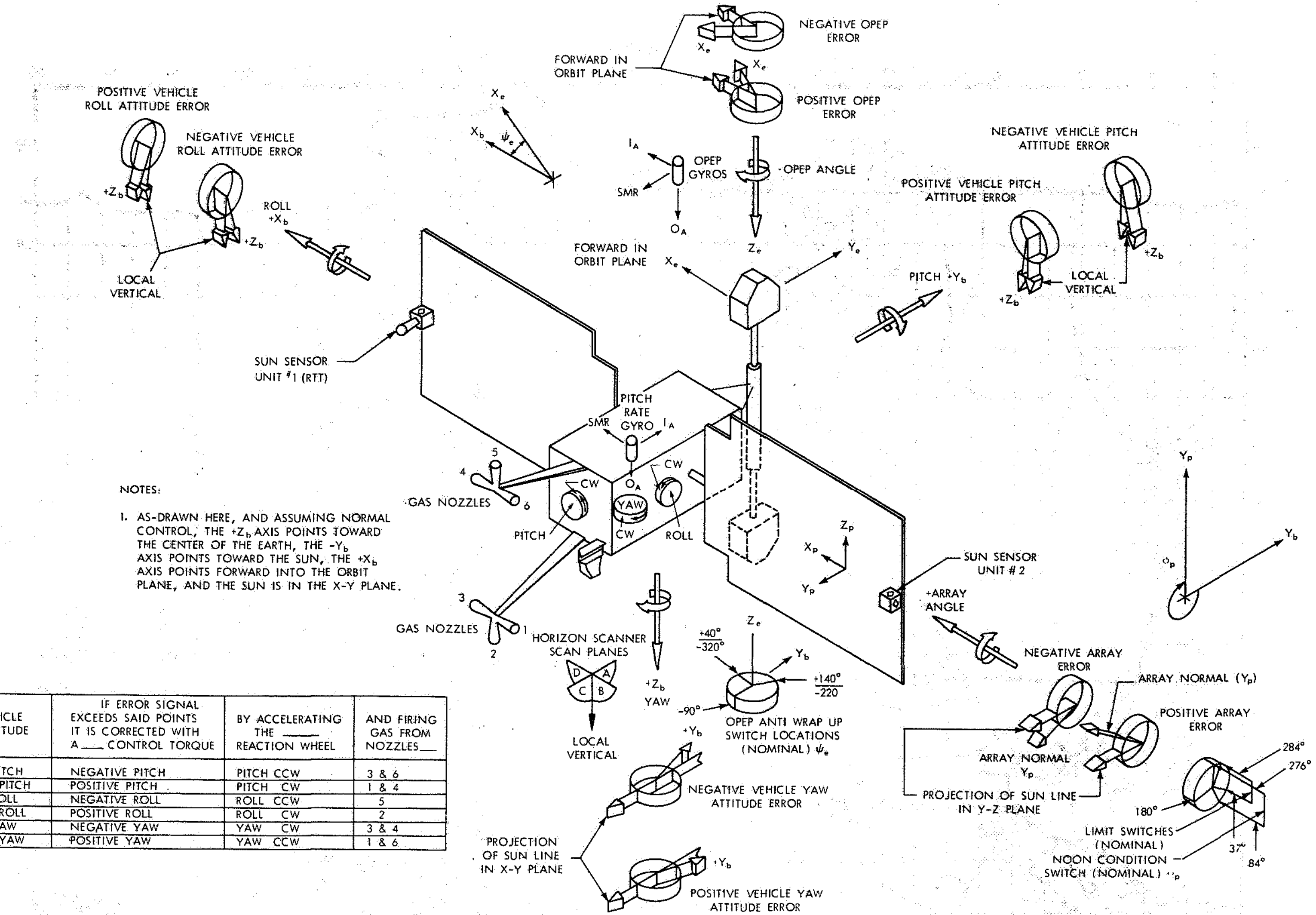


Figure 3–Orbital Subsatellite Plot-First Revolution



NOTES:

1. AS-DRAWN HERE, AND ASSUMING NORMAL CONTROL, THE $+Z_b$ AXIS POINTS TOWARD THE CENTER OF THE EARTH, THE $-Y_b$ AXIS POINTS TOWARD THE SUN, THE $+X_b$ AXIS POINTS FORWARD INTO THE ORBIT PLANE, AND THE SUN IS IN THE X-Y PLANE.

FOR A VEHICLE ____ ATTITUDE ERROR	IF ERROR SIGNAL EXCEEDS SAID POINTS IT IS CORRECTED WITH A ____ CONTROL TORQUE	BY ACCELERATING THE ____ REACTION WHEEL	AND FIRING GAS FROM NOZZLES____
POSITIVE PITCH	NEGATIVE PITCH	PITCH CCW	3 & 6
NEGATIVE PITCH	POSITIVE PITCH	PITCH CW	1 & 4
POSITIVE ROLL	NEGATIVE ROLL	ROLL CCW	5
NEGATIVE ROLL	POSITIVE ROLL	ROLL CW	2
POSITIVE YAW	NEGATIVE YAW	YAW CW	3 & 4
NEGATIVE YAW	POSITIVE YAW	YAW CCW	1 & 6

Figure 4—OGO Spacecraft Coordinate Systems

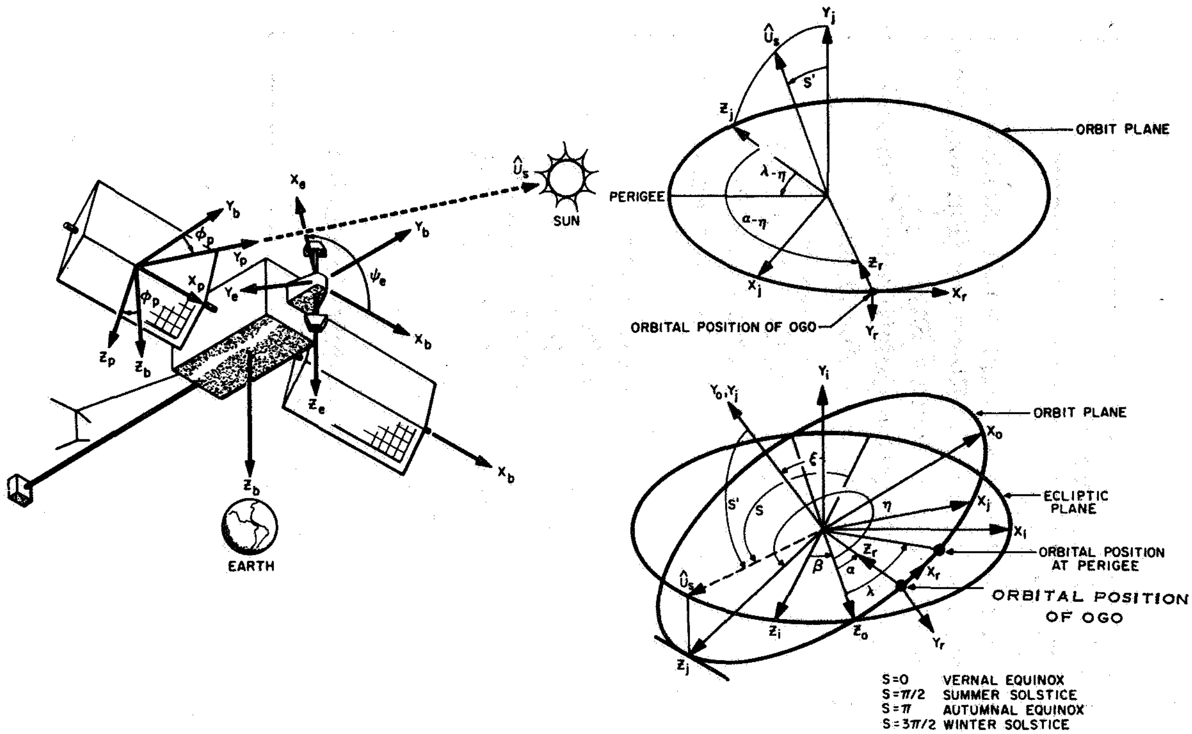


Figure 5–OGO Coordinate System

THE EXPERIMENTS

OGO-B will carry 20 experiments. Their general description and the cognizant scientist for each are listed in the table of Figure 6. Their location on the spacecraft is given in Figure 7.

SPACECRAFT TELEMETRY AND DATA-HANDLING

PCM Telemetry

OGO-B uses a split-phase PCM/PM digital telemetry system, in which each telemetry word contains 9 bits.

Exp. No.	Experimenter	Affiliation	Experiment
4901	Anderson	Univ. of Calif.	Solar Protons
4902	Wolfe	Ames Research Center	Plasma Protons (Electrostatic Analyzer)
4903	Bridge	M. I. T.	Plasma Protons & Electrons (Faraday Cup)
4904	Cline	GSFC	Positrons and Gamma Rays
4905	Davis & Konradi	GSFC	Trapped Radiation (Scintillation Counter)
4906	McDonald & Ludwig	GSFC	Cosmic Ray Isotopic Abundance
4907	Simpson	Univ. of Chicago	Cosmic Ray Spectra & Fluxes
4908	Van Allen	State Univ. of Iowa	Trapped Radiation (Geiger Counters)
4909	Winkler	Univ. of Minnesota	Electron Spectra & Total Ionization
4910	Smith	JPL	Low Frequency Magnetic Field Variations
	Holzer	UCLA	
4911	Heppner	GSFC	Magnetic Field Measurements
4912	Sagalyn	AFCRL	Thermal Charged Particles
4913	Whipple	GSFC	Thermal Charged Particles
4914	Lawrence	NBS	Electron Density by RF Propagation
4915	Taylor	GSFC	Atmospheric Composition (1–45 AMU)
4916	Alexander	GSFC	Micron Dust Particles
4917	Helliwell	Stanford Univ.	VLF Noise & Propagation
4918	Haddock	Univ. of Michigan	Radio Astronomy
4919	Mange	USNRL	Geocoronal Lyman-Alpha Scattering
4920	Wolff	GSFC	Gegenschein Photometry

Figure 6–Summary of OGO-B Experiments

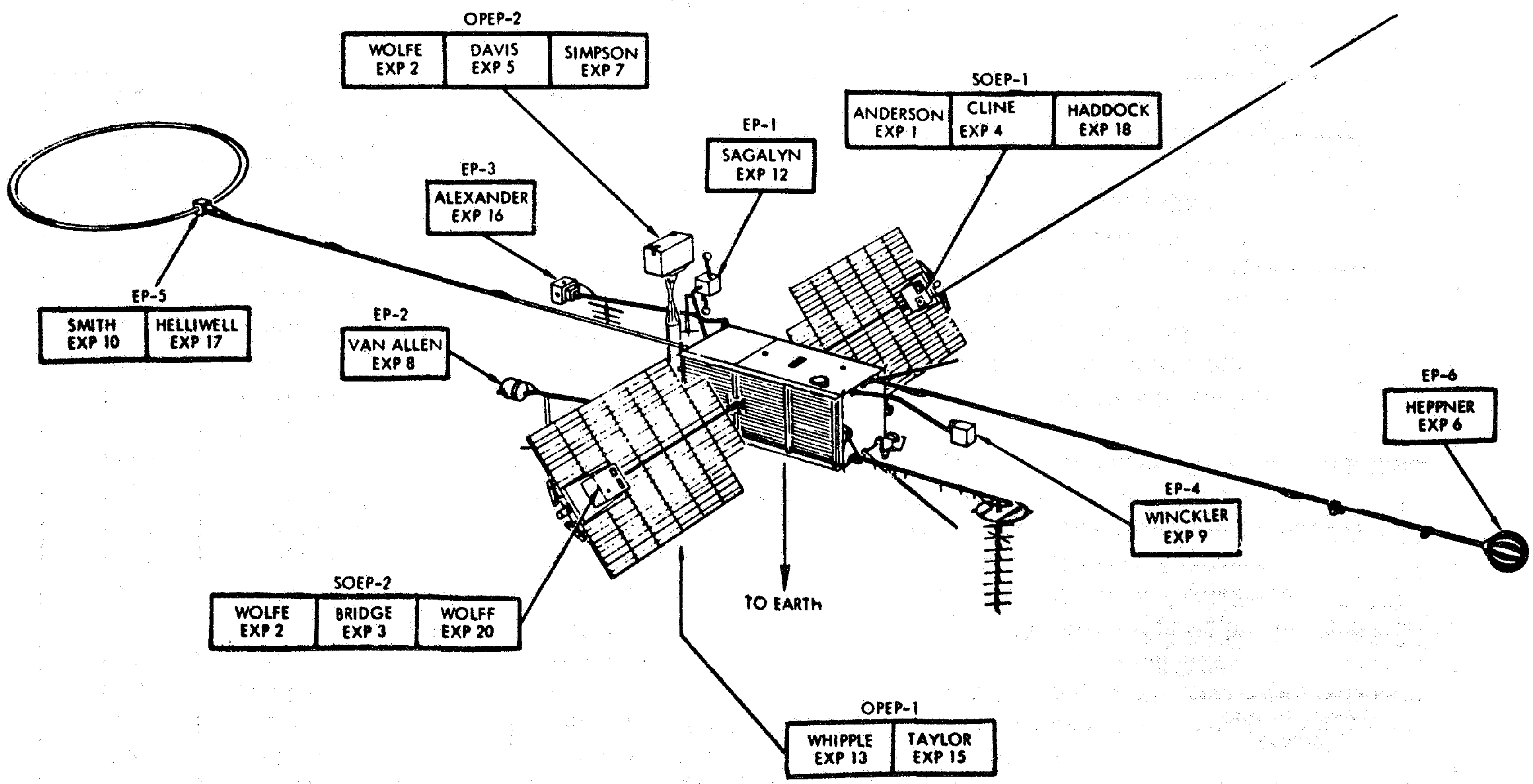
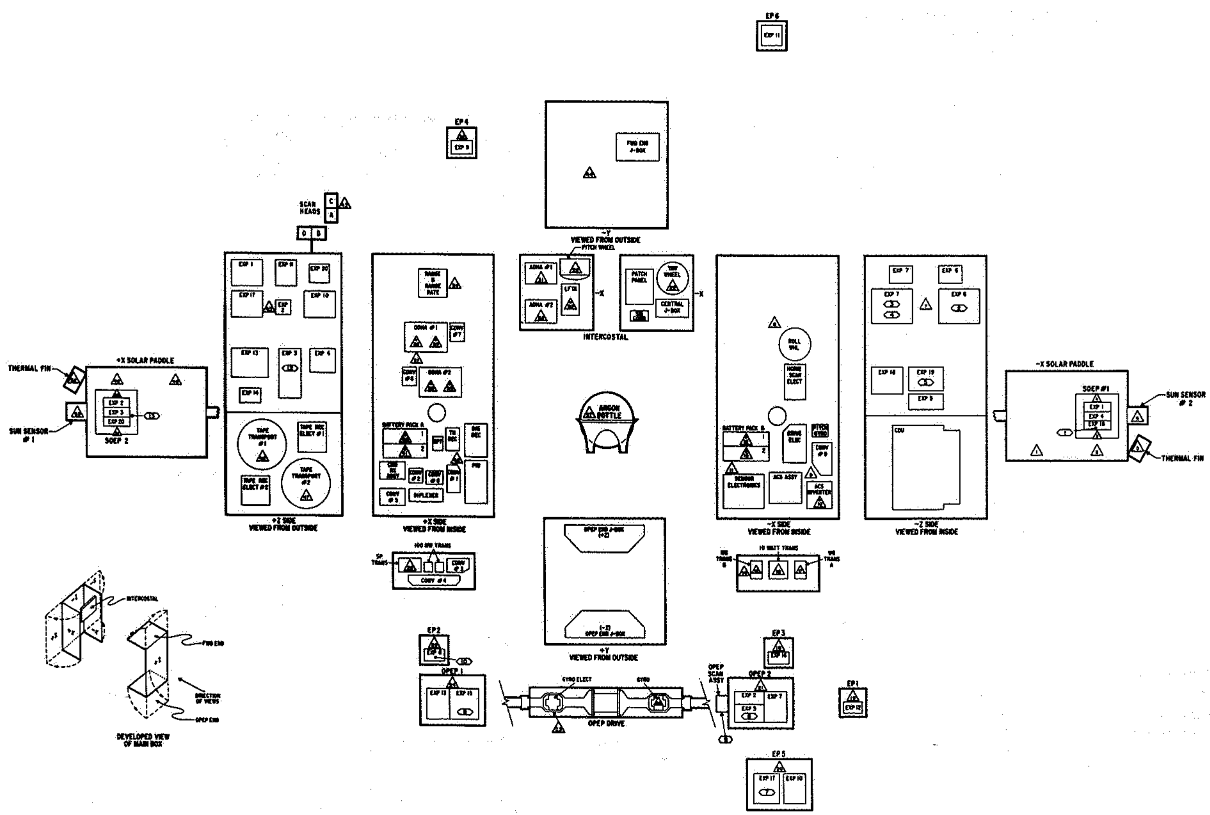


Figure 7–Experiment Mounting Locations

SPACECRAFT AND EXPERIMENT THERMISTOR LOCATION
OGO-B



LEGEND

SPACECRAFT THERMISTORS

△BASE PLATE MOUNT △COMPONENT MOUNT

1. E1: SC3-1/600
2. E2: SC3-2/601
3. E28: SC3-62/675
4 E29: SC3-65/700
5. D13: SC3-19/622
6. A26: SC3-101/744
7. E21: SC3-36/643
8. E7: SC3-7/606
9. E8: SC3-8/607
10. A32: SC3-99/742
11. E24: SC3-39/646
12. D50: SC3-68/703
13. D51: SC3-69/704
14. E27: SC3-46/655
15. C2: SC3-71/706
16. C4: SC3-61/674
    -125/744
17. C1: SC3-70/705
18. E15: SC3-23/626
19. E13: SC3-21/624
20. E17: SC3-14/615
21. E20: SC3-35/642
22. A30: SC3-100/743
23. A37: SC3-33/640
24. E19: SC3-34/641
25. E14: SC3-22/625
26. C3: SC3-72/707
27. A3: SC2-6/405
28. A33: SC3-98/741
29. A34: SC3-97/740
30. F17: SC3-86/725
31. F24: SC2-EG1-81/520
32. F32: SC2-EG2-81/520
33. E16: SC3-24/627
34. E23: SC3-38/645
35. F14: SC2-98/541
36. F20: SC3-87/726
37. E5: SC3-5/604
38. F15: SC2-99/542
39. F22: SC3-88/727
40. D11: SC3-66/701
41. D12: SC3-67/702
42. E6: SC3-6/605
43. A9: SC3-103/746
44. A8: SC3-104/747
45. E22: SC3-37/644
46. F8: SC3-84/723
47. F16: SC3-85/724
48. E3: SC3-3/602
49. E4: SC3-4/603
50. E26: SC3-30/635
51. E25: SC3-40/647
52. D14: SC3-20/623
53. A25: SC3-102/745

⊂⊃ EXPERIMENT THERMISTORS

1. SOEP 1, EXP 18, PRE-AMP, SC1-78/115
2. -Z DOOR, EXP 6, SCINTILLATOR ASS'Y, SC1-EG1-15/016
   EG2-63/076
3. -Z DOOR, EXP 7, COMPOSITION TELESCOPE, SC1-119/166
4. -Z DOOR, EXP 7, PROTON-ALPHA TELESCOPE, SC1-120/167
5. -Z DOOR, EXP 19, ELECTROMETERS, SC1-84/123
6. OPEP 2, EXP 5, ELECTROMETER, SC1-31/036
7. EP 5, EXP 17, ANT FEED MANIFOLD, SC1-83/122
8. OPEP 1, EXP 15, ELECT. ASS'Y, SC1-EG1-29/034
   EG2-9/010
9. OPEP 2 (UNCAGED), SC1-12/013
10. EP 2, EXP 8, ELECTRONIC PACKAGE, SC1-44/053
11.
12. +Z DOOR, EXP 3, ELECTRON EXP, MC-36/044, 107/153
    (the 8th step in exp. data seq. of 8 steps)
    ELECTRONIC PACKAGE,
13. SOEP 2, EXP 3, PROTON EXP, MC-10/012, 42/052, 74/112, 106/152
    (the 67th step in exp. data seq. of 69 steps)
    ELECTRONIC PACKAGE,

Figure 7A—Spacecraft and Experiment Thermistor Location, OGO-B

PARTICIPATING EXPERIMENTERS

INTRODUCTION

The primary objective of the Observatory is the successful fulfillment of the scientific mission as defined by the objectives of the experiments. The highly elliptical OGO-B orbit allows the Observatory to traverse the radiation belts and to make a series of geophysical measurements from the region near the earth and through the magnetosphere to interplanetary space. The payload consists of 20 experiments designed for the study of charged particles, measurement of magnetic fields, and observation of various ionospheric and radio-astronomical phenomena.

EXPERIMENTS

A brief description of scientific objectives and detection devices of each of the twenty experiments is presented in the following paragraphs. Included is the principal experimenter and his affiliation. The experiment numbers shown were arbitrarily assigned during the initial phases of the program purely for identification and convenience in referencing and in no way indicate priority or relative importance.

Solar Protons (Experiment No. 1)

Dr. K. A. Anderson
University of California
Berkeley, California

The primary objective of this experiment is to measure the energy spectrum and intensity of solar protons with energies between 2 Mev and 100 Mev. A measure of the spatial inhomogeneities and time variations of the solar proton flux and fluxes attributable to solar flares will also be obtained. The sensor is a solar oriented scintillation counter. Both the pulse height output of the counter, which is a measure of the energy of impinging protons absorbed in the scintillation crystal, and the pulse count are monitored by the telemetry.

Plasma Protons (Electrostatic Analyzer) (Experiment No. 2)

Dr. J. H. Wolfe
Ames Research Center
Moffett Field, California

This experiment measures the flux and energy spectrum of protons in the energy range from 100 ev to 20 Kev. Three electrostatic analyzers are utilized, with two oriented into the orbital plane and one solar oriented. Each analyzer consists of two closely spaced hemispherical conducting plates which, when charged, exert a coulomb force on charged particles between the plates. Thus, only particles with the correct charge to mass ratio and energy for a given electric field are admitted to a collector after deflection by the plates. A differential energy spectrum is obtained by varying the electric field. Further, the solar oriented analyzer is equipped with deflection plates and four electrometer tubes in such a manner as to provide information concerning the direction of the incoming flux relative to the sun-vehicle line and local magnetic field line.

Plasma Protons and Electrons (Faraday Cup) (Experiment No. 3)

Dr. H. J. Bridge
Massachusetts Institute of Technology
Cambridge, Massachusetts

This experiment consists of two separate but closely related experiments designed to measure plasma properties, with primary concern directed to properties, of the interplanetary medium and the earth's magnetosphere. Plasma proton flux, energy spectrum from 10 ev to 10 Kev, and direction are measured by the Faraday Cup oriented along the satellite-sun vector. A Faraday Cup contains several grids biased with a stepping voltage to allow only particles of the correct sign and with energy greater than the retarding potential to impinge on a collector. Direction is determined by the relative outputs of three collectors arranged within the cup. Plasma electron flux and the energy spectrum within the range 25 ev to 2 Kev are measured by a Faraday cup mounted on the spacecraft earth facing door. Additional scientific objectives include measurements of the temporal and spatial variations of the above quantities and correlation of all data with magnetic field measurements.

Positron Search and Gamma Rays (Experiment No. 4)

Dr. T. L. Cline
Goddard Space Flight Center
Greenbelt, Maryland

This experiment will investigate the possible existence of low-energy positrons trapped in a permanent or transitory manner in the radiation belts, and the possible arrival of low-energy solar or interplanetary positrons at the edge of the magnetosphere. Also, the flux and spectrum of solar gamma rays will be measured. Instrumentation consists of a multiple scintillation counter-photomultiplier tube device oriented toward the sun. Positrons are detected by the coincidence- and anti-coincidence logic of the detector system in the detection of gamma rays produced by the positron annihilation reaction:

$$e^{+} + e^{-} \rightarrow 2\gamma$$

<u>Trapped Radiation (Scintillation Counter)</u> (Experiment No. 5)

Mr. L. R. Davis & A. Konradi
Goddard Space Flight Center
Greenbelt, Maryland

A study of geomagnetically trapped electrons and protons will be provided by this experiment. Specifically, the directional intensity of protons, the directional energy flux of electrons, and the absorption curves of these particles will be determined by an ion-electron phosphor scintillation detector located behind a stepping variable absorption wheel. The detector is mounted in an orbital plane experiment package and upon ground command can scan ±110 degrees relative to the spacecraft velocity vector. This scanning technique allows the particle pitch angle distribution to be measured directly. Studies of the above parameters should provide further clarification of such problems as particle lifetimes and the processes by which trapped particles are lost.

<u>Isotopic Abundance and Galactic Cosmic Rays</u> (Experiment No. 6)

Dr. F. B. McDonald and Dr. G. H. Ludwig
Goddard Space Flight Center
Greenbelt, Maryland

This experiment utilizes two separate sensing devices: a dE/dX vs. E scintillation telescope for isotopic abundance measurements and a Geiger counter triaxial telescope. The primary objectives are to measure the flux, charge, and energy of primary cosmic radiation. The dE/dX vs. E scintillation counter provides a knowledge of the energy of a particle and its rate of energy loss, which enables the particle to be identified. Two major objectives are (1) a determination of the amount of interstellar material through which primary cosmic rays have passed, and (2) a study of the various forms of modulation of hydrogen and helium nuclei. The triaxial telescope is designed primarily as a monitor of the background cosmic ray intensity above the earth's atmosphere. A secondary objective is the study of the charge and energy spectra of cosmic rays produced by the sun.

Cosmic Ray Spectra and Fluxes (Experiment No. 7)

Dr. J. A. Simpson
University of Chicago
Chicago, Illinois

The scientific objectives of this experiment are to measure the intensity and energy distribution of high energy cosmic rays in the range 0.3 Mev to 4 Bev/nucleon. The origin of galactic cosmic rays, acceleration mechanisms, and radiation modulation from interplanetary magnetic fields are of primary interest. In addition to protons and alpha particles, measurements will also be made of the heavier cosmic ray constituents, such as lithium, beryllium, boron and oxygen. Detection is provided by a dE/dX vs. E scintillation device, solid-state detectors, and PM tubes mechanized so as to provide information defining the charge, mass, and energy of the particles as well as the acceptance angle.

Trapped Radiation (Geiger Counters) (Experiment No. 8)

Dr. J. A. Van Allen
State University of Iowa
Iowa City, Iowa

The objectives of this experiment are to study the absolute intensity and energy spectrum of geomagnetically trapped electrons and protons in the energy range from 40 Kev to 3 Mev as a function of position and time. This study is a continuing effort to improve the observational foundations for understanding the dynamics of the trapped particles and their relationship to aurorae, magnetic storms and ionospheric perturbations. While the Observatory is near apogee, a study of the passage of energetic particles through interplanetary space will also be provided. The experiment detector is comprised of one omnidirectional Geiger tube and six Geiger tubes mounted in groups of three on mutually perpendicular axes. Thus, in addition to energy measurements, directionality is also provided by noting the difference in count rates from identically shielded tubes.

Electron Spectra and Total Ionization (Experiment No. 9)

Dr. J. R. Winckler
University of Minnesota
Minneapolis, Minnesota

An electron spectrometer is utilized by this experiment to measure the electron energy spectra in the 50 Kev to 4 Mev range in the Van Allen radiation zone. The electrometer is a swept field magnetic spectrograph with a scintillator-photomultipler arrangement constituting the electron detector. Simultaneously, an ionization chamber measures the intensity of the total ionizing radiation. The experiment assists in the study of the injection, trapping, and loss mechanisms acting in the earth's radiation belts.

Low Frequency Magnetic Field Variations (Experiment No. 10)

Dr. E. J. Smith	Dr. R. E. Holzer
Jet Propulsion Laboratory	University of California
Pasadena, California	Los Angeles, California

The scientific objectives of this experiment are to investigate the nature of extremely low-frequency (0.01 cps to 3 kc) fluctuations in the terrestrial geomagnetic field, in the interplanetary field, the interface, and to investigate the relationship between the observed fluctuations in these three regions of space and the simultaneous variations at the earth's surface. Sufficient data may be obtained to furnish information relative to trapped particle acceleration mechanisms and hydromagnetic wave propagation. The magnetometer is composed of three search coils mounted mutually orthogonally and situated at the end of one of the spacecraft long booms. On an attitude-stabilized spacecraft such as OGO-B, this type of magnetometer is insensitive to fixed (dc) magnetic fields.

Magnetic Field Strength and Direction (Experiment No. 11)

Dr. J. P. Heppner
Goddard Space Flight Center
Greenbelt, Maryland

A combination of component flux-gate sensors and a rubidium-vapor magnetometer is employed to provide comprehensive magnetic field measurements. The objectives are to accurately measure the interaction of solar and geomagnetic field phenomena, to measure the local field sources such as ring currents, to study the rapid field fluctuations with frequency ranges covering at least four orders of magnitude, and to provide charts and mathematical descriptions for the International World Magnetic Field Survey. The flux-gate sensors are triaxially mounted to measure both the sense and magnitude of the ambient magnetic field within a range of ±500 gamma. The rubidium-vapor magnetometer is a duo dual-cell system with an output frequency proportional to the magnitude of the magnetic field. The range of the vapor magnetometer is from approximately 3 gamma to 0.14 gauss. The experiment is located on one of the long booms.

Thermal Charged Particles (Experiment No. 12)

Dr. R. C. Sagalyn
Air Force Cambridge Research Laboratory
Bedford, Massachusetts

The purpose of this experiment is to measure the flux and energy distributions of electrons and positive ions in the thermal energy range of 0.2 ev to 1 Kev. Further, the spacecraft potential with respect to the undisturbed plasma field will be measured. A spherical electron trap and a spherical ion trap, both of which are mesh balls surrounding collectors, are the sensing devices. Sweeping and stepping potentials are applied to the periphery of the balls to establish retarding potentials and thus analyze the energy of particles reaching the collectors.

Thermal Charged Particles (Experiment No. 13)

Dr. E. C. Whipple
Goddard Space Flight Center
Greenbelt, Maryland

The objectives of this experiment are to obtain the densities and energy distributions of both negative and positive ions in the low energy or thermal ranges throughout the Observatory orbit. In addition to densities and temperatures, ion masses and the flux and directions of quasi-energetic particle beams will also be measured. From analysis of the above parameters, the polarity and magnitude of the spacecraft potential will be obtained. The sensor is oriented into the Observatory orbital plane and consists of a planar ion trap which separates particles according to their polarity and energy by a retarding potential technique.

Electron Density by RF Propagation (Experiment No. 14)

Mr. R. S. Lawrence
National Bureau of Standards
Boulder, Colorado

This experiment measures the electron density along the propagation path of signals transmitted from the Observatory to ground stations. The Doppler shift and Faraday rotation of two coherent frequencies (40 and 360 Mc) transmitted from the Observatory are measured by ground stations situated around the earth. Both frequencies are phase modulated by 20 kc and 200 kc sine waves.

Atmospheric Composition (1-45 AMU) (Experiment No. 15)

Mr. H. A. Taylor
Goddard Space Flight Center
Greenbelt, Maryland

The objective of this experiment is to measure the positive ion composition between one and 45 atomic mass units throughout the Observatory orbit. The instruments used are Bennett r-f mass spectrometers oriented into the orbital plane. This type of spectrometer utilizes retarding a-c and d-c fields to exclude ions not satisfying the velocity and phase conditions established by the fields from reaching an ion detector. Resolution is 1 AMU. To provide greater sensitivity, two separate spectrometers are used, one sensitive to 1-6 AMU ions and the other to 7-45 AMU ions.

Micron Dust Particles (Experiment No. 16)

Mr. W. M. Alexander
Goddard Space Flight Center
Greenbelt, Maryland

The objective of this experiment is to measure the mass, velocity, directionality, intensity, and time and spatial variations in the micrometeorite flux throughout the Observatory orbit. Four similar sensors accept particles from four different directions relative to the Observatory coordinate system. A plasma cloud/clocking/microphonic sensor arrangement yields the desired parameters.

VLF Noise and Propagation (Experiment No. 17)

Dr. R. A. Helliwell
Stanford University
Stanford, California

This experiment will increase the overall understanding of the VLF phenomena in the earth's magnetosphere. The phenomena to be studied include the terrestrial noise produced from such atmospherics as lightning noise, VLF emissions produced by solar particles and of general extraterrestrial origin, and the propagation of VLF signals from low frequency ground stations. A 0.2 to 100 kc receiver with a circular antenna erected in orbit provides the Observatory instrumentation. Much of the data will be compared with ground observations.

Radio Astronomy (Experiment No. 18)

Dr. F. T. Haddock
University of Michigan
Ann Arbor, Michigan

The prime objective of this experiment is to investigate the dynamic radio spectrum of solar and jovian (Jupiter) radio-noise bursts and galactic emissions. The investigations cover the frequency range from 2 to 4 Mc by a receiver with automatic repetitive tuning. The primary time of interest is the first few minutes subsequent to a solar flare. During this time, the frequency drift rate, bandwidth, and duration of the fastdrift solar bursts will be observed.

Geocoronal Lyman-Alpha Scattering (Experiment No. 19)

Dr. P. W. Mange
Naval Research Laboratory
Washington, D. C.

The objective of this experiment is to measure the intensity of Lyman-alpha radiation (1216A) and locate the scattering layer. This wavelength is the fundamental resonance line of neutral hydrogen and could therefore provide a measure of the neutral hydrogen density in the interplanetary medium. Instrumentation consists of four ion chambers sensitive to the Lyman-alpha wavelength. The chambers are mounted on the anti-earth side of the Observatory.

Gegenschein Photometry (Experiment No. 20)

Dr. C. L. Wolff
Goddard Space Flight Center
Greenbelt, Maryland

A scanning image dissector is employed by this experiment to obtain images of the sky in the antisolar direction. The Gegenschein (counterglow) originates from back-scattered sunlight from particles in space. Some information relative to the nature of the scattering medium, such as whether gas or dust and whether the medium is collective or dispersed, will also be obtained.

Bit rates in use during real-time transmissions will be 64, 8 or 1 kilobits per second. On-board tape-recorders will record data at 1 kilobit per second. Playback of tape-recorded data will be at a transmission rate of 64 kilobits per second.

EGO carries two redundant Equipment Groups for data handling, termed EG1 and EG2. Normally EG1 will handle data for real-time transmission and EG2 will handle data being recorded on-board the spacecraft. Their functions can be switched upon command from the ground if required. As in some cases with OGO-A, if a specific data format is in use with EG1, that same data format may experience a change in telemetry channel assignments when used with EG2.

One frame of telemetry data will consist of 128 9-bit words. Twelve words of the frame will contain as fixed inputs: the frame sync pattern, the spacecraft clock readout, spacecraft data handling status words, and sampling of the three spacecraft subcommutators. Assignment of data outputs to the remaining words of the 128-word frame will vary in format according to whether the outputs are supplied in the spacecraft Main Frame mode, in one of the 32 Flexible Format modes or in the Accelerated Subcommutator Mode. The Main Frame commutator assigns outputs to the 128-word frame from all experiments except 4914 which does not use the S/C PCM data format. Selection of one of the Flexible Format modes, made by ground command only, will replace Main Frame assignments and assign outputs from the spacecraft subcommutators to the 128-word frame. Selection of a flexible format for assigning outputs to the 128-word frame in effect results in super-commutation of subcomm outputs in the main frame. Selection of the Accelerated Subcommutator mode, obtained by ground command, will assign subsystem outputs from spacecraft subcommutator #2 (Channel 98) to the 116 non-fixed words of the frame. The format for the Main Frame mode is given as Figures 8 and 9. The format corresponding to the Accelerated Subsystems commutator is the same as that given in Figure 18 for spacecraft subcommutator #2 with the exception that channels 97, 98, 99 become "frozen" to a constant and that words 1-3, 33-35, and 65-67, respectively contain the normally fixed inputs of frame sync, spacecraft clock, and data-handling status.

Recording of data onto the on-board tape recorders may occur simultaneously with real time transmissions. Data is recorded on tape recorders 1 & 2, normally under control of Equipment Group 2. Recording takes place at a rate of 1 kilobit per second and play back at a rate of 64 kilobits per second. When recording at the 1 kilobit rate, one tape recorder will become full in 12 hours. Recording onto the next recorder will begin automatically. Upon ground command real time transmissions will be interrupted, tape recorders automatically dumped, and an automatic return made to simultaneous recording and real time transmission. Tape recorded data will be played back to ground acquisition stations in a reversed time sequence with tape recorder #1 dumped first and playing the data out in a direction opposite to that in which recording took place, being immediately followed by tape recorder #2. (While tape recorder #1 is being played back, tape recorder #2 continues to record. It is therefore possible to obtain continuous data coverage for the lifetime of the S/C.)

OGO-B MAIN TELEMETRY FORMAT

EQUIPMENT GROUP I

HORIZONTAL MATRIX LINES	KI01	KI02	KI03	KI04	KI05	KI06	KI07	KI08
RI1	1 / 000 SYNC WORD #1 000 110 010	2 / 001 SYNC WORD #2 011 111 000	3 / 002 SYNC WORD #3 101 011 010	4 / 003 2 SOEP 2 PROBE, OUTPUT 1	5 / 004 2 SOEP 2 PROBE, OUTPUT 2	6 / 005 2 SOEP 2 PROBE, OUTPUT 3	7 / 006 2 SOEP 2 PROBE, OUTPUT 4	8 / 007 18 RECEIVER IF VOLTAGE
RI2	17 / 020 20 LIGHT INTENSITY	18 / 021 20 INTENSITY AND SCAN LINE NO	19 / 022 7 D1 PULSE HEIGHT DATA	20 / 023 7 D4 RATE DATA	21 / 024 2 OPEP 2 PROBE 1 OUTPUT	22 / 025 2 OPEP 2 PROBE 2 OUTPUT	23 / 026 2 HIGH VOLTAGE READOUT	24 / 027 15 1-6 AMU 10^{-10} CURRENT DATA
RI3	33 △ / 040 ACCUMULATED TIME (SECS) 2^{24} ← 2^{18}	34 / 041 ACCUMULATED TIME (SECS) 2^{17} ← 2^{9}	35 / 042 ACCUMULATED TIME (SECS) 2^{8} ← 2^{0}	36 / 043 3 ELECTRON CUP DATA AND MONITORS	37 / 044 10 X AXIS WAVEFORM	38 / 045 10 Y AXIS WAVEFORM	39 / 046 10 Z AXIS WAVEFORM	40 / 047 15 1-6 AMU 10^{-12} CURRENT DATA
RI4	49 / 060 7 D1 PULSE HEIGHT DATA	50 / 061 7 D3 PULSE HEIGHT DATA	51 / 062 7 D4 PULSE HEIGHT DATA	52 / 063 7 COMBINATION RATE DATA	53 / 064 7 D4 RATE DATA	54 / 065 15 1-6 AMU 10^{-13} CURRENT DATA	55 / 066 4 A PULSE HEIGHT DATA	56 / 067 4 B PULSE HEIGHT DATA
RI5	65 / 100 2^5 … 2^0 SUBCOM WORD NUMBER THIS FRAME ENABLE PULSE EG MODE	66 / 101 XMITTED EG MAIN COM ACCEL SC FF 2^4 … 2^0 FF NO	67 / 102 OTHER EG MAIN COM ACCEL SC FF 2^4 … 2^0 FF NO.	68 / 103 15 1-6 AMU 10^{-14} CURRENT DATA	69 / 104 15 7-45 AMU 10^{-10} CURRENT DATA	70 / 105 15 7-45 AMU 10^{-11} CURRENT DATA	71 / 106 15 7-45 AMU 10^{-12} CURRENT DATA	72 / 107 15 7-45 AMU 10^{-13} CURRENT DATA
RI6	81 / 120 1 PULSE HEIGHT DATA	82 / 121 1 PULSE HEIGHT DATA	83 / 122 1 PULSE HEIGHT DATA	84 / 123 1 PULSE HEIGHT DATA	85 / 124 18 RECEIVER IF VOLTAGE	86 / 125 10 X AXIS WAVEFORM	87 / 126 10 Y AXIS WAVEFORM	88 / 127 10 Z AXIS WAVEFORM
RI7	97 / 140 SUBCOM 1 DATA WORD HERE	98 / 141 SUBCOM 2 DATA WORD HERE	99 / 142 SUBCOM 3 DATA WORD HERE	100 / 143 9 ION CHAMBER ELECTROMETER OUTPUT	101 / 144	102 / 145 11 R_b VAPOR MAGNETOMETER DATA	103 / 146 18 RECEIVER IF VOLTAGE	104 / 147 5 ABSORBER WHEEL POSITION
RI8	113 / 160 9 ION CHAMBER DATA	114 / 161 8 PARTICLE COUNT 2^8 TO 2^{14}	115 / 162 8 PARTICLE COUNT 2^0 TO 2^7	116 / 163 9 ELECTRON SPECTROMETER DATA	117 / 164 10 X AXIS WAVEFORM	118 / 165 10 Y AXIS WAVEFORM	119 / 166 10 Z AXIS WAVEFORM	120 / 167 18 RECEIVER IF VOLTAGE

HORIZONTAL MATRIX LINES	KI09	KI10	KI11	KI12	KI13	KI14	KI15	KI16
RI1	9 / 010 13 SENSOR CONTROLS AND DATA	10 / 011 3 PROTON CUP DATA AND MONITORS	11 / 012 20 FILTER NUMBER	12 / 013 13 SENSOR CONTROLS AND DATA	13 / 014 5 ELECTROMETER OUTPUT	14 / 015 10 X AXIS WAVEFORM	15 / 016 10 Y AXIS WAVEFORM	16 / 017 10 Z AXIS WAVEFORM
RI2	25 / 030 5 PARTICLE COUNT	26 / 031 18 RECEIVER IF VOLTAGE	27 / 032 15 1-6 AMU 10^{-11} CURRENT DATA	28 / 033 7 COMBINATION RATE DATA	29 / 034 7 D5 RATE DATA	30 / 035 11 FLUXGATE COIL A, -30 TO +30 GAMMA	31 / 036 11 FLUXGATE COIL B, -30 TO +30 GAMMA	32 / 037 11 FLUXGATE COIL C, -30 TO +30 GAMMA
RI3	41 / 050 13 SENSOR CONTROLS AND DATA	42 / 051 3 PROTON CUP DATA AND MONITORS	43 / 052 9 ION CHAMBER DATA	44 / 053 13 SENSOR CONTROLS AND DATA	45 / 054 18 RECEIVER IF VOLTAGE	46 / 055 17 0.2-1.6 KC RECEIVER OUTPUT	47 / 056 17 1.6-12.5 KC RECEIVER OUTPUT	48 / 057 17 12.5-100 KC RECEIVER OUTPUT
RI4	57 / 070 4 PULSE COUNT	58 / 071 6 A PULSE HEIGHT DATA	59 / 072 6 B PULSE HEIGHT DATA	60 / 073 6 EVENTS COUNT - BOTH TELESCOPES	61 / 074 10 X AXIS WAVEFORM	62 / 075 10 Y AXIS WAVEFORM	63 / 076 10 Z AXIS WAVEFORM	64 / 077 18 RECEIVER IF VOLTAGE
RI5	73 / 110 13 SENSOR CONTROLS AND DATA	74 / 111 3 PROTON CUP DATA AND MONITORS	75 / 112 OPEP 2 SHAFT POSITION	76 / 113 13 SENSOR CONTROLS AND DATA	77 / 114 5 ELECTROMETER OUTPUT	78 / 115 19 ION CHAMBERS A,B,C COMBINED OUTPUT	79 / 116 19 ION CHAMBER D OUTPUT	80 / 117 10 Z AXIS 10 CPS
RI6	89 / 130 5 PARTICLE COUNT	90 / 131 9 ION CHAMBER DATA	91 / 132 11 FLUXGATE COIL A, -500 TO +500 GAMMA	92 / 133 11 FLUXGATE COIL B, -500 TO +500 GAMMA	93 / 134 11 FLUXGATE COIL C, -500 TO +500 GAMMA	94 / 135 11 FLUXGATE COIL A, -30 TO +30 GAMMA	95 / 136 11 FLUXGATE COIL B, -30 TO +30 GAMMA	96 / 137 11 FLUXGATE COIL C, -30 TO +30 GAMMA
RI7	105 / 150 13 SENSOR CONTROLS AND DATA	106 / 151 3 PROTON CUP DATA AND MONITORS	107 / 152 3 ELECTRON CUP DATA AND MONITORS	108 / 153 13 SENSOR CONTROLS AND DATA	109 / 154 15 7-45 AMU 10^{-14} CURRENT DATA	110 / 155 17 0.2-1.6 KC RECEIVER OUTPUT	111 / 156 17 1.6-12.5 KC RECEIVER OUTPUT	112 / 157 17 12.5-100 KC RECEIVER OUTPUT
RI8	121 / 170 9 ELECTRON SPECTROMETER DATA	122 / 171 9 ELECTRON SPECTROMETER DATA	123 / 172 9 ELECTRON SPECTROMETER DATA	124 / 173 9 ELECTRON SPECTROMETER DATA	125 / 174 12 ELECTRON SPHERE OUTPUT	126 / 175 12 SPHERE VOLTAGE STATUS	127 / 176 12 ION-PROTON SPHERE OUTPUT	128 / 177 12 SWEEP, BIAS AND ENERGY MODES

VERTICAL MATRIX LINES

△ THE 2^{24} BIT IS A 2^0 UPDATE—

Figure 8—Main Telemetry Format EG 1

OGO-B MAIN TELEMETRY FORMAT

EQUIPMENT GROUP 2

HORIZONTAL MATRIX LINES	KI01	KI02	KI03	KI04	KI05	KI06	KI07	KI08
RI1	1 / 000 SYNC WORD #1 000 110 010	2 / 001 SYNC WORD #2 011 111 000	3 / 002 SYNC WORD #3 101 011 010	4 / 003 2 SOEP 2 PROBE, OUTPUT 1	5 / 004 2 SOEP 2 PROBE, OUTPUT 2	6 / 005 2 SOEP 2 PROBE, OUTPUT 3	7 / 006 2 SOEP 2 PROBE, OUTPUT 4	8 / 007 18 RECEIVER IF VOLTAGE
RI2	17 / 020 20 LIGHT INTENSITY	18 / 021 20 INTENSITY AND SCAN LINE NO	19 / 022 7 D1 PULSE HEIGHT DATA	20 / 023 7 D4 RATE DATA	21 / 024 2 OPEP 2 PROBE 1 OUTPUT	22 / 025 2 OPEP 2 PROBE 2 OUTPUT	23 / 026 2 HIGH VOLTAGE READOUT	24 / 027 15 1-6 AMU 10^{-10} CURRENT DATA
RI3	33 △ 040 ACCUMULATED TIME (SECS) 2^{24} ← 2^{18}	34 / 041 2^{17} ← 2^{9}	35 / 042 2^{8} ← 2^{0}	36 / 043 3 ELECTRON CUP DATA AND MONITORS	37 / 044 10 X AXIS WAVEFORM	38 / 045 10 Y AXIS WAVEFORM	39 / 046 10 Z AXIS WAVEFORM	40 / 047 15 1-6 AMU 10^{-12} CURRENT DATA
RI4	49 / 060 7 D1 PULSE HEIGHT DATA	50 / 061 7 D3 PULSE HEIGHT DATA	51 / 062 7 D4 PULSE HEIGHT DATA	52 / 063 7 COMBINATION RATE DATA	53 / 064 7 D4 RATE DATA	54 / 065 15 1-6 AMU 10^{-13} CURRENT DATA	55 / 066 4 A PULSE HEIGHT DATA	56 / 067 4 B PULSE HEIGHT DATA
RI5	65 / 100 2^6 2^5 2^4 2^3 2^2 2^1 2^0 SUBCOM WORD NUMBER THIS FRAME ENABLE PULSE EG MODE	66 / 101 XMITTED EG IS AT OR PS MAIN COM ACCEL BC FF 2^4 2^3 2^2 2^1 2^0 FF NO	67 / 102 OTHER EG IS OR WAS AT MAIN COM ACCEL BC FF 2^4 2^3 2^2 2^1 2^0 FF NO	68 / 103 15 1-6 AMU 10^{-14} CURRENT DATA	69 / 104 15 7-45 AMU 10^{-10} CURRENT DATA	70 / 105 15 7-45 AMU 10^{-11} CURRENT DATA	71 / 106 15 7-45 AMU 10^{-12} CURRENT DATA	72 / 107 15 7-45 AMU 10^{-13} CURRENT DATA
RI6	81 / 120 1 PULSE HEIGHT DATA	82 / 121 1 PULSE HEIGHT DATA	83 / 122 1 PULSE HEIGHT DATA	84 / 123 1 PULSE HEIGHT DATA	85 / 124 18 RECEIVER IF VOLTAGE	86 / 125 10 X AXIS WAVEFORM	87 / 126 10 Y AXIS WAVEFORM	88 / 127 10 Z AXIS WAVEFORM
RI7	97 / 140 SUBCOM 1 DATA WORD HERE	98 / 141 SUBCOM 2 DATA WORD HERE	99 / 142 SUBCOM 3 DATA WORD HERE	100 / 143 15 1-6 AMU 10^{-9} CURRENT DATA	101 / 144 15 7-45 AMU 10^{-9} CURRENT DATA	102 / 145 11 R_b VAPOR MAGNETOMETER DATA	103 / 146 18 RECEIVER IF VOLTAGE	104 / 147 5 ABSORBER WHEEL POSITION
RI8	113 / 160 9 ION CHAMBER DATA	114 / 161 8 PARTICLE COUNT 2^8 TO 2^{14}	115 / 162 8 PARTICLE COUNT 2^0 TO 2^7	116 / 163 9 ELECTRON SPECTROMETER DATA	117 / 164 10 X AXIS WAVEFORM	118 / 165 10 Y AXIS WAVEFORM	119 / 166 10 Z AXIS WAVEFORM	120 / 167 18 RECEIVER IF VOLTAGE

