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TELEMETRY DATA PROCESSING PLAN FOR THE OGO-A MISSION

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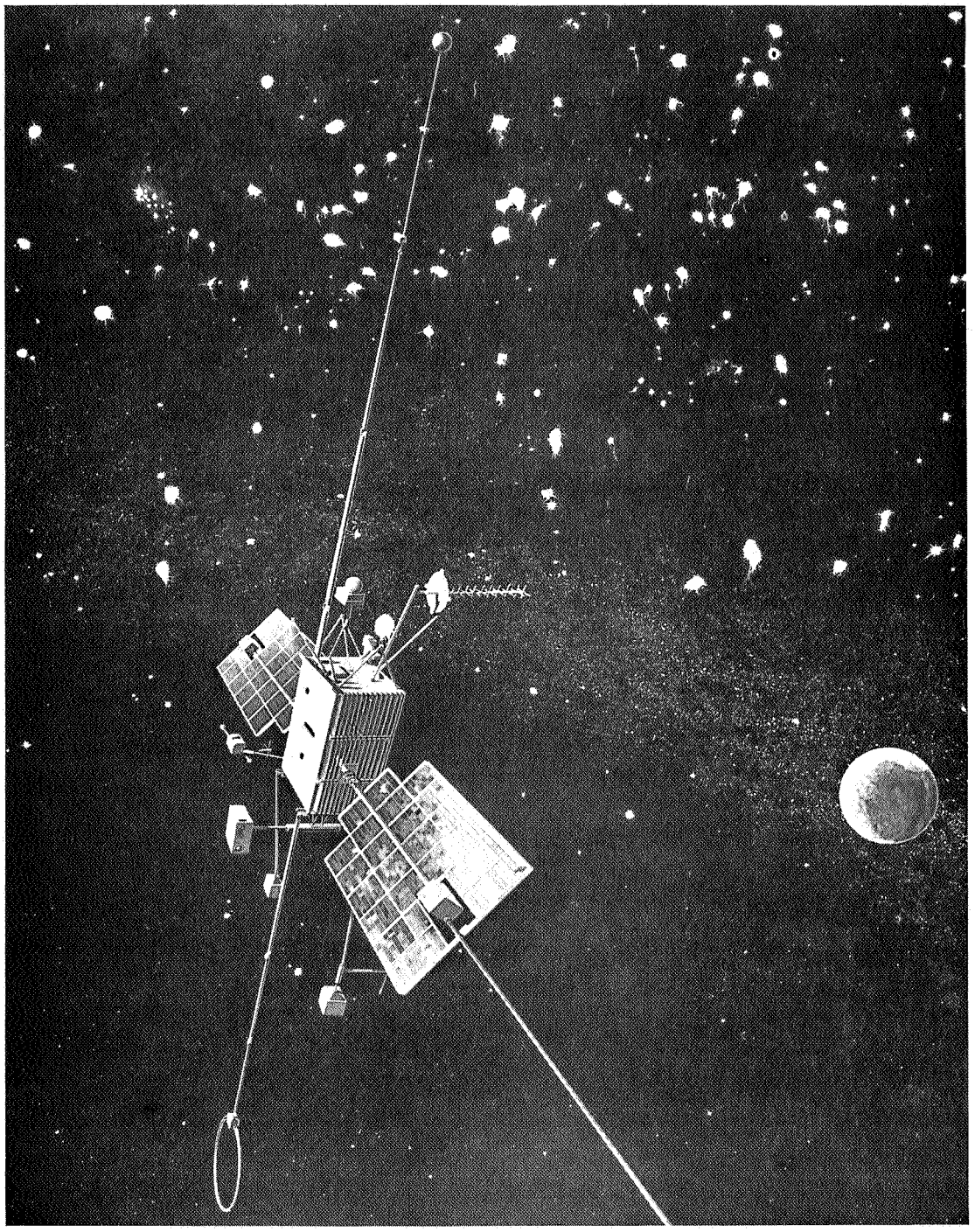

Frontispiece—Orbiting Geophysical Observatory

FOREWORD

The Telemetry Data Processing Plan for the OGO-A Mission was prepared for use by analysts, engineers, technicians, and programmers engaged in processing data for the Orbiting Geophysical Observatory satellites. Detailed information is presented for personnel engaged in production control, tape evaluation, analog-to-digital line operation, computer operation, plotting operation, quality control, and tape library maintenance at the Data Processing Branch. The document will also be of use to experimenters, subsystem engineers, ground station operators, and others concerned with the OGO project.