HORIZONTAL MATRIX LINES	KI09	KI10	KI11	KI12	KI13	KI14	KI15	KI16
RI1	9 / 010 13 SENSOR CONTROLS AND DATA	10 / 011 3 PROTON CUP DATA AND MONITORS	11 / 012 20 FILTER NUMBER	12 / 013 13 SENSOR CONTROLS AND DATA	13 / 014 5 ELECTROMETER OUTPUT	14 / 015 10 X AXIS WAVEFORM	15 / 016 10 Y AXIS WAVEFORM	16 / 017 10 Z AXIS WAVEFORM
RI2	25 / 030 5 PARTICLE COUNT	26 / 031 18 RECEIVER IF VOLTAGE	27 / 032 15 1-6 AMU 10^{-11} CURRENT DATA	28 / 033 7 COMBINATION RATE DATA	29 / 034 7 D5 RATE DATA	30 / 035 11 FLUXGATE COIL A, -30 TO +30 GAMMA	31 / 036 11 FLUXGATE COIL B, -30 TO +30 GAMMA	32 / 037 11 FLUXGATE COIL C, -30 TO +30 GAMMA
RI3	41 / 050 13 SENSOR CONTROLS AND DATA	42 / 051 3 PROTON CUP DATA AND MONITORS	43 / 052 9 ION CHAMBER DATA	44 / 053 13 SENSOR CONTROLS AND DATA	45 / 054 18 RECEIVER IF VOLTAGE	46 / 055 17 0.2-1.6 KC RECEIVER OUTPUT	47 / 056 17 1.6-12.5 KC RECEIVER OUTPUT	48 / 057 17 12.5-100 KC RECEIVER OUTPUT
RI4	57 / 070 4 PULSE COUNT	58 / 071 6 A PULSE HEIGHT DATA	59 / 072 6 B PULSE HEIGHT DATA	60 / 073 6 EVENTS COUNT - BOTH TELESCOPES	61 / 074 10 X AXIS WAVEFORM	62 / 075 10 Y AXIS WAVEFORM	63 / 076 10 Z AXIS WAVEFORM	64 / 077 18 RECEIVER IF VOLTAGE
RI5	73 / 110 13 SENSOR CONTROLS AND DATA	74 / 111 3 PROTON CUP DATA AND MONITORS	75 / 112 OPEP 2 SHAFT POSITION	76 / 113 13 SENSOR CONTROLS AND DATA	77 / 114 5 ELECTROMETER OUTPUT	78 / 115 19 ION CHAMBERS A,B,C COMBINED OUTPUT	79 / 116 19 ION CHAMBER D OUTPUT	80 / 117 10 Z AXIS 10 CPS
RI6	89 / 130 5 PARTICLE COUNT	90 / 131 9 ION CHAMBER DATA	91 / 132 11 FLUXGATE COIL A, -500 TO +500 GAMMA	92 / 133 11 FLUXGATE COIL B, -500 TO +500 GAMMA	93 / 134 11 FLUXGATE COIL C, -500 TO +500 GAMMA	94 / 135 11 FLUXGATE COIL A, -30 TO +30 GAMMA	95 / 136 11 FLUXGATE COIL B, -30 TO +30 GAMMA	96 / 137 11 FLUXGATE COIL C, -30 TO +30 GAMMA
RI7	105 / 150 13 SENSOR CONTROLS AND DATA	106 / 151 3 PROTON CUP DATA AND MONITORS	107 / 152 3 ELECTRON CUP DATA AND MONITORS	108 / 153 13 SENSOR CONTROLS AND DATA	109 / 154 15 7-45 AMU 10^{-14} CURRENT DATA	110 / 155 17 0.2-1.6 KC RECEIVER OUTPUT	111 / 156 17 1.6-12.5 KC RECEIVER OUTPUT	112 / 157 17 12.5-100 KC RECEIVER OUTPUT
RI8	121 / 170 9 ELECTRON SPECTROMETER DATA	122 / 171 9 ELECTRON SPECTROMETER DATA	123 / 172 9 ELECTRON SPECTROMETER DATA	124 / 173 9 ELECTRON SPECTROMETER DATA	125 / 174 12 ELECTRON SPHERE OUTPUT	126 / 175 12 SPHERE VOLTAGE STATUS	127 / 176 12 ION-PROTON SPHERE OUTPUT	128 / 177 12 SWEEP, BIAS AND ENERGY MODES

VERTICAL MATRIX LINES

△ THE 2^{25} BIT IS A 2^{0} UPDATE

Figure 9—Main Telemetry Format EG 2

FLEX FORMAT, SUBCOM, AND TELEMETRY WORD TIE-IN

FF GATE NO	TLM WORD	SUBCOM NUMBER AND WORD SLOT	FLEX FORMAT NOS.
1	D10	SC2-47	1 2 4 9 11 13 15 16
2	D10	SC2-47	1 2 4 9 11 15 28 29
3	GROUND		1 4 9 11 14 15 16 28
4	B11	NONE	1 4 9 11 15 28 30 32
5	F40	SC2-10,42,74,106	3 4 10 11 13 15 16 28 32
6	B12	NONE	3 4 10 11 15 28 29 32
7	A7	SC2-41,105	3 4 10 11 14 15 16 28 32
8	A10	SC2-23	3 4 10 11 15 28 30 32
9	A11	SC2-24	5 6 8 9 11 12 13 16 31 32
10	A4	SC2-25,89	5 6 8 9 11 12 29 31 32
11	A5	SC2-26,90	5 8 9 11 12 14 16 31 32
12	B13	NONE	5 8 9 11 12 30 31 32
13	B14	NONE	7 8 10 11 12 13 16 31 32
14	B1	SC3-9,73	7 8 10 11 12 29 31 32
15	A17	SC2-50,114	7 8 10 11 12 14 16 31 32
16	A18	SC2-51,115	7 8 10 11 12 30 31 32
17	A19	SC2-52,116	12 13 15 16 17 18 20 25 27 32
18	A20	SC2-53,116	12 15 17 18 20 25 27 29 32
19	A21	SC2-12,28,44,60,76,92,108,124	12 14 15 16 17 20 25 27 32
20	A22	SC2-13,29,45,61,77,93,109,125	12 15 17 20 25 27 30 32
21	A23	SC2-54,118	12 13 15 16 19 20 26 27 32
22	A24	SC2-55,119	12 15 19 20 26 27 29 32
23	B2	SC3-10,74	12 14 15 16 19 20 26 27 32
24	B3	SC3-11,75	12 15 19 20 26 27 30 32
25	B4	SC3-12,76	13 16 21 22 24 25 27 28 31 32
26	A31	SC2-11,43,75,107	21 22 24 25 27 28 29 31 32
27	B5	SC3-13,77	14 16 21 24 25 27 28 31 32
28	B6	SC3-15,79	21 24 25 27 28 30 31 32
29	B7	SC3-16,80	13 16 23 24 26 27 28 31 32
30	B8	NONE	21 23 24 26 27 28 29 31 32
31	B9	NONE	14 16 23 24 26 27 28 31 32
32	B10	NONE	21 23 24 26 27 28 30 31 32

Figure 10—Flexible Format, Subcomm and Telemetry Word Tie, in

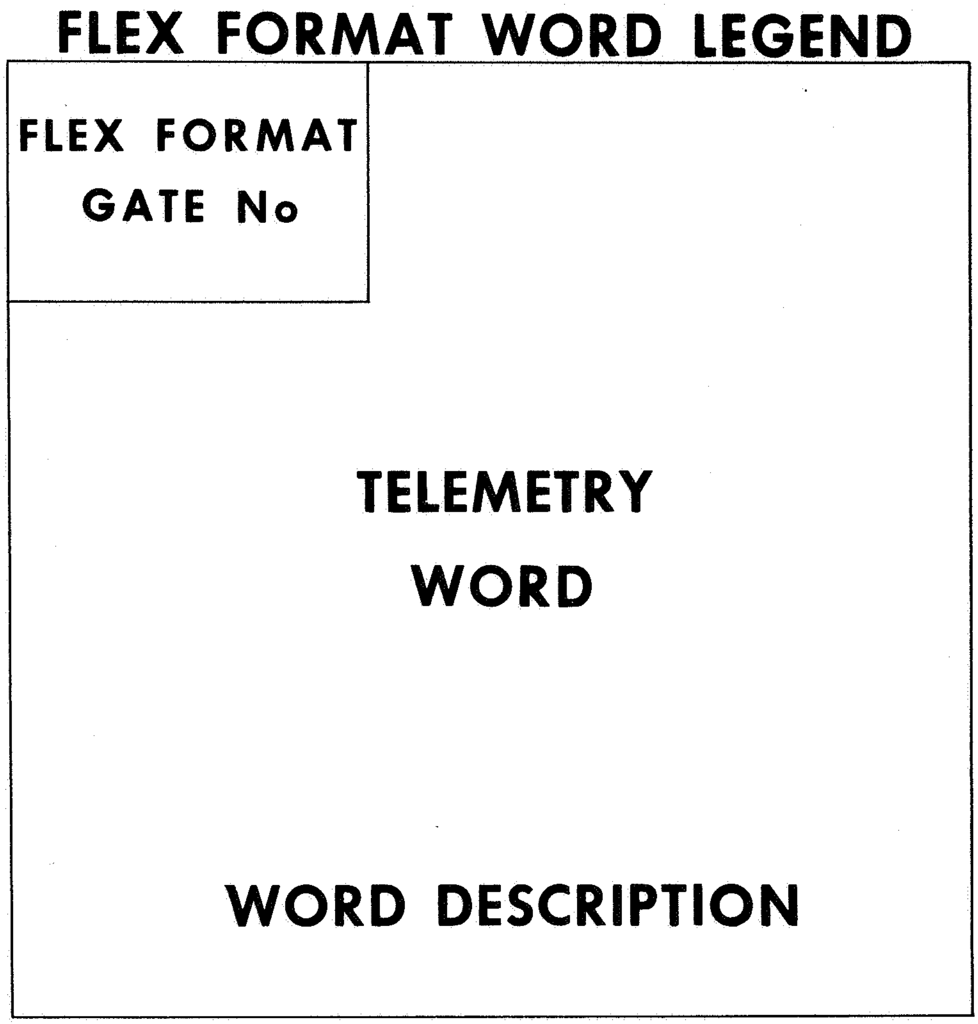


Figure 11–Flexible Format Word Legend

Each of the 128 words in a frame is classed as "digital" or "analog." The ninth or high-order bit of each analog word will never be used to convey data and will always be telemetered in a zero configuration.

Twelve words of the 128-word frame, as mentioned earlier, contain as a fixed input the continuous reading of the following functions:

Frame Sync Words (Words 1-3) – The frame sync bit pattern appears as Figure 13.

FLEX FORMAT No. 32

COMMANDS
RT – 276
DS – 176

FIXED WORDS			4 **B11** Deploy Bottle 1 PSIA	5 **F40** S/C Sep, Deploy, Exp Ord	6 **B12** Deploy Bottle 2 PSIA	7 **A7** Scan Heads Track Check	8 **A10** Yaw Error Signal
9 **A11** Array Error Signal	10 **A4** Pitch Error Signal	11 **A5** Roll Error Signal	12 **B13** Deploy Bottle 3 PSIA	13 **B14** Deploy Bottle 4 PSIA	14 **B1** EP 5, 360 ANT Deploy	15 **A17** Roll Wheel Tach RPM	16 **A18** Pitch Wheel Tach RPM
17 **A19** Yaw Wheel Tach RPM	18 **A20** Reaction Wheel Directions	19 **A21** Control Valves 1, 2, 5	20 **A22** Control Valves 3, 4, 6	21 **A23** ACS Modes Sun Sensor	22 **A24** Pitch Rate Gyro Demod	23 **B2** EP 6 Deploy	24 **B3** Array 1 Deploy
25 **B4** S/C Sep, Array 2 Deploy	26 **A31** Reaction Wheels On-Off	27 **B5** EP 1, EP 2, EP 3 Deploy	28 **B6** EP 4, Jets, 136 ANT Deploy	29 **B7** Hi-Gain ANT, OPEP Deploy	30 **B8** Pre-Deploy 1	31 **B9** Pre-Deploy 2	32 **B10** Pre-Deploy 3

Figure 12—Flexible Format 32

WORD 1	WORD 2	WORD 3
000 110 010	011 111 000	101 011 010

Figure 13—Frame sync word format

SPACECRAFT CLOCK READOUT (WORD 33 bit 3 through WORD 35 bit 9)

WORD 33									WORD 34									WORD 35								
1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
flag	unused	2^{24}	2^{23}	2^{22}	2^{21}	2^{20}	2^{19}	2^{18}	2^{17}	2^{16}	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}

Figure 14—Spacecraft clock format

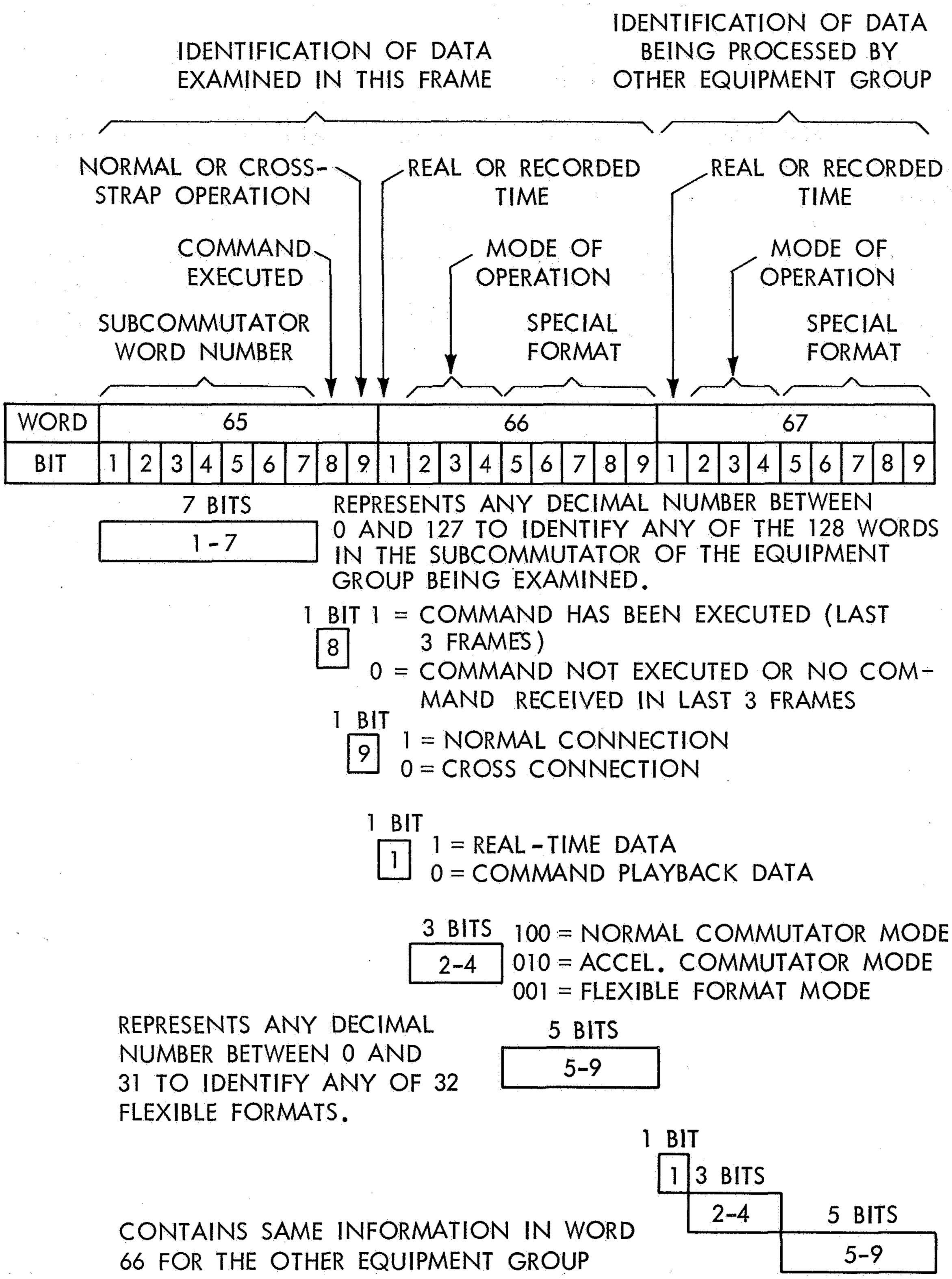


Figure 15–Spacecraft ID words

Spacecraft Clock Words (Words 33-35) – The spacecraft clock register updates once per second and is telemetered in the low-order 25 bits of Words 33, 34, 35 (See Figure 14). Bit 26 is unused, while bit 27 (high-order bit) indicates by a "1" configuration that updating of the clock register has occurred during the last 8 bits of Word 32. This flag is seen consistently only at the 1 k data rate.

Spacecraft Identification Words (Words 65-67) – The spacecraft ID Words reflect the current status of each equipment group: that group which is handling data currently under transmission and that which is not handling the presently transmitted data. The formats of Spacecraft ID Words appear as Figure 15.

Spacecraft Subcommutator Channels (Words 97-99) – OGO has three subcommutators. Subcommutator No. 1 assigns outputs from the spacecraft experiments to Word 97 of the Main Frame. Subcommutators Nos. 2 & 3 assign outputs from spacecraft subsystems sensors to Words 98 & 99 of the Main Frame respectively. The channel assignment formats of subcommutators Nos. 2 and 3 are given as Figures 18 and 19. OGO-B Subcommutator 2 & 3 channel assignments, as they differ from OGO-A and OGO-C, are given as Figure 20. The subcommutators each have 128 outputs and are synchronized with each other and the Main Frame. During assignment of outputs from the Accelerated Subsystems commutator to the 128 word telemetry frame, the outputs of Subcommutator 2 are assigned to corresponding words of the Main Frame, except for Main Frame Words 1-3, 33-35, 65-67, and 97-99, the fixed assignments of which override the corresponding Subcommutator 2 signals.

Special Purpose Telemetry

OGO-B will employ special purpose telemetry for experiment outputs which are not compatible with wideband PCM telemetry. The special purpose telemetry data will be transmitted as FM/PM modulation on a 400.85 Mc carrier. The bandwidth will be 100 kc.

OGO-B EXPERIMENT TELEMETRY FORMAT

SUBCOM I EQUIPMENT GROUP I

1 000	2 001	3 002	4 003 16 EXTRA COUNTS, TUBE ID	5 004 16 TUBE ID, 1st HIT DATA	6 005 16 1st HIT DATA, TUBE ID, 2nd HIT DATA	7 006 16 2nd HIT DATA	8 007
9 010 15 1-6 AMU 10^{-9} CURRENT DATA	10 011 10 X AXIS 10 CPS	11 012	12 013 OPEP 2 UNCAGED AND TEMP	13 014 15 7-45 AMU 10^{-9} CURRENT DATA	14 015 4 HIGH VOLTAGE	15 106 6 SCINTILLATOR ASSEMBLY TEMP	16 107
17 020 15 VA SWEEP VOLTAGE	18 021 10 X AXIS 30 CPS	19 022	20 023 15 1-6 AMU 10^{-9} CURRENT DATA	21 024	22 025 18 CRYSTAL CALIBRATOR	23 026 18 +18 VDC SUPPLY	24 027 18 ANT DEPLOY
25 030 15 7-45 AMU 10^{-9} CURRENT DATA	26 031 10 X AXIS 100 CPS	27 032	28 033 11 HEATER STATUS	29 034 15 ELECTRONICS ASSEMBLY TEMP	30 035 5 12 VDC SUPPLY	31 036 5 ELECTROMETER TEMP	32 037
33 040 15 1-6 AMU 10^{-9} CURRENT DATA	34 041 10 X AXIS 300 CPS	35 042	36 043	37 044 15 7-45 AMU 10^{-9} CURRENT DATA	38 045	39 046	40 047
41 050 15 7-45 AMU VS STEPPING VOLTAGE	42 051 10 X AXIS 1000 CPS	43 052	44 053 8 ELECTRONIC ASSEMBLY TEMP	45 054 15 1-6 AMU 10^{-9} CURRENT DATA	46 055	47 056	48 057
49 060 15 7-45 AMU 10^{-9} CURRENT DATA	50 061 10 X AXIS 10 CPS	51 062 1 PULSE COUNT BY 2^3 OR 2^7	52 063	53 064 15 1-6 AMU 8 MC RF VOLTAGE	54 065	55 066	56 067
57 070 15 1-6 AMU 10^{-9} CURRENT DATA	58 071 10 Y AXIS 30 CPS	59 072 2 INDEX PULSE SWITCH STATUS	60 073 2 OPEP HV LEVEL	61 074 15 7-45 AMU 10^{-9} CURRENT DATA	62 075 F3 RECORDER 1 PLAYBACK FREQ	63 076	64 077 F11 RECORDER 2 PLAYBACK FREQ
65 100	66 101	67 102	68 103	69 104	70 105	71 106	72 107
73 110 15 1-6 AMU 10^{-9} CURRENT DATA	74 111 10 Y AXIS 100 CPS	75 112	76 113 A29 OPEP GYRO MOTOR ERROR CURRENT	77 114 15 7-45 AMU 10^{-9} CURRENT DATA	78 115 18 SOEP I PRE-AMP TEMP	79 116 14 POWER STATUS	80 117
81 120 15 VA SWEEP VOLTAGE	82 121 10 Y AXIS 300 CPS	83 122 17 ANT TEMP	84 123 19 ELECTROMETERS TEMP	85 124 15 1-6 AMU 10^{-9} CURRENT DATA	86 125 10 Y AXIS 10 CPS	87 126 10 Y AXIS 30 CPS	88 127 10 Y AXIS 100 CPS
89 130 15 7-45 AMU 10^{-9} CURRENT DATA	90 131 10 Y AXIS 1000 CPS	91 132 10 X AXIS 1000 CPS	92 133 10 Z AXIS 1000 CPS	93 134 15 1-6 AMU VS STEPPING VOLTAGE	94 135	95 136	96 137 15 7-45 AMU 5MC RF VOLTAGE
97 140 15 1-6 AMU 10^{-9} CURRENT DATA	98 141 10 AMPLIFIERS GAIN	99 142 10 X AXIS 10 CPS	100 143 10 Y AXIS 10 CPS	101 144 15 7-45 AMU 10^{-9} CURRENT DATA	102 145 10 X AXIS 100 CPS	103 146 10 X AXIS 300 CPS	104 147 10 X AXIS 1000 CPS
105 150	106 151 10 Z AXIS 30 CPS	107 152 10 X AXIS 30 CPS	108 153 10 Y AXIS 30 CPS	109 154 15 1-6 AMU 10^{-9} CURRENT DATA	110 155 A27 OPEP GYROS ON-OFF	111 156 C17 R & R R STATUS	112 157 15 G_1 AND GUARD RING VOLTAGE
113 160 15 7-45 AMU 10^{-9} CURRENT DATA	114 161 10 Z AXIS 100 CPS	115 162 10 X AXIS 100 CPS	116 163 10 Y AXIS 100 CPS	117 164 15 REGULATED 20 VDC SUPPLY	118 165	119 166 7 COMPOSITION TELESCOPE TEMP	120 167 7 ALPHA TELESCOPE TEMP
121 170 15 1-6 AMU 10^{-9} CURRENT DATA	122 171 10 Z AXIS 300 CPS	123 172 10 AMPLIFIERS GAIN	124 173 10 Z AXIS 30 CPS	125 174 15 7-45 AMU 10^{-9} CURRENT DATA	126 175 10 Z AXIS 100 CPS	127 176 10 Z AXIS 300 CPS	128 177 10 Z AXIS 1000 CPS

Figure 16—Subcomm 1, EG 1 Format

OGO-B EXPERIMENT TELEMETRY FORMAT

SUBCOM I EQUIPMENT GROUP 2

1 000	2 001	3 002	4 003 16 EXTRA COUNTS, TUBE ID	5 004 16 TUBE ID, 1st HIT DATA	6 005 16 1st HIT DATA, TUBE ID, 2nd HIT DATA	7 006 16 2nd HIT DATA	8 007
9 010 15 ELECTRONICS ASSEMBLY TEMP	10 011 15 VA SWEEP VOLTAGE	11 012 15 7-45 AMU VS STEPPING VOLTAGE	12 013 OPEP 2 UNCAGED AND TEMP	13 014 10 X AXIS 10 CPS	14 015 4 HIGH VOLTAGE	15 016	16 017 15 1-6 AMU VS STEPPING VOLTAGE
17 020	18 021 18 CRYSTAL CALIBRATOR	19 022 18 +18VDC SUPPLY	20 023 18 ANT DEPLOY	21 024 10 X AXIS 30 CPS	22 025	23 026	24 027
25 030 15 1-6 AMU 8 MC RF VOLTAGE	26 031	27 032	28 033 11 HEATER STATUS	29 034 10 X AXIS 100 CPS	30 035 5 12 VDC SUPPLY	31 036 5 ELECTROMETER TEMP	32 037 15 VA SWEEP VOLTAGE
33 040	34 041 15 7-45 AMU 5MC RF VOLTAGE	35 042 10 Y AXIS 300 CPS	36 043 10 Z AXIS 300 CPS	37 044 10 X AXIS 300 CPS	38 045 10 X AXIS 30 CPS	39 046 10 Y AXIS 30 CPS	40 047 10 Z AXIS 30 CPS
41 050	42 051	43 052 15 7-45 AMU VS STEPPING VOLTAGE	44 053 8 ELECTRONIC ASSEMBLY TEMP	45 054 10 X AXIS 1000 CPS	46 055	47 056	48 057 15 1-6 AMU VS STEPPING VOLTAGE
49 060	50 061	51 062 1 PULSE COUNT BY 2^3 OR 2^7	52 063	53 064 10 Y AXIS 10 CPS	54 065 15 VA SWEEP VOLTAGE	55 066	56 067
57 070	58 071	59 072 2 INDEX PULSE SWITCH STATUS	60 073 2 OPEP HV LEVEL	61 074 10 Y AXIS 30 CPS	62 075	63 076 6 SCINTILLATOR ASSEMBLY TEMP	64 077
65 100	66 101	67 102	68 103	69 104	70 105	71 106	72 107
73 110	74 111 15 VA SWEEP VOLTAGE	75 112 15 7-45 AMU VS STEPPING VOLTAGE	76 113	77 114 10 X AXIS 100 CPS	78 115 18 SOEP I PRE-AMP TEMP	79 116 14 POWER STATUS	80 117 15 1-6 AMU VS STEPPING VOLTAGE
81 120 10 Y AXIS 300 CPS	82 121	83 122 17 ANT TEMP	84 123 19 ELECTROMETERS TEMP	85 124 10 Y AXIS 1000 CPS	86 125 15 G_1 AND GUARD RING VOLTAGE	87 126	88 127
89 130	90 131	91 132 10 Z AXIS 1000 CPS	92 133 10 Z AXIS 100 CPS	93 134 10 AMPLIFIERS GAIN	94 135 10 Z AXIS 300 CPS	95 136 15 VA SWEEP VOLTAGE	96 137 10 Y AXIS 10 CPS
97 140 10 Y AXIS 30 CPS	98 141 10 Y AXIS 100 CPS	99 142 10 Y AXIS 300 CPS	100 143 10 Y AXIS 1000 CPS	101 144 10 Z AXIS 30 CPS	102 145 10 X AXIS 10 CPS	103 146 10 X AXIS 30 CPS	104 147 10 X AXIS 100 CPS
105 150 10 X AXIS 300 CPS	106 151 10 X AXIS 1000 CPS	107 152 15 7-45 AMU VS STEPPING VOLTAGE	108 153	109 154 10 Z AXIS 100 CPS	110 155	111 156 C17 R & RR STATUS	112 157 15 1-6 AMU VS STEPPING VOLTAGE
113 160	114 161	115 162	116 163	117 164 15 VA SWEEP VOLTAGE	118 165 10 Z AXIS 300 CPS	119 166 7 COMPOSITION TELESCOPE TEMP	120 167 7 ALPHA TELESCOPE TEMP
121 170 15 REGULATED 20 VDC SUPPLY	122 171	123 172	124 173	125 174 10 Z AXIS 1000 CPS	126 175	127 176	128 177

Figure 17—Subcomm 1, EG 2 Format

OGO-B SPACECRAFT TELEMETRY FORMAT

SUBCOM 2 EQUIPMENT GROUPS 1 & 2

1 · 400 **C6** WB TX A REV POWER	2 · 401 **C8** WB TX B REV POWER	3 · 402	4 · 403 **A1** ARGON HIGH PRESSURE	5 · 404 **A2** ARGON LOW PRESSURE	6 · 405 **A3** ARGON BOTTLE TEMP	7 · 406 **A12** ARRAY SHAFT ANGLE SINE	8 · 407 **A13** ARRAY SHAFT ANGLE COSINE
9 · 410 **D21** CONV 2 +9 VOLTS	10 · 411 **F40** DEPLOY EVENTS EXP ORD BUS	11 · 412 **A31** REACTION WHEELS ON-OFF	12 · 413 **A21** GAS CONTROL VALVES 1, 2, 5	13 · 414 **A22** GAS CONTROL VALVES 3, 4, 6	14 · 415 **A14** OPEP ANGLE SINE	15 · 416 **A15** OPEP ANGLE COSINE	16 · 417 **D47** CHARGE REGUL 1 EVENTS
17 · 420 **D1** BATTERY 1 CURRENT	18 · 421 **D4** ARRAY 1 CURRENT	19 · 422 **D8** BATTERY 1 VOLTAGE	20 · 423 **D2** BATTERY 2 CURRENT	21 · 424 **D5** ARRAY 2 CURRENT	22 · 425 **D9** BATTERY 2 VOLTAGE	23 · 426 **A10** YAW ERROR DEGREES	24 · 427 **A11** ARRAY ERROR DEGREES
25 · 430 **A4** PITCH ERROR DEGREES	26 · 431 **A5** ROLL ERROR DEGREES	27 · 432 **A6** SCAN HEADS SUN ALARM	28 · 433 **A21** GAS CONTROL VALVES 1, 2, 5	29 · 434 **A22** GAS CONTROL VALVES 3, 4, 6	30 · 435 **D6** ARRAY IA VOLTAGE	31 · 436 **D7** ARRAY IB VOLTAGE	32 · 437 **D48** BATTERY 2 EVENTS
33 · 440 **C12** IOW XMTR REV POWER	34 · 441 **C11** IOW XMTR FWD POWER	35 · 442 **C9** SP XMTR FWD POWER	36 · 443 **C5** WB XMTR A FWD POWER	37 · 444 **D28** CONV 5 +16 VOLTS	38 · 445 **D29** CONV 5 +9 VOLTS	39 · 446 **D30** CONV 5 -6 VOLTS	40 · 447 **D31** CONV 5 -16 VOLTS
41 · 450 **A7** SCAN HEADS TRACKING CHECK	42 · 451 **F40** DEPLOY EVENTS EXP ORD BUS	43 · 452 **A31** REACTION WHEELS ON-OFF	44 · 453 **A21** GAS CONTROL VALVES 1, 2, 5	45 · 454 **A22** GAS CONTROL VALVES 3, 4, 6	46 · 455 **D3** BATTERY 1 EVENTS	47 · 456 **D10** LOAD BUS VOLTAGE	48 · 457 **D49** CHARGE REGUL 2 EVENTS
49 · 460 **A16** OPEP AND ARRAY DRIVE MOTORS	50 · 461 **A17** ROLL TACH WHEEL RPM	51 · 462 **A18** PITCH TACH WHEEL RPM	52 · 463 **A19** YAW TACH WHEEL RPM	53 · 464 **A20** REACTION WHEELS DIRECTION	54 · 465 **A23** ACS MODES SUN SENSOR	55 · 466 **A24** PITCH RATE GYRO DEMOD.	56 · 467 **A40** SCAN HEAD A ANGLE
57 · 470 **A44** CSA STATUS	58 · 471 **A28** OPEP GYRO MOTOR TACH VOLTAGE	59 · 472 **A45** ACS POWER RELAY STATUS	60 · 473 **A21** GAS CONTROL VALVES 1, 2, 5	61 · 474 **A22** GAS CONTROL VALVES 3, 4, 6	62 · 475 **D36** CONV 7 +16 VOLTS	63 · 476 **D37** CONV 7 +9 VOLTS	64 · 477 **D23** CONV 2 -6 VOLTS
65 · 500	66 · 501	67 · 502	68 · 503 **F9** RECORDER 2 +9.5 VOLTS	69 · 504 **F10** RECORDER 2 -9.5 VOLTS	70 · 505 **A41** SCAN HEAD B ANGLE	71 · 506 **A38** EARTH SIZE (A & C)	72 · 507 **F13** RECORDER 2 GAS PRESSURE
73 · 510 **D21** CONV 2 +9 VOLTS	74 · 511 **F40** DEPLOY EVENTS EXP ORD. BUS	75 · 512 **A31** REACTION WHEELS ON-OFF	76 · 513 **A21** GAS CONTROL VALVES 1, 2, 5	77 · 514 **A22** GAS CONTROL VALVES 3, 4, 6	78 · 515	79 · 516 **F42** RECORDER 1 STATUS	80 · 517 **D47** CHARGE REGUL 1 EVENTS
81 · 520 **F24** EG 1 / **F32** EG 2 A/D CONV TEMP	82 · 521 **F25** EG 1 / **F33** EG 2 0.00-0.20 A/D CALIBRATION VOLTS	83 · 522 **F27** EG 1 / **F35** EG 2 1.70-1.72	84 · 523 **F29** EG 1 / **F37** EG 2 3.18-3.20	85 · 524 **F31** EG 1 / **F39** EG 2 5.06-5.08	86 · 525 **F41** DEPLOY SAFE RX 1/2 COMMAND SIGNAL PRESENT	87 · 526 **D38** CONV 7 -6 VOLTS	88 · 527 **C7** WB XMTR B FWD POWER
89 · 530 **A4** PITCH ERROR DEGREES	90 · 531 **A5** ROLL ERROR DEGREES	91 · 532 **A6** SCAN HEADS SUN ALARM	92 · 533 **A21** GAS CONTROL VALVES 1, 2, 5	93 · 534 **A22** GAS CONTROL VALVES 3, 4, 6	94 · 535	95 · 536 **F43** RECORDER 2 STATUS	96 · 537
97 · 540 **A42** SCAN HEAD C ANGLE	98 · 541 **F14** DDHA 1 EG 1 / **F15** DDHA 2 EG 2 DDHA OSC TEMP	99 · 542 **F15** DDHA 2 EG 1 / **F14** DDHA 1 EG 2	100 · 543 **F1** RECORDER 1 +9.5 VOLTS	101 · 544 **F2** RECORDER 1 -9.5 VOLTS	102 · 545 **A43** SCAN HEAD D ANGLE	103 · 546 **A39** EARTH SIZE (B & D)	104 · 547 **F5** RECORDER 1 GAS PRESSURE
105 · 550 **A7** SCAN HEADS TRACKING CHECK	106 · 551 **F40** DEPLOY EVENTS EXP. ORD. BUS	107 · 552 **A31** REACTION WHEELS ON-OFF	108 · 553 **A21** GAS CONTROL VALVES 1, 2, 5	109 · 554 **A22** GAS CONTROL VALVES 3, 4, 6	110 · 555	111 · 556 **F44** LFTA BIT RATES	112 · 557 **D49** CHARGE REGUL 2 EVENTS
113 · 560 **A16** OPEP AND ARRAY DRIVE MOTORS	114 · 561 **A17** ROLL TACH WHEEL RPM	115 · 562 **A18** PITCH TACH WHEEL RPM	116 · 563 **A19** YAW TACH WHEEL RPM	117 · 564 **A20** REACTION WHEELS DIRECTION	118 · 565 **A23** ACS MODES SUN SENSOR	119 · 566 **A24** PITCH RATE GYRO DEMOD.	120 · 567 **A40** SCAN HEAD A ANGLE
121 · 570 **A44** CSA STATUS	122 · 571 **A28** OPEP GYRO MOTOR TACH VOLTAGE	123 · 572 **A45** ACS POWER RELAY STATUS	124 · 573 **A21** GAS CONTROL VALVES 1, 2, 5	125 · 574 **A22** GAS CONTROL VALVES 3, 4, 6	126 · 575	127 · 576 **F45** EG 1 / **F47** EG 2 DDHA MODE	128 · 577 **F46** EG 1 / **F48** EG 2

Figure 18—Subcomm 2, EG 1 and 2 Format

OGO-B SPACECRAFT TELEMETRY FORMAT

SUBCOM 3 EQUIPMENT GROUPS 1 & 2

1 600 E1 ARRAY 1 INBD TEMP	2 601 E2 ARRAY 1 OUTBD TEMP	3 602 E3 ARRAY 2 INBD TEMP	4 603 E4 ARRAY 2 OUTBD TEMP	5 604 E5 +X SIDE (ADJ DDHA) TEMP	6 605 E6 +X SIDE (ADJ PIU) TEMP	7 606 E7 −X SIDE (ADJ ROLL WHEEL) TEMP	8 607 E8 −X SIDE (ADJ CONV 9) TEMP
9 610 B1 EP 5 & 360 MC ANT DEPLOY	10 611 B2 EP 6 DEPLOY	11 612 B3 ARRAY 1 DEPLOY	12 613 B4 AGENA SEP & ARRAY 2 DEPLOY	13 614 B5 EP1, EP2, EP3 DEPLOY	14 615 E17 EP 5 TEMP	15 616 B6 EP 4, 136 MC ANT & CONTROL JETS DEPL.	16 617 B7 OPEP & 400 HIGH GAIN ANT DEPLOY
17 620	18 621	19 622 D13 ARRAY 1A THERMAL FIN TEMP	20 623 D14 ARRAY 2A THERMAL FIN TEMP	21 624 E13 EP 1 TEMP	22 625 E14 EP 2 TEMP	23 626 E15 EP 3 TEMP	24 627 E16 EP 4 TEMP
25 630 D15 400 SYNC AMP VOLTS	26 631 D16 2461 SYNC AMP 2 VOLTS	27 632 D17 2461 SYNC AMP 1 VOLTS	28 633 D18 CONV 1 +70 VOLTS	29 634 D19 CONV 1 +23 VOLTS	30 635 E26 SOEP 2 TEMP	31 636 D20 CONV 2 +16 VOLTS	32 637 D22 CONV 2 +5 VOLTS
33 640 A37 OPEP DRIVE SHAFT TEMP	34 641 E19 OPEP 1 TEMP	35 642 E20 OPEP 2 TEMP	36 643 E21 −Z DOOR (ADJ EXP 6, 7) TEMP	37 644 E22 +Z DOOR (ADJ EXP 2, 17) TEMP	38 645 E23 +X SIDE (ADJ EXP 21) TEMP	39 646 E24 −X SIDE (ADJ BATTERY PACK B) TEMP	40 647 E25 SOEP 2 TEMP
41 650 C13 RX 1 AGC 1 DBM	42 651 C14 RX 1 AGC 2 DBM	43 652 D24 CONV 3 +70 VOLTS	44 653 D25 CONV 3 +23 VOLTS	45 654 A35 PITCH RATE GYRO TACH RPM	46 655 E27 WB XMTR PANEL TEMP	47 656 D26 CONV 4 +70 VOLTS	48 657 D27 CONV 4 +23 VOLTS
49 660 D39 CONV 8 +16 VOLTS	50 661 D40 CONV 8 +9 VOLTS	51 662 D41 CONV 8 -6 VOLTS	52 663 D42 CONV 9 +20 VOLTS	53 664 D32 CONV 6 +16 VOLTS	54 665 D33 CONV 6 +9 VOLTS	55 666 D34 CONV 6 -6 VOLTS	56 667 D35 CONV 6 -16 VOLTS
57 670 D43 CONV 9 +10 VOLTS	58 671 D44 CONV 9 -20 VOLTS	59 672 D45 CONV 9 28 VAC	60 673 D46 ACS INVERTER 400 CPS 115 VAC	61 674 C4 IOW XMTR TEMP	62 675 E28 SOEP 1 TEMP	63 676 C15 RX 2 AGC 1 DBM	64 677 C16 RX 2 AGC 2 DBM
65 700 E29 SOEP 1 TEMP	66 701 D11 BATTERY A1 TEMP	67 702 D12 BATTERY A2 TEMP	68 703 D50 BATTERY B1 TEMP	69 704 D51 BATTERY B2 TEMP	70 705 C1 WB XMTR A TEMP	71 706 C2 WB XMTR B TEMP	72 707 C3 SP XMTR TEMP
73 710 B1 EP5 & 360 MC ANT DEPLOY	74 711 B2 EP6 DEPLOY	75 712 B3 ARRAY 1 DEPLOY	76 713 B4 AGENA SEP & ARRAY 2 DEPLOY	77 714 B5 EP1, EP2, EP3 DEPLOY	78 715	79 716 B6 EP4, 136 MC ANT & CONT JETS DEPLOY	80 717 B7 OPEP & 400 MC HI GAIN ANT DEPLOY
81 720 F26 EG 1 | F34 EG 2 0.50-0.52	82 721 F28 EG 1 | F36 EG 2 2.64-2.66 A/D CALIBRATION VOLTS	83 722 F30 EG 1 | F38 EG 2 4.12-4.14	84 723 F8 RECORDER 1 TEMP	85 724 F16 RECORDER 2 TEMP	86 725 F17 LFTA BD ASS'Y 2 TEMP	87 726 F20 DDHA 1 BD ASS'Y 4 TEMP	88 727 F22 DDHA 2 BD ASS'Y 4 TEMP
89 730 D15 400 SYNC AMP VOLTS	90 731 D16 2461 SYNC AMP 2 VOLTS	91 732 D17 2461 SYNC AMP 1 VOLTS	92 733 D18 CONV 1 +70 VOLTS	93 734 D19 CONV 1 +23 VOLTS	94 735	95 736 D20 CONV 2 +16 VOLTS	96 737 D22 CONV 2 +5 VOLTS
97 740 A34 PITCH WHEEL TEMP	98 741 A33 YAW WHEEL TEMP	99 742 A32 ACS INVERTER TEMP	100 743 A30 OPEP GYRO CASE TEMP	101 744 A26 SUN SENSOR 2 TEMP	102 745 A25 SUN SENSOR 1 TEMP	103 746 A9 SCAN HDS A B C TEMP	104 747 A8 −Y PANEL TEMP
105 750 C13 RX 1 AGC 1 DBM	106 751 C14 RX 1 AGC 2 DBM	107 752 D24 CONV 3 +70 VOLTS	108 753 D25 CONV 3 +23 VOLTS	109 754 A35 PITCH RATE GYRO TACH RPM	110 755	111 756 D26 CONV 4 +70 VOLTS	112 757 D27 CONV 4 +23 VOLTS
113 760 D39 CONV 8 +16 VOLTS	114 761 D40 CONV 8 +9 VOLTS	115 762 D41 CONV 8 -6 VOLTS	116 763 D42 CONV 9 +20 VOLTS	117 764 D32 CONV 6 +16 VOLTS	118 765 D33 CONV 6 +9 VOLTS	119 766 D34 CONV 6 -6 VOLTS	120 767 D35 CONV 6 -16 VOLTS
121 770 D43 CONV 9 +10 VOLTS	122 771 D44 CONV 9 -20 VOLTS	123 772 D45 CONV 9 28 VAC	124 773 D46 ACS INVERTER 400 CPS 115 VAC	125 774 C4 IOW XMTR TEMP	126 775	127 776 C15 RX 2 AGC 1 DBM	128 777 C16 RX 2 AGC 2 DBM

Figure 19—Subcomm 3, EG 1 and 2 Format

Subcommutator #2 (Channel 98)

		OGO-A
1	C6	Power -WB/TX#1 Rev.
2	C8	Power -WB/TX#2 Rev.
3	C10	Power SP/TX
4	A1	Argon High Pressure
5	A2	Argon Low Pressure
6	A3	Temp. Argon Bottle
7	A12	Array Shaft sine
8	A13	Array Shaft cosine
9	D21	Voltage Conv. #2 (+9v)
10	F40	Boom deployment
11	A31	Reaction Wheel drive
12	A21	Gas Valves
13	A22	Gas Valves
14	A14	OPEP sine
15	A15	OPEP cosine
16	D47	Charge Reg. #1
17	D1	Batt. #1 Charge Current
18	D4	Paddle #1 current
19	D8	Batt. #1 voltage out
20	D2	Batt. #2 charge current
21	D5	Paddle #2 current
22	D9	Batt. #2 voltage out
23	A10	Yaw error signal
24	A11	Array error signal
25	A4	Pitch error
26	A5	Roll error
27	A6	Sun Alarm Signal
28	A21	Gas valves
29	A22	Gas valves
30	D6	Paddle 1a volts
31	D7	Paddle 1b volts
32	D48	Charge Reg. #2
33	C12	Power-Tracking/TX (Rev)
34	C11	Power-Tracking/TX (Fwd)
35	C9	Power-SP/TX (Fwd)
36	C5	Power-WB/TX 1 (Fwd)
37	D28	Voltage Conv #5 (+16V)
38	D29	Voltage Conv #5 (+9v)
39	D30	Voltage Conv #5 (-6v)
40	D31	Voltage Conv #5 (-16v)
41	A7	Horizon Scanner heads
42	F40	Boom deployment
43	A31	Reaction wheel drive

		OGO-A
44	A21	Gas valves
45	A22	Gas valves
46	D3	Charge Reg. #1
47	D10	Load Bus
48	D49	Charge Reg. #2
49	A16	Drive motors
50	A17	Roll tach
51	A18	Pitch Tach
52	A19	Yaw Tach
53	A20	Reaction Wheel Direction
54	A23	ACS mode
55	A24	Pitch rate gyro
56		
57	A27	Gyro A or B
58	A28	Gyro motor volts
59	A29	Gyro motor current
60	A21	Gas valves
61	A22	Gas valves
62	D36	Voltage conv 7 (+16v)
63	D37	Voltage conv 7 (+9v)
64	D23	Voltage conv 2 (-6v)
65		
66		
67		
68	F9	Tape Record #2 (+9.5v)
69	F10	Tape Record #2 (-9.5v)
70	F11	Tape record #2 ϕ detector
71		
72	F13	Tape Record #2 pressure
73	D21	Voltage Conv #2 (+9v)
74	F40	Boom deployment
75	A31	Reaction wheel drive
76	A21	Gas valves
77	A22	Gas valves
78		
79	F42	Tape Record #1 status
80	D47	DDHA #2 status
81	F24	Temp. ADHA
82	F25	Voltage Cal. (0)
83	F27	Voltage Cal. (1.7)
84	F29	Voltage Cal. (3.18)
85	F31	Voltage Cal. (5.06)
86	F41	Rec. Signal Present

		OGO-A
87	D38	Voltage conv 7 (-6v)
88	C7	Power WB/TX 2 (Fwd)
89	A4	Pitch error
90	A5	Roll error
91	A6	Sun Alarm Signal
92	A21	Gas valves
93	A22	Gas valves
94		
95	F43	Tape Record #2 status
96		
97	A36	ACS inverter output
98	F14	Temp. DDHA #1 OSC.
99	F15	Temp. DDHA #2 OSC.
100	F1	Tape Record #1 (+9.5v)
101	F2	Tape Record #1 (-9.5v)
102	F3	Tape Record #1 ϕ detector
103		
104	F5	Tape Record #1 pressure
105	A7	Horizon scanner heads
106	F40	Boom deploy
107	A31	Reaction wheel drive
108	A21	Gas valves
109	A22	Gas valves
110		
111	F44	LFTA status
112	D49	Charge reg. #2
113	A16	Drive motors, Array, OPEP
114	A17	Roll tach
115	A18	Pitch tach
116	A19	Yaw Tach
117	A20	Reaction wheel direction
118	A23	ACS mode
119	A24	Pitch rate gyro
120		
121	A27	Gyro A or B
122	A28	Gyro motor (volts)
123	A29	Gyro motor (amps)
124	A21	Gas valves
125	A22	Gas valves
126		
127	F45	DDHA #1 status
128	F46	DDHA #1 status

Figure 20–OGO A, B, C Subcomm 2 and 3 Channel Assignments Compared

Subcommutator #3 (Channel 99)

OGO-A

1	E1	Temp. Paddle #1 (-X) IN
2	E2	Temp. Paddle #1 (-X) OUT
3	E3	Temp. Paddle #2 (+X) IN
4	E4	Temp. Paddle #2 (+X) OUT
5	E5	Temp. Mounting Plate (+X)
6	E6	Temp. Mounting Plate (+X)
7	E7	Temp. Mounting Plate (-X)
8	E8	Temp. Mounting Plate (-X)
9	B1	EP5 hinge 1,2,3; 360 ant. hinge
10	B2	EP6 hinge 1,2,3
11	B3	Paddle #1 hinge 1,2,3
12	B4	Paddle #2 hinge 1,2,3
13	B5	EP1, EP2, EP3, 400 mc ant hinge 1
14	E17	Temp. EP5
15	B6	136 ant, EP4, Cont. jet 1,2, hinge
16	B7	400 ant, OPEP drive hinge 1,2
17		
18		
19	D13	Temp. Chg. Reg. Paddle #1
20	D14	Temp. Chg. Reg. Paddle #2
21	E13	Temp. EP1
22	E14	Temp. EP2
23	E15	Temp. EP3
24	E16	Temp. EP4
25	D15	Sync signal amplitude 400 cps
26	D16	Sync signal amplitude 2461 cps 0°
27	D17	Sync signal amplitude 2461 cps 90°
28	D18	Voltage Conv. 1 (+70v)
29	D19	Voltage Conv. 1 (+23v)
30	E26	Temperature SOEP +X (-Y)
31	D20	Voltage conv. 2 (+16v)
32	D22	Voltage conv. 2 (+5v)
33	A37	Temp. OPEP drive shaft
34	E19	Temp. OPEP 1 + Z
35	E20	Temp. OPEP 2 - Z
36	E21	Temp. exp. mtg. plate (-Z)
37	E22	Temp. exp. mtg. plate (+Z)
38	E23	Temp. exp. mtg. plate (+X)
39	E24	Temp. exp. mtg. plate (-X)
40	E25	Temp. SOEP +X (+Y)
41	C13	Rx#1 AGC-1
42	C14	Rx#1 AGC-2
43	D24	Voltage conv. 3 (+70v)

OGO-A

44	D25	Voltage conv. 3 (+23v)
45	A35	Pitch rate gyro tach
46	E27	Temp. radiator
47	D26	Voltage conv. 4 (+70v)
48	D27	Voltage conv. 4 (+23v)
49	D39	Voltage conv. 8 (+16v)
50	D40	Voltage conv. 8 (+9v)
51	D41	Voltage conv. 8 (-6v)
52	D42	Voltage conv. 9 (+20v)
53	D32	Voltage conv. 6 (+16v)
54	D33	Voltage conv. 6 (+9v)
55	D34	Voltage conv. 6 (-6)
56	D35	Voltage conv. 6 (-16v)
57	D43	Voltage conv. 9 (+10v)
58	D44	Voltage conv. 9 (-20v)
59	D45	Voltage conv. 9 2461 AC
60	D46	ACS inverter 400 cps
61	C4	Temp. Tracking TX
62	E28	Temp. SOEP -X (+Y)
63	C15	RX#2 AGC1
64	C16	RX#2 AGC2
65	E29	Temp. SOEP -X (-Y)
66	D11	Temp. Batt. 1a
67	D12	Temp. Batt. 1b
68	D50	Temp. Batt. 2a
69	D51	Temp. Batt. 2b
70	C1	Temp. WB/TX #1
71	C2	Temp. WB/TX #2
72	C3	Temp. SP/TX
73	B1	EP5 hinge 1,2,3; 360 ant hinge
74	B2	EP6 hinge 1,2,3
75	B3	Paddle 1 hinge 1,2,3
76	B4	Paddle 2 hinge 1,2,3
77	B5	EP1, EP2, EP3, 400 ant, hinge 1
78		
79	B6	136 ant, EP4, Cont. jet 1,2 hinge
80	B7	400 ant, OPEP drive hinge 1,2
81	F26	Voltage Cal. (0.5)
82	F28	Voltage Cal. (2.64)
83	F30	Voltage Cal. (4.12)
84	F8	Temp. Tape Record 1
85	F16	Temp. Tape Record 2
86	F17	Temp. LFTA

OGO-A

87	F20	Temp. DDHA 1
88	F22	Temp. DDHA 2
89	D15	Sync signal amplitude 400 cps
90	D16	Sync signal amplitude 2461 0°
91	D17	Sync signal amplitude 2461 90°
92	D18	Voltage conv. 1 (+70v)
93	D19	Voltage conv. 1 (+23v)
94		
95	D20	Voltage conv. 2 (+16v)
96	D22	Voltage conv. 2 (+5v)
97	A34	Temp. pitch reaction wheel
98	A33	Temp. yaw reaction wheel
99	A32	Temp. ACS inverter
100	A30	Temp. OPEP gyro bracket
101	A26	Temp. Sun sensor #2
102	A25	Temp. Sun sensor #1
103	A9	Temp. Horizon scanner head 2
104	A8	Temp. Horizon scanner head 1
105	C13	RX#1 AGC-1
106	C14	RX#1 AGC-2
107	D24	Voltage conv. 3 (+70v)
108	D25	Voltage conv. 3 (+23v)
109	A35	Pitch rate gyro tack
110		
111	D26	Voltage Conv. 4 (+70v)
112	D27	Voltage Conv. 4 (+23v)
113	D39	Voltage Conv. 8 (+16v)
114	D40	Voltage Conv. 8 (+9v)
115	D41	Voltage Conv. 8 (-6v)
116	D42	Voltage Conv. 9 (+20v)
117	D32	Voltage Conv. 6 (+16v)
118	D33	Voltage Conv. 6 (+9v)
119	D34	Voltage Conv. 6 (-6v)
120	D35	Voltage Conv. 6 (-16v)
121	D43	Voltage Conv. 9 (+10v)
122	D44	Voltage Conv. 9 (-20v)
123	D45	Voltage Conv. 9 2461 AC
124	D46	ACS inverter 400 cps
125	C4	Temp. tracking TX
126		
127	C15	RX#2 AGC-1
128	C16	RX#2 AGC-2

Figure 20–OGO A, B, C Subcomm 2 and 3 Channel Assignments Compared (Continued)

Subcommutator #2 (Channel 98)

		OGO-B
1	C6	Power -WB/TX #1 Rev.
2	C8	Power -WB/TX #2 Rev.
3		
4	A1	Argon High Pressure
5	A2	Argon Low Pressure
6	A3	Temp. Argon Bottle
7	A12	Array Shaft sine
8	A13	Array Shaft cosine
9	D21	Voltage Conv. #2 (+9v)
10	F40	Boom deployment
11	A31	Reaction wheel drive
12	A21	Gas valves
13	A22	Gas valves
14	A14	OPEP sine
15	A15	OPEP cosine
16	D47	Charge Reg. #1
17	D1	Batt. #1 Charge Current
18	D4	Paddle #1 current
19	D8	Batt. #1 voltage out
20	D2	Batt. #2 charge current
21	D5	Paddle #2 current
22	D9	Batt. #2 voltage out
23	A10	Yaw error signal
24	A11	Array error signal
25	A4	Pitch error
26	A5	Roll error
27	A6	Sun Alarm Signal
28	A21	Gas valves
29	A22	Gas valves
30	D6	Paddle 1a volts
31	D7	Paddle 1b volts
32	D48	Charge Reg. #2
33	C12	Power-Tracking/TX (Rev)
34	C11	Power-Tracking/TX (Fwd)
35	C9	Power-SP/TX (Fwd)
36	C5	Power-WB/TX 1 (Fwd)
37	D28	Voltage Conv #5 (+16v)
38	D29	Voltage Conv #5 (+9v)
39	D30	Voltage Conv #5 (-6v)
40	D31	Voltage Conv #5 (-16v)
41	A7	Horizon Scanner heads
42	F40	Boom deployment
43	A31	Reaction wheel drive

		OGO-B
44	A21	Gas valves
45	A22	Gas valves
46	D3	Charge Reg. #1
47	D10	Load Bus
48	D49	Charge Reg. #2
49	A16	Drive motors
50	A17	Roll tach
51	A18	Pitch Tach
52	A19	Yaw Tach
53	A20	Reaction wheel direction
54	A23	ACS mode
55	A24	Pitch rate gyro
56		
57	A27	Gyro A or B
58	A28	Gyro motor volts
59	A20	Gyro motor current
60	A21	Gas valves
61	A22	Gas valves
62	D36	Voltage conv. 7 (+16v)
63	D37	Voltage conv. 7 (+9v)
64	D23	Voltage conv. 2 (-6v)
65		
66		
67		
68	F9	Tape Record #2 (+9.5v)
69	F10	Tape Record #2 (-9.5v)
70	F11	Tape Record #2 ϕ detector
71	A38	Earth Size (A,C)
72	F13	Tape Record #2 pressure
73	D21	Voltage conv. #2 (+9v)
74	F40	Boom deployment
75	A31	Reaction wheel drive
76	A21	Gas valves
77	A22	Gas valves
78		
79	F42	Tape Record #1 status
80	D47	DDHA #2 status
81	F24	Temp. ADHA
82	F25	Voltage Cal. (0)
83	F27	Voltage Cal. (1.7)
84	F29	Voltage Cal. (3.18)
85	F31	Voltage Cal. (5.06)
86	F41	Rec. Signal Present

		OGO-B
87	D38	Voltage conv. 7 (-6v)
88	C7	Power WB/TX 2 (Fwd)
89	A4	Pitch error
90	A5	Roll error
91	A6	Sun Alarm Signal
92	A21	Gas valves
93	A22	Gas valves
94		
95	F43	Tape Record #2 status
96		
97		
98	F14	Temp. DDHA #1 OSC.
99	F15	Temp. DDHA #2 OSC
100	F1	Tape Record #1 (+9.5v)
101	F2	Tape Record #1 (-9.5v)
102	F3	Tape Record #1 ϕ detector
103	A39	Earth Size (B,D)
104	F5	Tape Record #1 pressure
105	A7	Horizon scanner heads
106	F40	Boom deploy
107	A31	Reaction wheel drive
108	A21	Gas valves
109	A22	Gas valves
110		
111	F44	LFTA status
112	D49	Charge reg. #2
113	A16	Drive motors, Array, OPEP
114	A17	Roll tach
115	A18	Pitch tach
116	A19	Yaw tach
117	A20	Reaction wheel direction
118	A23	ACS mode
119	A24	Pitch rate gyro
120		
121	A27	Gyro A or B
122	A28	Gyro motor (volts)
123	A29	Gyro motor (amps)
124	A21	Gas valves
125	A22	Gas valves
126		
127	F45	DDHA #1 status
128	F46	DDHA #1 status

Figure 20—OGO A, B, C Subcomm 2 and 3 Channel Assignments Compared (Continued)

Subcommutator #3 (Channel 99)

	OGO-B	
1	E1	Temp. Paddle #1 (-X) IN
2	E2	Temp. Paddle #1 (-X) OUT
3	E3	Temp. Paddle #2 (+X) IN
4	E4	Temp. Paddle #2 (+X) OUT
5	E5	Temp. Mounting Plate (+X)
6	E6	Temp. Mounting Plate (+X)
7	E7	Temp. Mounting Plate (-X)
8	E8	Temp. Mounting Plate (-X)
9	B1	EP5 hinge 1,2,3; 360 ant. hinge
10	B2	EP6 hinge 1,2,3
11	B3	Paddle #1 hinge 1,2,3
12	B4	Paddle #2 hinge 1,2,3
13	B5	EP1, EP2, EP3, 400 mc ant hinge 1
14	E17	Temp. EP 5
15	B6	136 ant, EP4, Cont. jet 1,2 hinge
16	B7	400 ant, OPEP drive hinge 1,2
17		
18		
19	D13	Temp. Chg. Reg. Paddle #1
20	D14	Temp. Chg. Reg. Paddle #2
21	E13	Temp. EP1
22	E14	Temp. EP2
23	E15	Temp. EP3
24	E16	Temp. EP4
25	D15	Sync signal amplitude 400 cps
26	D16	Sync signal amplitude 2461 cps 0°
27	D17	Sync signal amplitude 2461 cps 90°
28	D18	Voltage Conv 1 (+70v)
29	D19	Voltage Conv. 1 (+23v)
30	E26	Temperature SOEP +X (-Y)
31	D20	Voltage conv. 2 (+16v)
32	D22	Voltage conv. 2 (+5v)
33	A37	Temp. OPEP drive shaft
34	E19	Temp. OPEP 1 +Z
35	E20	Temp. OPEP 2 -Z
36	E21	Temp. exp. mtg. plate (-Z)
37	E22	Temp. exp. mtg. plate (+Z)
38	E23	Temp. exp. mtg. plate (+X)
39	E24	Temp. exp. mtg. plate (-X)
40	E25	Temp. SOEP +X (+Y)
41	C13	Rx#1 AGC-1
42	C14	Rx#1 AGC-2
43	D24	Voltage conv. 3 (+70v)

	OGO-B	
44	D25	Voltage conv. 3 (+23v)
45	A35	Pitch rate gyro tach
46	E27	Temp. radiator
47	D26	Voltage conv. 4 (+70v)
48	D27	Voltage conv. 4 (+23v)
49	D39	Voltage conv. 8 (+16v)
50	D40	Voltage conv. 8 (+9v)
51	D41	Voltage conv. 8 (-6v)
52	D42	Voltage conv. 9 (+20v)
53	D32	Voltage conv. 6 (+16v)
54	D33	Voltage conv. 6 (+9v)
55	D34	Voltage conv. 6 (-6)
56	D35	Voltage conv. 6 (-16v)
57	D43	Voltage conv. 9 (+10v)
58	D44	Voltage conv. 9 (-20v)
59	D45	Voltage conv. 9 2461 AC
60	D46	ACS inverter 400 cps
61	C4	Temp. Tracking TX
62	E28	Temp. SOEP -X (+Y)
63	C15	RX #2 AGC 1
64	C16	RX #2 AGC 2
65	E29	Temp. SOEP -X (-Y)
66	D11	Temp. Batt. 1a
67	D12	Temp. Batt. 1b
68	D50	Temp. Batt. 2a
69	D51	Temp. Batt. 2b
70	C1	Temp. WB/TX #1
71	C2	Temp. WB/TX #2
72	C3	Temp. SP/TX
73	B1	EP5 hinge 1,2,3; 360 ant hinge
74	B2	EP6 hinge 1,2,3
75	B3	Paddle 1 hinge 1,2,3
76	B4	Paddle 2 hinge 1,2,3
77	B5	EP1, EP2, EP3, 400 ant, hinge 1
78		
79	B6	136 ant, EP4, Cont. jet 1,2 hinge
80	B7	400 ant, OPEP drive hinge 1,2
81	F26	Voltage Cal. (0.5)
82	F28	Voltage Cal. (2.64)
83	F30	Voltage Cal. (4.12)
84	F8	Temp. Tape Record 1
85	F16	Temp. Tape Record 2
86	F17	Temp LFTA

	OGO-B	
87	F20	Temp. DDHA 1
88	F22	Temp. DDHA 2
89	D15	Sync signal amplitude 400 cps
90	D16	Sync signal amplitude 2461 0°
91	D17	Sync signal amplitude 2461 90°
92	D18	Voltage conv. 1 (+70v)
93	D19	Voltage conv. 1 (+23v)
94		
95	D20	Voltage conv. 2 (+16v)
96	D22	Voltage conv. 2 (+5v)
97	A34	Temp. pitch reaction wheel
98	A33	Temp. yaw reaction wheel
99	A32	Temp. ACS inverter
100	A30	Temp. OPEP gyro bracket
101	A26	Temp. Sun sensor #2
102	A25	Temp. Sun sensor #1
103	A9	Temp. Horizon scanner head 2
104	A8	Temp. Panel (-Y, middle)
105	C13	RX #1 AGC-1
106	C14	RX #1 AGC-2
107	D24	Voltage conv. 3 (+70v)
108	D25	Voltage conv. 3 (+23v)
109	A35	Pitch rate gyro tack
110		
111	D26	Voltage conv. 4 (+70v)
112	D27	Voltage conv. 4 (+23v)
113	D39	Voltage conv. 8 (+16v)
114	D40	Voltage conv. 8 (+9v)
115	D41	Voltage conv. 8 (-6v)
116	D42	Voltage conv. 9 (+20v)
117	D32	Voltage conv. 6 (+16v)
118	D33	Voltage conv. 6 (+9v)
119	D34	Voltage conv. 6 (-6v)
120	D35	Voltage conv. 6 (-16v)
121	D43	Voltage conv. 9 (+10v)
122	D44	Voltage conv. 9 (-20v)
123	D45	Voltage conv. 9 2461 AC
124	D46	ACS inverter 400 cps
125	C4	Temp. tracking TX
126		
127	C15	RX #2 AGC-1
128	C16	RX #2 AGC-2

Figure 20–OGO A, B, C Subcomm 2 and 3 Channel Assignments Compared (Continued)

Subcommutator #2 (Channel 98)

		OGO-C
1	C6	Power -WB/TX #1 Rev.
2	C8	Power -WB/TX #2 Rev.
3	F24	Temp. ADHA
4	A1	Argon High Pressure
5	B1	E.P. #5 and 360 ant hinges
6	A3	Temp. Argon Bottle
7	A12	Array Shaft sine
8	A13	Array shaft cosine
9	D1	Batt. #1 current
10	F40	Boom deployment
11	A31	Reaction Wheel drive
12	A21	Gas valves
13	A22	Gas valves
14	D49	Charge Rate Status
15	B10	Pre-deployment EP 1,2,3
16	D2	Batt. #2 current
17	D11	Bus Status
18	D4	Paddle #1 current
19	D8	Batt. #1 voltage out
20	D47	Batt. #1 status
21	D5	Paddle #2 current
22	D9	Batt. #2 voltage out
23	A39	Earth Size
24	A11	Array error signal
25	A4	Pitch error
26	A5	Roll error
27	A6	Sun Alarm Signal
28	A21	Gas valves
29	A22	Gas valves
30	D6	Paddle 1a volts
31	D7	Paddle 1b volts
32	D48	Batt. #2 status
33	B12	Deploy bottles press. #2 (+Z top)
34	B13	Deploy bottles press. #3 (-Z top)
35	F9	Tape Record #2 (volts)
36	C5	Power -WB/TX 1 (Fwd)
37	D42	ACS conv. 9 (+20v)
38	D44	ACS conv. 9 (-20v)
39	D45	ACS conv. 9 (28v)
40	D46	ACS inverter 400 cps. volts
41	A7	Horizon Scanner heads
42	A10	Yaw error
43	A31	Reaction wheel drive

		OGO-C
44	A21	Gas valves
45	A22	Gas valves
46	D55	Batt. #1 3 cell volts
47	D43	ACS conv. #9 (+10v)
48	D10	Load bus
49	A16	Drive motors
50	A17	Roll tach
51	A18	Pitch tach
52	A19	Yaw tach
53	A20	Reaction wheel direction
54	A23	ACS mode
55	A24	Pitch rate gyro
56	B3	Paddle #1 hinge
57	B2	EP #6 hinge
58	B6	136 ant, EP4, cont. jet 1 & 2, hinge
59	B7	hi gain ant, OPEP drive hinge
60	A21	Gas valves
61	A22	Gas valves
62	D17	Array 1 (-X) current
63	D20	Voltage conv. 2 (+16v)
64	D23	Voltage conv. 2 (-6v)
65	F3	Tape Record 1 ϕ detector
66	F10	Tape Record 2 -9.5v
67	F11	Tape Record 2 ϕ detector
68	C9	Power SP/TX (Fwd)
69	D58	#2 Thermal fin drive (volts)
70	D22	Voltage conv. 2 (+5v)
71	B8	Pre-deploy array 1, OPEP 1, EP5,6
72	F13	Tape Record #2 pressure
73	D1	Batt. #1 current
74	F40	Boom deployment
75	A31	Reaction wheel drive
76	A21	Gas valves
77	A22	Gas valves
78		
79	F42	Tape Record #1 status
80	D2	Batt. #2 current
81	A38	Earth Size
82	F25	Voltage Cal. (0)
83	F27	Voltage Cal. (1.7)
84	F29	Voltage Cal. (3.18)
85	F31	Voltage Cal. (5.06)
86	B4	Agena Sep., Array 2 hinge

		OGO-C
87	D56	Batt. #2 3 cell volts
88	C7	Power WB/TX 2 (Fwd)
89	A4	Pitch error
90	A5	Roll error
91	A6	Sun Alarm Signal
92	A21	Gas valves
93	A22	Gas valves
94		
95	F43	Tape Record #2 status
96		
97	F14	Temp. DDHA #1 OSC.
98	D3	Reg. Failure Mode Status
99	F15	Temp. DDHA #2 OSC.
100	D50	Temp. Batt. #2
101	D51	Temp. Batt. #1
102	D57	#1 Thermal fin drive (volts)
103	B9	Pre-deploy 2 EP4, Array 2, OPEP 2
104	F5	Tape Record #1 pressure
105	A7	Horizon scanner heads
106	A10	Yaw error
107	A31	Reaction wheel drive
108	A21	Gas valves
109	A22	Gas valves
110		
111	F44	LFTA status
112	D10	Load Bus
113	A16	Drive motors, Array, OPEP
114	A17	Roll tach
115	A18	Pitch tach
116	A19	Yaw tach
117	A20	Reaction wheel direction
118	A23	ACS mode
119	A24	Pitch rate gyro
120	B3	Array 1 hinge 1,2,3
121	B2	EP 6, hinge 1,2,3
122	B6	136 ant, EP4, Cont jet 1,2, hinge
123	B7	Hi gain ant, OPEP drive hinge
124	A21	Gas valves
125	A22	Gas valves
126		
127	F45	DDHA #1 status
128	F46	DDHA #1 status

Figure 20–OGO A, B, C Subcomm 2 and 3 Channel Assignments Compared (Continued)

Subcommutator #3 (Channel 99)

		OGO-C
1	E1	Temp. Paddle #1 (-X) IN
2	E2	Temp. Paddle #1 (-X) OUT
3	E3	Temp. Paddle #2 (+X) IN
4	E4	Temp. Paddle #2 (+X) OUT
5	E5	Temp. Mounting Plate (+X)
6	E6	Temp. Mounting Plate (+X)
7	E7	Temp. Mounting Plate (-X)
8	E8	Temp. Mounting Plate (-X)
9	A2	Argon Low pressure
10	A27	OPEP gyro A/B
11	A29	OPEP gyro motor error rate
12	F41	Rx 1&2 signal present
13	A32	Temp. ACS inverter
14	E17	Temp. EP 5
15	A14	OPEP sine
16	A15	OPEP cosine
17	D52	Voltage conv. 10 (+16v)
18	D54	Voltage conv. 10 (-6v)
19	D13	Temp. Chg. Reg. Paddle #1
20	D14	Temp. Chg. Reg. Paddle #2
21	E13	Temp. EP1
22	E14	Temp. EP2
23	E15	Temp. EP3
24	E16	Temp. EP4
25	D15	Sync signal amplitude 400 cps
26	D16	Sync signal amplitude 2461 cps 0°
27	D36	Voltage conv. 7 (+16v)
28	D37	Voltage conv. 7 (+9v)
29	D38	Voltage conv. 7 (-6v)
30	E26	Temp. SOEP #1 (-X)
31	A36	ACS inverter output
32	D53	Voltage conv. 10 (+9v)
33	A37	Temp. OPEP drive shaft
34	E19	Temp. OPEP 1 +Z
35	E20	Temp. OPEP 2 -Z
36	E21	Temp. exp. mtg. plate (-Z)
37	E22	Temp. exp. mtg. plate (+Z)
38	E23	Temp. exp. mtg. plate (+X)
39	E24	Temp. exp. mtg. plate (-X)
40	B14	Deploy bottles press. 4 (-Z bottom)
41	C13	Rx #1 AGC-1
42	C14	Rx #1 AGC-2
43	D24	Voltage conv. 3 (+70v)

		OGO-C
44	D25	Voltage conv. 3 (+23v)
45	A35	Pitch rate gyro tach
46	B15	Temp. cable
47	D26	Voltage conv. 4 (+70v)
48	D27	Voltage conv. 4 (+23v)
49	D39	Voltage conv. 8 (+16v)
50	D40	Voltage conv. 8 (+9v)
51	D41	Voltage conv. 8 (-6v)
52	A28	OPEP gyro motor tach
53	D32	Voltage conv. 6 (+16v)
54	D33	Voltage conv. 6 (+9v)
55	D34	Voltage conv. 6 (-6)
56	D35	Voltage conv. 6 (-16v)
57	D28	Voltage conv. 5 (+16v)
58	D29	Voltage conv. 5 (+9v)
59	D30	Voltage conv. 5 (-6v)
60	D31	Voltage conv. 5 (-16v)
61	B11	Deploy bottles press. 1 (+Z bottom)
62	E28	Temp. EP1
63	C15	RX #2 AGC 1
64	C16	RX #2 AGC 2
65	E29	Temp. SOEP #2 (+X)
66	D21	Voltage conv. 2 (+9v)
67	D12	Batt. Limits + status
68	F1	Voltage Tape Record 1 (+9.5)
69	F2	Voltage Tape Record 1 (-9.5)
70	C1	Temp. WB/TX #1
71	C2	Temp. WB/TX #2
72	C3	Temp. SP/TX
73	A2	Argon Low Pressure
74	A27	OPEP gyro A/B
75	A29	Gyro motor error rate
76	F41	RX 1+2 signal present
77	A32	Temp. ACS inverter
78		
79	A14	OPEP sine
80	A15	OPEP cosine
81	F26	Voltage Cal. (0.5)
82	F28	Voltage Cal. (2.64)
83	F30	Voltage Cal. (4.12)
84	F8	Temp. Tape Record 1
85	F16	Temp. Tape Record 2
86	F17	Temp. LFTA

		OGO-C
87	F20	Temp. DDHA 1
88	F22	Temp. DDHA 2
89	D15	Sync signal amplitude 400 cps
90	D16	Sync signal amplitude 2461 0°
91	D17	Voltage conv. 7 (+16v)
92	D37	Voltage conv. 7 (+9)
93	D38	Voltage conv. 7 (-6v)
94		
95	A36	ACS inverter output
96	D53	Voltage conv. 10 (+9v)
97	A34	Temp. pitch reaction wheel
98	A33	Temp. yaw reaction wheel
99	B5	EP1, EP2, EP3, 400 ant hinge 1
100	A30	Temp. OPEP gyro bracket
101	A26	Temp. Sun sensor #2
102	A25	Temp. Sun sensor #1
103	A9	Temp. horizon scanner head A
104	E30	Temp. Panel (-Y, middle)
105	C13	RX #1 AGC-1
106	C14	RX #1 AGC-2
107	D24	Voltage conv. 3 (+70v)
108	D25	Voltage conv. 3 (+23v)
109	A35	Pitch rate gyro tack
110		
111	D26	Voltage conv. 4 (+70v)
112	D27	Voltage conv. 4 (+23v)
113	D39	Voltage conv. 8 (+16v)
114	D40	Voltage conv. 8 (+9v)
115	D41	Voltage conv. 8 (-6v)
116	A28	OPEP gyro motor tack
117	D32	Voltage conv. 6 (+16v)
118	D33	Voltage conv. 6 (+9v)
119	D34	Voltage conv. 6 (-6v)
120	D35	Voltage conv. 6 (-16v)
121	D28	Voltage conv. 5 (+16v)
122	D29	Voltage conv. 5 (+9v)
123	D30	Voltage conv. 5 (-6v)
124	D31	Voltage conv. 5 (-16v)
125	B11	Deploy bottles press. 1 (+Z bottom)
126		
127	C15	RX #2 AGC-1
128	C16	RX #2 AGC-2

Figure 20–OGO A, B, C Subcomm 2 and 3 Channel Assignments Compared (Continued)

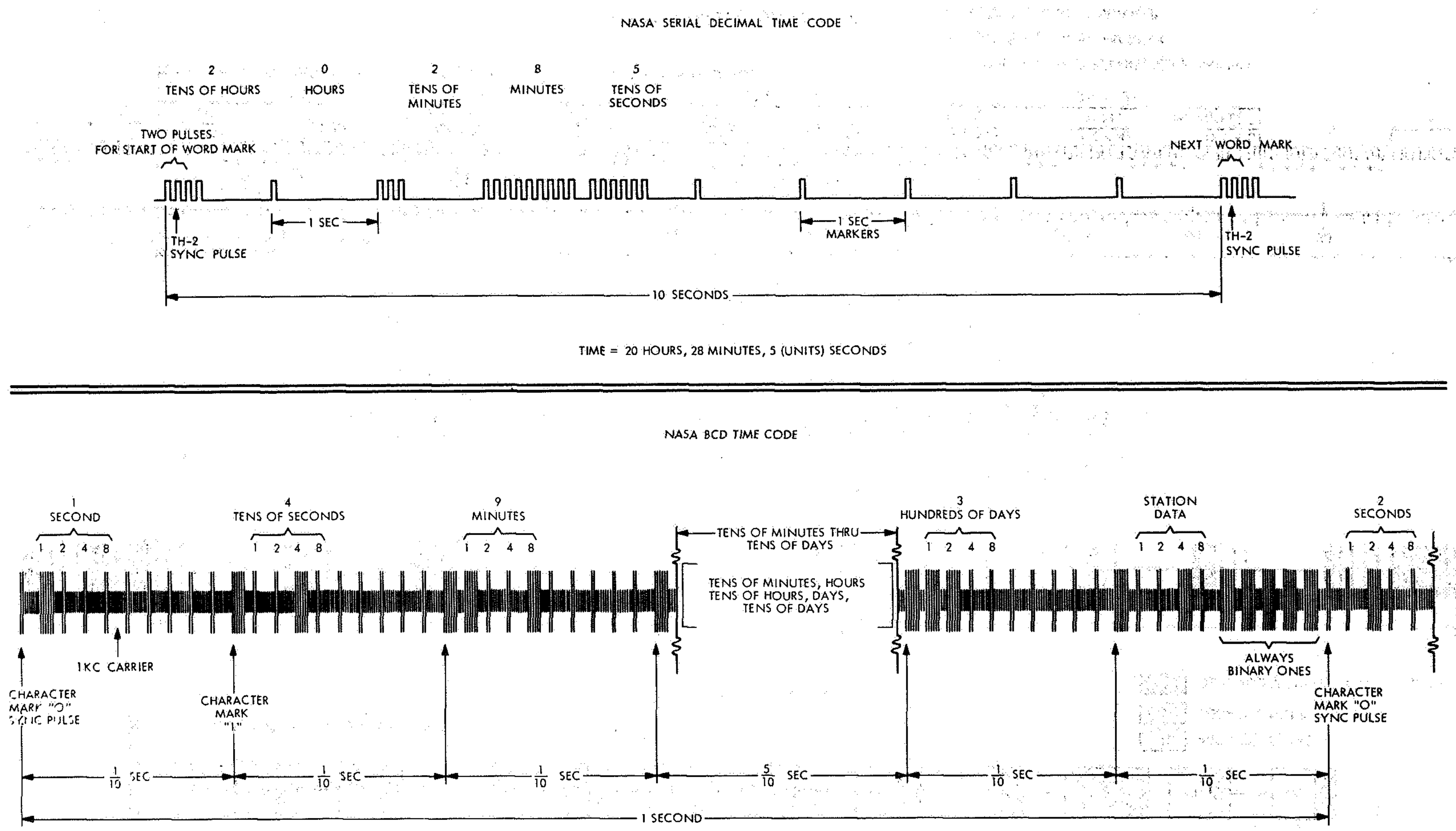


Figure 21–BCD, SD, WWV Time Code

Details of the time-code transmissions from radio station WWV. For this particular example, the signals indicate the 50th second of the 23rd minute, of the 10th hour, of the 121st day of the current year. One second later, the first of the "units" pulses in the group designating "seconds" will change from "0" (a 2-millisecond pulse) to "1" (a 6-millisecond pulse), indicating the 51st second.

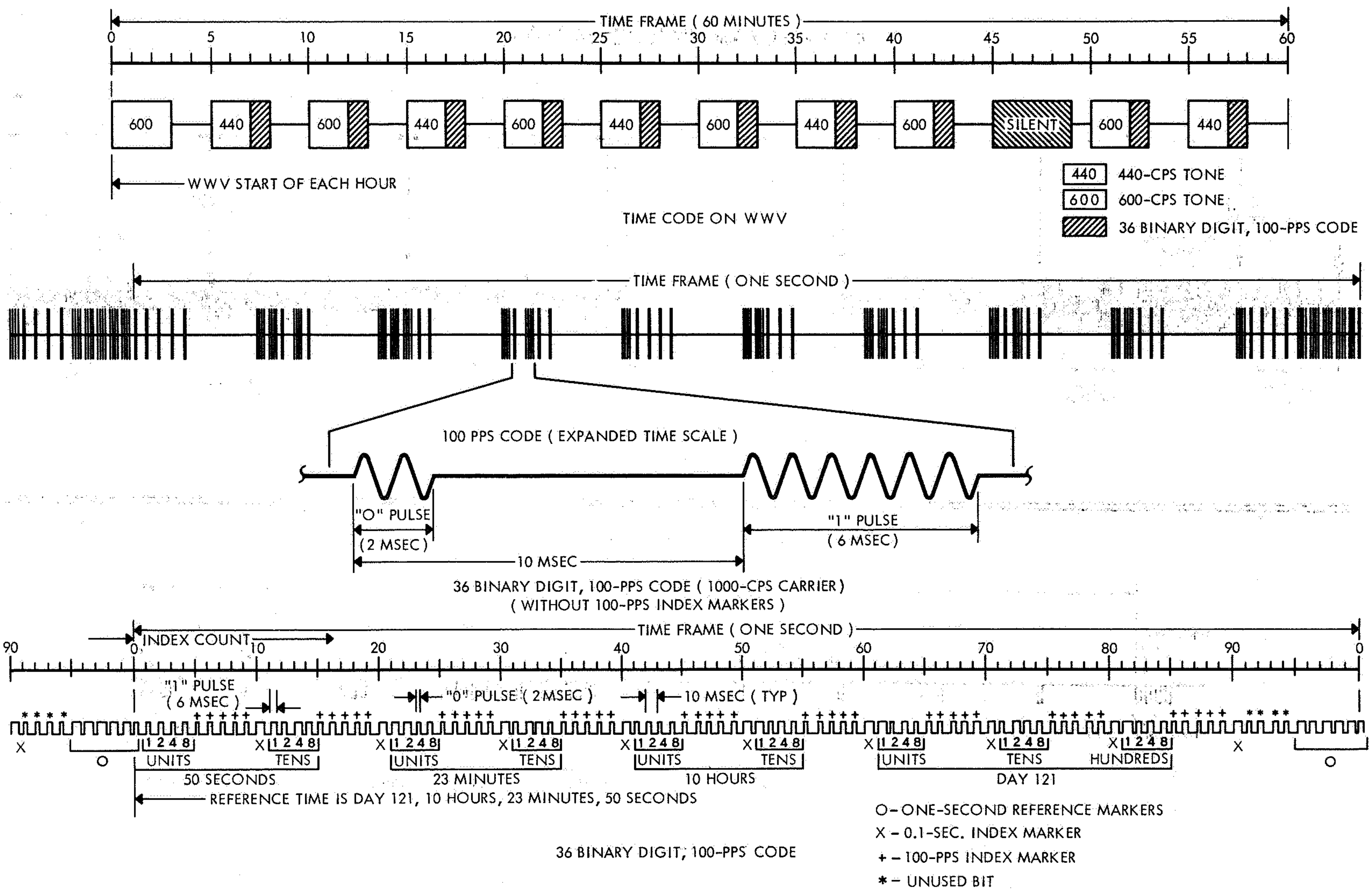


Figure 21 (Continued)–BCD, SD, WWV Time Code

SECTION II. GROUND STATION OPERATIONS

THE DATA-ACQUISITION STATIONS

Data telemetered from OGO-B will be recorded at the following data-acquisition stations. Those designated as primary are distinguished by their increased command capability, their real time data link with GSFC, and increased telemetry reception capability afforded by their 85-ft parabolic antennas. Otherwise, primary and secondary stations alike will acquire and record both PCM and Special Purpose telemetry from OGO. The general flow of data at the acquisition stations is indicated on Figure 23.

OGO-B TELEMETRY DATA ACQUISITION STATIONS

Station & Location	Letter Codes			No. Code	Command Capability	Real Time Data Link to GSFC	Support Function	Antenna
	1 Ltr	3 Ltrs	6 Ltrs					
Gilmore Creek, Alaska	T	SKA	ULASKA	19	Digital & Tone	Yes	Primary	85 ft Parabolic
Rosman, N. Carolina	U	ROS	ROSMAN	20	Digital & Tone	Yes	Primary	85 ft Parabolic
Johannesburg, U. of S. Africa	Q	JOB	JOBURG	16	Digital & Tone	None	Secondary	40 ft Parabolic
Quito, Ecuador	F	QUI	QUITOE	5	Digital & Tone	None	Secondary	40 ft Parabolic
Santiago, Chile	J	SNT	SNTAGO	8	Digital & Tone	None	Secondary	40 ft Parabolic
Winkfield, England	P	WNK	WNKFLD	15	Digital & Tone	None	Mobile	14 ft
ORORAL		ACT	ORORAL	21	Digital & Tone	None	Secondary	85 ft Parabolic
Darwin		DAR	DARWIN	$\overline{21}$	Digital & Tone	None	Mobile	14 ft

Octal Number Digit	Nomenclature
106	OPEP HTRS OFF
107	EXP ORD ON
110	EXP 1 SCALE IC 1
111	EXP 10 WH IC 5
112	EXP 10 IFC OFF IC 9
113	EXP 13 Go IC 13
114	EXP 17 MODE II IC 17
115	EXP 2 SWITCH IC 21
116	OPEP 2 UNCAGE IC 25
117	
126	OPEP HTRS ON
127	EXP ORD OFF
130	EXP 10 SH IC 2
131	EXP 10 WM IC 6
133	EXP 13 Go IC 14
134	EXP 17 MODE III_1 IC 18
135	EXP 1 SCALE IC 22
150	EXP 10 SM IC 3
151	EXP 10 WL IC 7
152	EXP 12 DEPLOY IC 11
153	EXP 13 Go IC 15
154	EXP 17 MODE III_8 IC 19
155	OPEP-2 ENABLE IC 23
170	EXP 10 SL IC 4
171	EXP 10 IFC ON IC 8
172	EXP 13 Go IC 12
173	EXP 17 MODE I IC 16
174	EXP 17 DEPLOY IC 20
175	OPEP-2 DISABLE IC 24
200	SOEP-1 HTR ON PC 1
201	EP 4, HTRS ON PC 3
202	EXP 1 ON PC 5
203	EXP 2 OPEP ON PC 7
204	EXP 3 MB ON PC 9
205	EXP 4 ON PC 11
206	EXP 5 EG 1 PC 13 ON
207	EXP 7 ON PC 15
210	EXP 15 CAL PC 33 ON
211	EXP 15 Vs PC 35 ON
212	EXP 15 Vs PC 37 ON
213	EXP 16 ON PC 39
214	EXP 18 ON PC 41
215	EXP 19 ON PC 43
216	R & RR ON PC 45
217	OPEP-2 SCAN ON PC 47
220	SOEP-1 HTR OFF PC 1
221	EP 4, 5 HTRS OFF PC 3
222	EXP 1 OFF PC 5
223	EXP 2 OPEP OFF PC 7
224	EXP 3 MB OFF PC 9
225	EXP 4 OFF PC 11
226	EXP 5 EG 2 PC 13 OFF
227	EXP 7 OFF PC 15
230	EXP 15 CAL PC 33 OFF
231	EXP 15 Vs PC 35 OFF
232	EXP 15 Vs PC 37 OFF
233	EXP 16 OFF PC 39
234	EXP 18 OFF PC 41
235	EXP 19 OFF PC 43
236	R & RR OFF PC 45
237	OPEP 2 SCAN OFF PC 47

Octal Number Digit	Nomenclature
240	OPEP HTRS ON PC 2
241	EP 1,2,3 HTRS ON PC 4
242	EXP 2 MB & SOEP ON PC 6
243	EXP 11 LAMP PC 8 ON
244	EXP 3 SOEP ON PC 10
245	EXP 5 ON PC 12
246	EXP 6 ON PC 14
247	EXP 8 ON PC 16
250	EXP 15 Vs PC 34 ON
251	EXP 15 Vs PC 36 ON
252	EXP 15 ON PC 38
253	EXP 17 ON PC 40
254	EXP 18 ANT DEPLOY ON PC 42
255	EXP 20 ON PC 44
256	EXP 13 ON PC 46
260	OPEP HTRS OFF PC 2
261	EP 1,2,3 HTRS OFF PC 4
262	EXP 2 MB & SOEP OFF PC 6
263	EXP 11 LAMP PC 8 OFF
264	EXP 3 SOEP OFF PC 10
265	EXP 5 OFF PC 12
266	EXP 6 OFF PC 14
267	EXP 8 OFF PC 16
270	EXP 15 VS PC 34 OFF
271	EXP 15 Vs PC 36 OFF
272	EXP 15 OFF PC 38
273	EXP 17 OFF PC 40
274	EXP 18 ANT DEPLOY OFF PC 42
275	EXP 20 OFF PC 44
276	EXP 13 OFF PC 46
300	EXP 9S ON PC 17
301	EXP 9I ON PC 19
302	EXP 11 FG ON PC 21
303	EXP 11 Rb A ON PC 23
304	EXP 12 ON PC 25
305	EXP 14 ON PC 27
306	EXP 15 G1 PC 29 ON
307	EXP 15 CAL PC 31 ON
320	EXP 9S OFF PC 17
321	EXP 9I OFF PC 19
322	EXP 11 FG OFF PC 21
323	EXP 11 Rb A OFF PC 23
324	EXP 12 OFF PC 25
325	EXP 14 OFF PC 27
326	EXP 15 G1 PC 29 OFF
327	EXP 15 CAL PC 31 OFF
341	EXP 10 ON PC 20
342	EXP 11 Rb B ON PC 22
343	EXP 11 PC 24 ON
344	EXP 13 ON PC 26
345	EXP 15 G1 PC 28 ON
346	EXP 15 CAL PC 30 ON
347	EXP 15 CAL PC 32 ON
361	EXP 10 OFF PC 20
362	EXP 11 Rb B OFF PC 22
363	EXP 11 PC 24 OFF
364	EXP 13 OFF PC 26
365	EXP 15 G1 PC 28 OFF
366	EXP 15 CAL PC 30 OFF
367	EXP 15 CAL PC 32 OFF

Figure 22–OGO-B Commands

TCA-500

OGO - B COMMANDS

044/070

POWER

316 REG 1 VOLT LO	356 REG 2 VOLT LO	336 REG 1 VOLT HI	376 REG 2 VOLT HI
104 REG 1 CHG 33/2	164 REG 1 CHG 33/12	144 REG 1 CHG 1/2	124 REG 1 CHG 1/12
105 REG 2 CHG 33/2	165 REG 2 CHG 33/12	145 REG 2 CHG 1/2	125 REG 2 CHG 1/12
317 REGS 95° NORM	337 REGS 95° OVRD	354 AUTO 12A EN	374 AUTO 12A DIS
016 REG 1 NORM-BYP	056 REG 1 NORM	076 REG 1 BYP	036 REG 1 OVRD
315 REG 2 NORM-BYP	355 REG 2 NORM	375 REG 2 BYP	335 REG 2 OVRD
006 UV1 RESET	046 UV2 RESET	026 UV1 OVRD	066 UV2 OVRD

ACS

	121 ACS NORM	141 ACS ENABLE	161 ACS EXECUTE
102 ACS MODE 1	122 ACS MODE 2A	142 ACS MODE 2C	162 ACS MODE 3
103 SUN SENS NORM	123 SUN SENS COARSE	167 OPEP ENABLE	147 OPEP DISABLE
	371 GAS NORM 1	352 GAS NORM 2	333 GAS DELAY
	372 JETS ENABLE 1	353 JETS ENABLE 2	334 JETS DISABLE
	332 PR GYRO ON 1	313 PR GYRO ON 2	351 PR GYRO OFF
	331 ACS ON 1	312 ACS ON 2	311 ACS OFF
310 CSA ARM	330 CSA SAFE	314 -YAW SPIN	373 +YAW SPIN

COMM

001 WB OVRD	020 WB A ON	040 WB B ON	060 WB OFF
024 SP ON	044 SP OFF	054 SP MOD NORM	074 SP MOD PCM
143 SP TO OMNI	163 SP TO DIRECT	~~146 TAPE REC ON~~	~~166 TAPE REC OFF~~

DATA HANDLING

002 TR 1 ON	022 TR 1 OFF	042 TR 2 ON	062 TR 2 OFF	061 TAPE PB
	011 RT MC	031 RT ASC	051 RT FF	
	012 DS MC	032 DS ASC	052 DS FF	
	013 1 KB RATE	033 8 KB RATE	053 64 KB RATE	
003 EG 1 ON	023 EG 1 OFF	041 EG 1 RT	010 MO1 SEL	050 HFTU1 SEL
043 EG 2 ON	063 EG 2 OFF	021 EG 2 RT	030 MO2 SEL	070 HFTU 2 SEL

TRACKING

005 100 MW A ON	025 100 MW B ON	064 100 MW OFF	045 10 WATT ON	065 10 WATT OFF
		216 R & RR ON	236 R & RR OFF	

LAUNCH

100 ARM BUS	140 BOOM 1 DEPLOY	160 BOOM 2 DEPLOY	101 ACS START
107 EXP ORD ARM	127 EXP ORD SAFE	116 OPEP 2 UNCAGE	

OPEP Lim. Sw.

137 -220°	157 -90°	177 -320°

HEATERS

126 OPEP DR ON	106 OPEP DR OFF
200 SOEP 1 ON	220 SOEP 1 OFF
241 EP 1,2,3 ON	261 EP 1,2,3 OFF
~~340 ARM DR ON~~	~~360 ARM DR OFF~~
240 OPEP ON	260 OPEP OFF
201 EP 4,5 ON	221 EP 4,5 OFF
107 EXP 17 ANT ON	127 EXP 17 ANT OFF

OPEP 2 SCAN

217 CONTROL ON	237 CONTROL OFF
155 RUN	175 STOP

EXP 1

202 ON	222 OFF	110 SCL 8	135 SCL 128

EXP 2

203 OPEP ON	223 OPEP OFF	
242 MB & SOEP ON	262 MB & SOEP OFF	115 EG SEL

EXP 3

204 MB ON	224 MB OFF	244 SOEP ON	264 SOEP OFF

EXP 4

205 ON	225 OFF

EXP 5

245 ON	265 OFF	206 TO EG 1	226 TO EG 2

EXP 6

246 ON	266 OFF

EXP 7

207 ON	227 OFF

EXP 8

247 ON	267 OFF

EXP 9

300 ES ON	320 ES OFF	301 I ON	321 I OFF

EXP 10

341 ON	361 OFF	
111 WH	131 WM	151 WL
130 SH	150 SM	170 SL
171 IFC ON	112 IFC OFF	

EXP 11

	302 FG ON	322 FG OFF	
303 MAG A ON	323 MAG A OFF	342 MAG B ON	362 MAG B OFF
263 IGN ON	243 IGN INHIB	343 SP. HTRS. ELECT ON	363 SP. HTRS. ELECT OFF

EXP 12

304 ON	324 OFF
152 DEPLOY	

EXP 13

256 ON	276 OFF	113 AUTO	133 ZERO
344 ON	364 OFF	153 AUTO	172 ZERO

EXP 14

305 ON	325 OFF

EXP 15

	252 ON	272 OFF	
306 GI ZERO	326 GI -15V	365 VS AUTO	345 VS STOE
	307 CAL A ON	347 CAL B ON	210 CAL C ON
	327 CAL A OFF	367 CAL B OFF	230 CAL C OFF
250 HI A ON	270 HI A OFF	251 HI B ON	271 HI B OFF
211 LO A ON	231 LO A OFF	212 LO B ON	232 LO B OFF
	346 CAL PHASE ON	366 CAL PHASE OFF	

EXP 16

213 ON	233 OFF	136 IFC

EXP 17

	253 ON	273 OFF	
173 MODE I	114 MODE II	134 MODE III/1	154 MODE III/8
	174 DEPLOY		

EXP 18

214 ON	234 OFF
254 DEPLOY ON	274 DEPLOY OFF

EXP 19

215 ON	235 OFF

EXP 20

255 ON	275 OFF

Figure 22A–OGO-B Commands (Continued)

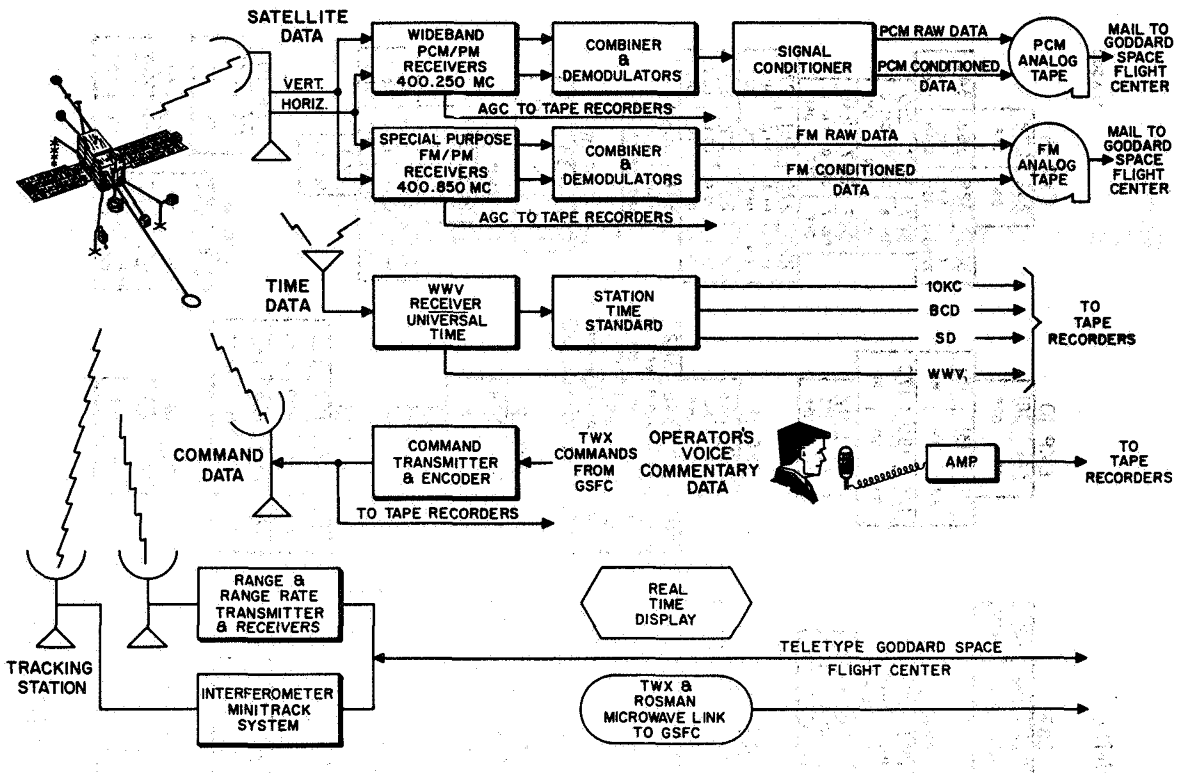


Figure 23—Flow Chart of Data at Stations

DATA ACQUISITION OPERATIONS

PCM/PM Data

a. Analog Tape Track assignments for PCM/PM data are as follows:

Track	Record Amplifier	Source	Signal
1	Direct	Multiplex System	Receiver AGC's and 10kc
2	Direct	Transmitter Control Panel	Commands
3	Direct	Diversity Combiner	Unconditioned PCM Data
4	Direct	Time Standard System	BCD Time Code
5	Direct	PCM-DHE	Conditioned PCM Data
6	FM	Time Standard System	Serial Decimal Time Code
7	Direct	Audio Amplifier	Voice Commentary & WWV Time

Formats of the BCD, Serial Decimal and WWV Time Codes appear as Figure 17.