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SECTION 1
INTRODUCTION AND SUMMARY

Data from scientific instruments onboard satellites are recorded on magnetic tapes at the NASA data acquisition network stations and sent to the Data Systems Division, Data Processing Branch for evaluation, processing, reduction, and further preparation for analysis. Further responsibilities include spacecraft attitude computations, additional processing of experiment data by request of the experimenter, and processing of spacecraft subsystem data. A telemetry data processing plan has been prepared to help accomplish the above-mentioned tasks for the Orbiting Geophysical Observatories (OGO-A Mission).

The OGO's, the first of a series of sophisticated scientific satellites, have been designed to accommodate many types of highly diversified scientific and technological experiments that will telemeter back to earth an avalanche of data. The techniques of reducing and processing these data require specific knowledge of the data processing problem with all of its aspects; i. e., the control of the experiment data in the OGO's, the data transmission, acquisition, etc., to the data's final preparation for analysis. Therefore details of the extensive data processing operations as well as pertinent OGO spacecraft-details are presented in the Telemetry Data Processing Plan for the OGO-A Mission.

The plan contains nine sections and three appendices. Section 1 is the Introduction and Summary. Section 2 presents the overall OGO program, the OGO-A mission, and the observatory tracking equipment. Section 3 presents the multiplexing and transmission of experiments and subsystem data in the OGO-A spacecraft. The multiplexing of data handled by the pulse code modulation (PCM) telemetry is emphasized. Section 4 describes the ground data acquisition stations including procedures, standards, and schedules governing their operations. OGO-A data processing and PCM analog data processing are described in Section 5. OGO-A data processing on digital computers is described in Section 6. Section 7 describes the techniques used to process the PCM digital data in each of the four major intermediate programs of the 060-A plan. The four major end-data programs for PCM data are described in Section 8. These programs yield decommutated digital data from commands, experiments, spacecraft subsystems data, and attitude-orbit data. These data together with special-purpose data constitute the end goal of the OGO-A mission. Because it uses frequency-division multiplexing, special-purpose data is separate and distinct from PCM data and must be processed accordingly. Section 9 describes the techniques used to process these data. In conclusion, two appendices present (A) the disposition of data, and (B) the descriptions and locations of experiments and names of experimenters. The command system of the OGO-A spacecraft and the OGO spacecraft instrumentation list are incorporated by reference in Appendix C.

SECTION 2
ORBITING GEOPHYSICAL OBSERVATORIES

2.1 OVERALL OGO PROGRAM

The Orbiting Geophysical Observatory (OGO) program's first objective is to conduct numerous, diversified experiments for making scientific measurements within the earth's ionosphere, magnetosphere, and in cislunar space to obtain a better understanding of the earth-sun relationship. The second objective is to design, develop, and launch a series of standard observatory spacecraft with a basic system design that can be easily adopted to carry numerous and diverse experiments.

Eleven missions (two different types) are currently planned in the OGO program. See Table 2-1. In one type (EGO), the spacecraft describes a highly elliptical orbit ranging in altitude from less than one to greater than 20 earth radii. In the other type of mission (POGO), the spacecraft describes a nearly circular orbit at heights less than one earth radii.

The OGO program is under development by Space Technology Laboratories for Goddard Space Flight Center. The project management structure for the OGO program is given in Figure 2-1.

Table 2-1

Planned OGO Missions

Present Designation	Former Designation	Type of Orbit
OGO-A	5-49	Eccentric
OGO-B	S-49a	Eccentric
OGO-C	5-50	Polar
OGO-D	S-50a	Polar
OGO-E	s-59	Eccentric
OGO-F	S-60	Polar
OGO-G	S-69	Eccentric
OGO-H	5-70	Polar
OGO-I	s-79	Eccentric
OGO-J	(None)	Polar
OGO-K	(None)	Eccentric