Commands and PCM data are discussed further in Section III. OGO-B commands, their octal codes, and their actions are also displayed on Figure 22.

b. Recording procedures are as follows:

Ampex FR-607 tape recorders will be used at the data acquisition stations. All data will be recorded using 14 inch reels. Tape length will be 4800 ft, tape width will be 1/2 inch, and tape thickness 1-1/2 mils.

Playback data will be recorded on 14 inch reels so that an entire dump can be recorded on one tape.

Recording duration and tape speeds for the varied modes and bit rate of PCM data are as follows:

Mode & Bit Rate	Maximum Recording Duration	Tape Speed	Reel Size
1 Kilobit Real Time	112 minutes	7-1/2 ips	14
8 Kilobit Real Time	112 minutes	7-1/2 ips	14
64 Kilobit Real Time	28 minutes	30 ips	14
64 Kilobit Playback	28 minutes	30 ips	14

Additional PCM recording requirements are as follows. Playback data will be recorded on a different tape from real time data. There shall be no more than one pass per tape for any of the four categories of data enumerated above. When a recording period terminates prior to the end of a tape, no further recording from following passes will be made on that tape.

c. Mailing procedures are as follows. All recorded station tapes will be airmailed with accompanying tape logs, to the following address:

Analog Tape Library
Code 564,
Goddard Space Flight Center,
Greenbelt, Maryland, U.S.A.

FM/PM Special Purpose Data

a. Analog tape track assignments for FM/PM data are as follows:

Track	Record Amplifier	Source	Signal
1	Direct	Time Standard System & Multiplexed System	Receiver AGC's & 10 kc Reference
2	Direct	Transmitter Control Panel	Commands
3	Direct	Diversity Combiner	FM Data
4	Direct	Time Standard System	BCD Time Code
5	Direct	Time Standard System	100 kc Reference
6	FM	Time Standard System	Serial Decimal Time Code
7	Direct	Audio Amplifier	Voice Commentary & WWV Time

Formats of the BCD, Serial Decimal and WWV Time Codes appear as Figure 21.

Commands are discussed in Section III and FM Data experimenter bandwidth assignments in Section IV

b. Recording procedures are as follows:

Ampex FR-607 tape-recorders will be used and the FM data will be recorded using 10-1/2 inch reels. Tape length will be 2400 ft., tape width will be 1/2 inch, and tape thickness 1-1/2 mil.

Tape speed for recording of FM data will be 30 ips, with the maximum duration of recording set at 14 minutes. Recording will be done on the basis of one pass per tape. When a recording period terminates prior to the end of a tape, no further recording from following passes will be made on that tape.

c. Mailing procedures are as follows. All recorded station tapes will be airmailed with accompanying tape logs, to the following address:

Analog Tape Library
Code 564
Goddard Space Flight Center,
Greenbelt, Maryland, U.S.A.

Common PCM/PM and FM/PM Considerations

Figure 24 shows the Magnetic Tape Log form which will accompany each EGO analog station tape mailed to the Data Processing Branch. The Log will indicate whether data on the tape is PCM or FM, the recording tape speed, and for PCM data, the bit-rate. The Data Acquisition stations will also indicate on the Log certain additional information about the recorded data when such information is readily obtainable at the station. This information will be indicated by letter code affixed to the logged analog tape number and will distinguish the following types of data in the manner given below.

Letter Code	Definition
C	Tape Contains Commands Only
A	Tape Contains PCM Accelerated Subcom data only
R	Tape Contains PCM Real time Data only
P	Tape Contains PCM Playback Data only

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MAGNETIC TAPE LOG

Date ____________________

Satellite(s) Name ____________________

Tape No. ____________________

Make Recorder ____________________

Model ____________________ **Serial No.** ____________________

Station Name ____________________ **No.** ____________________

Geodetic Coordinates

Latitude ____________________

Longitude ____________________

TRACK	RECORD PLUG-IN			LINK (RF) FREQUENCY	TRACK FUNCTION								RECORDER INPUTS
	AMPLIFIER	CENTER FREQUENCY	BANDPASS FILTER		DETECTED SIGNAL	CONVERTED SIGNAL	SIGNAL LEVEL	TIMING	REFERENCE	SPEED CONTROL	LOCAL	SPECIAL	CENTER FREQUENCY MODULATION SUBCARRIER BANDWIDTHS, ETC.
1	DPFCN												
2	DPFCN												
3	DPFCN												
4	DPFCN												
5	DPFCN												
6	DPFCN												
7	DPFCN												

TAPE SPEED

I.P.S.

D – Direct
P – Pulse Width
F – FM
C – Control Track
N – Non-return-to-zero

NOT REWOUND

MAILED TO:

Cumulative Msg. DTG. ____________ ____________

PASS NO.	PREDICT TIME	START TIME	STOP TIME	TAPE NO.	SINPO	LINK (RF) FREQ.	MINS DATA	EQUIP. PARA.	OPER. PARA.	TAPE MAILED

EQUIPMENT PARAMETERS		OPERATIONS PARAMETERS	
1		1	
2		2	
3		3	
4		4	

ADDITIONAL REMARKS

Figure 24–Ground Station Magnetic Tape Log

SECTION III. PROCESSING SYSTEMS

The data processing methods, computer programs, hardware systems, and processing controls used for OGO are outlined below. Operational use of these facilities as they are employed during Launch Back-Up and Post-Launch operations, during Quick Look Passes, and for Normal Production processing, is outlined in Section IV, "Data Processing Operations."

A. PCM PROCESSING

Processing of PCM data for OGO-B is divided among three successive phases: analog/digital conversion, edit-quality control, and decommutation. These phases are augmented by concurrent processing of spacecraft commands and generation of spacecraft attitude-orbit tapes. Each are outlined below.

1. Processing Control

Control of production processing, and monitoring of production quality are vested in two groups, the Production Control Group and Quality Control Group, respectively (Figure 25).

Production Control Personnel - Production Control Personnel are responsible for scheduling the analog/digital conversion of PCM data, for scheduling

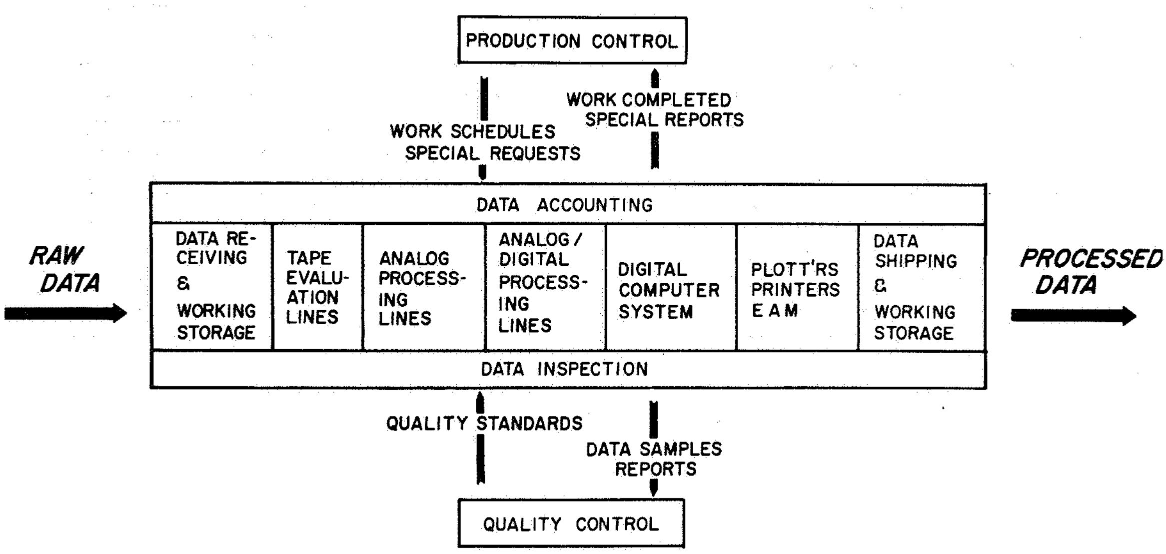


Figure 25–Production Flow & Control Chart

editing, decommutation, and quality checks by the Quality Control Group. Production Control also generates, records, and reports the accounting information required for the efficient monitoring and production processing of OGO data. In addition these personnel schedule the processed data for shipment and assure that these are accompanied by the proper shipping documents. Production Control personnel also schedule and monitor the operations necessary for processing spacecraft commands, the OGO-B attitude-orbit tape, and subsystem data processing.

Quality Control Personnel - Quality Control Personnel are responsible for monitoring the accuracy and validity of PCM data as reported by the edit and quality control program. Based on their scrutiny of various quality indicators, Quality Control personnel make the decision to release edited data for decommutation, to submit data for re-digitizing and/or re-editing, or to reject it as unprocessable. The Quality Control group is responsible for monitoring output of the decommutation program to assure that data files have been processed in chronological order on a run and that time intervals of output data files are non-overlapping. The Quality Control group also monitors the processing of spacecraft commands recorded on the ground station analog tapes and checks these with commands recorded at the OGO Control Center to assure that only valid commands are processed and dispatched to experimenters.

2. Processing System

The OGO-B PCM data processing system is outlined below functionally and nearly in the chronological order in which data is processed. Specific applications of each function during various operational modes are described further in Section IV, "Data Processing Operations."

Analog Tape Acquisition and Handling -

Tape receipt. Upon receipt, magnetic tapes from the ground stations will be placed in the analog tape library. The information contained on the station log sheet will be punched into an analog card (see Figure 38). A chronological listing (Figure 56) based on both analog and digital cards will be produced monthly to indicate the status of processing of data received. These lists will be sent to the OGO Project Manager, to the EGO Project Scientist, to all OGO-B experimenters, and to Production Control. In addition to the monthly listing, Production Control will receive a weekly progress report.

Tape evaluation. From shipments received, tapes recorded by each station will be evaluated for recording technique and conformity to standards by the Tape Evaluation Group (Figure 26 shows one of the tape evaluation stations).

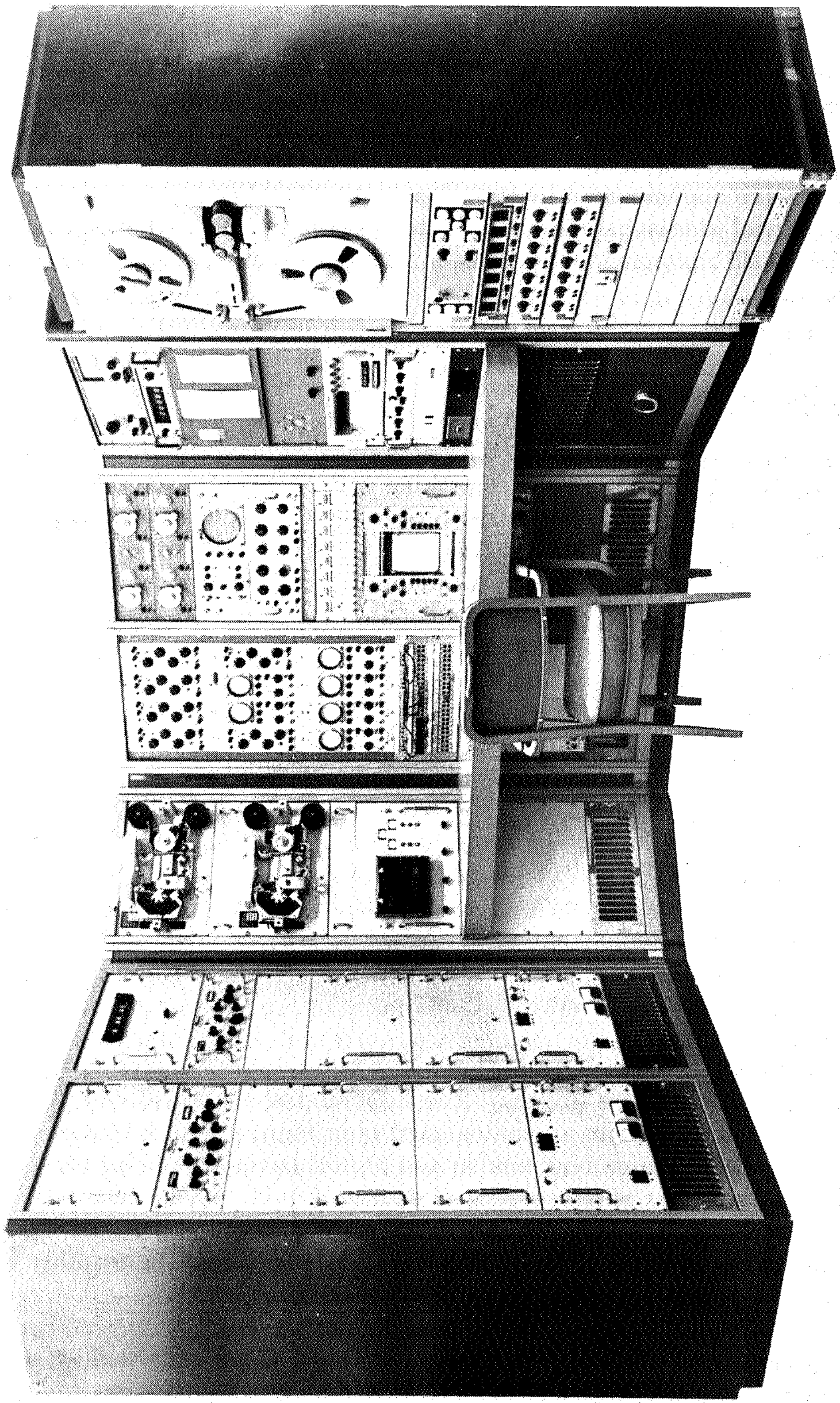


Figure 26–Tape Evaluation Line

The Network Operations Branch of the Network Engineering and Operations Division will be notified immediately of any gross anomalies detected. All stations will be rated in a report sent to the head of the Operations Branch, Operations and Support Division.

Tape storage. Analog tapes will be stored in the Central Processing Facility, GSFC, until the data contained on them have been processed. One month after the processed data are released to the experimenters the analog tapes will be sent to the Federal Archives for dead storage.

Analog-to-Digital Conversion -

The processing line. Analog tapes with tracks as described in Section II, "Data Acquisition Operations," must be converted into a digital format for digital computer processing (see Figure 27 for schematic, Figure 28 for appearance of processing line). The signal from a data track is fed into the PCM signal processor where the waveform is reconditioned. Figure 29 gives the format of a frame of analog data, and Figure 30 shows the PCM sequence of S/C word 1 as they are encountered during this phase. After bit synchronization is established in the bit synchronizer, the search is begun for the 27-bit frame-sync word. After a 27-bit word conforming to the expected sync word is found, it must be verified by appearing 3 consecutive times in the proper location with no more than 2 bit errors per sync pattern. The proper location within the frame is decided by starting the word counter assuming the first appearance of the sync word to be correct. If the 27-bit word is found at some location other than the expected one, the process is repeated using the most recently located 27-bit word as the starting point. Once frame sync is established, buffer records corresponding to 8 TM frames, 45 36-bit wide per frame, are written. Both time codes (binary-coded decimal and serial decimal, tracks 4 and 5 respectively) are decoded. A calibrated tracking oscillator is used to update the accumulator which in turn is compared periodically against both time standards. The input to this oscillator is a 10-kc reference frequency recorded on track 1. An elaborate system of flags is generated by the line which, when properly analyzed, indicates the quality of the time recorded on the buffer tape. (These flags are used in the quality control and edit program to facilitate the time computation.) In addition to generation of the buffer tape, the processing line decodes spacecraft commands recorded on track 2 of the analog tape and punches commands and associated times on paper tape for further processing. Additional special handling is required in the analog-to-digital conversion of tape-recorder playback data. During tape-recorder "dumps" the data is in a reversed time-sequence when it is telemetered to the ground and recorded. In order to obtain the telemetry words and bits in their proper time sequence, an analog tape containing playback data, unlike one of real time data, must be physically "turned over" prior to digitization.

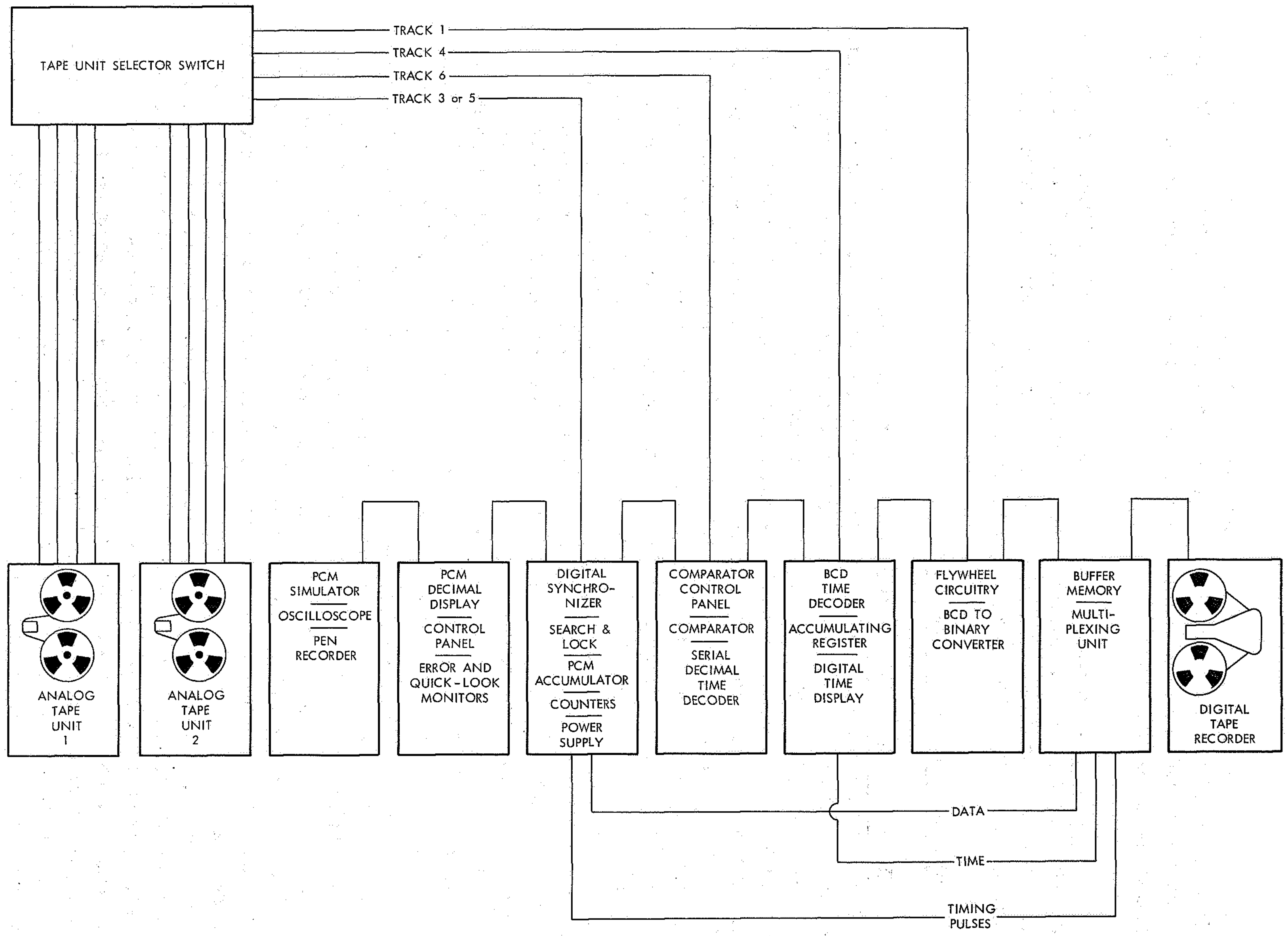


Figure 27–A/D Processing Line

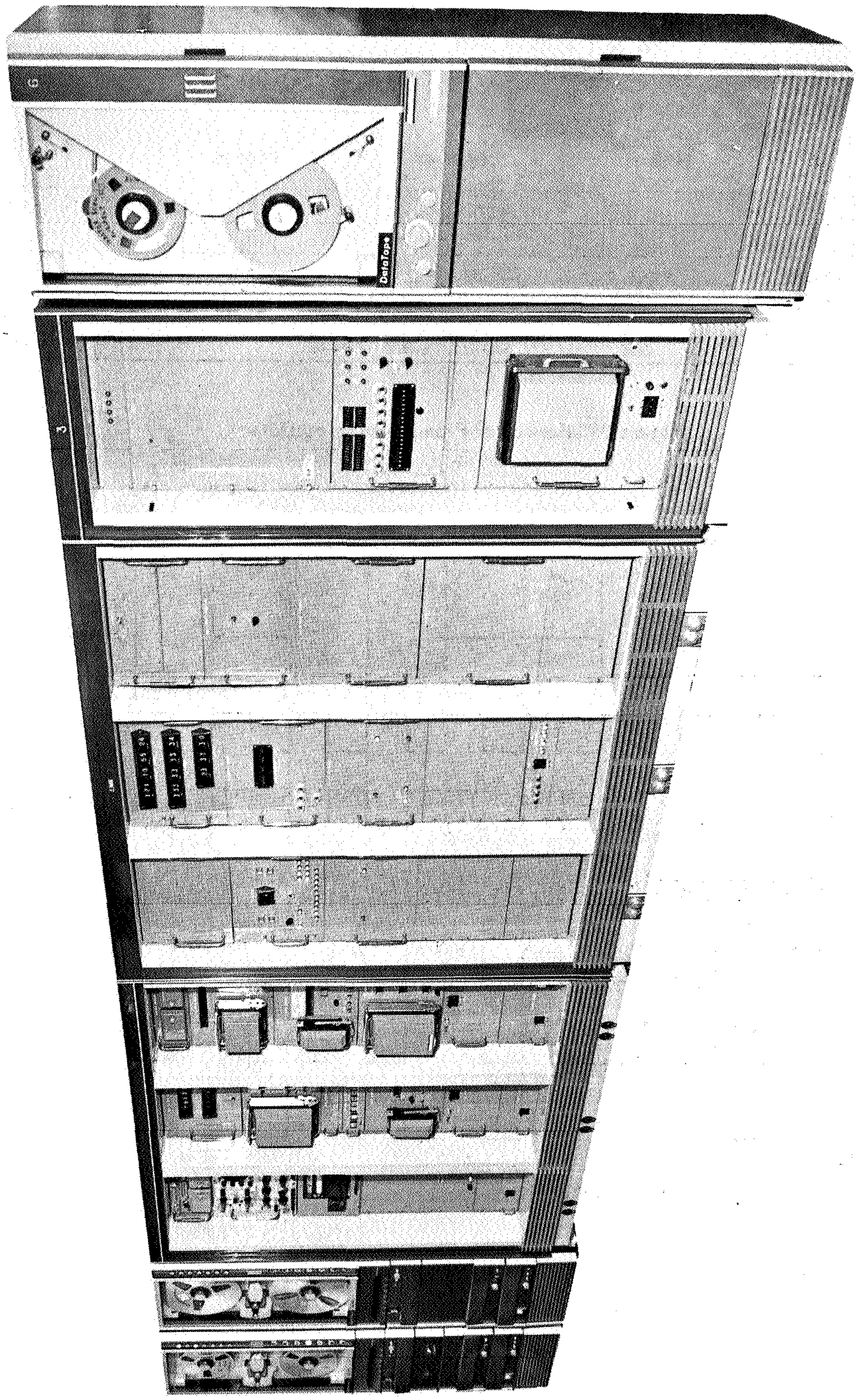


Figure 28–A/D Processing Line

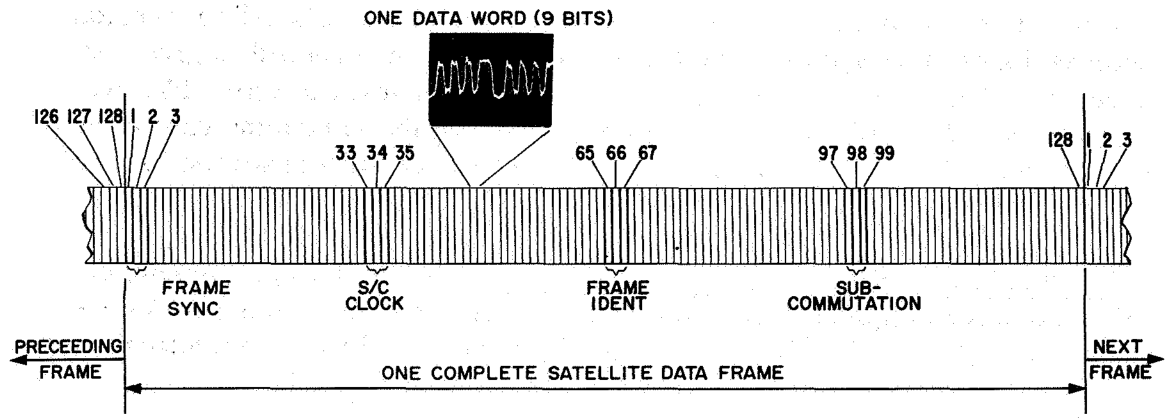


Figure 29—Format of Frame of Analog Data

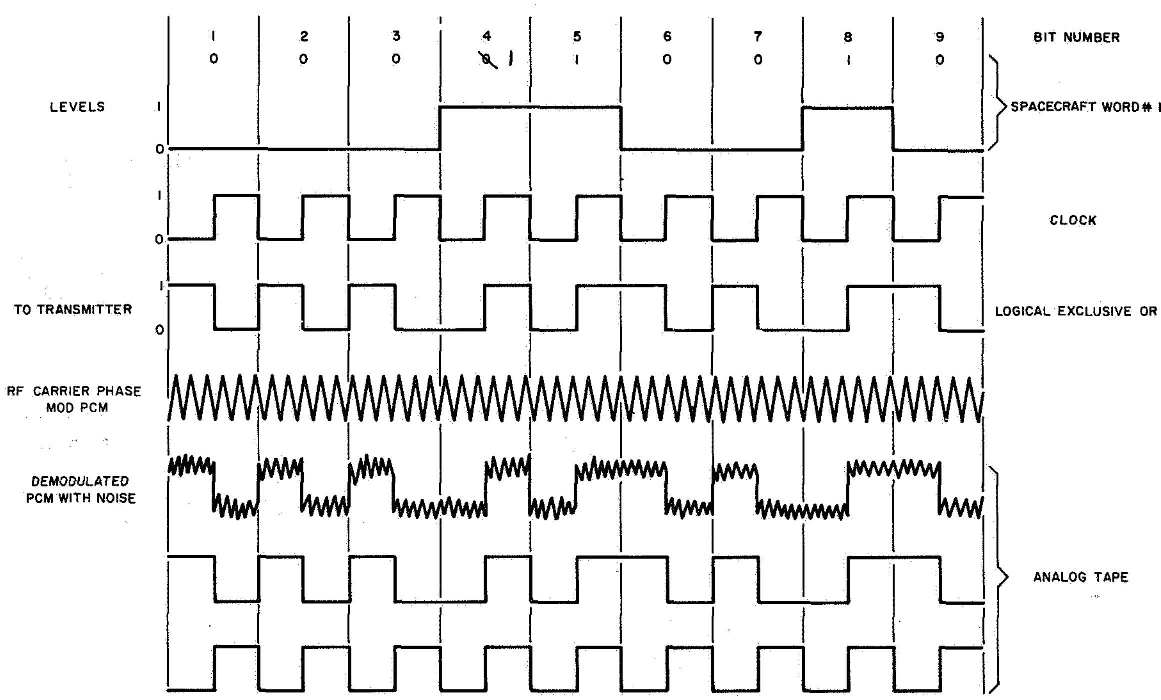


Figure 30—PCM Sequence of S/C Word 1

Formats of the buffer tape generated during analog-to-digital conversion appear as Figures 31 and 32. The format of a buffer tape record is given on Figure 34. Each buffer frame consists of 270 characters, of which 256 are allotted to the 128 words of the telemetry frame. Of the remaining characters, six are reserved as status flag fields for the frame, two are reserved for the day of year, and six for the milliseconds of day of the frame.

Intermediate Digital Computer Processing - Intermediate processing of PCM data, using as general input the buffer tapes generated during A/D conversion, consists of extensive editing, quality control and time correction using

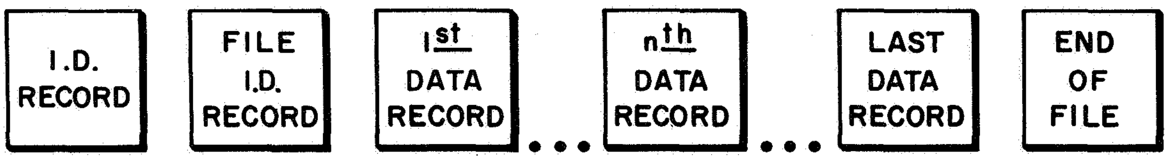
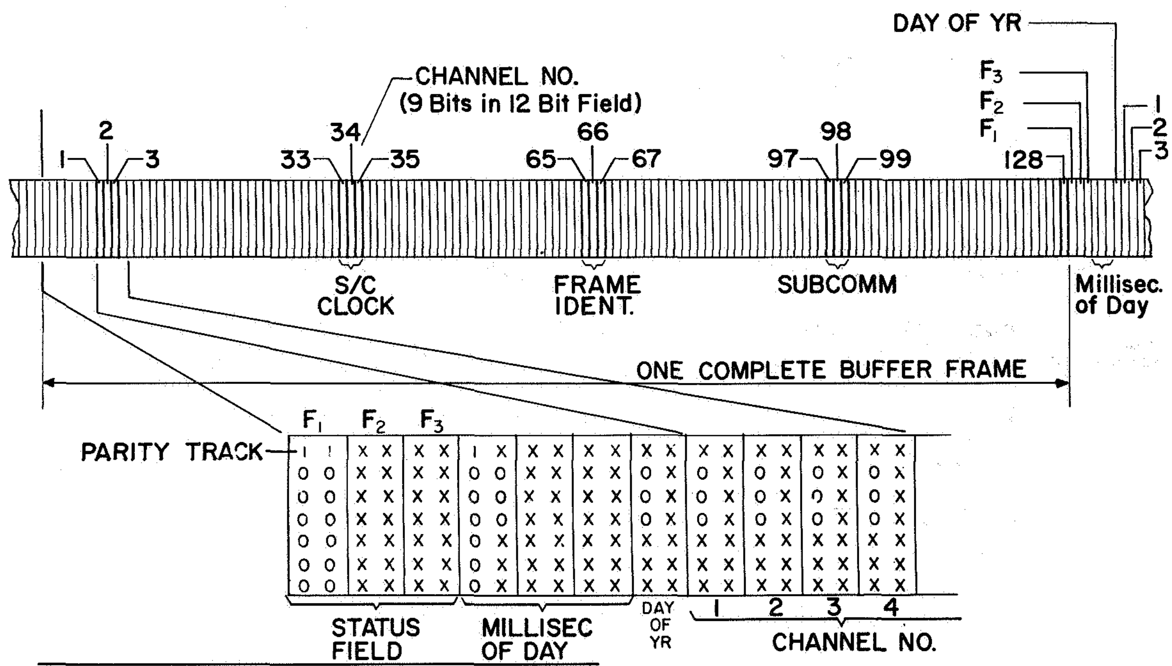


Figure 31–Format of Buffer Tape



1. F_1 IS A CONSTANT (RESERVED FOR COMPUTER DETERMINED FLAGS)
2. F_2 IS A FLAG RELATING TO HARDWARE DETERMINED TIME STATUS
3. F_3 IS A FLAG RELATING TO HARDWARE DETERMINED SYNC STATUS

Figure 32–Format of Buffer Data

Buffer ID Record 1

Character	Information
1-4	Buffer tape number
5-6	Year of digitization
7-9	Day of digitization
10-11	A/D operator ID
12-13	A/D line used
14-18	Blank

Buffer ID Record 2

Character	Information
1-5	Satellite Identification
6-7	Year of recording
8-10	Station number
11-14	Analog tape number
15-16	Analog file number
17-18	Blank

Figure 33–Buffer ID Format

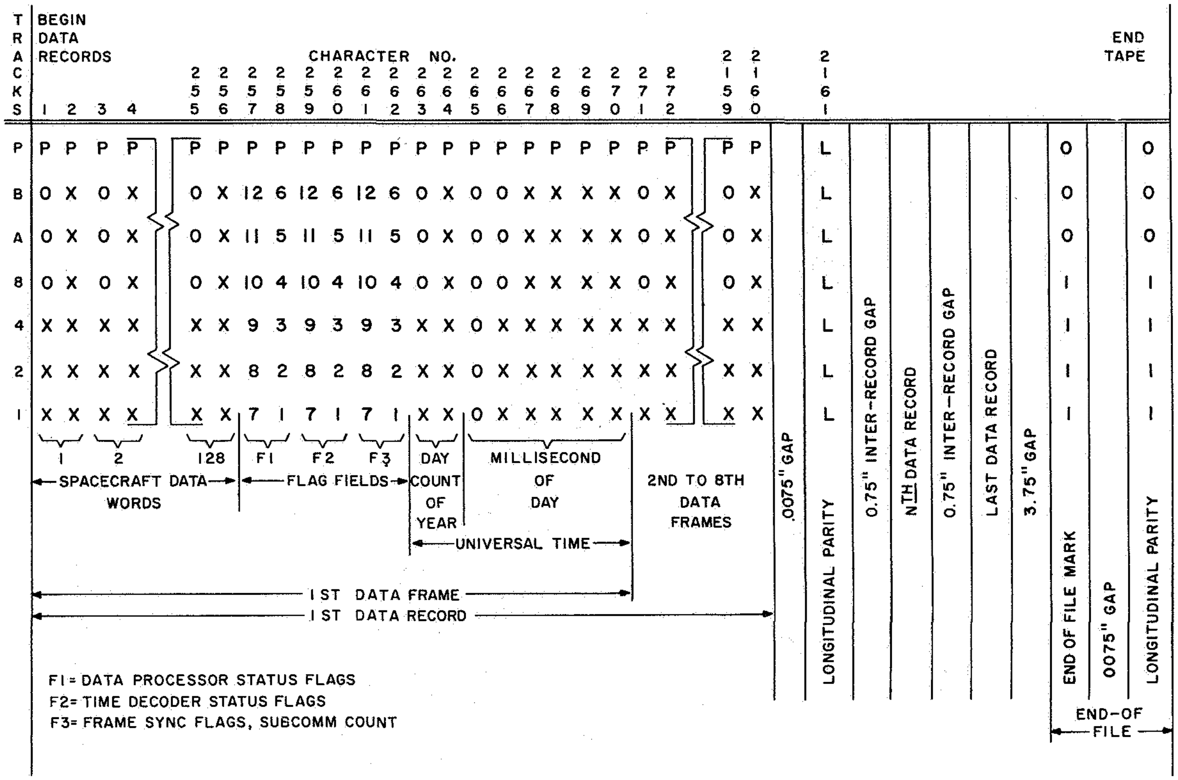


Figure 34–Format of Buffer Tape Record

the UNIVAC 1107 digital computer (Figure 35). For tape-recorder playback data the processing also includes an initial and essential reformatting. The intermediate stage processing is further described below.

Playback Reformat and Time Correction - The Reformat and Time Correction Program is used solely for playback data and as a stage in processing is a necessary antecedent to editing, quality control and time correction functions performed in the edit phase. Reformatting of playback data consists of proper chronological ordering of segments of playback data on the buffer tape. The initial disarray of playback data segments on a buffer tape stems from the data being dumped serially from two spacecraft tape recorders (reference Figure 36). Determination of a data segment in the program depends on an accurate identification and verification in the data of apparent "backward" jumps in the spacecraft block. After being reformatted, playback data is written in the proper chronological order on a new "buffer" tape and is now amenable to editing, quality control, and time correction functions of the Edit Program.

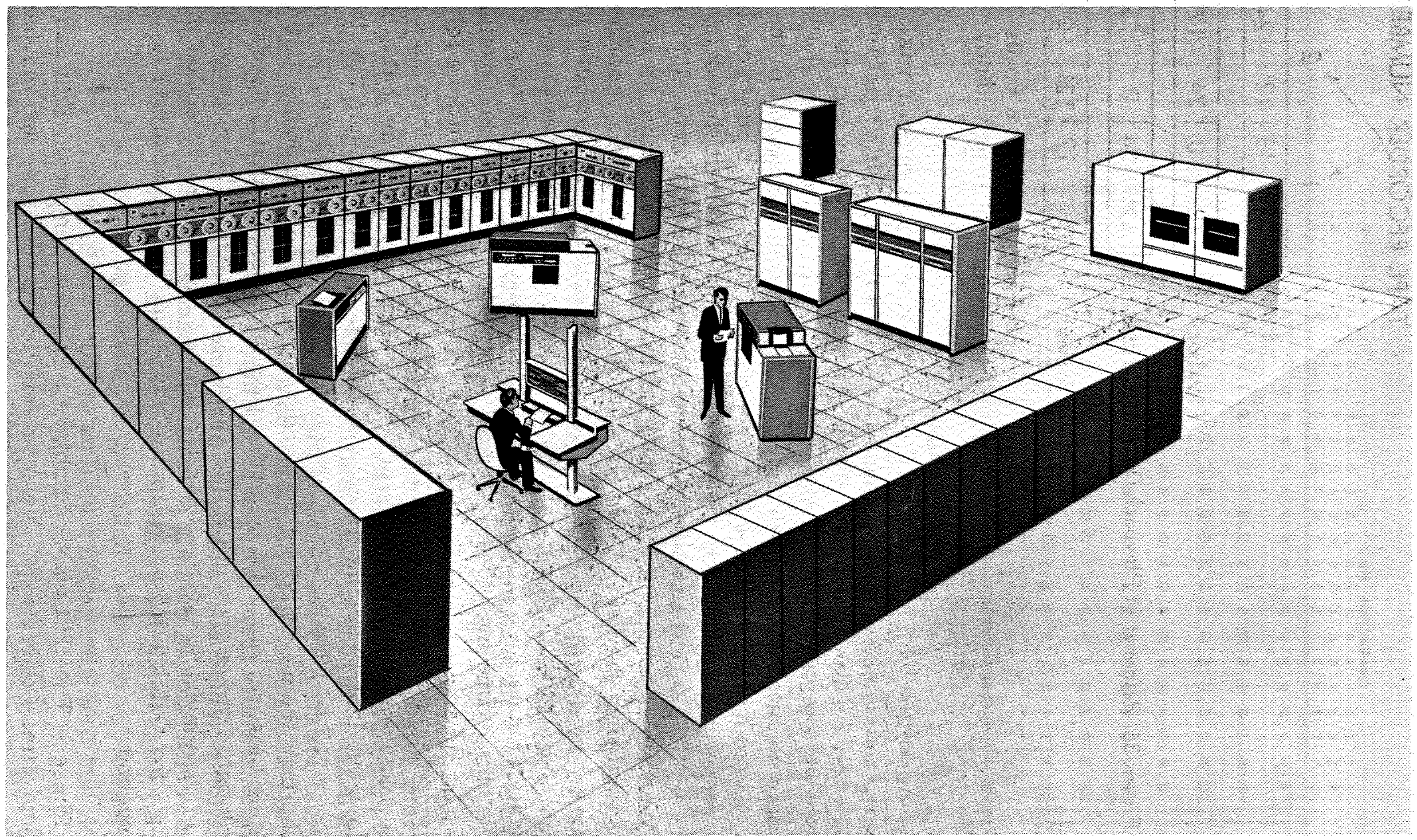


Figure 35–Univac 1107 Digital Computer

TAPE RECORDER NUMBER

	1		2	
Record	0	12	12'	24
Playback	12	0	24	12'
Digitize	12'	24	0	12
Reformat	0	12	12'	24

where numbers within boxes represent real time of data.

Figure 36–Reformat of Playback Data

Time correction which occurs in the playback reformat program is an optional feature to be used during reformatting and in lieu of Edit Program time correction when certain spacecraft clock conditions required by the latter are not met or when Quick Look is in vogue. The rule will be that Normal Production data will only be reformatted, with time correction in this case left to the edit program. In general, time correction when applied to OGO-B playback data alludes to more extensive processing than when applied to real time data. Time correction applied to real time data involves the transformation of GMT time recorded on the analog tape at the ground station to the GMT time as which the data was sampled in the S/C. Time correction as applied to tape recorder playback data entails not only a transformation to Universal Time, but must also take into account that ground station GMT time as recorded on an analog tape of playback data is unusable. The fact that the playback data is telemetered and recorded at the ground station in reversed time sequence, plus the possibility that it may have reposed in data storage on spacecraft tape recorders for some time before a dump, jointly afford no easy direct correlation with ground station time. The Playback Reformat Program time correction requires that a buffer tape of playback data be accompanied to the computer by a console key-in (Figure 32) of a matched pair of times. One is a high-resolution spacecraft clock reading obtained from Real Time data and the other a corresponding Universal Time. Using these as input the computer then ascribes updated Universal Times to playback data frames by making use of the higher resolution spacecraft clock readings in the playback data. When the above "raw" time correction is employed (e.g., for Quick Look data) time of any frame will be accurate to less than one second.

<u>Edit Phase</u> – The Edit phase combines two prime functions, Edit and Quality Control, and Time Correction. These are applied to real time and playback data alike.

```
RUN Ø9:12:27
PLM,IO9,5ØØØ,5ØØØ
MSG:
LOG NUMBER Ø74
MOUNT PROG
-CR1 TERMINATED
AR 6/2 PROG
MOUNT INPUT
AR 4/1Ø,11 INPUT
MOUNT OUTPUT
AR 5/Ø,1,2,3 OUTPUT
KEY IN-TOTAL NUMBER OF PLAYBACK TAPES TO BE PROCESSED
2

OPERATOR TYPE 1ST S/C TIME (OCTAL)
135Ø43551

OPERATOR TYPE UNIVERSAL TIME (DECIMAL)
311Ø7836

DAY COUNT MUST BE 3 CHARACTERS LEADING ZEROS WHEN NECESSARY
DAY COUNT OF YEAR (DEC)
Ø94


  INPUT TAPE IDENTIFICATION
BUFFER TAPE NUMBER          ØØ6Ø
ANALOG TAPE NUMBER          ØØØ6

END RUN Ø9:17:38
```

Figure 37–Playback Time Correction Console Key-In

Edit Program - The Edit Program produces edit tapes which contain files of data in chronological order, the order being independent of the ground station of recording. The one ordering constraint is that playback data and real time data files never appear together on an output tape. In practice, playback edit runs on the computer are made separate from runs for real time data.

To produce edit tapes with files in chronological order, the input buffer tapes must be called for in proper order. To assure this the computer compares the chronologically arranged analog cards (Figure 38) with the internal file label of each buffer tape. In addition to its time-ordering use, the analog card is compared with the remaining portions of the buffer file label, and both are written as part of the edit file label record (format given in Figure 39).

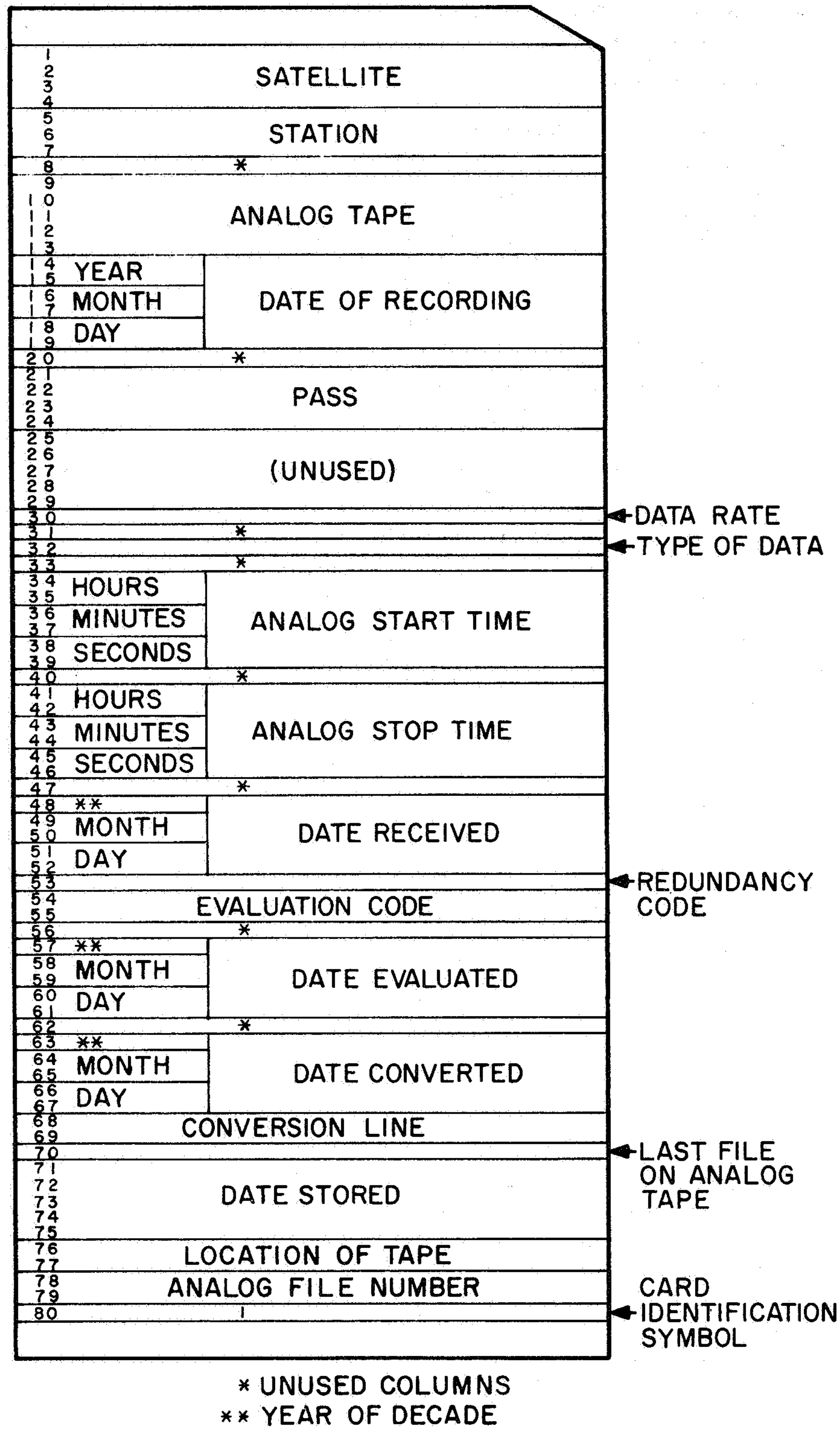


Figure 38–Analog Card Format

Label (ID) Record for OGO-B, Master Binary Tape and all Experimenters Decomm Tapes

The first record per file is called the Label record. It serves as a means to identify the data contained on that file of which it is a part. Each record will contain 120 six-bit characters in a form suitable for direct printing.

The format of the Label record is as follows:

Character	Representation
1 - 5 + Space	Satellite Identification (assigned after launch) Example: 65021 where: 65 = year of launch 02 = Beta 1 = object
7 - 8 + Space	Year
10 - 12 + Space	Station Number Example 001 = Blossom Point 020 = Rosman
14 - 15 + Space	Analog File Number
17 - 20 + Space	Analog Tape Number
22 - 23 + Space	Buffer File Number
25 - 28 + Space	Buffer Tape Number
30 - 32 + Space	Date of data digitization (day of year)
34 - 66	Will be identical to character 1-33 unless an error was found in those characters. If that is the case, then this portion of the record will contain the corrected values of that field.
67 + Space	Type of data contained in file 0 = 4 kilobit real time 1 = 16 kilobit real time 2 = 64 kilobit real time 3 = command storage playback
69 - 71 + Space 73 - 77 + Space	Day of year Seconds of day start time of data
79 + Space	Is Flexible Format in use? 1 = Yes 0 = No
81 - 82	Flexible Format Number
83 - 88	Blank
89 + Space	Equipment Group in use (1 or 2)
91 - 94 + Space	Master Binary Tape Number
96 - 97 + Space	Master Binary File Number
99 - 100 + Space 102 - 103	A/D line operator ID A/D line ID
104 - 113	Blank
114 - 115	Reel Sequence Number
116 - 118	Run Number
119 - 120	Experiment Number

Figure 39—Edit & Decomm Label Record Format

Disagreement between the analog card and the buffer file label is indicated on an edit listing (Figure 46) and the contents of the analog card are accepted as the correct identification of the input buffer file.

In processing the buffer tape the computer accepts the 8-frame buffer records and reformats them into 128-frame edit records, corresponding to one cycle of the spacecraft subcommutators. It adds a special frame to the 128 data frames so the edit record actually carries a total of 129 frames (Figure 40). Label records are carried over from the buffer format to the edit format but are modified and added to by the program.

Each 8-frame buffer record is inspected for format errors. This includes verifying the proper word, frame and record lengths. Each buffer frame is also tested for bit slippage in the frame sync word. When detected, the frame is "shifted" back to its appropriate bit positions. A record of bit slippage corrections is maintained by the computer and printed on the edit listing.

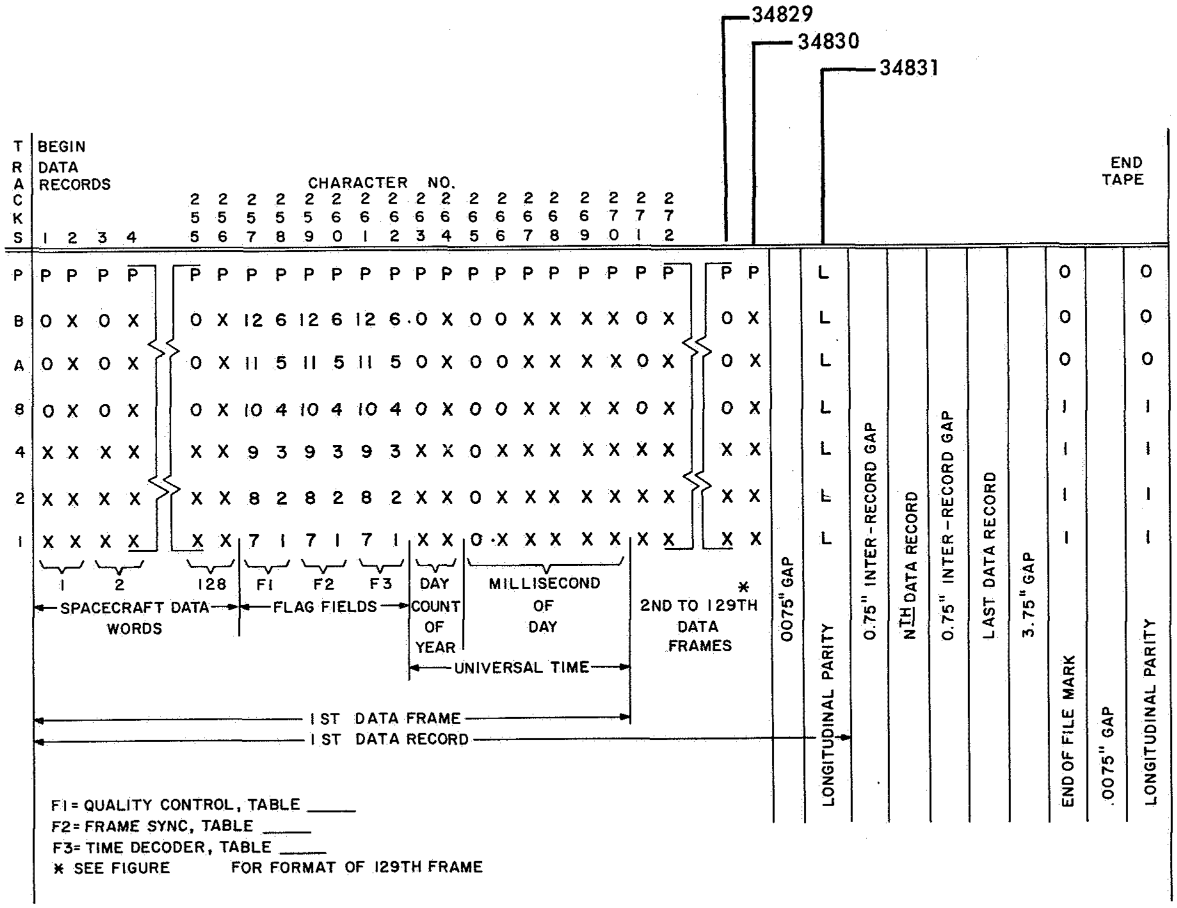


Figure 40—Format of Edit Tape Data Record

Every frame sync word is checked for bit errors. If three or more bit errors are found in the sync pattern, the frame is flagged in the status flag field as having data words of questionable validity. The total sum of sync bit errors for each frame is also reported in the frame status field. The sync bit error sums are further accumulated so that for each file of data on the edit tape, the percentage of frames having 0, 1, 2, and 3 or more bit errors respectively, will be calculated and listed.

Further checks are made by the computer on the accuracy and validity of the data. The parity, bit rate, data type (real time or playback), and spacecraft operational mode (normal, accelerated, subcom, or flexible format mode) of the data are checked and listed. The subcommutator count is checked for proper sequencing and data words are checked to assure that characters containing 9-bit telemetry words have 3 leading zeros. The computer will also insert frames of fill data (Figure 28) in an edit record to maintain integrity of the format and time-consistancy. When fill data has been inserted, the status field of the appropriate frame will be so flagged. Time fields and status fields (Figures 42, 43, 44) will remain associated with a frame whether it is useful data or fill data.*
The milliseconds of day for each frame is checked to assure that the update of time is commensurate with the kilobit rate of the data frame.

The following is the format for a fill data word and the difference between fill data and normal data:

Normal Data Word *		Fill Data Word *	
0	X	1	0
0	X	0	0
0	X	0	0
X	X	0	0
X	X	0	0
X	X	0	0

* 2 characters/word

Figure 41–Format of Fill Data

*This is true of data which is time corrected by the edit program. However data processed as "quick look" or that which cannot be processed by the time correction portion of the edit program will have "fill" data in the time and status positions of those frames containing "fill" data.

Bit **	State	Representation for F1, Quality Control Status *
1-6		Total bit errors in the 27 bit frame sync word.
7	1	This frame is fill data
8	1	This frame is the beginning of a subcomm sequence
9 10	0 0	This frame contains 4 kilobit real time data
9 10	1 0	This frame contains 16 kilobits real time data
9 10	0 1	This frame contains 64 kilobits real time data
9 10	1 1	This frame contains command storage play-back data
11	1	This frame contains suspect data. This flag will appear when the bit errors in the frame sync word are ≥ 3.
12	1	This frame contains corrected time

*Computer determined
**Bit 12 is most significant bit , bit one is least significant bit

Figure 42–Quality Staus Fields

Bit	State	Representation for F2, Time Status *
1	1	BCD decoded time agrees with the accumulating register
2	1	BCD decoded time disagrees with the accumulating register
1 + 10	1	BCD decoded time agrees with both the accumulating register and Serial Decimal decoded time. The experimenter can have good confidence in time when these flags appear
1 + 9	1	BCD decoded time agrees with the accumulating register but disagrees with SD decoded time
2 + 3	1	BCD decoded time disagrees with the accumulating register but agrees with SD decoded time. The experimenter should not have confidence in this time
2 + 4	1	BCD decoded time disagrees with both the accumulating register and SD decoded time. The experimenter should not have confidence in this time
5	1	SD decoded time agrees with accumulating register
6	1	SD decoded time disagrees with accumulating register
5 + 7	1	SD decoded time agrees with accumulating register but not with BCD decoded time
5 + 8	1	SD decoded time agrees with both the accumulating register and BCD decoded time. Again, the experimenter can have good confidence in time when these flags appear
6 + 7	1	SD decoded time disagrees with both the accumulating register and BCD decoded time. The experimenter should not have confidence in this time
6 + 8	1	SD decoded time disagrees with the accumulating register but agrees with BCD decoded time
11		BCD to Binary Converter circuit is in error. The experimenter should not have confidence in this time
12	0 or 1	Not used at present

*Time status flags are a hardware function rather than computer determined. Experimenters should ignore this flag; it does not pertain to their data.

Figure 43–Quality Status Fields

Bit **	State	Representation for F3, Data Status*
1-7		Subcomm count; O - 127
8	1	Lock mode; in frame sync
8	0	Flywheel mode; still in lock but bit errors in frame sync exceed tolerance
9	1	In subcomm sync
9	0	Not in subcomm sync
10-12		Number of bit errors in frame sync word

*Data status flags are a hardware function rather than computer determined.
**Bit 12 is M.S., bit one is L.S.

Figure 44–Quality Status Fields

1 ORDER POLY FIT FOR 26 POINTS. BATCH NUMBER 1

TM = .26187328690999999+11 CM = .23571726499999999+08

.125748293567448+01 = B0 .108419966000000-15 = B1

	OCTAL S/C CLOCK	DATA INPUT DAY	DATA INPUT MILLI-SEC	CALCULATED DAY	CALCULATED MILLI-SEC	DIFFERENCE DAY	DIFFERENCE MILLI-SEC
1	0131720617	303	5185197	303	5185199	-0	-2
2	0131720630	303	5194198	303	5194199	-0	-1
3	0131720641	303	5203198	303	5203199	-0	-1
4	0131720652	303	5212198	303	5212199	-0	-1
5	0131720663	303	5221198	303	5221199	-0	-1
6	0131720674	303	5230198	303	5230199	-0	-1
7	0131720705	303	5239198	303	5239199	-0	-1
8	0131720716	303	5248198	303	5248199	-0	-1
15	0131721015	303	5311200	303	5311199	-0	1
16	0131721026	303	5320200	303	5320199	-0	1
17	0131721037	303	5329200	303	5329199	-0	1
18	0131721050	303	5338200	303	5338199	-0	1
19	0131721061	303	5347200	303	5347199	-0	1
20	0131721072	303	5356200	303	5356199	-0	1
24	0131734174	303	11054185	303	11054186	-0	-1

MEASURE = .75000000-00 SQUARE ROOT OF MEASURE = .86602540-00

Figure 45–Time Fit Listing

```
  80748345   EQUAL MILLISECONDS OF DAY

EDITED LABEL

 SAT  YR STA AN  AN  BU  BU  DAT  SAT  YR STA AN  AN  BU  BU  DAT K DAY  SEC  F FF      E BINA BI OP LI
  ID  RE  NO FI  TA  FI  TA  DIG   ID  RE  NO FI  TA  FI  TA  DIG R  YR  DAY  F NO      G TAPE FI ID ID

65491 65 061 01 0111 01 0112 337 65491 65 061 01 0111 01 0111 337 3 272 80748 0 00      2 0015 07 29 02

START TIME      80748345 FIRST CLOCK 007007660174  FRAME NUMBER       88

STOP TIME       82562625 LAST CLOCK 077707770777 FRAME NUMBER        127
END OF FILE


*BELOW SUMMARY IS FOR BIT STREAM UNADJUSTED FOR SHIFTS
   99.3659 PER CENT OF FRAMES WITH ZERO SYNC BIT ERRORS
     .0000 PER CENT OF FRAMES WITH ONE SYNC BIT ERROR
     .0000 PER CENT OF FRAMES WITH TWO SYNC BIT ERRORS
     .6341 PER CENT OF FRAMES WITH THREE OR MORE SYNC ERRORS

*BELOW SUMMARY IS FOR BIT STREAM ADJUSTED FOR SHIFTS
   99.6829 PER CENT OF FRAMES WITH ZERO SYNC BIT ERRORS
     .0000 PER CENT OF FRAMES WITH ONE SYNC BIT ERROR
     .0000 PER CENT OF FRAMES WITH TWO SYNC BIT ERRORS
     .3171 PER CENT OF FRAMES WITH THREE OR MORE SYNC ERRORS
 *SHIFT CNT TABLE..SYMMETRICAL ABOUT 0 SHIFTS OF BIT STREAM. LEFT (RIGHT) COL IS MAX LEFT(RIGHT) SHIFT. MAX IS
 0           0            0            0        1572            0            5            0            0


   98.2233 PER CENT OF FRAMES WITH ZERO SYNC BIT ERRORS
     .0000 PER CENT OF FRAMES WITH ONE SYNC BIT ERROR
     .0000 PER CENT OF FRAMES WITH TWO SYNC BIT ERRORS
    1.7766 PER CENT OF FRAMES WITH THREE OR MORE SYNC ERRORS
TOTAL NUMBER OF FRAMES PROCESSED       1576
```

Figure 46–Edit and Quality Listing

```
          TOTALS OF ERROR CONDITIONS  (FRAMES WITH LESS THAN THREE SYNC BIT ERRORS)
DATA TYPE--                 0  KILOBIT RATE--           0  SUBCOM COUNT--             0  DAY OF YEAR--            0
MODE-MAIN FRAME--        1550  MODE-ACCELERATED--       0  MODE-FLEXIBLE FORMAT       0  NONEXISTENT MODES--      0
INVALID TIME                0  DECODER STATUS CHANGE    0  SYNC COUNT--               0
LOSS OF FRAME SYNC         13  WRONG LENGTH RECORD--    0  PARITY ERROR--             0  CONTROL UNIT SEQ--       0
QQCARD
   STANALEDITLFFDAYSTART STOPKFRAME PERO PER1 PER2 PER3 MODE TIME TYPESUBCMOPSY
550610111001520027280748825623 1576 9822    0    0  177    0    0    0    029130

QFCARD
OGOBCPK0111  651029 0000   15 01 222548 225602  0111                         4
QACARD
OGOBCPK 0111 651029 0000         222548 225602                               1
```

Figure 46 (Continued)–Edit and Quality Listing

THE LAST EDIT TAPE NUMBER USED WAS- 15

OGOB QUALITY CONTROL AND EDIT SUMMARY
27 DEC 65

STAT-ION NUMBER	ANALOG TAPE	BUFFER TAPE	EDIT TAPE	DAY OF YEAR	UNCORRECTED ELAPSED TIME	UNCORRECTED START TIME	UNCORRECTED STOP TIME	CORRECTED ELAPSED TIME	CORRECTED START TIME	CORRECTED STOP TIME
061	0101	0101	0014	125	02 15 30	53159644	Ø61290344	02 15 30	53159644	61290344
061	0111	0111	0015	272	04 07 04	45440345	Ø60264625	04 07 04	45440345	60264625
061	0111	0111	0015	272	01 56 24	60429345	Ø67413625	01 56 24	60429345	67413625
061	0111	0111	0015	272	02 08 51	67571345	Ø75302409	02 08 51	67571345	75302409
061	0111	0111	0015	272	00 33 04	75465345	Ø77449649	00 33 04	75465345	77449649
061	0111	0111	0015	272	00 19 44	77481345	Ø78665625	00 19 44	77481345	78665625
061	0111	0111	0015	272	00 29 18	78829345	Ø80587473	00 29 18	78829345	80587473
061	0111	0111	0015	272	00 30 14	80748345	Ø82562625	00 30 14	80748345	82562625

OGOB END OF JOB

Figure 46 (Continued)–Edit and Quality Listing

Time Correction Phase – There are many facets to the time correction phase of the Edit Program.

(1) Real Time data:

Using selected tapes, ground station time is corrected for transmission delay from the S/C and the delay from WWV to the station. The high resolution points of the updating S/C clock are then found and the corresponding times (GMT) of update are then associated with them. The GMT and high resolution points are then punched onto cards. These cards are fed into another program which performs one to nth degree polynomial fits on the time. The residuals of the fits are compared and the best are chosen. The coefficients of the fits are fed back (Figure 45) into the Edit Program and all times on all tapes over specified intervals are corrected based upon this criteria. Residuals between computed time and the corrected ground time are printed to obtain further confidence in the accuracy.

(2) Playback data:

The coefficients of the fit previously chosen using RT data over a selected interval of time are input to the edit program when processing playback data. Since ground station time associated with the playback data has no value, no residuals are produced nor other comparisons made. Time computed from the polynomial fit is applied after the high resolution points of the S/C clock are found. If for some reason (e.g. noise), no high resolution points can be determined the data will be processed by the Quick look time correction and reformat program previously discussed.

Note: When the time correction procedures contained in the Edit program are used the time of any particular frame is accurate to ±4 ms. If the Quick look time correction procedures are used, time is accurate to within one second. The status field (Figure 42) contains a flag which, when lit, signifies that the time on the tape has been computed using the extensive time correction procedures of the edit program.

Quality Control

After each edit file (excluding Accelerated Subcommutator data) is completed a quality and housekeeping listing is printed (See Figure 46) which includes a formatted printing of the file label record as read independently from the input buffer file and the analog card; start and end times of the data file in terms of both Universal Time and spacecraft clock, the equipment group and flexible format in use, the rate of time between consecutive frames, the total number of frames with 0, 1, 2 and 3 or more frame sync bit errors. In addition, the total number of instances in the file in which frames with less than 3 sync bit errors reflected various unique error conditions or operational modes, is accumulated and listed for the file (Figure 46). A concise summary listing will be printed at the end of each computer run as shown in Figure 46. The listing will include action taken on every buffer file interrogated. It is to be Noted here however that ASC data is not processed by the Edit Program. If this data appears on a buffer tape, the start and end times of the ASC data are printed but the data itself is never outputted onto the Edit tape.

If a file is rejected, during the edit phase as it may be due to various conditions as invalid time, data type, mode, ID, record, and word length comparisons, generally the file rejected must be redigitized. If after redigitizing, the file is again rejected, it is set aside for the lifetime of the spacecraft before further remedial processing is done. When a file is rejected by the edit program, a brief message stating the reason will be given in the portion of the testing usually devoted to edit information.

In addition to punching time coefficient cards, the edit program punches for each file an edit card (Figure 47), a quality card (Figure 48), and a duplicate of the input analog card. The edit card becomes part of the records of the Production Control group in the further processing of the data. The quality card summarizes certain of the data quality indicators printed on the quality listing of each edited file, and is used to generate the quality listing which appears in Figure 49, and which summarizes this information for each edited file.

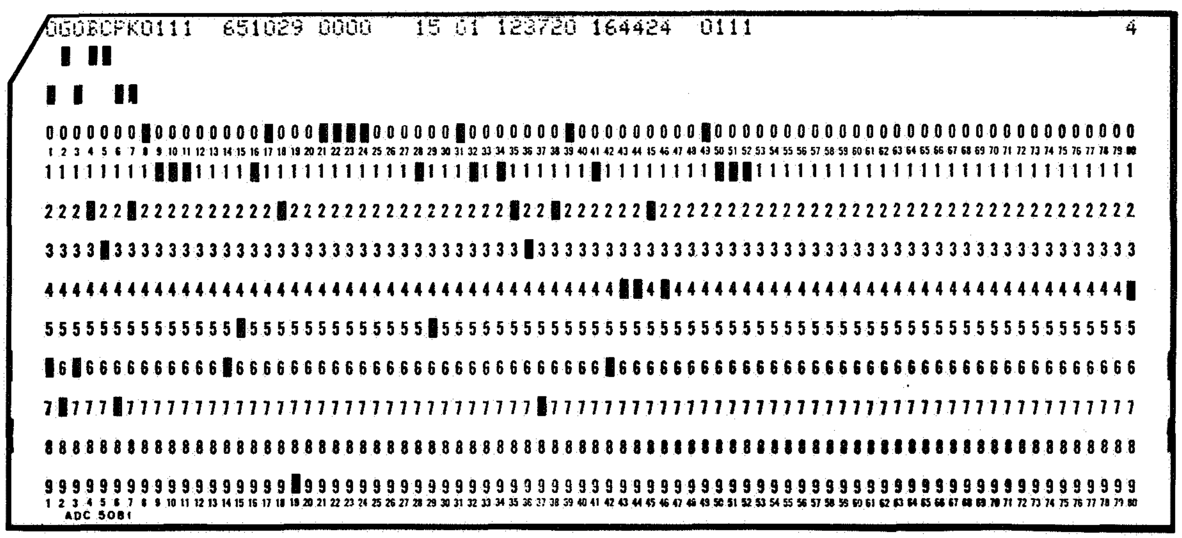


Figure 47–Edit Card

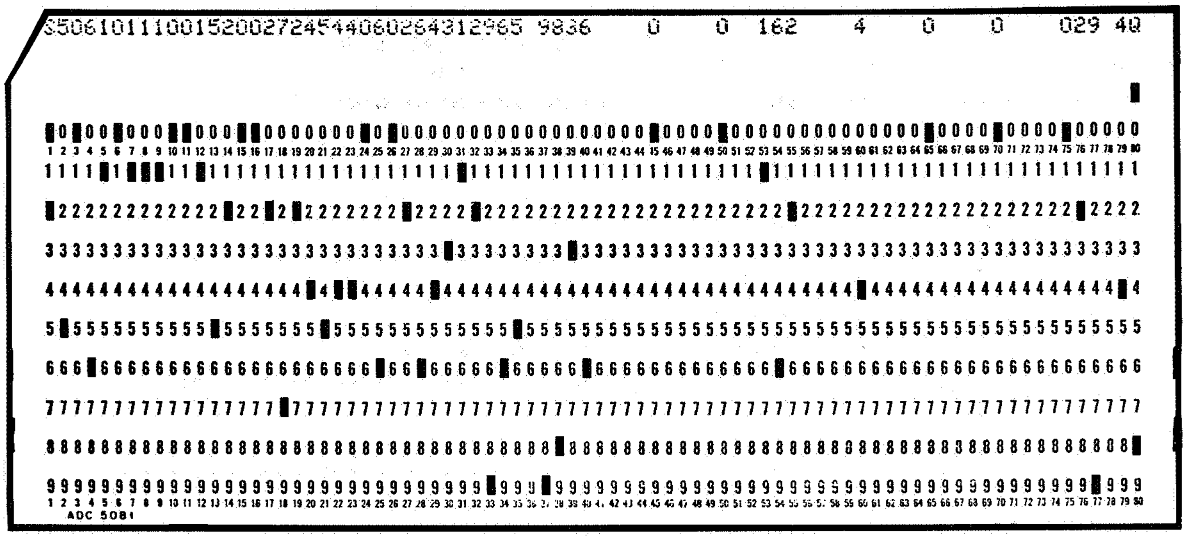


Figure 48–Quality Card

Edit tapes will be numbered by the program in consecutive order throughout the life of the satellite. The program also will instruct the computer operator to identify the completed edit tape with an external label. This label will show the OBO-B edit-tape number, the number of files included, the date of editing, and buffer tape from which it was made. Rejected files found capable of being reprocessed will be inserted in their proper position in the chronological sequence before decommutation if timely remedial reprocessing is anticipated. Otherwise, reprocessing will be allowed to proceed, but culminating in subsequent, separate decommutation of the data. Limiting the number of files per tape assures that all files will be completed on the original tape.

During processing of an edit file if a change in bit rate in spacecraft Equipment Group or in data format is observed, checked and verified by the computer, the current output file being written will be terminated and a new output file corresponding to the new configuration will be initiated. The data on the input buffer tape to the Edit and Quality Control program therefore, while containing one file representing one ground station pass, may ultimately be divided into two or more files emanating from the edit run.

Terminal Digital Computer Processing

Decommutation Phase – The decommutation process produces experimenter tapes from the edit tapes. The basic output is one data record for each experimenter from each 128-frame edit record. The experimenter may request any

OGO-B
QUALITY CARD LISTING

• LEGEND •

STA	STATION IDENTIFICATION NUMBER
TAPE NO	ANALOG TAPE NUMBER
EDIT NO	EDIT NUMBER
L	LINE IDENTIFICATION NUMBER
DAY	DATE RECORDED
START TIME	UNCORRECTED DIGITAL START TIME
STOP TIME	UNCORRECTED DIGITAL STOP TIME
KR	KILO BIT RATE
TOTAL FRAME	TOTAL FRAMES PROCESSED
0 ERROR	PERCENTAGE OF FRAMES WITH ZERO SYNC BIT ERRORS
1 ERROR	PERCENTAGE OF FRAMES WITH ONE SYNC BIT ERRORS
2 ERROR	PERCENTAGE OF FRAMES WITH TWO SYNC BIT ERRORS
3+ERROR	PERCENTAGE OF FRAMES WITH THREE OR MORE SYNC BIT ERRORS
MODE ERROR	NUMBER OF MODE CHANGES
IVAL TIME	NUMBER OF INVALID TIME COMPARISON
TYPE ERROR	NUMBER OF INVALID DATA TYPE CHANGES
SUBCM COUNT ERROR	NUMBER OF INVALID COMPARISONS OF BUFFER SUBCOM COUNT
OP ID	LINE OPERATOR IDENTIFICATION NUMBER
LOS FRA SYN	NUMBER OF TIMES FRAME SYNC WAS LOST
Q	QUALITY CARD IDENTIFICATION

STA	TAPE NO	EDIT NO	L	DAY	START TIME	STOP TIME	KR	TOTAL FRAME	0 ERROR	1 ERROR	2 ERROR	3+ ERROR	MODE ERROR	IVAL TIME	TYPE ERROR	SUBCM COUNT ERROR	OP ID	LOS FRA SYN	
16	1	1	2	249	6826	7295	1	2619	7369	22	15	2592	9	0	3	5	2	13	Q
20	1	2	2	249	11664	18162	1	41288	7066	126	42	2764	211	180	81	357	2	99	Q
20	2	3	2	249	18211	19037	2	41658	8601	32	3	1362	110	1	31	205	2	99	Q
20	3	4	2	249	18988	19201	2	11869	9627	16	1	353	12	1	0	5	2	19	Q
20	8	5	2	249	21308	23284	1	13467	9193	30	0	775	20	45	2	14	2	17	Q
20	10	6	2	249	23527	24629	1	7653	9073	168	20	736	30	4	7	26	2	9	Q
20	11	7	2	249	24975	25273	0	264	9696	0	0	303	0	6	0	0	2	6	Q
20	13	8	2	250	7022	7750	0	638	9874	0	0	125	0	6	0	0	2	2	Q
20	13	9	2	250	7763	9410	1	10633	8918	70	2	1008	5452	19	1	21	2	13	Q
20	14	10	2	250	16910	18385	1	10245	8254	62	0	1682	27	11	6	60	2	39	Q
5	8	11	2	251	67123	67975	2	47212	9074	4	0	921	92	1	12	127	2	99	Q
20	16	12	2	251	68044	68479	2	11888	9683	0	0	316	8	0	1	3	2	7	Q
20	16	13	2	251	68492	70335	1	12226	9460	0	0	538	4	12	0	6	2	4	Q
5	11	14	2	251	68481	69027	1	3791	9978	0	0	21	0	0	0	0	7	1	Q
5	12	15	2	251	69020	70009	1	5786	8956	0	0	1043	8	2	3	6	7	11	Q
5	13	16	2	251	69962	70917	1	5040	9517	0	0	482	1	3	0	0	7	2	Q
20	18	17	2	251	70616	71412	1	4954	8716	20	4	1259	4	10	0	0	7	16	Q
5	14	18	2	251	70904	71412	1	3204	5911	18	0	4069	3	27	3	6	7	12	Q
20	19	19	2	252	77920	79006	1	7548	7954	549	133	1361	103	15	19	56	7	5	Q
20	19	20	2	252	81012	82506	1	8760	7394	646	127	1831	141	19	38	159	7	21	Q
5	17	22	2	254	74543	74852	1	2142	7591	480	37	1890	16	6	1	5	7	5	Q
20	21	23	2	254	74594	76795	1	15287	9921	3	0	74	3	12	0	1	7	5	Q
5	19	25	2	254	75561	76558	1	6925	8059	950	102	888	102	0	50	127	7	6	Q
5	20	26	2	254	76425	77349	1	6421	7056	836	90	2016	136	0	63	190	7	30	Q
20	22	27	2	254	76675	78267	1	11061	9920	34	0	44	11	0	0	1	7	3	Q
5	23	28	2	254	77353	78267	1	6350	8214	1056	122	606	107	0	25	85	2	2	Q
20	23	29	2	254	86138	852	1	7740	9989	0	0	10	0	2	0	0	2	1	Q
20	24	31	2	255	902	2423	1	9521	9857	1	0	141	1	14	0	0	2	3	Q
5	27	32	2	255	1789	2201	1	2860	6430	1772	290	1506	120	5	35	130	2	5	Q
5	28	33	2	255	4732	5263	1	3686	6204	2034	393	1367	152	5	67	207	2	8	Q
5	28	34	2	255	5210	6004	1	5385	5983	2048	367	1600	203	0	85	312	2	7	Q
20	25	35	2	255	7718	8571	1	5931	9659	0	0	340	0	2	0	1	2	0	Q
20	25	36	2	255	8593	8785	1	1336	9940	0	0	59	0	4	0	0	2	1	Q
20	26	37	2	255	8758	9680	1	5888	9957	10	0	32	4	3	0	0	2	0	Q
20	26	38	2	255	9699	10110	1	2128	9558	4	0	437	5	4	0	0	2	1	Q
5	29	39	2	255	7742	8572	1	5760	6432	1765	319	1482	5219	0	39	228	2	0	Q
5	29	40	2	255	8593	9680	1	6648	5649	2003	497	1848	293	3	36	380	2	7	Q
5	29	41	2	255	9701	10110	1	2248	6098	1734	369	1797	91	3	15	102	2	10	Q
20	27	42	2	257	12012	12801	2	43736	9027	263	47	661	202	1	98	283	2	52	Q
20	29	43	2	257	12834	18289	1	37882	9782	17	4	195	32	3	1	16	7	14	Q
20	34	44	2	257	19141	23162	1	27157	2963	342	135	6559	296	186	112	561	7	99	Q
20	45	45	2	258	2621	9369	1	46736	9697	38	0	263	38	0	3	16	7	18	Q
20	48	46	2	258	23238	30004	1	42382	9331	136	9	522	119	29	4	49	7	25	Q
20	50	47	2	259	66739	67567	2	45992	9804	16	3	175	35	5	2	13	7	16	Q
20	52	48	2	259	67827	69302	1	10245	8803	0	0	1196	20	1	2	5	7	18	Q
20	54	50	2	259	69315	69980	2	36845	9300	84	12	603	85	0	10	103	7	42	Q
5	37	51	2	259	69495	70095	2	33355	8974	142	40	842	163	0	35	234	7	98	Q
20	54	52	2	259	69960	70296	2	18670	8802	112	19	1065	81	1	11	92	7	38	Q
5	37	53	2	259	70080	70473	2	21831	7107	300	87	2504	287	9	74	476	7	99	Q
5	39	54	2	259	70393	71240	2	47072	7155	663	113	2067	579	0	259	1232	7	99	Q
5	41	55	2	259	71671	71848	2	9608	3242	2103	879	3774	238	0	439	1074	7	12	Q
5	42	57	2	259	72412	72501	2	4729	2188	1901	960	4950	122	0	265	454	7	27	Q
5	43	59	2	259	73896	74300	1	2808	9971	0	0	28	0	2	0	0	7	1	Q
5	44	60	2	259	73882	76082	1	15280	8103	175	8	1712	413	2	178	272	7	8	Q

Figure 49–Quality Listing

arrangement of experimenter data, the time field (universal time of the first word of the telemetry frame), status flag fields and necessary subcommutated data, from that 128-frame edit record.

Each experimenter tape will contain one or more files of data (Figure 50). The last file of the tape will be terminated with four End of File Marks. Within each data file on the experimenter's tape, all data records will contain data of like kilobit rate and will be from the same spacecraft data format. Playback data files will never appear on the same tape as real time data files. A file will never contain data from more than one ground station pass, although several different files may have been generated from a single station pass.

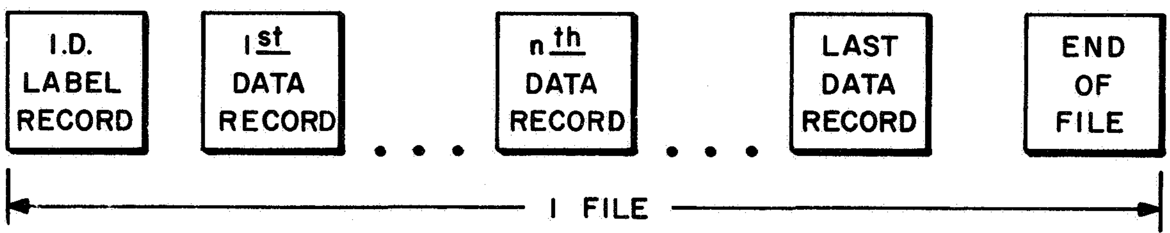


Figure 50—Format of a Decomm Tape File

Each file on the experimenter's tape will correspond to one of the input edit files. An experimenter receiving data from each of a number of edit files will therefore obtain a like number of files of decommutated data. The net effect of the correspondence with the input edit files is that a change in bit rate, spacecraft Equipment Group, or spacecraft data format will result in a new file appearing on an experimenter's decommutated data tape. Experimenter data will be on one-half inch wide magnetic tape written in binary mode (odd parity) with 556 characters to the inch. Each nine-bit telemetered word shall be represented by two six-bit characters. As shown in Figure 41, three zeros shall precede the first (2^8), second (2^7), and third (2^6) highest order bits in the first character. The six low-order bits go in the second character.

The experimenters' data tapes of maximum length (in terms of data files), is given in Figure 51. Experiment Number 14 is listed as void since it is not on the OGO PCM System. Experiment Number 21 is the Housekeeping Tape, another product of decommutation. It contains spacecraft subcommutator information extracted from Channels 97, 98, and 99 during decommutation, and is used as input to two other terminal stage processing programs, the attitude-orbit program and the spacecraft subsystems program. The format of the Housekeeping Tape is given as Figure 52.

MAXIMUM LENGTH OF EXPERIMENTER'S
DATA RECORDS

Experiment	Max. # of data files per tape
49-01	5
49-02	4
49-03	9
49-04	—
49-05	5
49-06	6
49-07	5
49-08	6
49-09	2
49-10	5
49-11	4
49-12	6
49-13	6
49-14	—
49-15	6
49-16	64
49-17	6
49-18	6
49-19	9
49-20	9
49-21	5

Figure 51–Maximum Length of Experimenters data records

The experimenter will receive fixed-length records even when a data dropout occurs. To maintain the standard record length and time consistency within the record, fill data (Figure 41) will be used to fill out the record. A 128-frame record containing fill data only will not be used. When data dropout exceeds the time span of 128 frames, a consequent time gap between records will then occur on the experimenters tape.

Since the major data unit of importance is a file and not a tape, each file will be labeled as shown in Figure 27. Each reel of tape mailed to the experimenter will be labeled with the following information: satellite name, experimenter's name, decommutation run number, experimenter's tape-sequence number from this run, and the number of files written on the experimenter's tape. The

Format For Housekeeping Decomm Tape

Character	Representation
1-6 + 42N	Status Fields
7-12 + 42N	Milliseconds of Day
13-16 + 42N	Spares
17-18 + 42N	Day of Year
19-24 + 42N	Frame Sync (Channels 1,2,3,)
25-42 + 42N	Channel 98, 99 s/c Subcomm
	75 OPEP shaft position
	33, 34, 35 s/c clock
	65, 66, 67 s/c ID

There are 5376 six bit characters/record or
896 thirty-six bit words/record.

Figure 52–Housekeeping Tape Format

Title Binary Record Format

Word No.	Form	Remarks	
0	Fixed Pt.	Fortran data record size indicator = 000375010001 octal. This indicates a total data word count of 253 words.	
1	Floating Pt.	Form of data identification = 76799361	
2-3	Floating Pt.	Satellite identification	
4	Floating Pt.	Date	U.T. Start Time of Satellite Data
5	Floating Pt.	Day Count of Year	
6	Floating Pt.	Seconds of Day	
7	Floating Pt.	Date	U.T. End Time of Satellite Data
8	Floating Pt.	Day Count of Year	
9	Floating Pt.	Seconds of Day	
10	Floating Pt.	$=\Delta t$ in seconds, if tape has equal intervals = 0, if tape has unequal intervals	
11	Floating Pt.	No. of data items in data record = 12 (includes a special type of item as item no. 12)	
12	Floating Pt.	No. of words per data item = 21	
13	Floating Pt.	No. of words per data item that are a function of time (these words follow the time words consecutively) = 16	
14	Floating Pt.	No. of words in data record = 256	
15	Floating Pt.	Spare	
16-26	Floating Pt.	Run identification data	
27	Floating Pt.	Date	Coordinate System Reference Data Time and Position
28	Floating Pt.	Day Count of Year	
29	Floating Pt.	Apparent Sidereal Time in radians	
30-40	Floating Pt.	Some of these are used for harmonics	
41	Floating Pt.	Date	Epoch
42	Floating Pt.	Day Count of Year	
43	Floating Pt.	Seconds of Day	
44	Floating Pt.	Semi-major axis, a (km)	
45	Floating Pt.	Eccentricity, e (ratio)	
46	Floating Pt.	Inclination, I (deg.)	
47	Floating Pt.	Right ascension of ascending node, Ω (deg.)	

Figure 53–Orbit 3A Tape Format

Word No.	Fixed	Remarks
48	Floating Pt.	Rate of change of R.A. of ascending node, (deg./day)
49	Floating Pt.	Argument of perigee, $\dot{\omega}$ (deg.)
50	Floating Pt.	Rate of change of argument of perigee, (deg/day)
51	Floating Pt.	Period, P (min.)
52	Floating Pt.	Rate of change of period, $\dot{P}$ (min./day)
53-253	Floating Pt.	Some of these are used for elements, drags, etc.
254	Fixed Pt.	Check sum of words in word no. 1-253
255	Fixed Pt.	Same as word 0

Data Binary Record Format

Word No.	Fixed	Remarks
0	Fixed Point	Fortran data record size indicator = 000375010001 octal. This indicates a total data word count of 253 words.
1	Floating Pt.	Type of data item indicator = 1 regular satellite data item = 2 ascending node crossing data item = 3 north point data item = 4 descending node data item = 5 south point data item = 6 sunlight entrance data item = 7 sunlight exit data item
2	Floating Pt.	Day of data
3	Floating Pt.	Day Count of Year — Time of Data Item
4	Floating Pt.	Second of Day
5	Floating Pt.	X — Satellite Position Vector in km.
6	Floating Pt.	Y
7	Floating Pt.	Z
8	Floating Pt.	$\dot{X}$ — Satellite Velocity Vector in km./sec.
9	Floating Pt.	$\dot{Y}$
10	Floating Pt.	$\dot{Z}$
11	Floating Pt.	Longitude (deg.) — Geodetic Position
12	Floating Pt.	Latitude (deg.)
13	Floating Pt.	Height above spherioid (km.)

Figure 53 (Continued)—Orbit 3A Tape Format

Word No.	Form	Remarks			
14	Floating Pt.	SX			
15	Floating Pt.	SY	Solar Vector in A.U.		
16	Floating Pt.	SZ			
17	Floating Pt.	L (earth radii)			McIllwain L Parameter
18	Floating Pt.	B (Gauss			Magnetic Field Strength
19	Floating Pt.	Right ascension		(deg.)	Real Field Coord. in
20	Floating Pt.	Declination		(deg.)	an Inertial System
21	Floating Pt.	Ascending node crossing no. (pass no.)			
22-231	Floating Pt.	10 other satellite data items			
232	Floating Pt.	= 99 (may be considered type of data indicator)			
233	Floating Pt.	Year of Data			
234	Floating Pt.	= 999 if no ascending node item occurred. = % of orbit in sunlight if an ascending node item occurred in this record			
235-252		Spares in last item			
253		Spare in record			
254	Fixed Point	Check sum of data words in word no. 1-253			
255	Fixed Point	Same as word 0			

The last valid data item is followed by an item of 9's. If the last valid data item fills a record, a record follows which contains 9's in words 1-21. 9's are equal to 99999999 in floating point. Following the sentinel item record are 2 sentinel records containing 99999999 in word 1. Words 0, 254, and 255 follow the same format as that of regular data records. An EOF ends the tape.

NOTES:

Longitude is positive east of Greenwich, negative west.

Northern latitudes are positive, southern latitudes are negative.

Fortran record size indicator = 000375010001 octal in each record on this tape. This indicates a total word count per record of 253 words.

Date of data = day + 100 (months + year (100)). (Example: Feb. 10, 1962 at 2 hours is recorded as 620210 in date of data, 41 in day count of year and 7200 in seconds of day).

Reference day data of apparent sidereal time is obtained from "The American Ephemeris and Nautical Almanac" for the given year.

Figure 53 (Continued)–Orbit 3A Tape Format computer operator will be instructed by the program to write this information on a label and to attach the label to the tape on the particular channel and unit assigned to the experimenter.

Attitude-Orbit Program

In order that the actual attitude of the spacecraft (as opposed to the ideal or theoretical attitude), be computed, spacecraft data from the Housekeeping Tape must be merged with orbit data (see Figure 53) provided by the Systems and Analysis Section of D. S. Division. Housekeeping data will not be available in the required chronological order until approximately four weeks after launch at which time computation of the actual attitude of the spacecraft will take place. The attitude-orbit program can be run without Housekeeping data to provide the ideal or theoretical attitude of the spacecraft. This will be done only upon request during the four weeks after launch, using predicted Orbit data obtained from the Systems and Analysis group. The format of the attitude-orbit tape is given on Figure 54. The attitude-orbit tape will be in binary mode, 556 characters per inch. Each tape can hold up to and including 3 full orbits.

Spacecraft Commands

Final processing of spacecraft commands on the digital computer is preceded by the transferral of commands to punched cards from the A/D conversion line, and by a comparison of the commands with OGO Control Center Command Reports by Quality Control. Punched cards of verified commands are then reformatted on the UNIVAC 1107, which also produces a command listing (Figure 55). The reformatted command cards are then written on magnetic tape for shipment to experimenters. At the end of each four month period after launch a cumulative summary in the same format of all commands processed through that date, will be shipped to experimenters on magnetic tape.

Analysis Programs for Goddard Experimenters

In addition to the data processing discussed throughout the remainder of this document, data from four GSFC experiments (Experiments 49-13, 49-15, 49-16, 49-20) will be analyzed using programs designed and written under the supervision of Data Processing Branch personnel. These programs will provide the experimenters with a display of the data acquired by their respective experiments in such a manner that their study of the data and final conclusions may be accomplished readily.

ATTITUDE-ORBIT TAPE FORMAT

All data is represented in floating point format:

left 9 bits	characteristic
right 27 bits	mantissa

There is one orbit per file. After the EOF following the last data record, there is a (250 word) record of floating point nines, i.e., 99999999.0, which is followed by an EOF. Orbit 1 starts at the first ascending node after launch. All attitude-orbit tapes have odd parity.