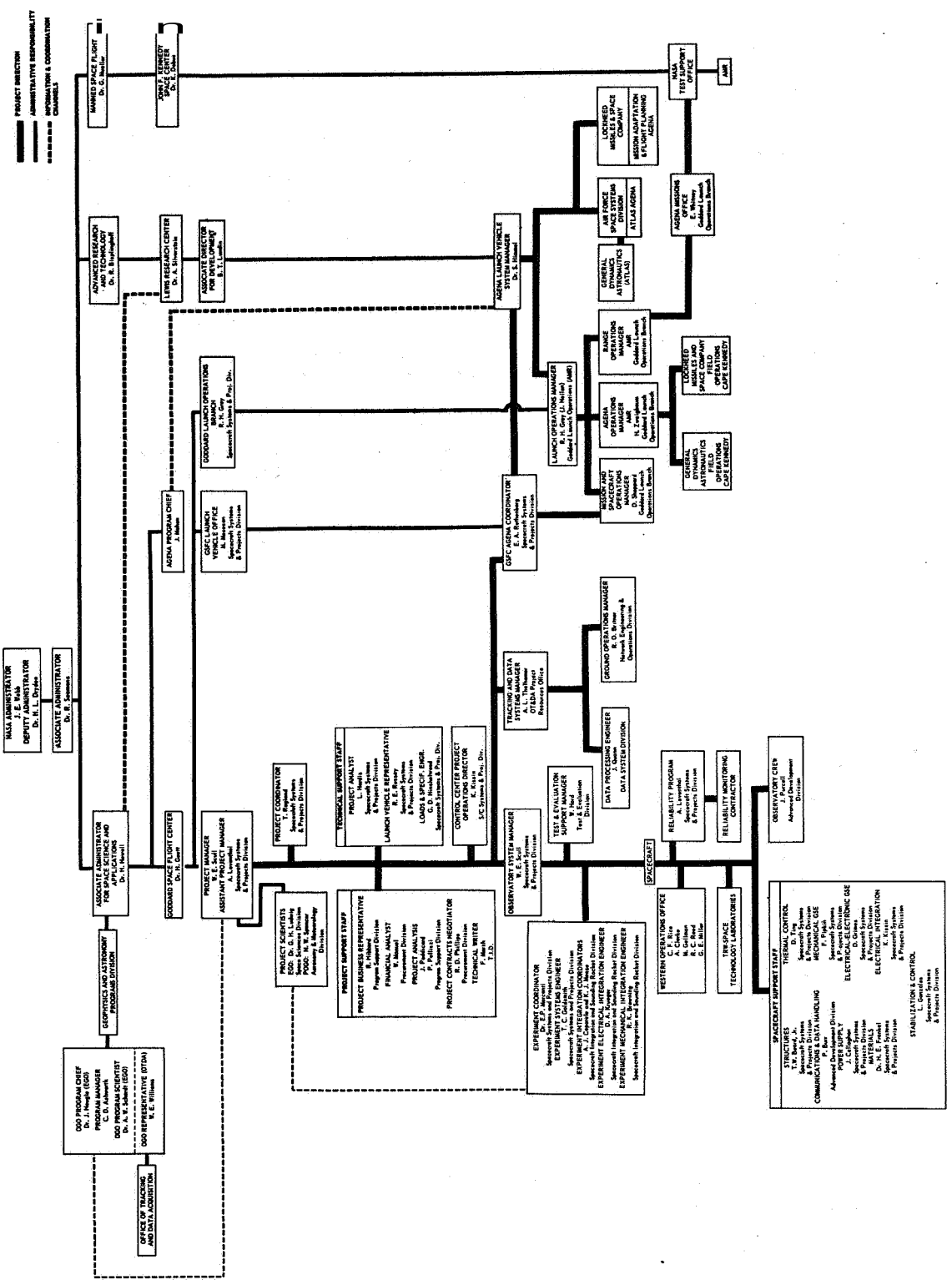


Figure 2-1. Project Management Organization Chart, EGO

The OGO program has disclosed new problems in data handling. In the past, a relatively small number of experiments has been carried in various satellites. Each of these previous missions has resulted in acquiring large quantities of data during several months of useful life. It is estimated that 10,000 analog magnetic tapes will be used during the one-year lifetime of each OGO mission. Such a large volume of data requires a data handling system as near totally automatic as possible, using state of the art techniques.

In the handling of OGO data, telemetry data are received from the spacecraft via UHF link and recorded on analog magnetic tapes at the primary and secondary STADAN network stations. The analog tapes are then mailed to Goddard Space Flight Center for processing. Each tape, as it is received from the acquisition station, is evaluated and classified according to its quality. A log accompanies each tape, from the time of initial reception of data to final processing. Then, each experimenter receives his data on digital tapes according to specifications, containing orbital, housekeeping, and experimental information. Separate orbital and attitude tapes also accompany the experimenter tapes. Further data analysis is performed by the experimenter.

2.2 OGO-A MISSION

As the first mission of the OGO program, the OGO-A was launched by an Atlas-Agena B vehicle on 7 September 1964 from the Atlantic Missile Range and injected into an eccentric orbit of approximately 31 degrees inclination. The spacecraft weighs about 1500 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-A 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. A backup mission, OGO-B, is planned in the event of catastrophic failure of the first.

The OGO-A spacecraft contains subsystems for power supplies, active and passive thermal control, attitude control, communications, and data handling. The spacecraft structure (Figure 2-2) consists of a rectangular parallelepiped main body with appendages comprised of a two-panel solar array, two orbital plane experimental packages (OPEP), that provides mountings for atmosphere and ionosphere experiments which must be external to and isolated from the main body. Besides the solar cells, each panel of the solar array contains a solar oriented experimental package (SOEP). The communications and data handling subsystems are of primary importance to data processing, Appendix B lists the experiments' names and numbers, their locations in the spacecraft, and the names and addresses of the principal experimenters. Figure 2-3 shows the Data Processing Branch's organization.