Attitude-Orbit Label Record				
Word	Symbol	Function or Name	Description, Notes	Units
1	ID	Identification		none
2 3 4		Start time of orbit	Greenwich Mean Time (GMT) is used. This is also called Universal Time.	year month day
5 6	tE1	Eclipse start	Start time of eclipse in GMT.	day millisec of day
7 8	tE2	Eclipse end	End time of eclipse in GMT	day millisec of day
9 10	tO1	Orbit start	Start time of orbit. That is, time of the ascending node. The ascending node is that point in the equatorial plane through which the satellite passes while going from south to north. See Figure (c).	day millisec of day

Figure 54–Attitude-Orbit Tape Format and Definitions

Word	Symbol	Function or Name	Description, Notes	Units
11 12	t02	Orbit end	End time in GMT of this orbit and start time of the next orbit. That is, time of the next ascending node. See Figure (c).	day millisec of day
13 14	tn	Noon turn	Time in GMT of predicted noon turn. The paddles are only able to rotate through 180°. When the paddles are looking straight up ($\varphi_p = 270°$) or straight down ($\varphi_p = 90°$) at the sun, the spacecraft turns 180° about the body Z axis, so the paddle may reverse its direction of rotation and still continue to follow the sun. See data record word 121.	day millisec of day
15 16	τ	Epoch	The arbitrary reference time in GMT at which the orbital elements were computed.	day millisec of day
17	Δt	Sampling rate	The values in the data records are given at intervals of $t_a + \Delta t$. The value of Δt is expected to be 60,000 milliseconds (1 min).	milliseconds
18		Orbit number	Orbit zero is from launch to the first ascending node. Orbit one starts at the first ascending node	none

Figure 54–Attitude-Orbit Tape Format and Definitions (Continued)

Word	Symbol	Function or Name	Description, Notes	Units
			and ends at the second a ascending node. The n^{th} orbit starts at the n^{th} ascending node. See Figure (c).	
19	a	Semi-major axis	The semi-major axis of the orbital ellipse (1 Earth radius = 6371.2 km). See Figure (a).	earth radii
20	e	Eccentricity	The eccentricity of the orbital ellipse. See Figure (a).	none
21	i	Inclination	The angle of the orbital plane and the earth's equatorial plane. See Figure (b).	degrees
22	Ω	Longitude of ascending node	The angle between the Geocentric Equatorial Inertial (GEI) X axis (Υ) and the position vector of the ascending node. See Figure (d).	degrees
23	$\dot{\Omega}$		Rate of change of Ω.	degrees/day
24	ω	Argument of perigee	Perigee is that orbital point which is nearest the earth. ω is the angle between the position vector of the ascending node and the position vector of perigee. See Figure (c).	degrees
25	$\dot{\omega}$		Rate of change of ω.	degrees/day

Figure 54–Attitude-Orbit Tape Format and Definitions (Continued)

Word	Symbol	Function or Name	Description, Notes	Units
26	T	Period	The time required to make one orbit.	minutes
27	$\dot{T}$		Rate of change of T.	minutes/day
28-99			Spares	
100	r	Spin rate	If the spacecraft is spinning about an axis which is stabilized with respect to the craft, the spin rate, r, is given as a positive number.	degree/sec
101	$\dot{r}$		Rate of change of r	degrees/sec/day
102-104	A	GEI spin axis	A = (Ax, Ay, Az) and is the spin axis as a unit vector in GEI coordinates A is defined so the spin rate, r, is positive with respect to the right-hand rule	none
105-107	Ab	Body spin axis	Ab = (Abx, Aby, Abz) is the spin axis as a unit vector represented in body coordinates. This representation will not change when the spin axis is stabilized with respect to the spacecraft.	none
108-116	R1	First spin matrix	In each of R1, R2, and R3, the first three words contain the values in the top	none

Figure 54—Attitude-Orbit Tape Format and Definitions (Continued)

Word	Symbol	Function or Name	Description, Notes	Units
117-125	R2	Second spin matrix	row of the matrix, the second three words contain the values in the middle row of the matrix, and the last three words contain the bottom row of the matrix.	
126-134	R3	Third spin matrix		
			Let: $b(T_1) = \begin{bmatrix} bXx & bYx & bZx \\ bXy & bYy & bZy \\ bXz & bYz & bZz \end{bmatrix}$ where bXx through bZz are defined in data record words 49-57, i.e., bx, by, and bz at T_1 where T_1 is defined in word 1 of the data record. Now let $\bar{b}(T)$ be the interpolation of $b(T_1)$ to time T with no correction for spin. Then: $b(T) = \bar{b}(T)\ R1 + \bar{b}(T)\ R2 \sin \sigma (T) + b(T)\ R2 \cos \sigma (T) = \bar{b}(T) \left\| R1 + R2 \sin \sigma (T) + R3 \cos \sigma T \right\|$ where b(T) defines the body coordinate axes in GEI coordinates, as in $b(T_1)$, and	

Figure 54–Attitude-Orbit Tape Format and Definitions (Continued)

Word	Symbol	Function or Name	Description, Notes	Units
			σ (T) is the angle from the spin vector $A(T_1)$ = (Ax, Ay, Az) at time T_1 to spin vector A(T) at time T. See Application 3 in Appendix B for more details.	
135-250			Spares	
Attitude-Orbit Data Record				
1	T1	Time	Day count.	days
2			Milliseconds of day in Greenwich Mean Time (GMT). All data in this record corresponds to T_1.	milliseconds
3 4 5	TL	Local Time	Local Apparent Solar Time of subsatellite point.	hours minutes tenths of minutes
6	α	Right ascension	The angle from the first point of Aries (♈) to the equatorial plane projection of the spacecraft position vector. See Figure (e).	degrees
7	δ	Declination	The angle from the equatorial plane projection of the spacecraft position vector to the	degrees

Figure 54–Attitude-Orbit Tape Format and Definitions (Continued)

Word	Symbol	Function or Name	Description, Notes	Units
			spacecraft position vector. See Figure (e).	
8,9, 10	P	Position vector	P = (Px, Py, Pz) is the position vector of the spacecraft in Geocentric Equatorial Inertial (GEI) coordinates. GEI co-ordinates are also known as Universal coordinates. See Figure (e).	kilometers
11,12, 13	V	Velocity vector	V = (Vx, Vy, Vz) is the direction and magnitude of the spacecraft velocity in GEI coordinates. See Figure (e).	kilometers/ sec
14,15, 16	S	Solar vector	S = (Sx, Sy, Sz) is the position vector of the sun in GEI coordinates.	kilometers
17	φ	Latitude	Geodetic latitude of sub-satellite point on the spheroid. North is +, South is −. The International Spheroid is used: a = semi-major axis = 6378.388 km f = flattening = 297. = a/a-b.	degrees
18	λ	Longitude	Geodetic longitude of sub-satellite point on the spheroid. East is +, West is −.	degrees

Figure 54–Attitude-Orbit Tape Format and Definitions (Continued)

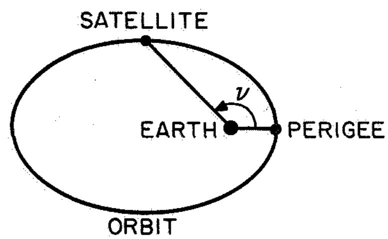
Word	Symbol	Function or Name	Description, Notes	Units
19	h	Height	Height of satellite above the spheroid. See Figure (e).	kilometers
20	ν	True anomaly	Orbital central angle between perigee and satellite with earth as focus. See Figure (a). 	degrees
21	Φ	Sun earth satellite angle	The angle between the satellite position vector and the sun position vector.	degrees
22,23, 24	bXI	Ideal body roll axis	bXI = (bXIx, bXIy, bXIz) is the ideal body X axis as a unit vector in GEI coordinates.	none
25,26, 27	bYI	Ideal body pitch axis	bYI = (bYIx, bYIy, bXIz) is the ideal body Y axis as a unit vector in GEI coordinates.	none
28,29, 30	bZI	Ideal body yaw axis	bZI = (bZIx, bZIy, bZIz) is the ideal body Z axis as a unit vector in GEI coordinates.	none

Figure 54–Attitude-Orbit Tape Format and Definitions (Continued)

Word	Symbol	Function or Name	Description, Notes	Units
31,32 33	PXI	Ideal paddle roll axis	PXI = (PXIx, PXIy, PXIz) is the paddle X axis as a unit vector in GEI coordinates.	none
34,35, 36	PYI	Ideal paddle pitch axis	PYI = (PYIx, PYIy, PYIz) is the paddle Y axis as a unit vector in GEI coordinates.	none
37,38, 39	PZI	Ideal paddle yaw axis	PZI = (PZIx, PZIy, PZIz) is the paddle Z axis as a unit vector in GEI coordinates.	none
40,41 42	EXI	OPEP ideal roll axis	EXI = (EXIx, EXIy, EXIz) is the OPEP X axis as a unit vector in GEI coordinates.	none
43,44, 45	EYI	OPEP ideal pitch axis	EYI = (EYIx, EYIy, EYIz) is the OPEP Y axis as a unit vector in GEI coordinates.	none
46,47, 48	EZI	OPEP ideal yaw axis	EZI = (EZIx, EZIy, EZIz) is the OPEP Z axis as a unit vector in GEI coordinates.	none
49,50, 51	bX	Actual body roll axis	bX = (bXx, bXy, bXz) is the body X axis as a unit vector in GEI coordinates.	none
52,53, 54	bY	Actual body pitch axis	bY = (bYx, bYy, bYz) is the body Y axis as a unit vector in GEI coordinates.	none

Figure 54–Attitude-Orbit Tape Format and Definitions (Continued)

Word	Symbol	Function or Name	Description, Notes	Units
55,56, 57	bZ	Actual body yaw axis	bZ =(bZx, bZy, bZz) is the body Z axis as a unit vector in GEI coordinates.	none
58,59, 60	PX	Actual paddle roll axis	PX = (PXx, PXy, PXz) is the paddle X axis as a unit vector in GEI co- ordinates.	none
61,62, 63	PY	Actual paddle pitch axis	PY = (PYx, PYy, PYz) is the paddle Y axis as a unit vector in GEI co- ordinates.	none
64,65, 66	PZ	Actual paddle yaw axis	PZ = (PZx, PZy, PZz) is the paddle Z axis as a unit vector in GEI co- ordinates.	none
67,68, 69	EX	Actual OPEP roll axis	EX = (EXx, EXy, EXz) is the OPEP X axis as a unit vector in GEI co- ordinates.	none
70,71, 72	EY	Actual OPEP pitch axis	EY = (EYx, EYy, EYz) is the OPEP Y axis as a unit vector in GEI co- ordinates.	none
73,74, 75	EZ	Actual OPEP yaw axis	EZ = (EZx, EZy, EZz) is the OPEP Z axis as a unit vector in GEI co- ordinates.	none
76	R	Magnetic range	$R = L \cos^2 (\varphi m)$ where L is the McIlwain parameter of the magnetic shell con- taining the spacecraft, and	earth radii

Figure 54–Attitude-Orbit Tape Format and Definitions (Continued)

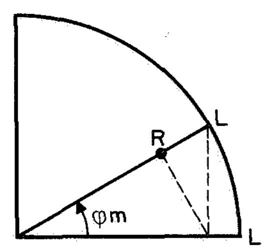
Word	Symbol	Function or Name	Description, Notes	Units
			φ m is the magnetic latitude of the spacecraft. Note that R is analogous to, but not equal to, $\|P\|$, the magnitude of the position vector.	
77	φ m	Magnetic latitude	The latitude of the spacecraft in geomagnetic coordinates. At the magnetic equator φm = 0. See Figure (f).	degrees
			 RELATIONSHIP BETWEEN L AND R	
78	L	McIllwain parameter	A magnetic shell parameter which is almost constant along lines of force. L is used to label each shell. Note that in the ideal case (dipole field), L is the magnitude of the position vector on the magnetic equator of the line of force. See Figure (f).	earth radii
79	B	Field strength	The magnitude of magnetic field strength at	gamma

Figure 54–Attitude-Orbit Tape Format and Definitions (Continued)

Word	Symbol	Function or Name	Description, Notes	Units
			the spacecraft. See Figure (c).	
80	B/B_0	Ratio	B is defined above. B_0 is the equatorial field strength of the shell. See Figure (f).	none
81	φI	Ingress latitude	The latitude of the point on the surface of the earth at which the magnetic line of force passing through the spacecraft enters the earth. See Figure (f).	degrees
82	λI	Ingress longitude	The longitude of the point on the surface of the earth at which the magnetic line of force passing through the spacecraft enters the earth. See Figure (f).	degrees
83	φE	Egress latitude	The latitude of the point on the surface of the earth at which the magnetic line of force passing through the spacecraft leaves the earth. See Figure (f).	degrees
84	λE	Egress longitude	The longitude of the point on the surface of the earth at which the magnetic line of force passing through the spacecraft leaves the earth. See Figure (f).	degrees

Figure 54—Attitude-Orbit Tape Format and Definitions (Continued)

Word	Symbol	Function or Name	Description, Notes	Units
85,86, 87	$\hat{B}$	B vector	$\hat{B}$ = (Bx, By, Bz) is the direction of the magnetic line of force expressed as a unit vector in the GEI system.	none
88,89, 90	Bb	B Body	Bb = (Bbx, Bby, Bbz) is the unit direction vector, $\hat{B}$, expressed in the body coordinate system.	none
91,92, 93	BP	B Paddle	BP = (BPx, BPy, BPz) is the unit direction vector, $\hat{B}$, expressed in the paddle coordinate system.	none
94,95, 96	BE	B OPEP	BE = (BEx, BEy, BEz) is the unit direction vector, $\hat{B}$, expressed in the OPEP coordinate system.	none
97,98, 99	$B\hat{B}G$	$B\hat{B}$ geodetic	$B\hat{B}G$ is the product of the field strength, B, times the unit vector, $\hat{B}G = (\hat{B}GE, \hat{B}GN, \hat{B}GV)$, where $(\hat{B}GE, \hat{B}GN, \hat{B}GV)$ is the unit vector, $\hat{B}$, expressed in geodetic coordinates. Note that this is a left-handed system instead of a right-handed system.	

Figure 54–Attitude-Orbit Tape Format and Definitions (Continued)

Word	Symbol	Function or Name	Description, Notes	Units
100-108	TGSE	GSE transformation	This is the transformation matrix which changes the GEI representation of a vector to GSE (Geocentric Solar Ecliptic) representation. The vector remains fixed. Words 100, 101, and 102 contain the values for the top row of the matrix, words 103, 104, and 105 contain the values for the middle row of the matrix, and words 106, 107, and 108 contain the values of the bottom row of the matrix. Any vector, v, in GEI is transformed by the relation $v_{GSE} = (\text{matrix})\, v_{GEI} = \text{TGSE}\, v_{GEI}$	none
109-117	TGSM	GSM transformation	This is the transformation matrix which changes the GEI representation of a vector to GSM (Geocentric Solar Magnetic) representation. The vector remains fixed. Words 109, 110, and 111 contain the top row of the matrix, words 112, 113, and 114 contain middle row of the matrix, and words 115, 116 and 117 contain the bottom row of the matrix.	none

Figure 54—Attitude-Orbit Tape Format and Definitions (Continued)

Word	Symbol	Function or Name	Description, Notes	Units
118-120	A	GEI spin axis	A = (Ax, Ay, Az) is the unit spin axis in GEI co-ordinates.	none
121	φP	Paddle angle	The paddle shaft angle is φP = 90° when the paddle is looking in the direction of the body +Z axis (toward earth), it is φ_p = 180° when the paddle is looking in the -Y body axis direction (away from the OPEP), and φP = 270° when the paddle is looking in the body -Z direction (away from the earth). Movement of the paddle is restricted such that $90° \leq \varphi_p \leq 180°$.	
122	ΨE	OPEP angle	The OPEP shaft angle is ΨE = 0 when the OPEP is looking in the body +X direction (away from the spacecraft), and ΨE = 90° when the OPEP is looking in the body +Y direction (away from the spacecraft), and ΨE = 270° when the OPEP is looking in the body -Y direction (looking over the spacecraft). The OPEP can rotate through more than 360°.	degrees

Figure 54—Attitude-Orbit Tape Format and Definitions (Continued)

Word	Symbol	Function or Name	Description, Notes	Units
123	none	Attitude data flag	This flag is assigned the floating point value -1.0 if any housekeeping discrepancies are detected.	none
124	none	NO DATA flag	A value of 2^K or any combination of $2^{K1} \cdot 2^{K2} \cdots 2^{K5}$ in the NO DATA flag signifies that the data indicated by the flag was not available. The ideal value is used when the actual value is not available. The following table is used in words 124 and 125: bit value — data 2^0 roll 2^1 pitch 2^2 yaw 2^3 ψE = OPEP shaft angle 2^4 φP = Paddle shaft angle 2^5 Array error (Note that word 124 is floating point.)	
125	none	SUSPECT DATA flag	This word warns that the indicated data is of a suspected nature. The indica-	none

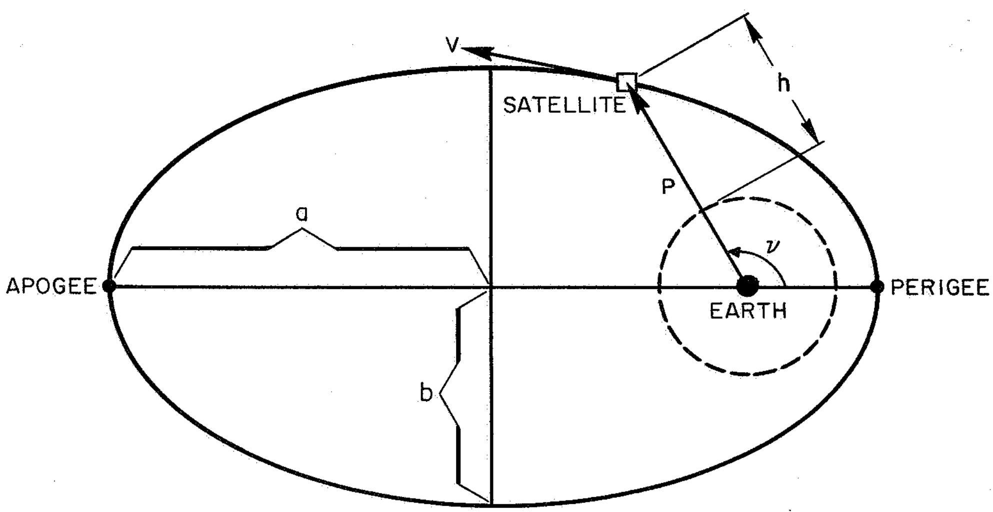
Figure 54–Attitude-Orbit Tape Format and Definitions (Continued)

Word	Symbol	Function or Name	Description, Notes	Units
			tions are the same as for word 124.	
126	T2	Time	T2 = T1 + Δt and is defined the same as T1.	none
127-250			Defined the same as words 2-125 except that time T2 is used.	none

Abbreviations

EOF	End of File
GEI	Geocentric Equatorial Inertial (coordinates)
GMT	Greenwich Mean Time
GSE	Geocentric Solar Equatorial
GSM	Geocentric Solar Magnetic

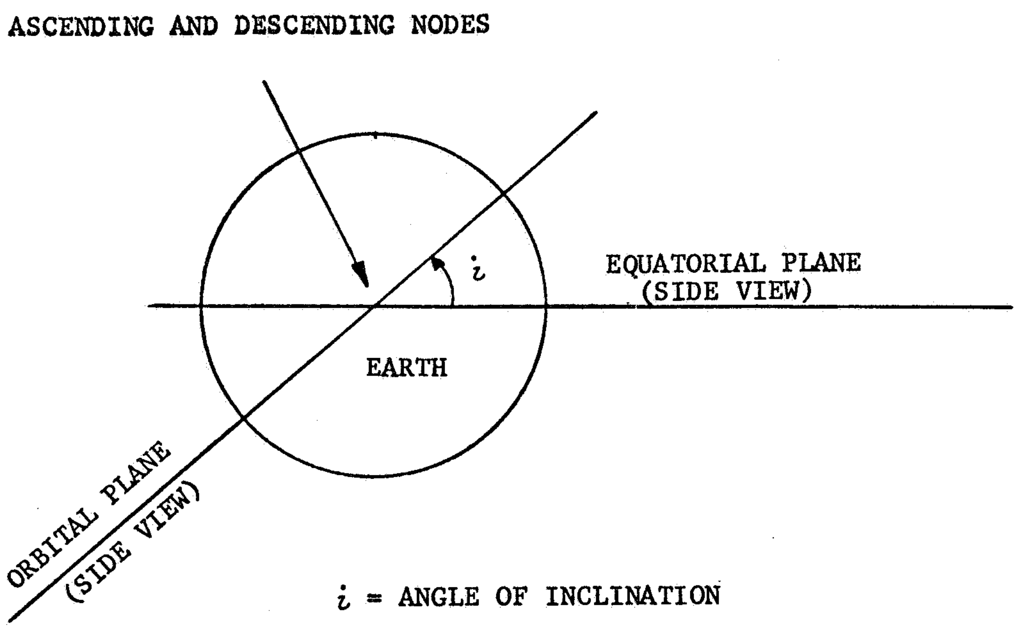
Figure 54–Attitude-Orbit Tape Format and Definitions (Continued)



$e = \sqrt{1 - b^2/a^2}$ = ECCENTRICITY
a = SEMI-MAJOR AXIS
b = SEMI-MINOR AXIS
P = POSITION VECTOR
V = VELOCITY VECTOR
ν = TRUE ANOMALY
h = HEIGHT OF SATELLITE

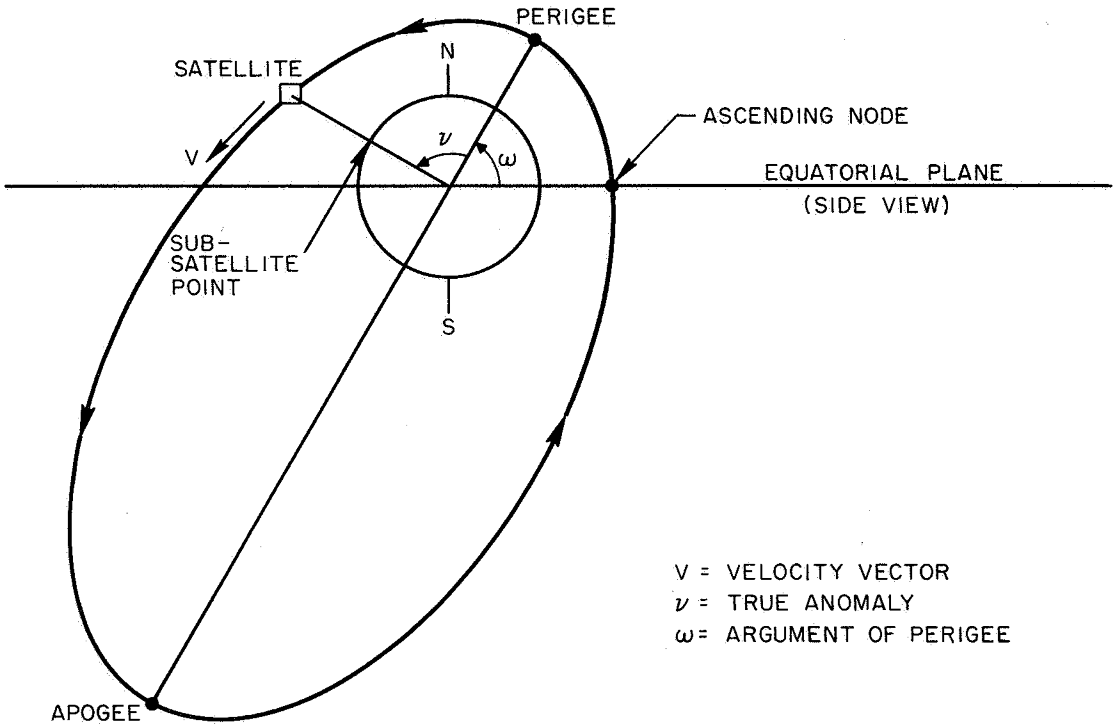
(a)

Figure 54–Attitude-Orbit Tape Format and Definitions (Continued)



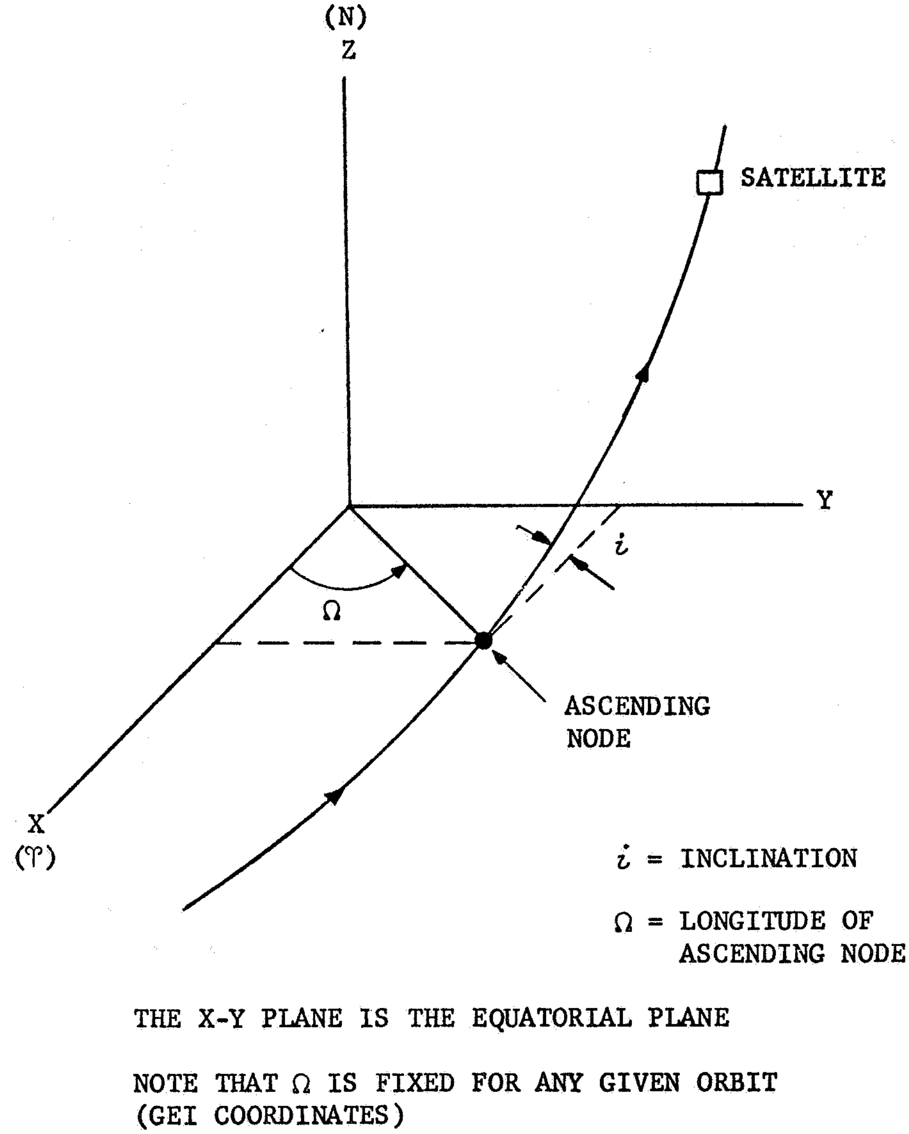
(b)

Figure 54–Attitude-Orbit Tape Format and Definitions (Continued)



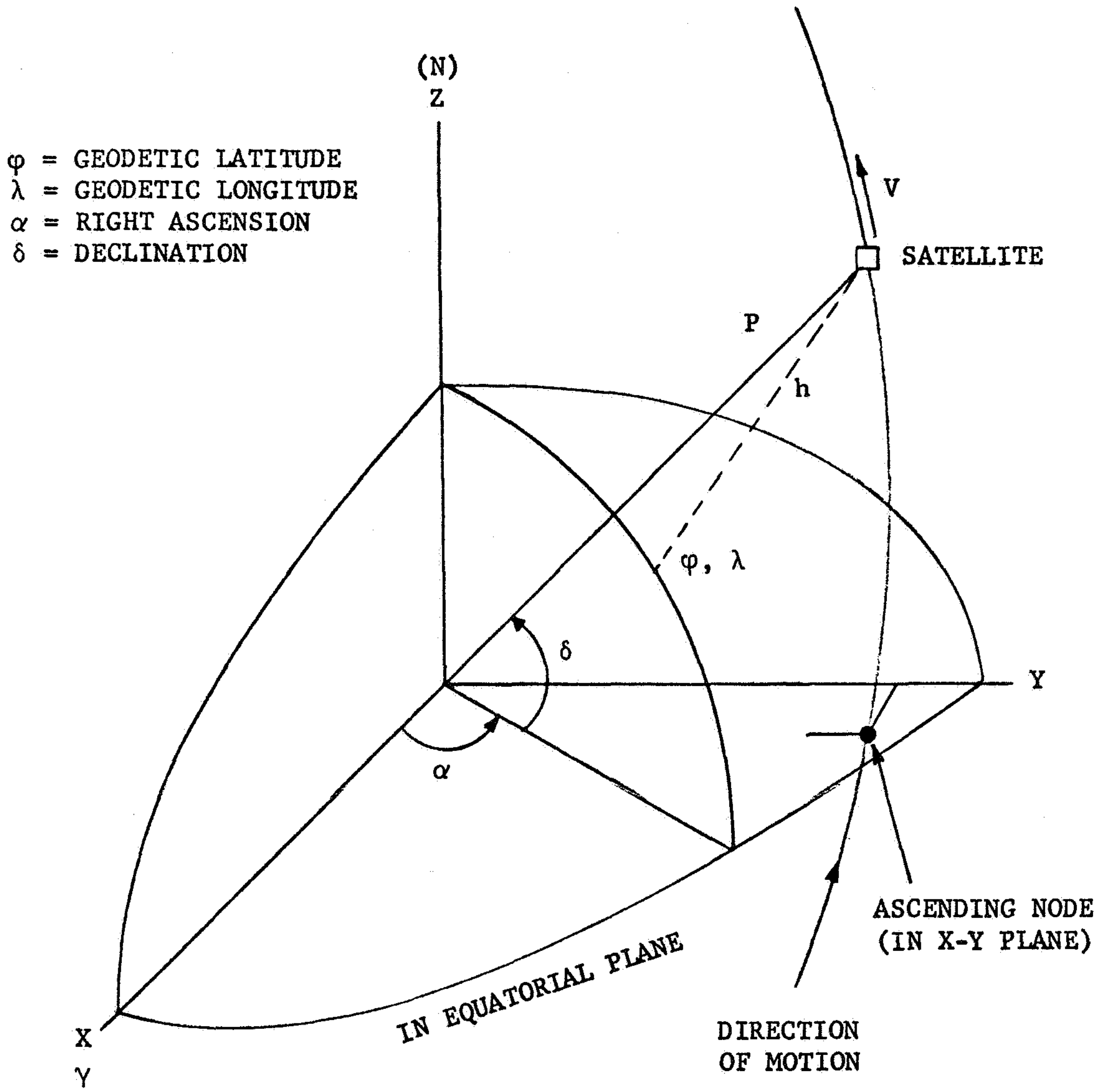
(c)

Figure 54–Attitude-Orbit Tape Format and Definitions (Continued)



(d)

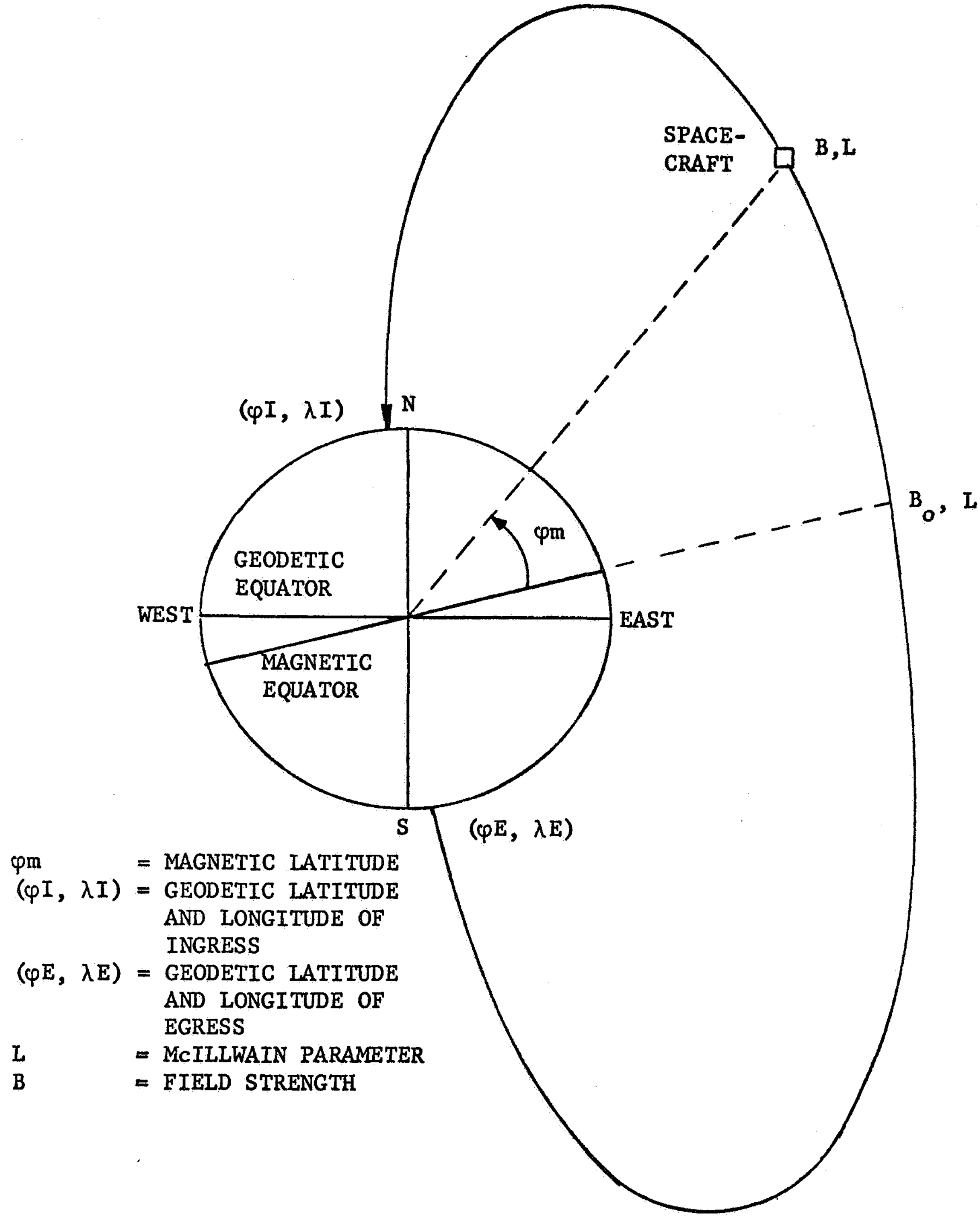
Figure 54–Attitude-Orbit Tape Format and Definitions (Continued)



NOTE THAT α IS MEASURED FROM THE FIRST POINT ARIES (♈) WHICH IS FIXED, AND λ IS MEASURED FROM GREENWICH WHICH SPINS WITH THE EARTH.

(e)

Figure 54–Attitude-Orbit Tape Format and Definitions (Continued)



(f)

Figure 54–Attitude-Orbit Tape Format and Definitions (Continued)

S49 COMMAND CARDS

EACH CARD CONTAINS THE PERTINENT INFORMATION FOR ONE COMMAND.
COLUMN ASSIGNMENTS ARE GIVEN BELOW.

SSSSS	SATELLITE ID
YY	YEAR
GGG	GROUND STATION AT WHICH ANALOG DATA TAPE WAS RECORDED
TTTT	ANALOG DATA TAPE NUMBER CONTAINING DATA CORRESPONDING IN
DDD	DAY COMMAND WAS SENT
HH	HOUR COMMAND WAS SENT
MM	MINUTE COMMAND WAS SENT
	TIME TO THE TIME OF THE COMMAND
SS	SECOND COMMAND WAS SENT
MILLISEG	TIME IN MILLISECONDS OF THE DAY COMMAND WAS SENT
AAA	COMMAND ADDRESS IN OCTAL
CCC	COMMAND CODE IN OCTAL
XXXXXX	DESCRIPTION OF COMMAND FUNCTION

SSSSSYYGGGTTTT	DDD	HH	MM	SS	MILLISEC	AAACCC	XXXXXXXXXXXXXXXXXXXXXXXXX
6454165 201421	50	22	10	30	79830000	44041	A EG 2 TO TAPE SELECT
6454165 201421	50	22	18	45	80325000	44253	X17 PC 40 ON
6454165 201421	50	22	18	57	80337000	44114	X17 IC 17
6454165 201421	50	22	19	7	80347000	44024	C XMTR SPEC PURP ON
6454165 201421	50	22	22	24	80544000	44253	X17 PC 40 ON
6454165 201421	50	22	22	33	80553000	44114	X17 IC 17
6454165 201421	50	22	23	39	80619000	44020	C XMTR WIDE A ON
6454165 201421	50	22	25	53	80753000	44253	X17 PC 40 ON
6454165 201421	50	22	26	3	80763000	44114	X17 IC 17
6454165 201423	50	22	30	21	81021000	44042	A TAPE 2 ON
6454165 201421	50	22	30	21	81021000	44042	A TAPE 2 ON
6454165 201421	50	22	30	42	81042000	44253	X17 PC 40 ON
6454165 201423	50	22	30	42	81042000	44024	C XMTR SPEC PURP ON
6454165 201423	50	22	30	42	81042000	44253	X17 PC 40 ON
6454165 201421	50	22	30	42	81042000	44024	C XMTR SPEC PURP ON
6454165 201423	50	22	30	44	81044000	44206	X5 PC 13 ON
6454165 201423	50	22	30	44	81044000	44207	X7 PC 15 ON
6454165 201421	50	22	30	44	81044000	44206	X5 PC 13 ON
6454165 201421	50	22	30	44	81044000	44207	X7 PC 15 ON
6454165 201423	50	22	30	45	81045000	44300	X9 PC 17 ON
6454165 201423	50	22	30	45	81045000	44303	X11 PC 23 ON
6454165 201421	50	22	30	45	81045000	44300	X9 PC 17 ON
6454165 201421	50	22	30	45	81045000	44303	X11 PC 23 ON
6454165 201423	50	22	30	46	81046000	44302	X11 PC21 ON
6454165 201423	50	22	30	47	81047000	44304	X12 PC 25 ON
6454165 201423	50	22	30	47	81047000	44344	X13 PC 26 ON
6454165 201421	50	22	30	47	81047000	44304	X12 PC 25 ON
6454165 201421	50	22	30	47	81047000	44344	X13 PC 26 ON
6454165 201423	50	22	30	48	81048000	44252	X5 PC 38 ON
6454165 201423	50	22	30	48	81048000	44345	X15 PC 28 ON
6454165 201421	50	22	30	48	81048000	44252	X5 PC 38 ON
6454165 201421	50	22	30	48	81048000	44345	X15 PC 28 ON
6454165 201423	50	22	30	49	81049000	44306	X15 PC 29 ON
6454165 201421	50	22	30	49	81049000	44306	X15 PC 29 ON
6454165 201423	50	22	30	50	81050000	44251	X15 PC 36 ON

*The format of the Command Listing above applies to both OGO-B and OGO-A (S-49). The OGO-A command list above will be replaced by OGO-B commands at final publication.

Figure 55–Command Listing

S49 SATELLITE PROCESSING PAGE 008

STA	TAPE NO	FILE NO	DATE RECORD	PASS NO		START TIME	STOP TIME	BUF NO	L	EDIT TAPE	EDIT FILE	RECVD DATE	DIGIT DATE	EDIT DATE	DECOM DATE	SHIP DATE	COMMENTS
ROS	0398	01	641017	0016	D	025646	045215	0247	C4	221	01	41020	41124	41207	50106	50106	*
ROS	0403	01	641017	0016	D	044949	060104	0248	C4	222	01	41020	41124	41207	50106	50106	*
ROS	0407	01	641017	0017	D	183312	184602	0249	C4	223	01	41021	41124	41207	50106	50106	*
ROS	0411	01	641017	0017	D	191058	200748	0250	C4	224	01	41021	41124	41207	50106	50106	*
ROS	0414	01	641017	0017	D	200731	202132	0251	C4	225	01	41021	41124	41207	50106	50106	*
ROS	0415	01	641017	0017	D	202120	210710	0252	C4	226	01	41021	41124	41207	50106	50106	*
ROS	0418	01	641017	0017	D	210731	212104	0253	C4	227	01	41021	41124	41207	50106	50106	*
ROS	0420	01	641017	0017	D	212134	221710	0254	C4	228	01	41021	41124	41207	50106	50106	*
ROS	0422	01	641017	0017	D	221731	223057	0255	C4	229	01	41021	41124	41207	50106	50106	*
ROS	0424	01	641017	0017	D	223059	232712	0759	C4	305	01	41026	41215	41220	50106	50106	*
ROS	0427	01	641017	0017	D	232700	234001	0257	C4	230	01	41021	41124	41207	50106	50106	*
ROS	0428	01	641017	0017	A	233900	234200					41021	UD20				*
ROS	0429	01	641017	0017	D	234132	003708	0258	C4	231	01	41026	41124	41207	50106	50106	*
ROS	0431	01	641018	0017	D	003555	013208	0259	C4	232	01	41026	41124	41207	50106	50106	*
ROS	0435	01	641018	0017	D	013112	022707	0260	C4	233	01	41026	41124	41207	50106	50106	*
ROS	0438	01	641018	0017	D	022612	032206	0261	C4	234	01	41021	41124	41207	50106	50106	*
ROS	0441	01	641018	0017	D	032111	041706	0262	C4	235	01	41021	41124	41207	50106	50106	*
ROS	0444	01	641018	0017	D	041610	041838	0263	C4	236	01	41021	41124	41207	50106	50106	*
SKA	0189	01	641018	0017	A	050000	055700					41022	UT10				*
SKA	0192	01	641018	0017	A	060000	065700					41022	UT10				*
SKA	0188	01	641018	0017	A	065700	075300					41022	UT10				*
SKA	0193	01	641018	0017	A	075700	085200					41022	UT10				*
SKA	0203	01	641018	0017	A	085200	094700					41022	UT10				*
SKA	0201	01	641018	0017	A	094700	104300					41022	UT10				*
SKA	0205	01	641018	0017	A	104200	113200					41022	UT10				*
JOB	0115	01	641018	0017	D	121850	135706	0264	C4	243	01	41026	41124	41207	50106	50106	*
JOB	0116	01	641018	0017	D	135708	154742	0265	C4	244	01	41028	41124	41207	50106	50106	*
JOB	0117	01	641018	0017	D	154743	173818	0730	C4	336	01	41028	41214	41215	50106	50106	*
JOB	0118	01	641018	0017	D	173324	174313	0731	C4	337	01	41028	41214	41215	50106	50106	*
ROS	0446	01	641018	0017	D	174304	183858	0268	C4	247	01	41021	41124	41207	50107	50107	*
ROS	0447	01	641018	0017	D	183832	203134	0269	C4	248	01	41021	41124	41207	50107	50107	*
ROS	0448	01	641018	0017	D	202908	222210	0270	C4	249	01	41021	41124	41207	50107	50107	*
ROS	0449	01	641018	0017	D	221943	001245	0271	C4	250	01	41021	41124	41207	50107	50107	*
ROS	0450	01	641019	0017	D	001019	020321	0272	C4	251	01	41021	41124	41207	50107	50107	*
ROS	0451	01	641019	0017	D	020054	035624	0273	C4	252	01	41021	41124	41207	50107	50107	*
ROS	0452	01	641019	0017	D	035357	054927	0274	C4	253	01	41021	41124	41207	50107	50107	*
ROS	0453	01	641019	0017	A	054400	055100					41021	UD20				*
ROS	0454	01	641019	0017	D	193201	210750	0745	C4	512	01	41026	41215	50105	50107	50108	*
ROS	0455	01	641019	0017	D	210524	230054	0276	C4	255	01	41026	41124	41207	50107	50108	*
ROS	0456	01	641019	0017	D	225559	005129	0277	C4	256	01	41026	41124	41207	50107	50108	*
ROS	0457	01	641020	0017	D	004902	024205	0278	C4	257	01	41026	41124	41207	50107	50108	*
ROS	0458	01	641020	0017	D	023938	043240	0279	C4	258	01	41026	41124	41207	50107	50108	*
ROS	0459	01	641020	0017	D	043013	062811	0280	C4	259	01	41026	41124	41207	50107	50108	*
JOB	0119	01	641020	0018	D	103125	104547	0281	C4	260	01	41029	41125	41207	50107	50108	*
JOB	0120	01	641020	0018	D	104410	105820	0282	C4	261	01	41029	41125	41207	50107	50108	*
JOB	0123	01	641020	0018	D	105811	110603	0283	C4	262	01	41029	41125	41207	50107	50108	*
JOB	0126	01	641020	0018	D	113107	121217	0284	C4	263	01	41029	41125	41207	50107	50108	*
JOB	0127	01	641020	0018	D	121207	122606	0285	C4	264	01	41029	41125	41207	50107	50108	*
JOB	0128	01	641020	0018	D	122626	132202	0286	C4	265	01	41029	41125	41207	50107	50108	*
JOB	0129	01	641020	0018	D	131917	141511	0287	C4	266	01	41029	41125	41207	50107	50108	*
JOB	0130	01	641020	0018	D	141339	150915	0288	C4	267	01	41029	41125	41207	50107	50108	*
JOB	0131	01	641020	0018	D	150820	160301	0289	C4	268	01	41029	41125	41207	50107	50108	*
ROS	0460	01	641020	0018	D	155311	165305	0733	C4	338	01	41026	41214	41215	50107	50108	*
ROS	0461	01	641020	0018	D	165210	170218	0291	C4	270	01	41026	41125	41207	50107	50108	*
ROS	0462	01	641020	0018	D	170215	171602	0292	C4	271	01	41028	41125	41207	50107	50108	*

Figure 56–Chronological Listing

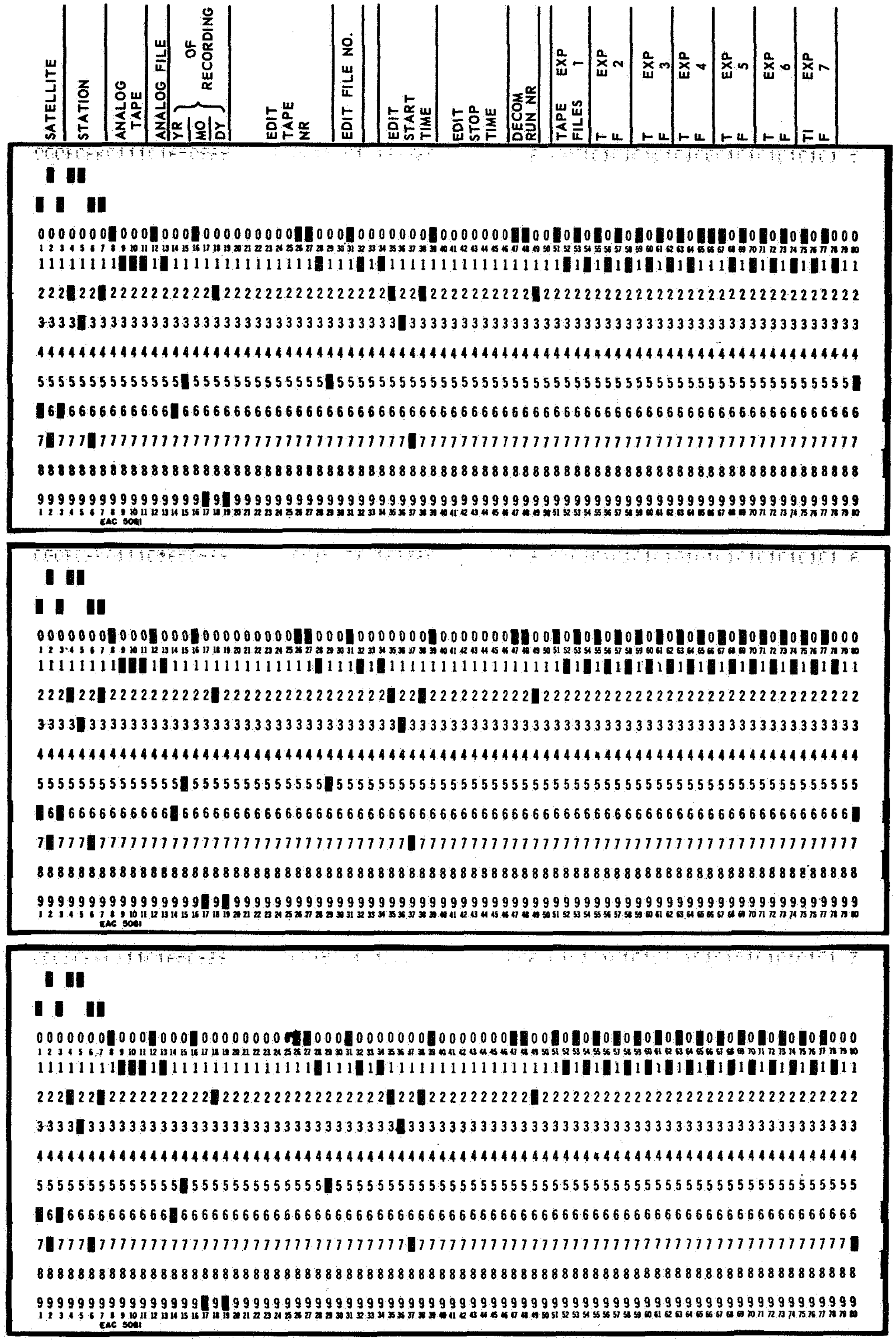


Figure 57–Decomm Card Format

Spacecraft Subsystem Processing

Processing of the S/C subsystem data falls into two categories: launch support and normal production phase. Operationally the processing of this data is shown in Figures 65 through 71. The launch support phase provides the OGO Project Office with plots and printouts of specified data on a near real time basis for the purpose of furnishing back-up support to the Control Center as well as complementing the processing and analysis done in the Control Center. The processing done in the normal production phase is used for detailed analysis of spacecraft history and/or failure analysis, etc.

The following pages represent the OGO Project Office data processing requirements for OGO-B. The listings are arranged by subsystem. The plots will be generated in the order of the listings and overlays placed at the end of each subsystem film strip. Three sets of film will be generated with one set delivered to Ken Kissen in the OGO Project Office, one set sent to TRW/STL and the third set sent to John Quann of the Telemetry Computation Branch.

The OGO-B requirements and program will be very similar to that for OGO-C. Such modifications for different calibrations & channel assignments which are necessary are relatively easy to add to update the program. In the list of requirements on the following pages the different subsystems are divided into separate display groups. This is how the data will normally be processed. However the case may arise where plots from different groups might be needed in one group. The program has this flexibility – to build display groups using parameter cards as input.

Real Time, Main Commutator Mode – 5 minutes of data per plot will be processed for a real time pass. This can represent 130 samples/parameter or 26 samples/minute at the 64 kb rate.

Real Time and Data Storage Accelerated Subcomm Mode – 2 minute sampling will be used primarily during early orbital operations for determining that the 0.5° sec pitch rate is proper, that 2 complete earth acquisition cycles occur every 24 minutes, etc. Once these plots verify the proper functioning of the ACS the S/C can be commanded to start earth acquisition at the appropriate time.

Data Storage Main Commutator and Flexible Format Mode – 1 orbit and 1 week plots will comprise the requirements for the normal production phase. All plots will be sufficiently labeled as to plot scale, parameter, time, etc. Examples of some plots are given in Figure 72. (Note S-50 data is used in the figures). Only playback data will be used as input in the generation of these plots.

Note: The time period covered by the data plots may be changed by simply inserting a card specifying the time interval desired.

The listing is as follows:

Set 1 Conditions: Data Mode ASC RT & DS, ACS Mode 1, 2A, 2B, or 2C
X (abscissa) = Time

Plot #	Time Scale	Parameter	Parameter Scale	Remarks
1	24 min & 2 min	A1	1000 to 3000 psia	
	"	A3	10° to 30°	
	"	A21,A22	4 levels	Gas jets (events) should be plotted as number of firing. Use all samples.
2	"	A4	±8°	
3	"	A5	±8°	
4	"	A7, A38, A39	Events	
5	"	A10	±25°	
6	"	A11	±25°	
7	"	A17	±250 to 1400 RPM	Use A20 to affix signs where applicable to A17, A18, A19.
	"	A31	Indicate roll wh. on	
	"	A20 (wheel dir)		
8	"	A18	±250 to 1400 RPM	
	"	A31	Indicate pitch wh. on	
9	"	A19	±250 to 1400 RPM	
	"	A31	Indicate yaw wh. on	
	"	A20		
10	"	A24	0 to -0.6°/sec	

Set II Conditions: Data Mode ASC, ACS Mode 3

Plot #	Time Scale	Parameter	Parameter Scale	Remarks
1	24 min & 2 min	A4	±4°	16° Total
		A5	±4°	
2	"	A10	±8°	32° Total
		A11	±8°	
3	"	A17, A20	±250 to 1400 RPM	
		A31	Indicate roll wh. on	
4	"	A18, A20	±250 to 1400 RPM	
		A31	Indicate pitch wh. on	
5	"	A19, A20	±250 to 1400 RPM	
		A31	Indicate yaw wh. on	
6	"	A12, A13	90° to 270°	
		A16	Array drive on or off and direction	
7	"	A23	Events	

Set III Conditions: MC & FF, RT & DS, 5 min/day orbit & week ACS Mode 3

Plot #	Time Scale (and true anomaly)	Parameter	Parameter Scale	Remarks
1	week	A1	0 to 3000 psi	
		A3	-10°C to +40°C	
2	5 min & orbit/true anomaly	A4	+4°	16° Total
		A5	+4°	
3	5 min & orbit/true anomaly	A10	+8°	32° Total
4	orbit/true anomaly	A17	±250 to 1400 RPM	Plot roll RW on-off
	"	A31	"	
5	"	A18	"	Plot pitch RW on-off
		A31		
6	"	A19	"	Plot yaw RW on-off
		A31		
7	"	A21, A22	Events	Note As+P.-P -P+Y, etc.
8	"	A12, A13	90° to 270°	
9	"	△ Theoretical Array Angle and Measured Array Angle		
10	orbit/true anomaly	A14, A15	0° to 360°	
11	"	△ Theoretical Array Angle and Measured Array Angle	±20°	
12	week	A9	-20° to +60°C	
13	week	A25	-20° to +60°C	Note sun on or sun off
14	orbit	A23		Note sun on or sun off

C&DH Subsystem

Set IV Conditions: MC & FF RT & DS, 5 min/day orbit & week

Plot #	Time Scale	Parameter	Parameter Scale	Remarks
1	5 min & week	C13, C14 F41A	-30 to -130 dbm	Use all calibration points and double plot redundant points. Note sig. pres. or not present.
2	"	C15, C16 F41B	"	"
3	week	F5	10 to 20 psia	(20 psia total)
		F13	10 to 20 psia	
4	"	F20	-5°C to +55°C	120°C total
		F22	-5°C to +55°C	Note when in sunlight or elipse
5	"	C5	3 to 6 watts	Do not overlap scales
		C6	0 to 0.1 watt	
6	"	C1	5°C to 35°C	Note WB A on or off
7	"	C7	3 to 6 watts	Do not overlap scales
		C8	0 to 0.1 watt	
8	"	C2	5°C to 35°C	Note WB B on or off
9	"	C9	0 to 1 watt	Do not overlap scale
		C3	0 to 40°C	

Power Subsystem

Set V Conditions: MC & FF RT & DS, 5 min/day orbit & week

Plot #	Time Scale	Parameter	Parameter Scale	Remarks
1	orbit	D10	20v to 40v	
2	5 min & orbit	(D4 + D5)		
		(D1 + D2)	3A to 11A	Load Current
3	"	(D10)X ((D4 + D5) - D1 + D2))	100w to 400w	Load Power
4	orbit	D1	±10A	
5	"	D2	±10A	
6	5 min & orbit	D8	20 to 40v	
		D55	2.5 to 5.1	Do not overlap
7	"	D9	20 to 40v	
		D56	2.5 to 5.1	"
8	orbit	D4	0 to 10A,	20A Total
		D5	0 to 10A	
9	"	D50	5° to 50°C	
10	"	D51	5° to 50°C	
11	"	D57	0 to 5v & 60° to +80°C	Overlay scales
12	orbit	D58, D14	0 to 5v & -60° to +80°C	Overlay scales
13	5 min & orbit	D6	20-40 volts	Overlay scales
		D7	0-20 volts	
		D17	0-4 amps	

Plot #	Time Scale	Parameter	Parameter Scale	Remarks
		Conv #2		
14	week	D20	+16 +1v	Do not overlay scales
		D21	+ 9 ±1v	
		D22	+ 5 ±0.5v	
		D23	- 6 ±0.5v	
		Conv #3		
15	week	D24	+70 ±2v	
		D25	+23 ±1v	"
		Conv. #4		
16	week	D26	+70 ±2v	
		D27	+23 ±1v	"
		Conv. #5		
17	week	D28	+16 ±1v	
		D29	+ 9 ±1v	
		D30	- 6 ±0.5v	
		D31	-16 ±1v	
		Conv. #6		
18	week	D32	+16 ±1v	
		D33	+ 9 ±1v	
		D34	- 6 ±0.5v	
		D35	-16 ±1v	
		Conv. #7		
19	week	D36	+16 ±1v	"
		D37	+ 9 ±1v	
		D38	- 6 ±0.5v	
		Conv. #8		
20	week	D39	+16 ±1v	Do not overlay scales
		D40	+ 9 ±1v	
		D41	- 6 ±0.5v	
		Conv. #9		
21	week	D42	+20 ±1v	
		D43	+10 ±1v	
		D44	-20 ±1v	
		D45	+28 ±1v	
		D46	115 ±5v	

Plot #	Time Scale	Parameter	Parameter Scale	Remarks
		Conv. #10		
22	week	D52	+16 ±1v	
		D53	+ 9 ±1v	
		D54	- 6 ±0.5v	
23	week	D15	400 cps	Sync signals Do not overlay scales
		D16	2461 cps 0° 2461 cps 90°	

Thermal Subsystem

Set VI Conditions: MC & FF DS only

Plot #	Time Scale	Parameter	Parameter Scale	Remarks
1	orbit & week	E1	-30°C to +80°C	
		E2	"	
		E3	"	
		E4	"	
2	"	D13	-50°C to +75°C	
		D14	"	
3	week	A33	20°C to 100°C	
		A34	"	
4	"	A25	-20°C to +80°C	
		A26	"	
5	"	A9	-20°C to 50°C	
		A30	20°C to 80°C	
		A32	0 to +60°C	
6	"	E28	-20°C to 80°C	
7	"	B15	-20°C to 60°C	
8	"	E13	-20°C to +50°C	
		E14	-20°C to +50°C	
		E14	"	
		E16	"	
		E17	"	
9	"	E19	-20°C to +40°C	
		E20	"	
10	"	SC1-50	95°C to 135°C	
		SC1-114	95°C to 135°C	
		SC1-51	25°C to 55°C	
		SC1-115	25°C to 55°C	

Plot #	Time Scale	Parameter	Parameter Scale	Remarks
11	week	SC1-96	-20°C to +60°C	
12	"	SC1-97	-20°C to +60°C	
13	"	SC1-110	-20°C to +60°C	
14	"	SC1-94	-20°C to +60°C	
		SC1-95	"	
15	"	SC1-62	"	
		SC1-117	"	
16	"	SC1-84	"	
		SC1-83	"	
17	"	SC1-118	-20°C to +60°C	
		SC1-119	"	
		SC1-48	"	
		SC1-54	"	
		All others	-5°C to +45°C	

Accounting

Two end-action features are employed to render periodic production accounting to all EGO experimenters, the Project Scientist, and the OGO Project Office of what data has been processed, what has not, and what the state of data quality is. For each file of decommutated data, the pertinent analog and edit cards are processed to produce the monthly Chronological Listing which appears as Figure 42. For each file of decommutated data, the quality card generated for the file during edit and quality control is also processed on the computer to produce the monthly Quality Listing which appears as Figure 56. Both listings are dispatched monthly to the parties above.

Punched Card Summary

A. Analog Card - punched from ground station log sheet by EAM personnel (Figure 38).

B. Time Coefficient Card - punched by the UNIVAC 1107 Time Fit Program to provide coefficients of the nth order polynomial time curve (Universal Time vs spacecraft clock) to Edit Program time-correction operations (Figure 45).

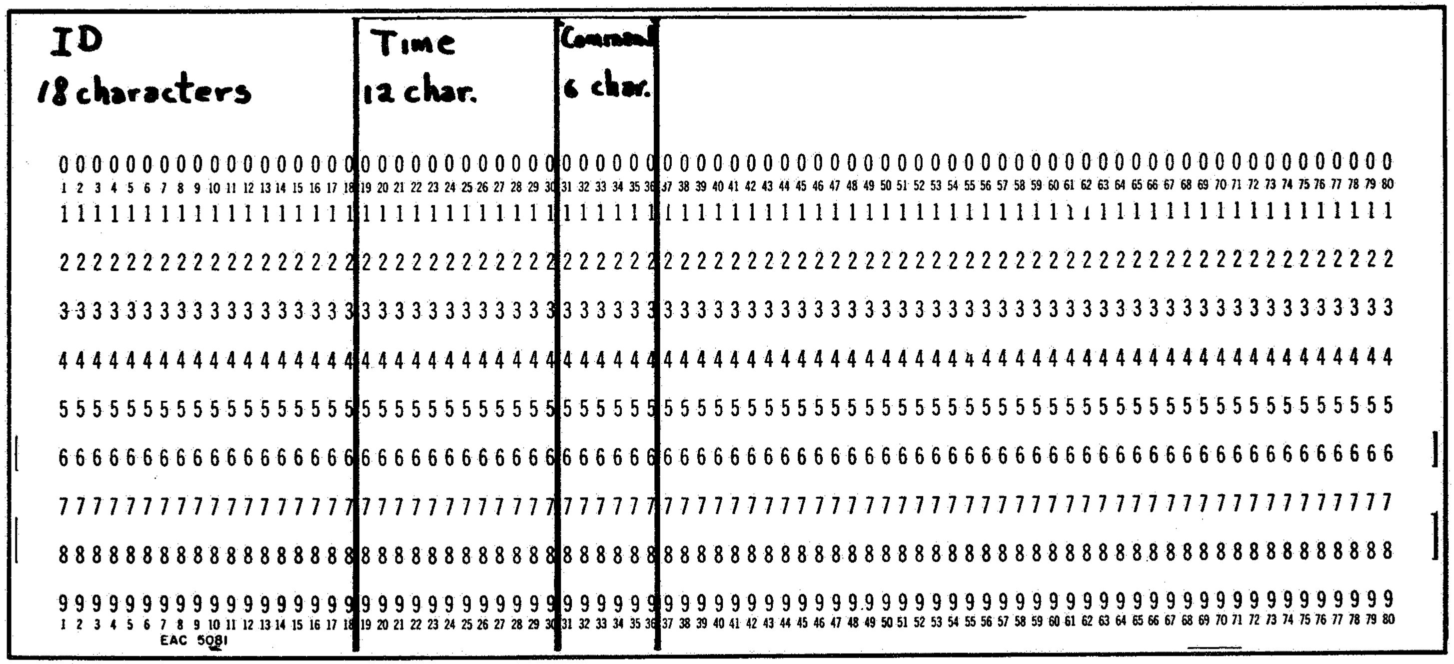
C. Edit Card - One card is produced by the computer for each file edited (Figure 47). These become part of the records of Production Control.

D. Quality Card - One card is produced by the computer for each file edited (Figure 48). These become part of the records of Production Control and contain quality information presented on the Edit listing of the file and on the monthly Quality Listing.

E. Decommutation Cards - These cards are produced by the computer after each file is processed (Figure 57). The information contained on them identifies the source, the bit rate, and spacecraft format of the file and where the file may be found on each of the experimenter's data tapes. The decommutation run numbers will also be included.

F. Intermediate Command Card - punched by Command decoder for use in the Command Card Reformat Program (Figure 58).

G. Reformatted Command Card - punched by the Command Card Reformat Program. The card images are written on magnetic tape and dispatched to all experimenters (Figure 59).



Command ID (BCD)	
Character	Information
1–5	Satellite ID
6–7	Year of recording
8–10	Station number
11–14	Analog tape number
15–16	Analog file number
17–18	Blank

Time (BCD)	
Character	Information
19–21	Day of Year
22–23	Hour
24–25	Minute
26–27	Second
28–30	Millisecond

Commands (Octal)	
Character	Information
31–33	Command Address
34–36	Command

Figure 58–Intermediate Command Card Format

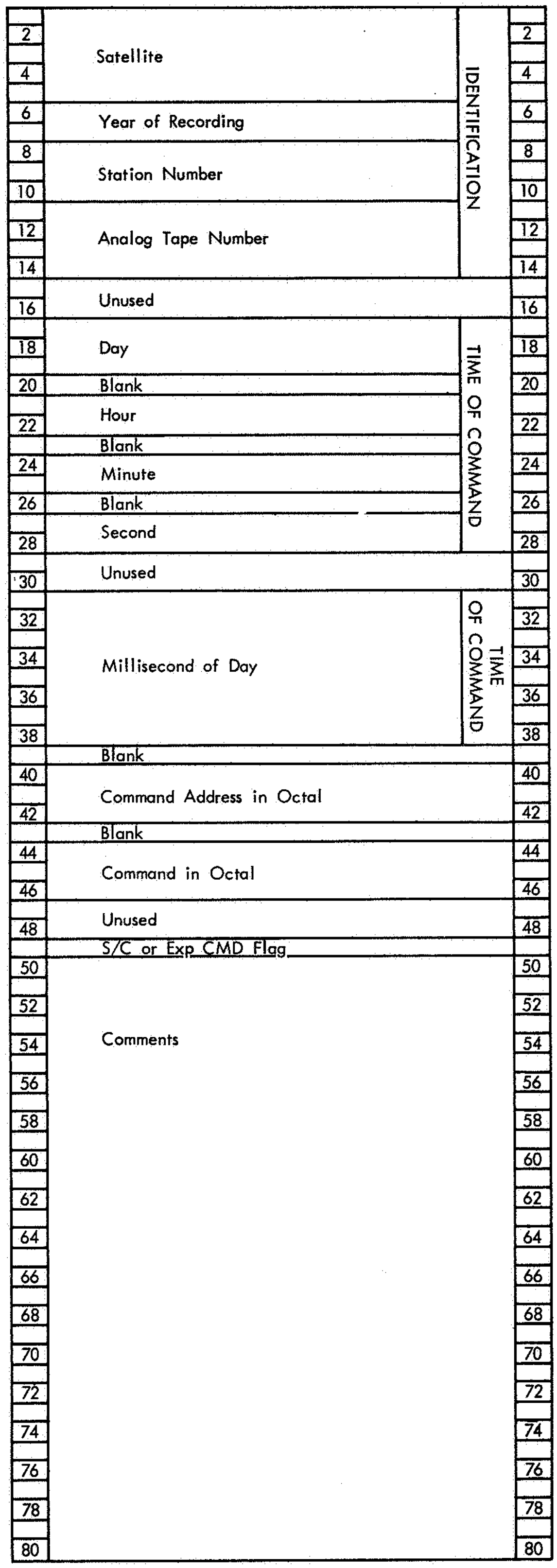


Figure 59–Reformatted Command Card

Listing Summary

A. Edit and Quality Control Listing - printed by the Edit and Quality Control Program for each edited file (Figure 46). The listing provides Quality Control personnel with the data quality indicators, file label listings, time-updating characteristics, and the summarized data validity checks which they must employ in their decision to release the edited file for decommutation or reject it for re-processing.

B. Decommutation Listing - printed by the Decommutation Program for each data file (Figure 60). The Label Record contents for each file are listed, as well as the contents of the file's decommutation cards. The listing is used by Quality Control personnel to assure that decommutated files do not overlap in time.

C. Shipping List - printed by the computer using the decommutation card as input (Figure 61). The shipping list in two copies accompanies each shipment of decommutated tapes to the experimenter and identifies the data files, spacecraft data formats, operational mode (real time or playback), bit rates, and start-stop times of the data on the tapes. Also identified are the analog, buffer and edit tape numbers associated with each file of decommutated data. One copy of the shipping list must be signed as a receipt by the experimenter and returned to the GSFC Data Processing Branch.

D. Quality Listing - printed monthly on a cumulative basis by the computer using the Quality cards as input (Figure 49). The listing provides for each edited file a summary of the data quality and validity determined for the file in the Edit Program. Specific items, referenced on the listing appear in the Legend (Figure 37) which accompanies each listing. The Quality listing is dispatched monthly to all experimenters, to the Project Scientist, and to the OGO Project.

E. Chronological Listing - printed monthly on a cumulative basis by the computer using the analog cards and updated by the Edit Program, and the Edit card (Figure 56). A separate listing is made for real time data and for playback data. Both indicate the extent of production processing rendered on all incoming ground station tapes, and both are distributed to all experimenters, to the Project Scientist, and to the OGO Project.

F. Command Listing - printed monthly on a non-cumulative basis by the computer using punched command cards (Figure 55). The listing contains spacecraft commands verified and released by the Quality Control group. The listing is distributed to all experimenters and to the OGO Project Office.

```
                    OGO DECOM XQT FLOW (CONSOLE LOG MORE COMPLETE)      DATE  140266  PAGE     5

65491 65 061 01 0111 01 0112 337 65491 65 061 01 0111 01 0111 337 3 272 45440 0 00     2 0015 01 29 02     0100214
OGOBCPK011101650929       0015 01 123720      002 01010101010101000101010101 5
OGOBCPK011101650929       0015 01 123720      002 01010101010101010101010101 6
OGOBCPK011101650929       0015 01 123720      002 01010101010101010101010101 7

65491 65 061 01 0111 01 0112 337 65491 65 061 01 0111 01 0111 337 3 272 60429 0 00     1 0015 02 29 02     0100214
OGOBCPK011101650929       0015 02 164709      002 01020102010201000102010201 02 5
OGOBCPK011101650929       0015 02 164709      002 01020102010201020102010201 02 6
OGOBCPK011101650929       0015 02 164709      002 01020102010201020102010201 02 7

65491 65 061 01 0111 01 0112 337 65491 65 061 01 0111 01 0111 337 3 272 67571 0 00     2 0015 03 29 02     0100214
OGOBCPK011101650929       0015 03 184611      002 0103010301030100010301030103 5
OGOBCPK011101650929       0015 03 184611      002 0103010301030103020101030103 6
OGOBCPK011101650929       0015 03 184611      002 0103010301030103010301030103 7

65491 65 061 01 0111 01 0112 337 65491 65 061 01 0111 01 0111 337 3 272 75465 0 00     1 0015 04 29 02     0100214
OGOBCPK011101650929       0015 04 205745      002 0104010401040100010401040104 5
OGOBCPK011101650929       0015 04 205745      002 0104010401040104020201040104 6
OGOBCPK011101650929       0015 04 205745      002 0104010401040104010401040104 7

65491 65 061 01 0111 01 0112 337 65491 65 061 01 0111 01 0111 337 3 272 77481 0 00     2 0015 05 29 02     0100214
OGOBCPK011101650929       0015 05 213121      002 0105010501050100010501050105 5
OGOBCPK011101650929       0015 05 213121      002 0105010501050105030101050105 6
OGOBCPK011101650929       0015 05 213121      002 0105010502010105010501050105 7

65491 65 061 01 0111 01 0112 337 65491 65 061 01 0111 01 0111 337 3 272 78829 0 00     1 0015 06 29 02     0100214
OGOBCPK011101650929       0015 06 215349      002 0201020102010100010602010106 5
OGOBCPK011101650929       0015 06 215349      002 0106020101060106030201060106 6
OGOBCPK011101650929       0015 06 215349      002 0201010602020106010601060106 7

65491 65 061 01 0111 01 0112 337 65491 65 061 01 0111 01 0111 337 3 272 80748 0 00     2 0015 07 29 02     0100214
OGOBCPK011101650929       0015 07 222548 225603002 0202020202020100020102020201 5
OGOBCPK011101650929       0015 07 222548 225603002 0201020201070107040102010107 6
OGOBCPK011101650929       0015 07 222548 225603002 0202010702030201020101070201 7
@P   HDG            OGO DECOM DIAGNOSTICS (IF ANY)
```

Figure 60–Decomm Listing

OGO EXPERIMENTER DATA TAPES

STA	TAPE	FILE	RECORDED			EDIT	EDIT	START		STOP		DECOM	EXP 1		EXP 2		EXP 3		EXP 5		EXP 6		EXP 7		EXP 8		EXP 9		EXP 10	
			YR	MO	DY	TAPE	FILE	HR	MN	HR	MN	RUN	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F
CPK	0111	01	65	09	29	0015	01	12	37			002	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01
CPK	0111	01	65	09	29	0015	02	16	47			002	01	02	01	02	01	02	01	02	01	02	01	02	01	02	01	02	01	02
CPK	0111	01	65	09	29	0015	03	18	46			002	01	03	01	03	01	03	01	03	01	03	01	03	01	03	01	03	01	03
CPK	0111	01	65	09	29	0015	04	20	57			002	01	04	01	04	01	04	01	04	01	04	01	04	01	04	01	04	01	04
CPK	0111	01	65	09	29	0015	05	21	31			002	01	05	01	05	01	05	01	05	01	05	01	05	01	05	01	05	01	05
CPK	0111	01	65	09	29	0015	06	21	53			002	02	01	02	01	02	01	01	06	02	01	01	06	01	06	02	01	01	06
CPK	0111	01	65	09	29	0015	07	22	25	22	56	002	02	02	02	02	02	02	02	01	02	02	02	01	02	01	02	02	01	07

TOTAL NO. OF FILES - 7

THIS COPY IS TO BE RETAINED FOR YOUR INFORMATION
PLEASE SIGN AND RETURN THE ATTACHED RECEIPT FORM TO -
DIGITAL DATA ACCOUNTING OFFICE
DIGITAL DATA CONTROLLER
NASA GODDARD SPACE FLIGHT CENTER
CODE 564
GREENBELT,MD. (20771)

EXP 1 - HOOKER - UCAL
EXP 2 - WOLFE - AMES
EXP 3 - VASYLIUNAS - MIT
EXP 5 - DAVIS - GSFC
EXP 6 - LUDWIG / MCDONALD / CLINE - GSFC
EXP 7 - LENTZ - CHICAGO
EXP 8 - BULGREN - IOWA
EXP 9 - WINKLER / ARNOLDY - UMINN
EXP 10 - HOLZER -UCAL

Figure 61A–Shipping Document

OGO EXPERIMENTER DATA TAPES

STA	TAPE	FILE	RECORDED YR	MO	DY	EDIT TAPE	EDIT FILE	START HR	MN	STOP HR	MN	DECOM RUN	EXP 11 T	F	EXP 12 T	F	EXP 13 T	F	EXP 15 T	F	EXP 16 T	F	EXP 17 T	F	EXP 18 T	F	EXP 19 T	F	EXP 20 T	F	EXP 21 T	F
CPK	0111	01	65	09	29	0015	01	12	37			002	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01
CPK	0111	01	65	09	29	0015	02	16	47			002	01	02	01	02	01	02	01	02	01	02	01	02	01	02	01	02	01	02	01	02
CPK	0111	01	65	09	29	0015	03	18	46			002	01	03	02	01	01	03	01	03	01	03	01	03	01	03	01	03	01	03	01	03
CPK	0111	01	65	09	29	0015	04	20	57			002	01	04	02	02	01	04	01	04	01	04	01	04	01	04	01	04	01	04	01	04
CPK	0111	01	65	09	29	0015	05	21	31			002	01	05	03	01	01	05	01	05	01	05	02	01	01	05	01	05	01	05	01	05
CPK	0111	01	65	09	29	0015	06	21	53			002	01	06	03	02	01	06	02	01	01	06	02	02	01	06	01	06	01	06	01	06
CPK	0111	01	65	09	29	0015	07	22	25	22	56	002	01	07	04	01	02	01	02	02	01	07	02	03	02	01	02	01	01	07	02	01

TOTAL NO. OF FILES - 7

THIS COPY IS TO BE RETAINED FOR YOUR INFORMATION
PLEASE SIGN AND RETURN THE ATTACHED RECEIPT FORM TO -
DIGITAL DATA ACCOUNTING OFFICE
DIGITAL DATA CONTROLLER
NASA GODDARD SPACE FLIGHT CENTER
CODE 564
GREENBELT,MD. (20771)

EXP 11 - HEPPNER / CAMPBELL - GSFC
EXP 12 - SAGALYN - AFCRL
EXP 13 - SCHMIDT - GSFC
EXP 15 - BOB STAGNER - GSFC
EXP 16 - STOCKWELL - GSFC
EXP 17 - RORDEN - STANFORD RESEARCH
EXP 18 - LINDSAY / LINDAHL - UMICH
EXP 19 - MANGE - NRL
EXP 20 - QUANN - GSFC
EXP 21 - QUANN - GSFC

Figure 61B—Shipping Document

G. Playback Reformat and Time Correction Listing – printed during operation of the Playback Reformat and Time Correction program to provide operating personnel with verification of valid playback reformatting and Quick-Look time correction (Figure 62).

```
 INPUT TAPE IDENTIFICATION

BUFFER TAPE NUMBER          0066
ANALOG TAPE NUMBER          0006
STATION NUMBER               020
S-50


 OUTPUT TAPE START TIME

000135041602  OCTAL SPACE CRAFT CLOCK        30108A36  CORRECTED GROUND TIME     12801014  UNCORRECTED GROUND TIME
    24396674  DECIMAL SPACE CRAFT CLOCK

          94  CORRECTED DAY COUNT OF YEAR         105  UNCORRECTED DAY COUNT OF YEAR

 OUTPUT TAPE STOP TIME

000135042174  OCTAL SPACE CRAFT CLOCK        30356A36  CORRECTED GROUND TIME     12808847  UNCORRECTED GROUND TIME
    24396924  DECIMAL SPACE CRAFT CLOCK

          94  CORRECTED DAY COUNT OF YEAR         105  UNCORRECTED DAY COUNT OF YEAR


TOTAL NUMBER OF RECORDS PROCESSED          110
```

Figure 62–Playback Reformat and Time Correction Listing

Tape Disposition

One month after the experimenter tapes have been released by Production Control, the analog station tapes and the edit tapes will be transferred to Federal Archives and the buffer tapes will be stored at GSFC Data Processing Branch.

The experimenter tapes will be mailed to the following addresses:

S-49 (OGO-B) DISTRIBUTION

02/04/66

EXP. NO.	EXPERIMENTER	DECOM TAPES	ATT/ORB TAPES	COMMAND CARDS	Q. CARD LISTINGS	CHRONO LISTINGS
1	MR. FLOYD B. HOOKER UNIVERSITY OF CALIFORNIA SPACE SCIENCES LABORATORY BERKELEY, CALIFORNIA 94720	X	X	X	X	X
2	DR. JOHN W. WOLFE SPACE SCIENCES DIVISION NASA AMES RESEARCH CENTER MOFFETT FIELD, CALIF. 94035	X	X	X	X	X
3	MR. VYTENIS VASYLIUNAS ROOM 20-D-004 MASSACHUSETTS INSTITUTE OF TECHNOLOGY CAMBRIDGE, MASS. 02139	X	X	X	X	X
5	MR. LEO DAVIS CODE 611 BLDG. 6, ROOM W-8 G.S.F.C.	X	X	X	X	X
6	DR. GEORGE LUDWIG C/O MRS. MCDILL CODE 560 BLDG. 6, ROOM W-12 G.S.F.C.	X				
	DR. GEORGE LUDWIG C/O IBM ROOM BLDG. 2, ROOM 34 G.S.F.C.		X			
	DR. GEORGE LUDWIG CODE 560 BLDG. 3, ROOM 226 G.S.F.C. * LISTING ONLY			*	X	X
7	DATA TAPE LIBRARIAN ENRICO FERMI INSTITUTE FOR NUCLEAR STUDIES UNIVERSITY OF CHICAGO 933 EAST 56TH STREET CHICAGO 37, ILLINOIS 60637	X	X	X	X	X

0054

Figure 63—CGO-B data distribution list with addresses

S-49 (OGO-A) DISTRIBUTION (CON'T.)

EXP. NO.	EXPERIMENTER	DECOM TAPES	ATT/ORB TAPES	COMMAND CARDS	Q. CARD LISTINGS	CHRONO LISTINGS
8	MR. WILLIAM BULGREN PHYSICS DEPARTMENT STATE UNIVERSITY OF IOWA 330 1/2 E. WASHINGTON STREET IOWA CITY, IOWA 52240	X	X	X	X	X
9	DR. J. R. WINKLER SCHOOL OF PHYSICS UNIVERSITY OF MINNESOTA MINNEAPOLIS, MINNESOTA 55455 * LOW DENSITY	X	*	X	X	X
10	MR. ROBERT E. HOLZER INSTITUTE OF GEOPHYSICS AND PLANETARY PHYSICS LOS ANGELES LABORATORIES UNIV. OF CALIF. AT LOS ANGELES LOS ANGELES, CALIFORNIA 90024	X	X	X	X	X
10A	MR. FRANK GREER CODE 564 BLDG. 14, ROOM N-88 G.S.F.C. * LISTING ONLY	X		*	X	
11	DR. J. HEPPNER CODE 613 BLDG. 21, ROOM G-52 G.S.F.C.	X	X	X	X	X

0048

EXP. NO.	EXPERIMENTER	DECOM TAPES	ATT/ORB TAPES	COMMAND CARDS	Q. CARD LISTINGS	CHRONO LISTINGS
12	DR. RITA SAGALYN AIR FORCE CAMBRIDGE RESEARCH LABORATORY GEOPHYSICS RESEARCH DIRECTORATE LAWRENCE G. HANSCOM FIELD BEDFORD, MASSACHUSETTS 01731	X	X	X	X	X
13	MR. JOHN SCHMIDT CODE 564 BLDG. 17, ROOM 42 G.S.F.C. * LISTING ONLY	X		*	X	X
14	MR. R. G. MERRILL SECTION 540.40 ITSA/ESSA BOULDER, COLORADO 80302		X			

Figure 63 (Continued)—OGO-B data distribution list with addresses

S-49 (OGO-A) DISTRIBUTION (CON'T.)

EXP. NO.	EXPERIMENTER	DECOM TAPES	ATT/ORB TAPES	COMMAND CARDS	Q. CARD LISTINGS	CHRONO LISTINGS
15	MR. HOWARD STAGNER CODE 564 BLDG. 17, ROOM 42 G.S.F.C. * LISTING ONLY ** 2 COPIES					
		X		*	**	**
16	MRS. JOAN STOCKWELL CODE 564 BLDG. 17, ROOM 42 G.S.F.C.				X	X
	MR. C. MCCRACKEN CODE 613 BLDG. 4, ROOM 166 G.S.F.C.					
17	MR. L. H. RORDEN BUILDING 308A STANFORD RESEARCH INSTITUTE MENLO PARK, CALIFORNIA 94025	X	X	X	X	X
						0052
18	MR. W. J. LINDSAY 905 PHYSICS-ASTRONOMY BLDG. THE UNIVERSITY OF MICHIGAN ANN ARBOR, MICHIGAN 48104	X	X	X	X	X
19	DR. P. W. MANGE NAVAL RESEARCH LABORATORY CODE 7121 WASHINGTON, D.C. 20390	X	X	X	X	X
20	MR. JOHN QUANN CODE 564 BLDG. 17, ROOM 42 G.S.F.C. * LISTING ONLY	X		*	X	X
21	MR. JOHN QUANN CODE 564 BLDG. 17, ROOM 42 G.S.F.C.	X		X		
	MR. WILFRED E. SCULL CODE 623 BLDG. 5, ROOM C-235 G.S.F.C.				X	X

Figure 63 (Continued)—OGO-B data distribution list with addresses

S-49 (OGO-A) DISTRIBUTION (CON'T.)

EXP. NO.	EXPERIMENTER	DECOM TAPES	ATT/ORB TAPES	COMMAND CARDS	Q. CARD LISTINGS	CHRONO LISTINGS
	MR. KENNETH KISSEN CODE 623 BLDG. 5, ROOM C-229 G.S.F.C.				X	X
	MR. RONALD BRITTNER CODE 535 BLDG. 14, ROOM N-282 G.S.F.C.				X	X
						0053
	MR. MORT PASTERNACK CODE 564 BLDG. 17, ROOM 30 G.S.F.C.				X	X
	MR. BILL FRITTS CODE 420.07 BLDG. 16, ROOM T4 G.S.F.C.				X	X
	MR. MICHAEL MAHONEY CODE 564 BLDG. 17, ROOM 10 G.S.F.C.				X	X
						0025

Figure 63 (Continued)–OGO-B data distribution list with addresses

Note: The OGO-B distribution will be identical to that for OGO-A with the following exception: EXP 10A – Frank Greer – since we do not except the s/c to spin no duplicate tape will be produced.

Special Purpose Data Processing

Processing of Special Purpose data for OGO-B is suited to the specific requirements of each of the Special Purpose experimenters. There are two on OGO-B:
4917 Dr. R. A. Helliwell
4911 Dr. J. P. Heppner

4917 will require the use of the analog tape dubbing station which has been established especially to serve those experimenters who require duplicate analog tapes. The specific processing operations for each experimenter is as follows.

Experiment 4917 Dr. R. A. Helliwell
Stanford University
Stanford, California

Special Purpose data will be processed onto 10-1/2 inch reels of 1 mil mylar (containing some 3600 ft of tape). Recording will be done at 7-1/2 ips. It is to be noted that the speed of recording at the ground station is at 30 ips.

Track 1 is SP filtered 51.5 to 54.5 Kc downconverted by the 5th harmonic of the 10 Kc reference frequency and passed through a 5 Kc low pass filter.

Track 2 is SP filtered 25-35 Kc discriminated and passed through a 1 Kc low pass filter

Track 3 is SP passed through a 13 Kc low pass filter

Track 4 is Serial Decimal Time

Track 5 is SP filtered 13-35 Kc

Track 6 is WWV and voice

Track 7 is 10 Kc reference.

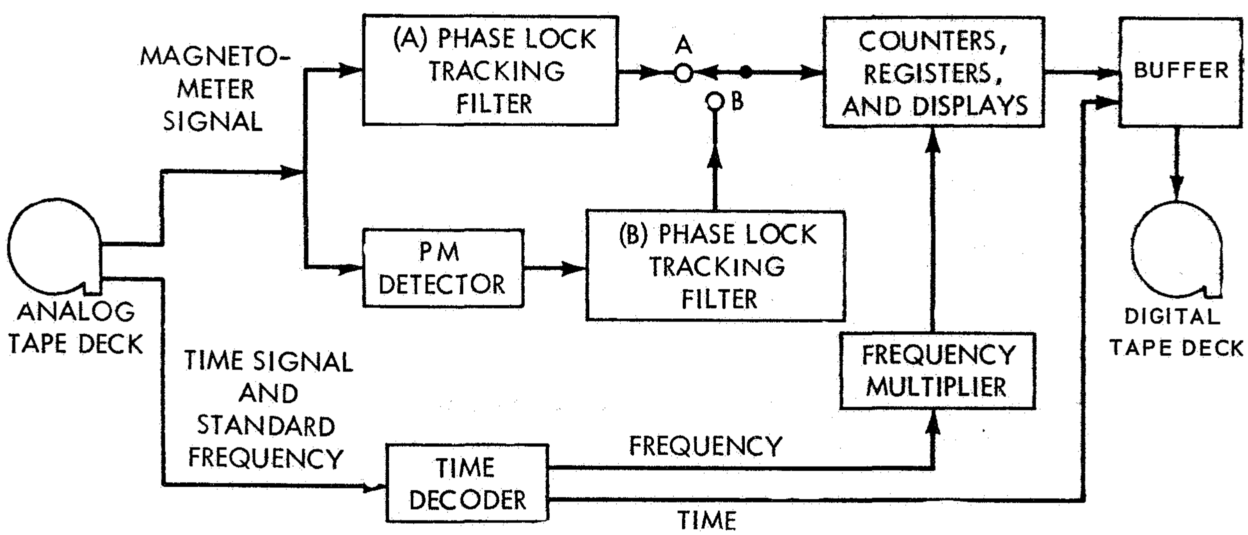
All tracks are direct except track 2 which is FM and track 4 which is FM with center frequency near 6 Kcs.

Experiment 4911 Dr. J. P. Heppner
GSFC – Code 611
Greenbelt, Maryland

A special processing line (see Figure 64) has been set up by the Data Processing Branch to reduce the special purpose rubidium magnetometer data for Experiment 49-11.

The special processor for OGO magnetometer data is outlined in the figure on the following page. The recorded telemetry signal, the ground station time signal, and the station standard frequency are obtained from the reproduce analog tape deck. The station standard frequency will be either 1 kc, 10 kc, or 100 kc. The tape deck can be made to reproduce the signals at either 1, 2, 4, 8, or 16 times the recorded speed.

When processing the direct magnetometer signal (channel No. 1), the "A" phase lock tracking filter is locked to the noisy magnetometer telemetry signal, and the output of the tracking filter is a relatively clean signal which is phase locked to the magnetometer signal. The frequency of this clean signal is measured in the Counter unit. The frequency is determined by measuring the number of cycles of the signal in a period of time, which can be selected by means of a set of switches on the control panel. The range of selection is 1 millisecond to 9.999 seconds. The standard frequency, extracted from the analog tape signal by a time decoder, is multiplied to 5 mc to be used for the timing in the frequency



Orbiting Geophysical Observatories Magnetometer Special Data Processor

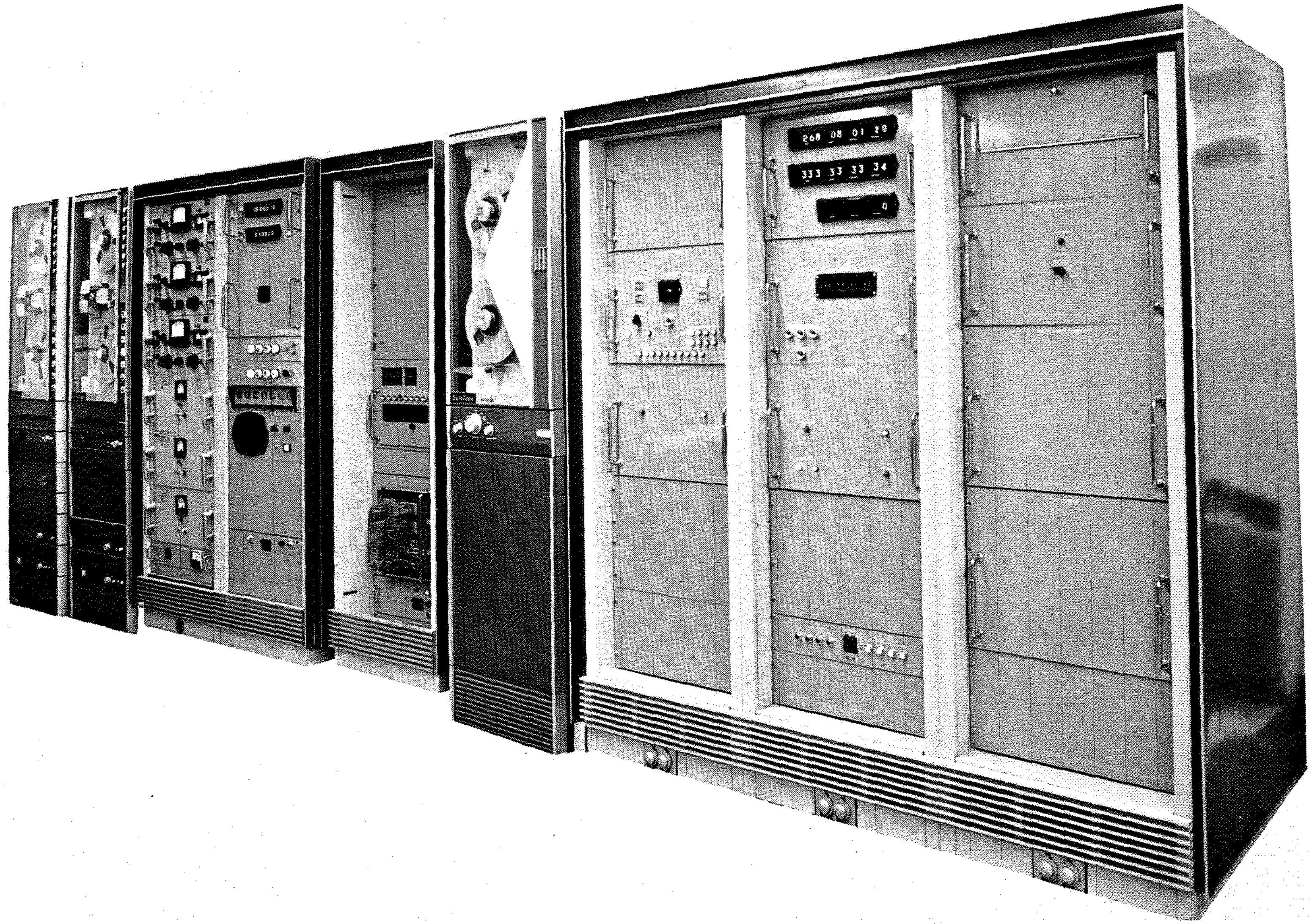


Figure 64–Experiment 4911 Rubidium Magnetometer Processing Line

measuring unit. By using this recorded standard frequency in this manner, compensation is obtained for effects of tape recorded wow and flutter. Specifically, a counter is started counting cycles of the multiplied standard frequency at a zero crossing of the tracking filter reproduction of the magnetometer signal. The counter is turned off at the second integral signal cycle after the preset time is reached. The number of signal cycles in this period is also counted. The ratio of these two counts gives the frequency of the magnetometer signal. At the shortest time period, the resolution is limited to one cycle of the 5 mc timing waveform, or 1 part in 5000. At the longest period, the resolution is approximately 1 part in 5×10^7.

When processing the channel No. 2 signal consisting of the subcarrier modulated with the magnetometer signal, the subcarrier is demodulated in the phase-locked PM detector. The resulting noisy low frequency magnetometer signal is fed into the "B" phase lock tracking filter. The output of the tracking filter is sent to the frequency measuring counters through switch position B. The magnetometer frequency data from the counter registers are put into the buffer where they are merged with ground station time from the time decoder and written on a digital tape in computer format. The time decoder, buffer, and digital tape unit are identical to those in the OGO PCM data processor and serve similar functions in the special magnetometer processor.

The digital buffer tape is next processed on the IBM 7010 computer where the data is edited, monitored for quality, and reformatted. The computer prints a quality listing, and writes the data on an edit tape in the IBM-compatible Moonlight Format. The quality listing and edit tape are then forwarded to the experimenter group.

Chronological Listing

A chronological listing of special purpose analog tapes, similar to those developed for PCM data, is printed on a monthly cumulative basis on the computer. The listing indicates the extent of processing rendered on all incoming ground station special purpose analog tapes. It is distributed to all Special Purpose experimenters, to the Project Scientist, and to the OGO Project.

Spacecraft Commands

As the Special Purpose analog tapes received from the ground stations contain spacecraft commands recorded at the station, in the manner of PCM analog tapes, the Special Purpose tapes can and will be used for obtaining spacecraft commands when the PCM analog tape command tracks are not available for this use.

Tape Disposition

Final output tapes from the Special Purpose processing operations will be sent to the addressees listed for those experimenters in the PCM data tape disposition list, Section III A.

IV. PROCESSING OPERATIONS

OGO-B data processing operations make use of the systems described in the preceding sections. The operations themselves are sustained by the workings of A/D, Production Control, and Quality Control Groups, and are configured by the mission being carried out. Launch back-up operations, real-time Quick Look passes, and normal production processing each shape the operation somewhat differently. These aspects are described below.

PRODUCTION CONTROL OPERATIONS

Scheduling

Production Control (PC) is responsible for ensuring that data are processed in chronological order in three phases of the data-processing operation: analog-to-digital conversion, quality control and edit, and decommutation.

The only exception to the chronological processing will be the data from the first 2 weeks after launch. These passes will be processed as received and sent as soon as possible to the experimenters.

After the satellite has been in orbit one month, the chronological processing of all passes will begin. Those original files from the first two weeks of post-launch operations will be processed again starting with the editing. Attitude computation using Housekeeping data also will take place one month after launch using the orbital data available at the time the attitude determination program is run.

Analog-to-Digital Conversion – Buffer tapes produced by the analog-to-digital conversion processing line must be chronological by station. To meet this requirement, Production Control will prepare for the processing-line operators a list of analog tapes to be processed on a particular day. To assure that all passes recorded have been received, Production Control will compare the station-by-station chronological file maintained by the analog tape library with cumulative telemetry reports received from the ground stations. All buffer tapes will be numbered consecutively throughout the life of the satellite.

Quality Control and Edit – The buffer tapes, each being chronological by station, should next be scheduled by PC to undergo computer quality-control checking and editing. The edit tapes are to be chronological by time. A regular number of files constitutes a computer run for quality-control checking and editing; at least one run shall be made every week, such that a minimum backlog is kept. In this phase of the data processing, PC must assure that, starting with the oldest unedited file and continuing through the number of files desired in each run, all files recorded at the ground stations have been digitized.

Decommutation – Production Control will schedule decommutation runs on the computer. The decommutation runs, will be scheduled every week. The edit tapes must be in chronological order for input to the decommutation program. Those edit tapes made from redigitized files (i.e., files rejected by the quality control program in an earlier run but later edited successfully) must be placed in proper sequence. The decommutation output card is shown in Figure 57.

Attitude Orbit Computation

Production Control will have the responsibility of the running of the Attitude-Orbit Program and the duping of the output tapes for all the OGO experimenters. Copies of the listings generated during a run should be burst and bound with copies forwarded to Quality Control and the Data Processing Engineer.

Functions of the Quality Control Group

The Quality Control Group shall have the responsibility of assuring that the tapes produced for the experimenters by the Data Processing Branch contain the proper information. To accomplish this, Quality Control must check the data tapes and listings produced during the computer operations. This includes the following:

(a) verification that the data files processed were in chronological order

(b) there existed no overlap of time nor were redundant data files processed

(c) determination of whether a faulty file should be reprocessed or deleted

(d) verification of time accuracy on all data tapes

(e) checking the listing generated by the Attitude-Orbit program for validity.

Other functions include:

(a) Processing of command cards and the preparation of command listings and tapes

(b) reformatting, listing and analysis of quality cards

(c) performing statistical analysis of S/C data performance, A/D and ground station data recovery performance.

Final approval as to whether experimenter data tapes and attitude-orbit tapes are to be shipped to experimenters must come through Quality Control.

Tape Evaluation

Analog tapes received from the data acquisition stations are evaluated for quality and use of approved recording techniques. Tapes are analyzed by data inspectors who compare them to established standards. Findings are summarized in weekly reports, which are used by the Network Operations Branch to check the efficiency of station equipment and station operator performance.

Modes of Operation

Six basic modes of operation will be employed for OGO-B: Real-time OGO Launch Support extending from launch to launch plus one week, Quick Look Processing for the first two weeks after launch, OGO Quick Look Processing for real time data tapes, Normal Production Processing for Playback Data Tapes, and Special Purpose Telemetry Processing. Flow-charts for each operation (Figures 65-71) indicate the requirements for all and the subtle differences distinguishing each.

Real Time OGO Launch Support (Figure 65) is intended as a supplement to the OGO Control Center during launch operations, and as a prime backup during this period in case the Control Center goes down. The more salient features of this operational mode are the processing of data arriving in real-time via OGO control Center from the Rosman and Ulaska ground station data links, the omission of precision time-correction functions to enhance processing speed, and the elaborate spacecraft subsystems data processing loop designed for direct support of Control Center operations.

OGO Quick Look Processing for the first two weeks after launch (Figure 66) differs chiefly in that processing of data will be rendered upon incoming ground station analog tapes on a rapid semi-chronological bases, i.e., chronological per decomm tape. These will be given a partial time correction only, edited, decommutated and shipped to experimenters as rapidly as possible. Later this data will be reprocessed in chronological order and given a complete time correction.

OGO Quick Look Processing conducted routinely after launch once or twice per week (Figure 67) is intended to give experimenters a quick look in detail of their experiment as it operates during normal satellite operations. The data will be received via data links thru OGO Control Center from the Rosman and/or

Ulaska stations. Real time data will be digitized, edited, decommutated and shipped to experimenters without time-corrections within 48 hours. Playback data will be processed, time corrected to an accuracy of $<$ 864 ms and dispatched to experimenters within 5 working days. All data will later be processed chronologically in the routine manner when the ground station tapes are received.

Normal Production for real time data and for Playback data will consist of the complete production processing and time-correction cycles as earlier described. It will differ for real-time and playback data processing to the extent required by playback reformatting and time-correction, as shown in the processing flow charts in Figures 68 and 69.

Special Purpose Telemetry Processing will occur as earlier described and as indicated in the processing flow chart of Figure 70. During spacecraft Quick Look passes over the Rosman and Ulaska ground stations, expected to occur once or twice per week, Experiment 49-11 Rubidium Magnetometer data will be received and processed in real-time as received over the data links via the OGO Control Center.

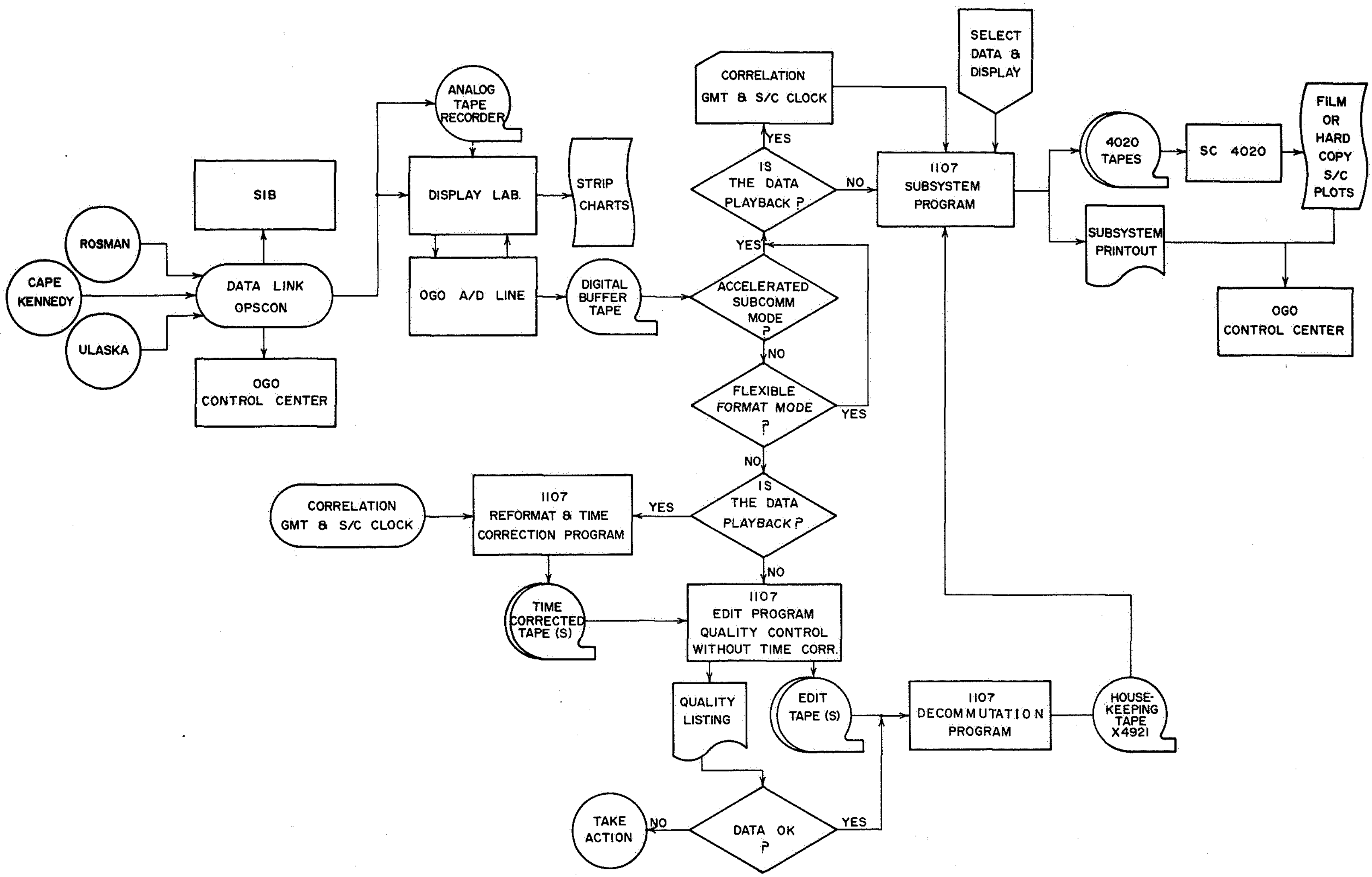


Figure 65–Real Time OGO Launch Support Launch to Launch +1 week

OGO QUICK LOOK PROCESSING FOR FIRST 2 WEEKS OF DATA AFTER LAUNCH

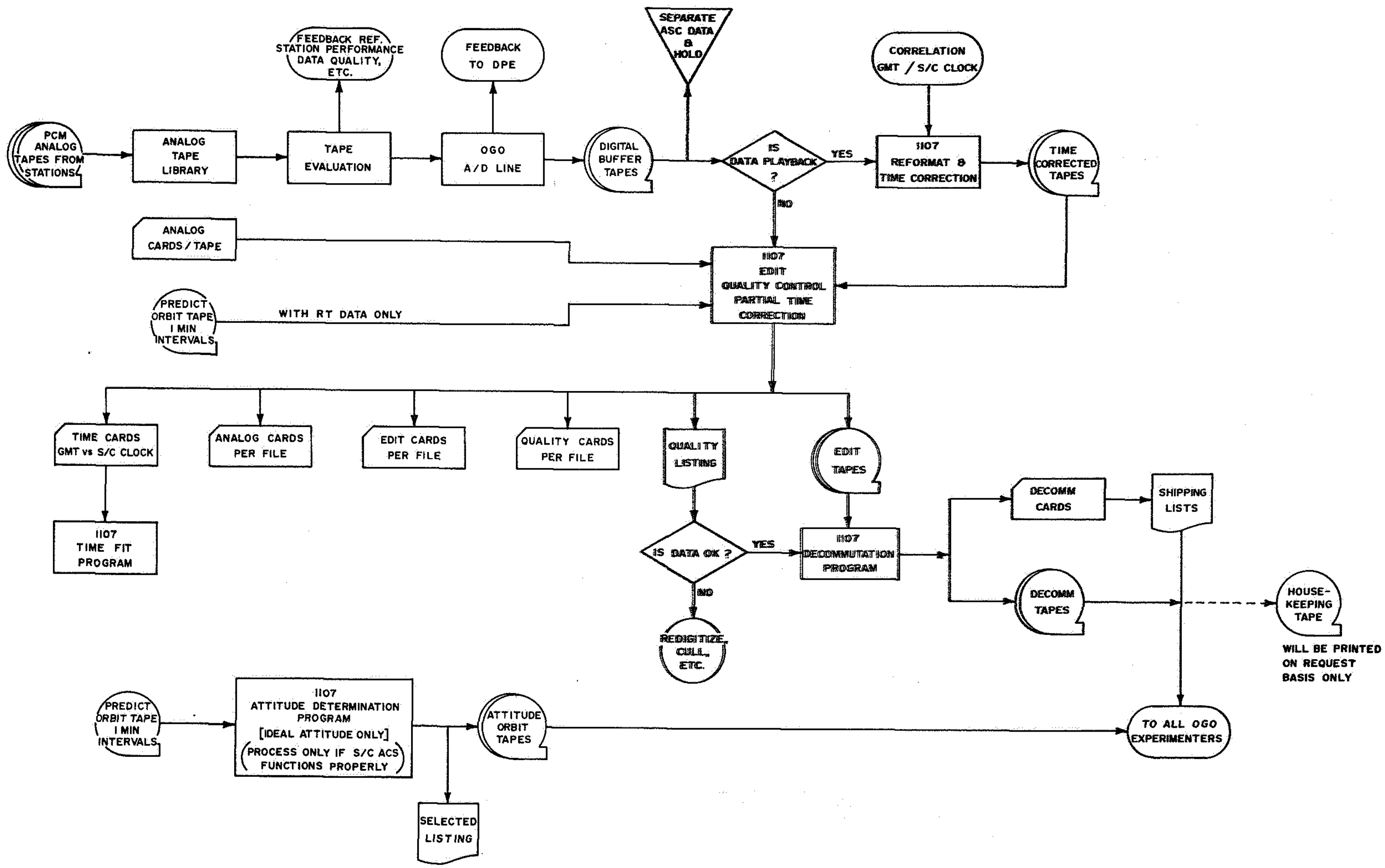


Figure 66–OGO Quick Look Processing First 2 weeks of Data after Launch

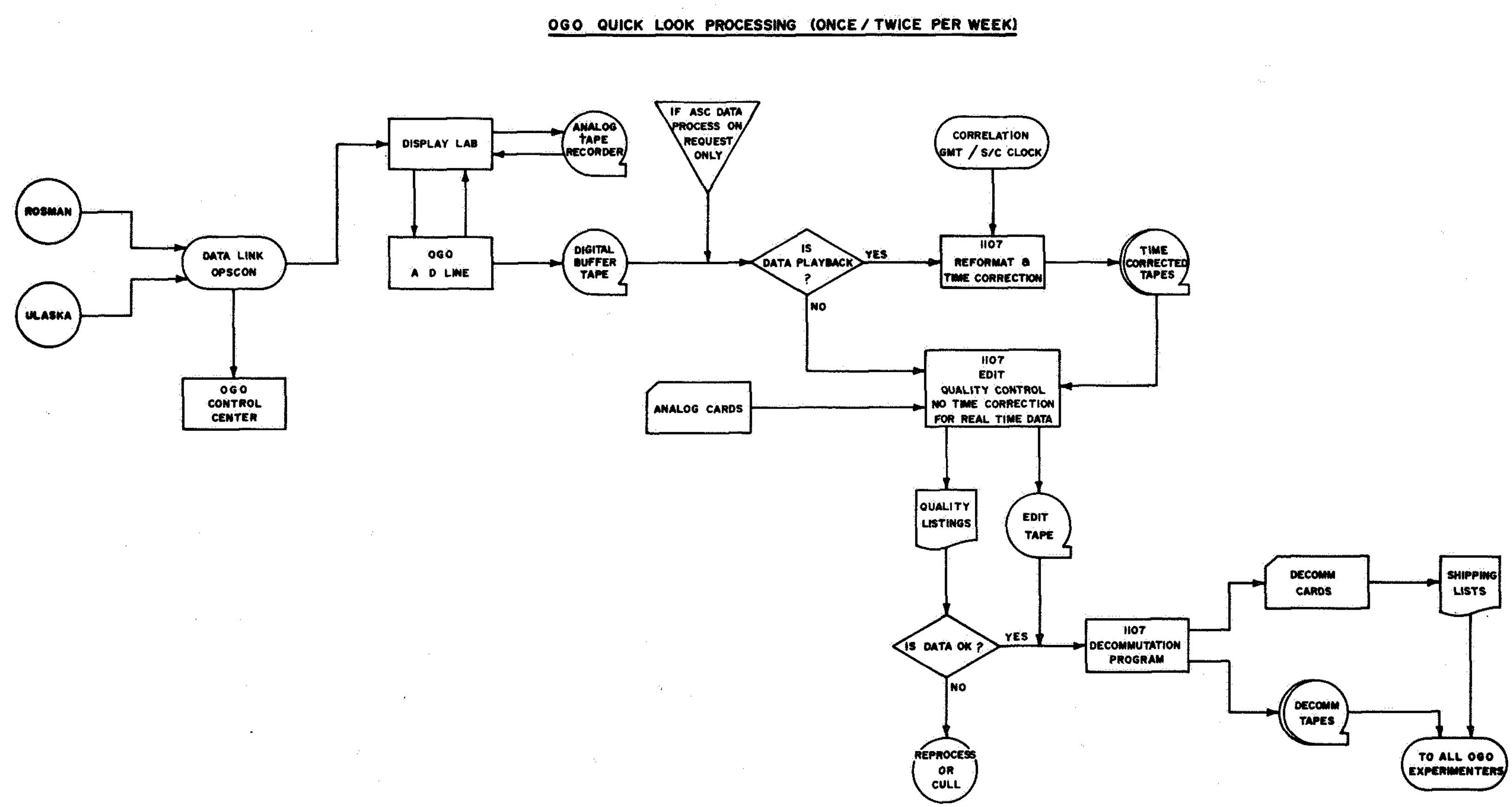


Figure 67–OGO Quick Look Processing (Once/Twice per week)

OGO REAL TIME DATA-NORMAL PRODUCTION

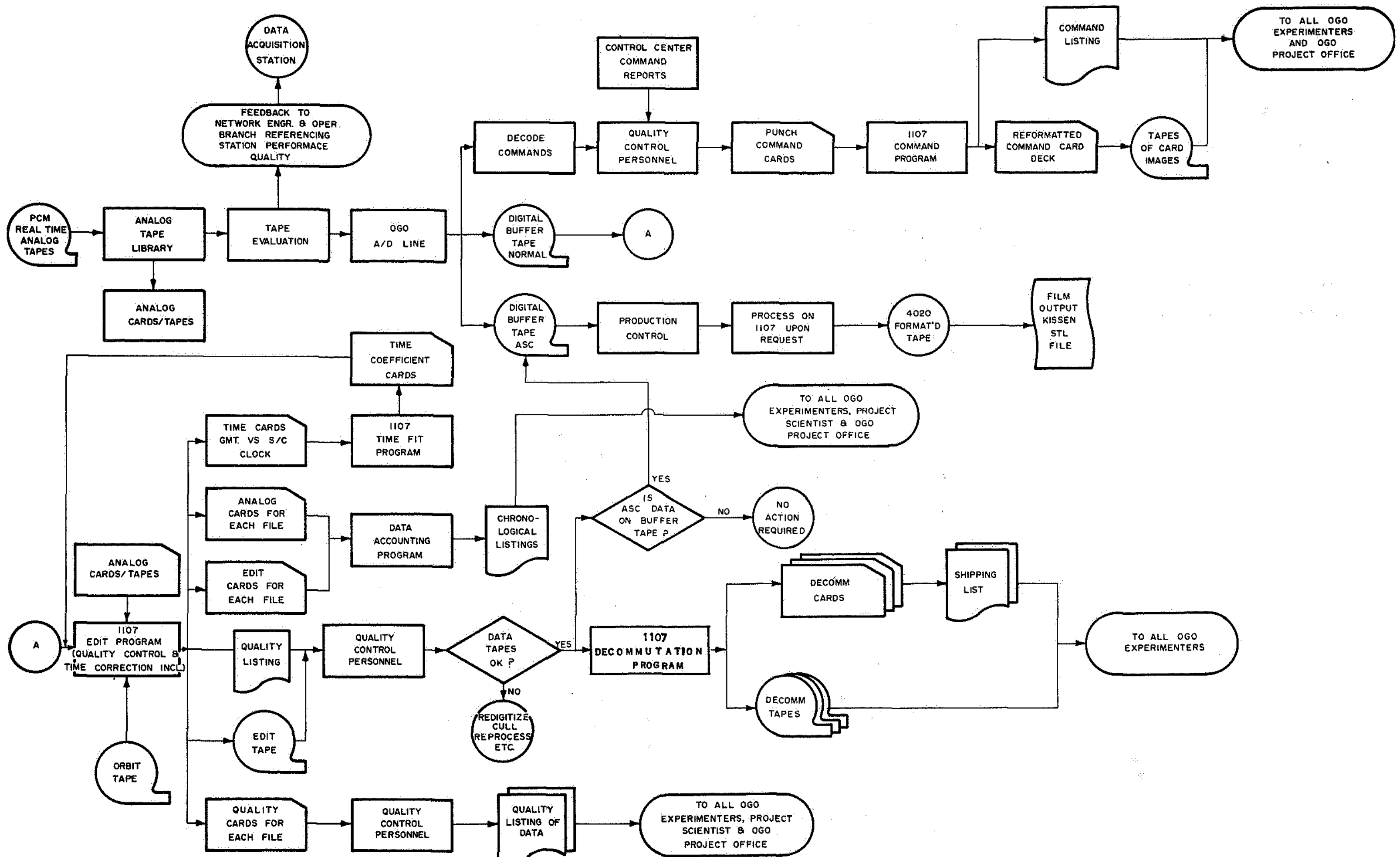


Figure 68—OGO Real Time data Normal Production

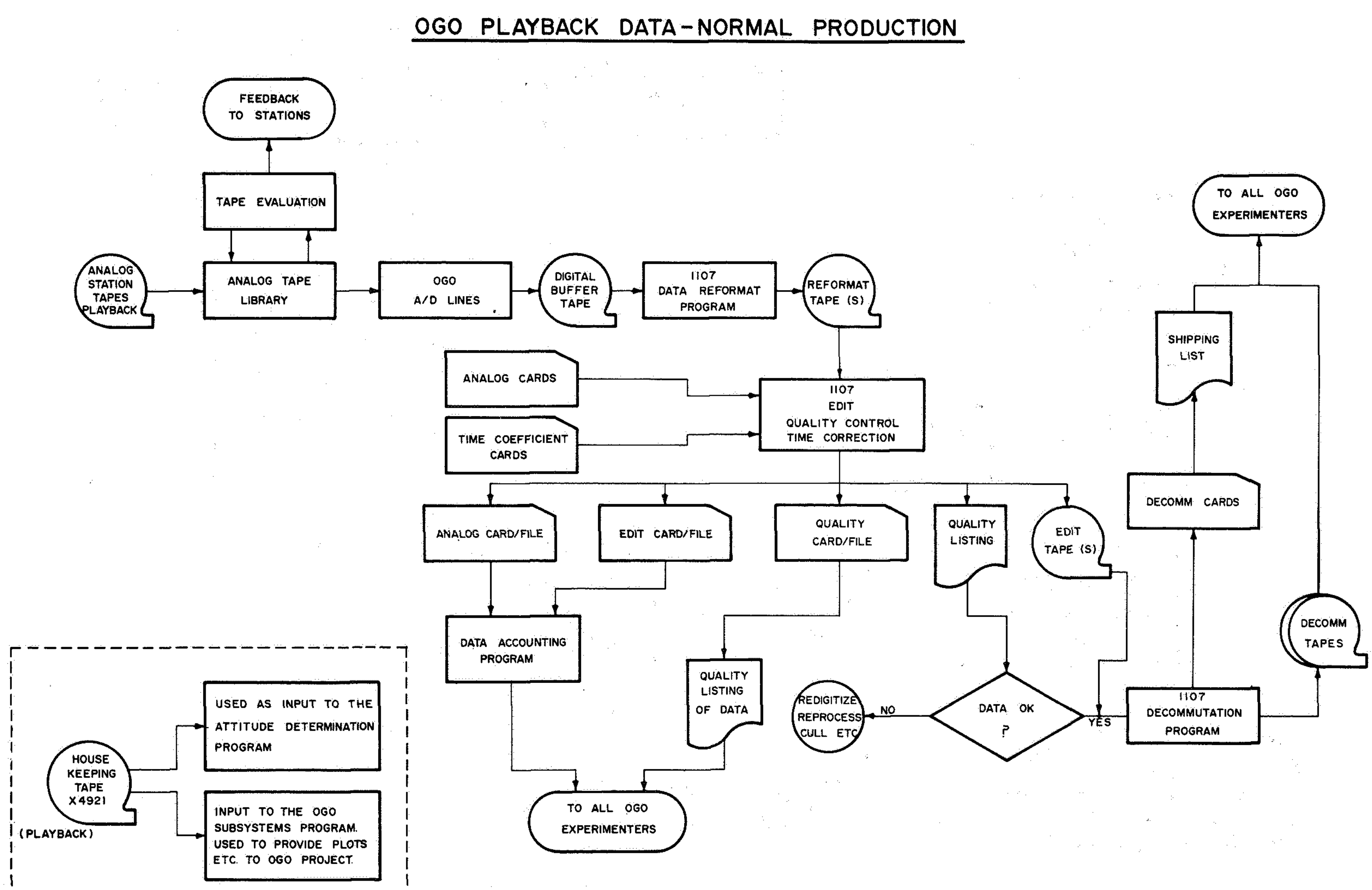


Figure 69–OGO Playback data Normal Production

SPECIAL PURPOSE TELEMETRY PROCESSING

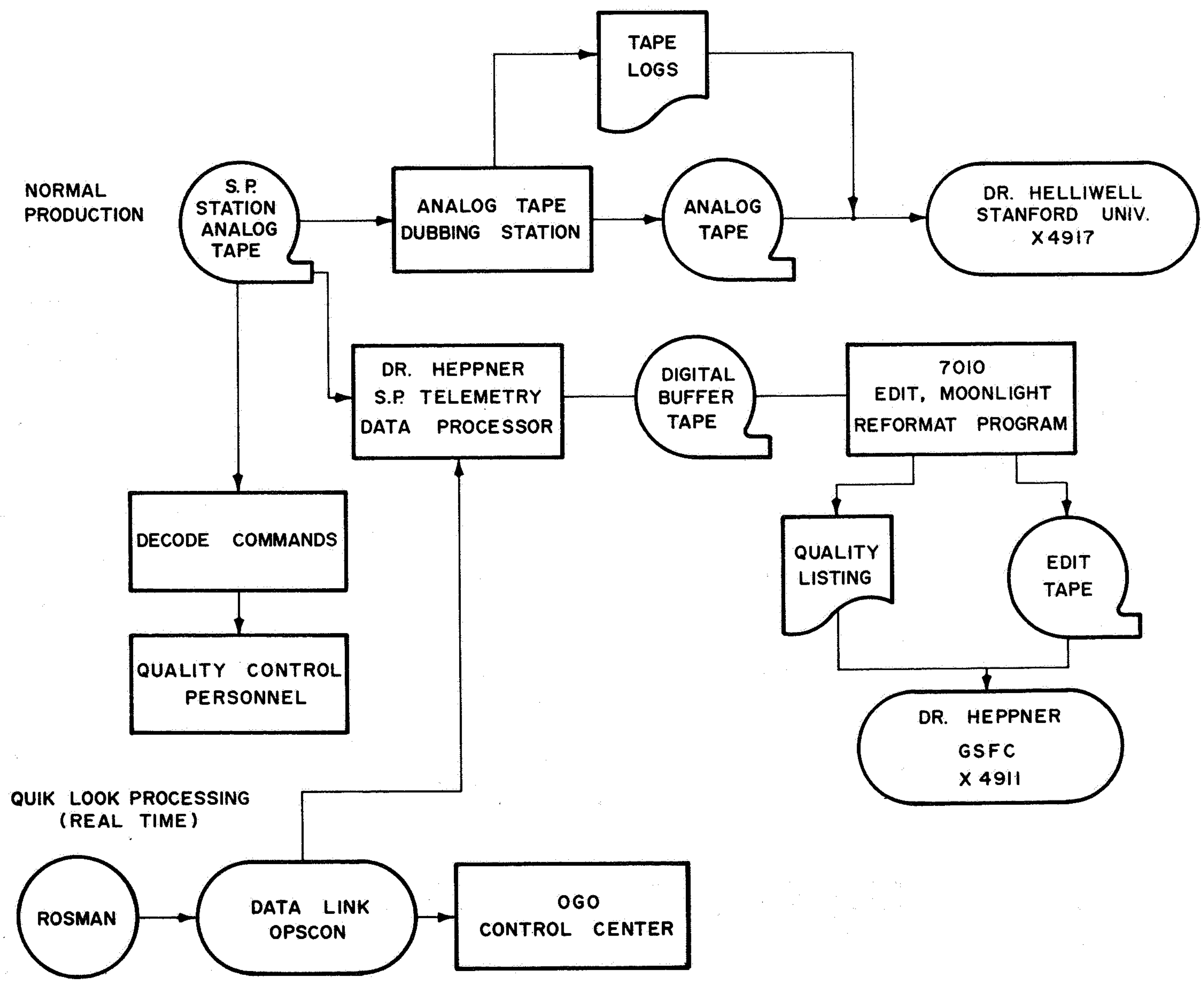


Figure 70–Special Purpose Telemetry Processing

ATTITUDE – ORBIT PROCESSING

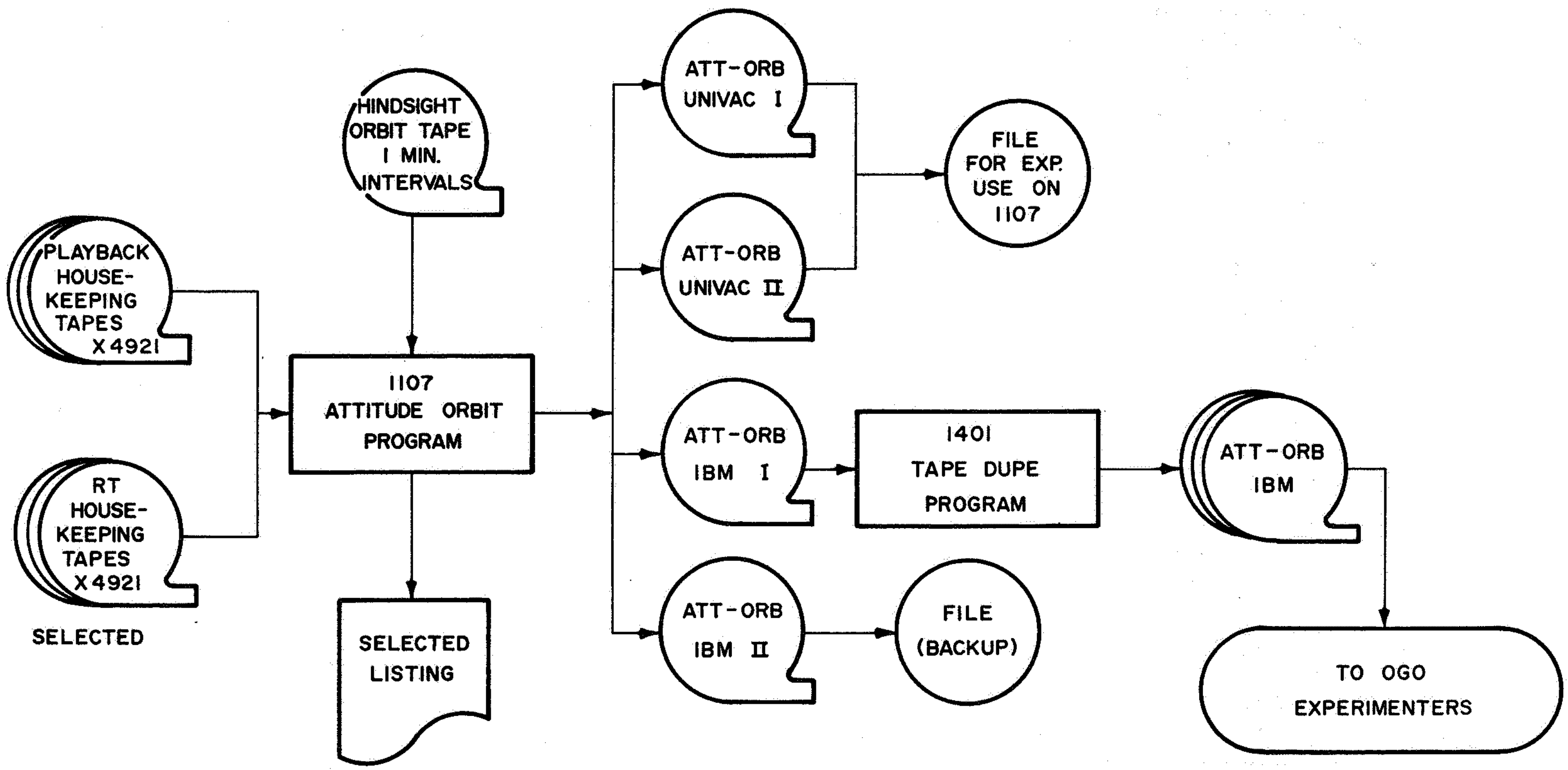


Figure 71–Attitude-Orbit Processing

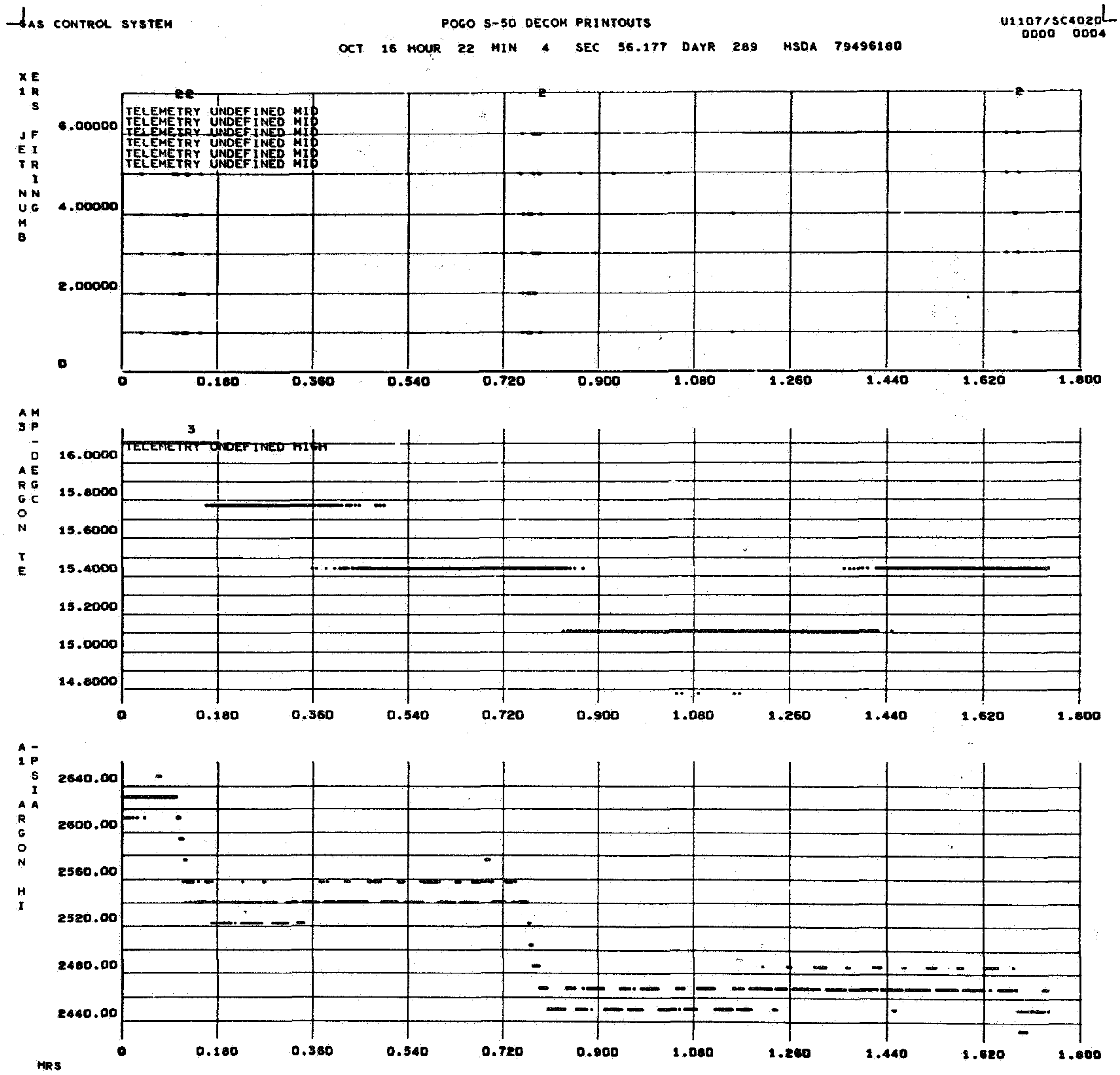


Figure 72A–OGO ACS Subsystem Plots

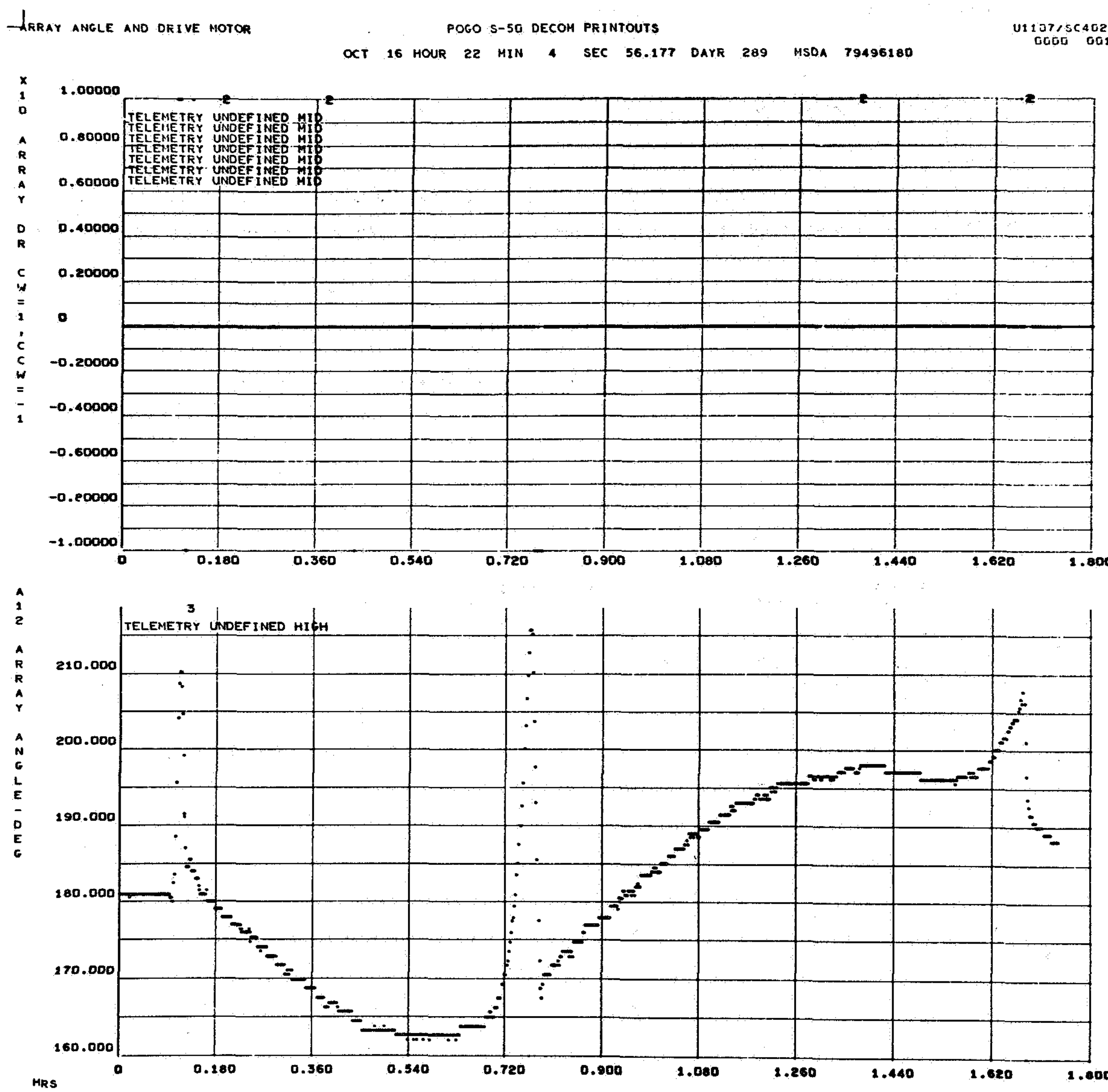


Figure 72B–OGO ACS Subsystem Plots

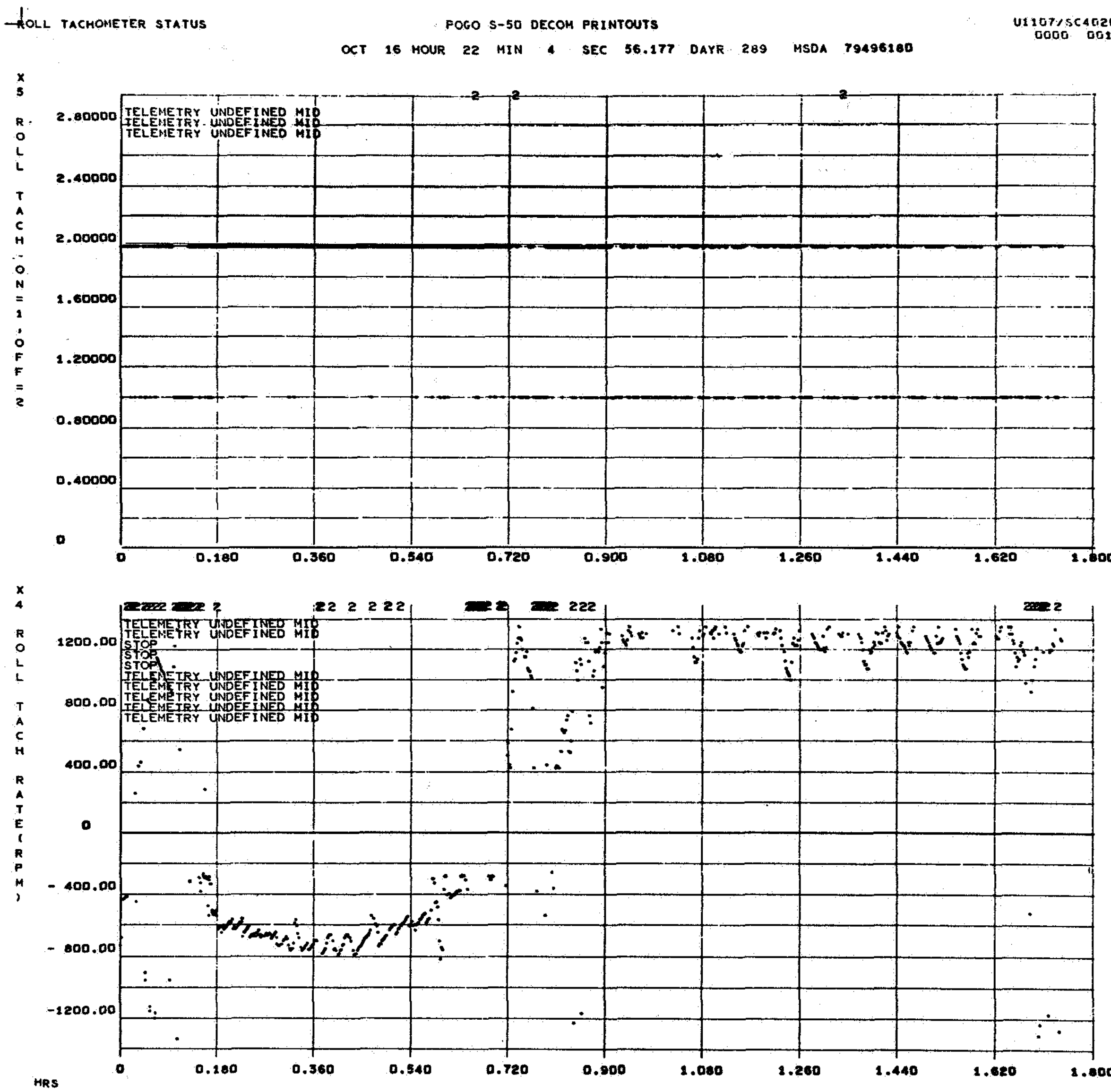


Figure 72C–OGO ACS Subsystem Plots

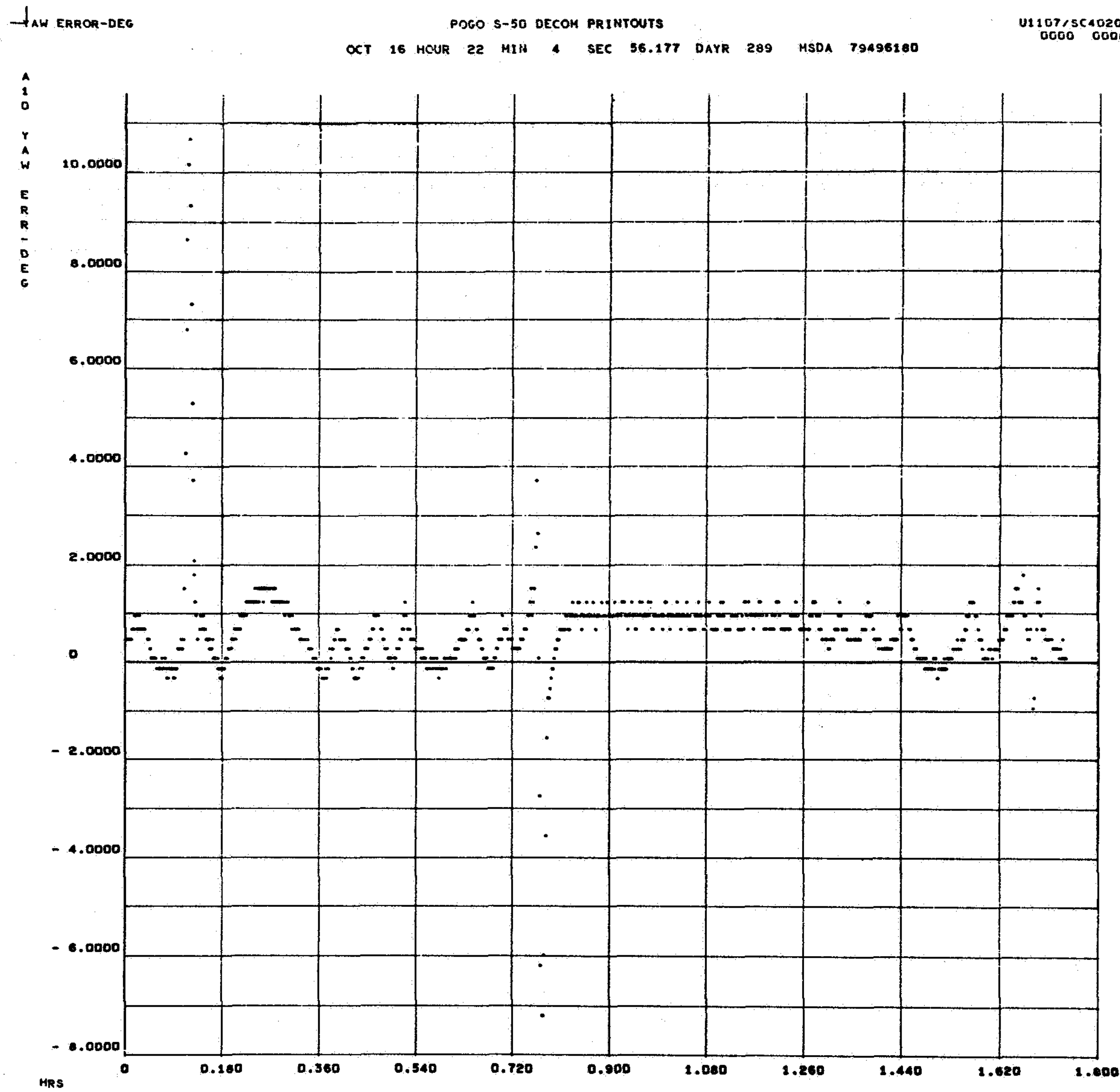


Figure 72D–OGO ACS Subsystem Plots

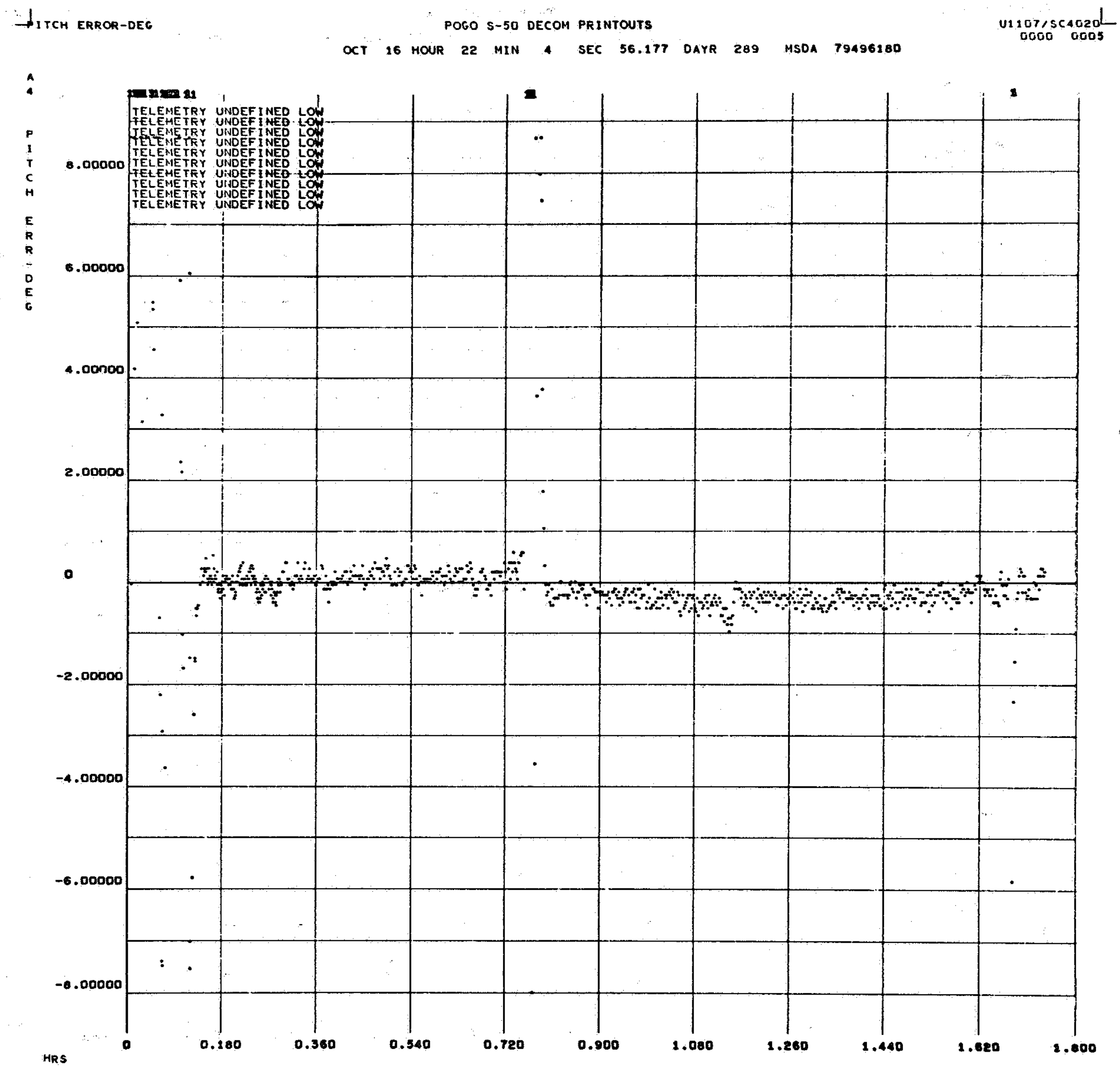


Figure 72E—OGO ACS Subsystem Plots

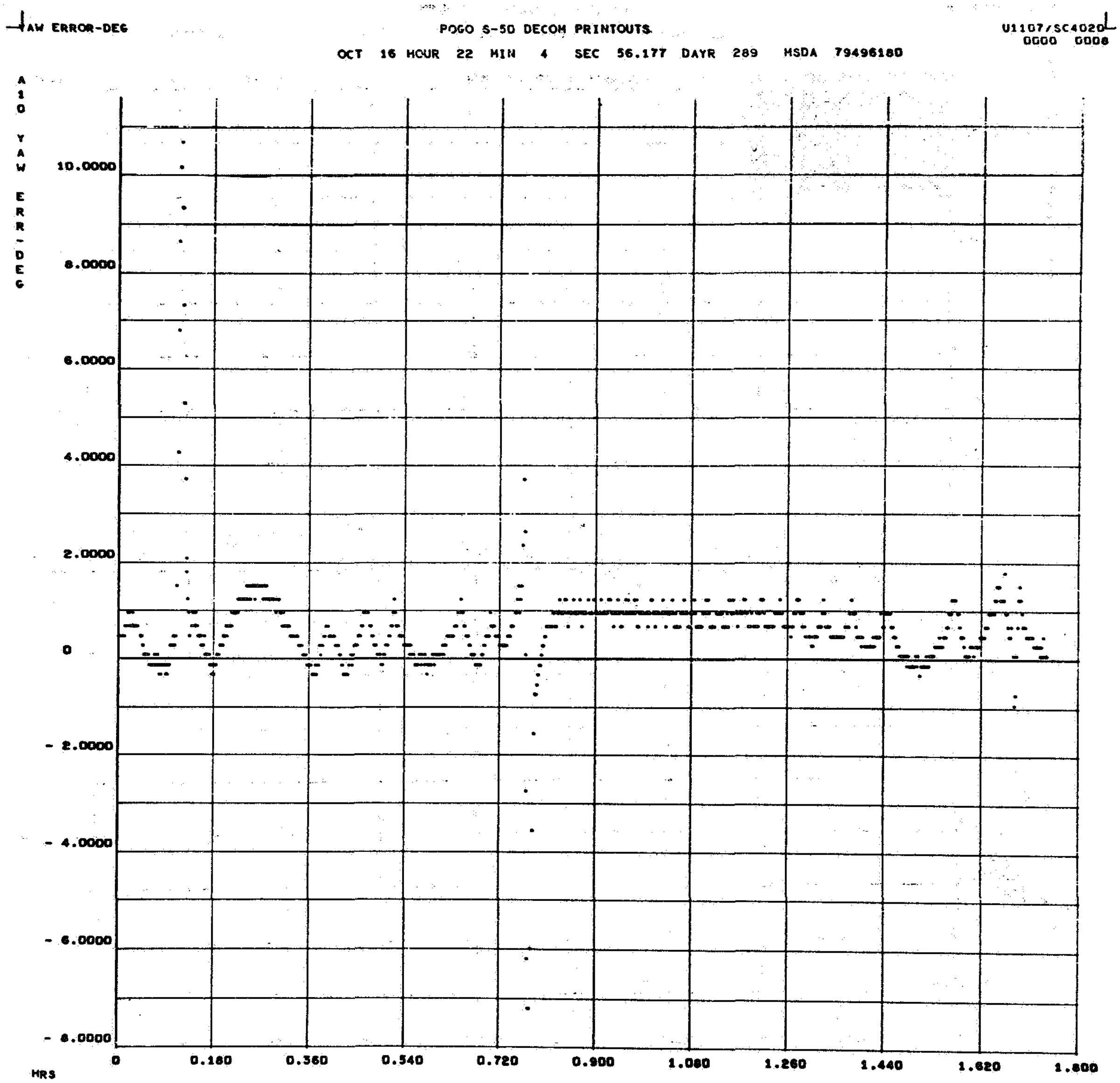


Figure 72F–OGO ACS Subsystem Plots

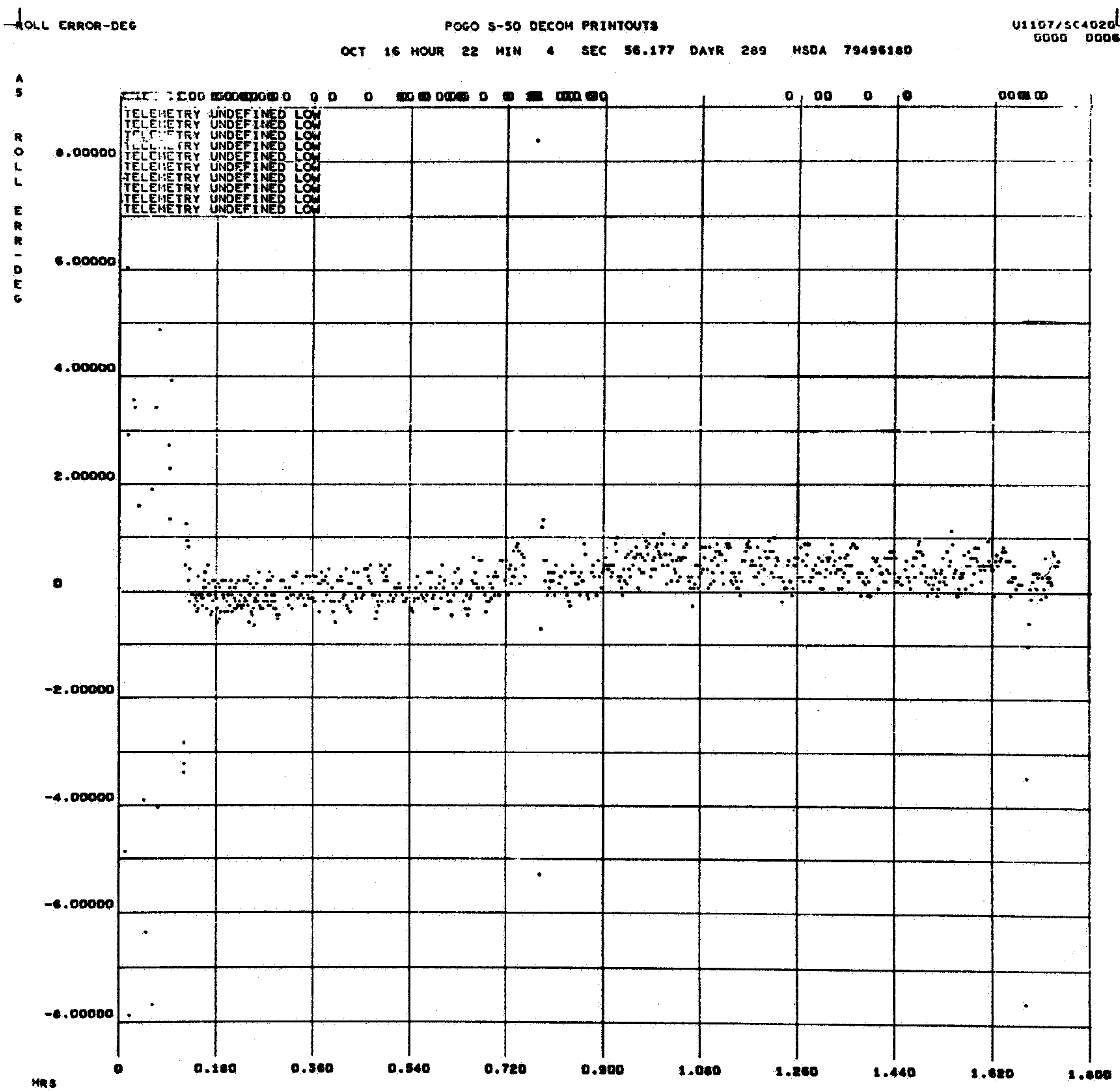


Figure 72G–OGO ACS Subsystem Plots