2.3 OGO-A DATA HANDLING AND TELEMETRY

Figure 2-4 is a block diagram of the data handling and telemetry subsystem which is designed to acquire, process, store, and telemeter, on command, experimental and spacecraft data. The data handling and telemetry subsystem also generates timing signals for the experiments and other spacecraft subsystems. The subsystem is a high-capacity digital and analog system which conditions, multiplexes, stores, and transmits data from the experiments and spacecraft subsystems to the data acquisition stations. Its design was based upon the criterion that the simplest practicable interface be used between the experiments and the data subsystems. The data handling and telemetry subsystem regulates three forms of data: (1) frequency division multiplexed data (special purpose telemetry), (2) time division multiplexed analog data (analog-to-digital converter and digital telemetry system), and (3) time division multiplexed digital data (digital telemetry system).

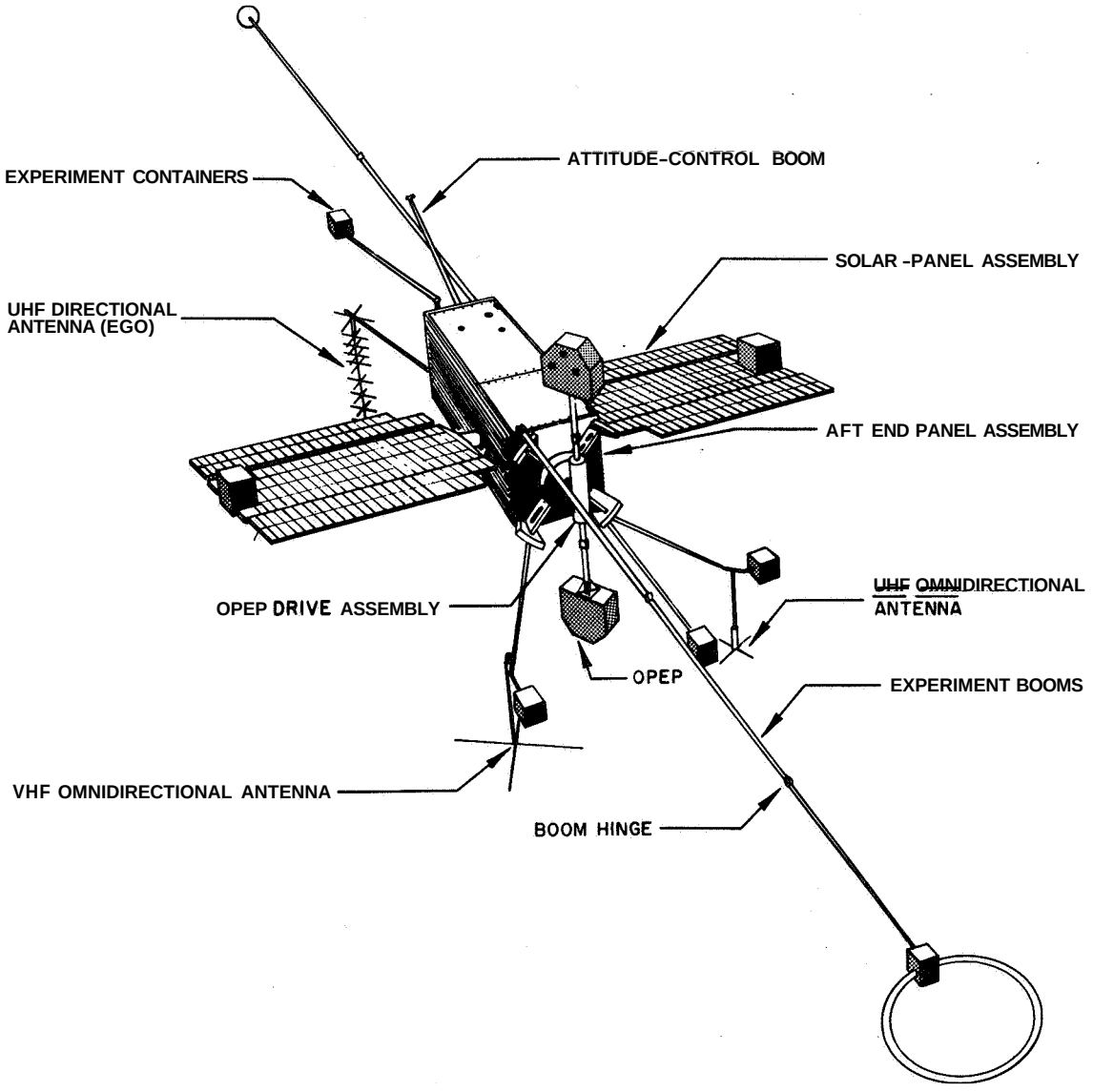


Figure 2-2. OGO Deployed Configuration and Antenna Array

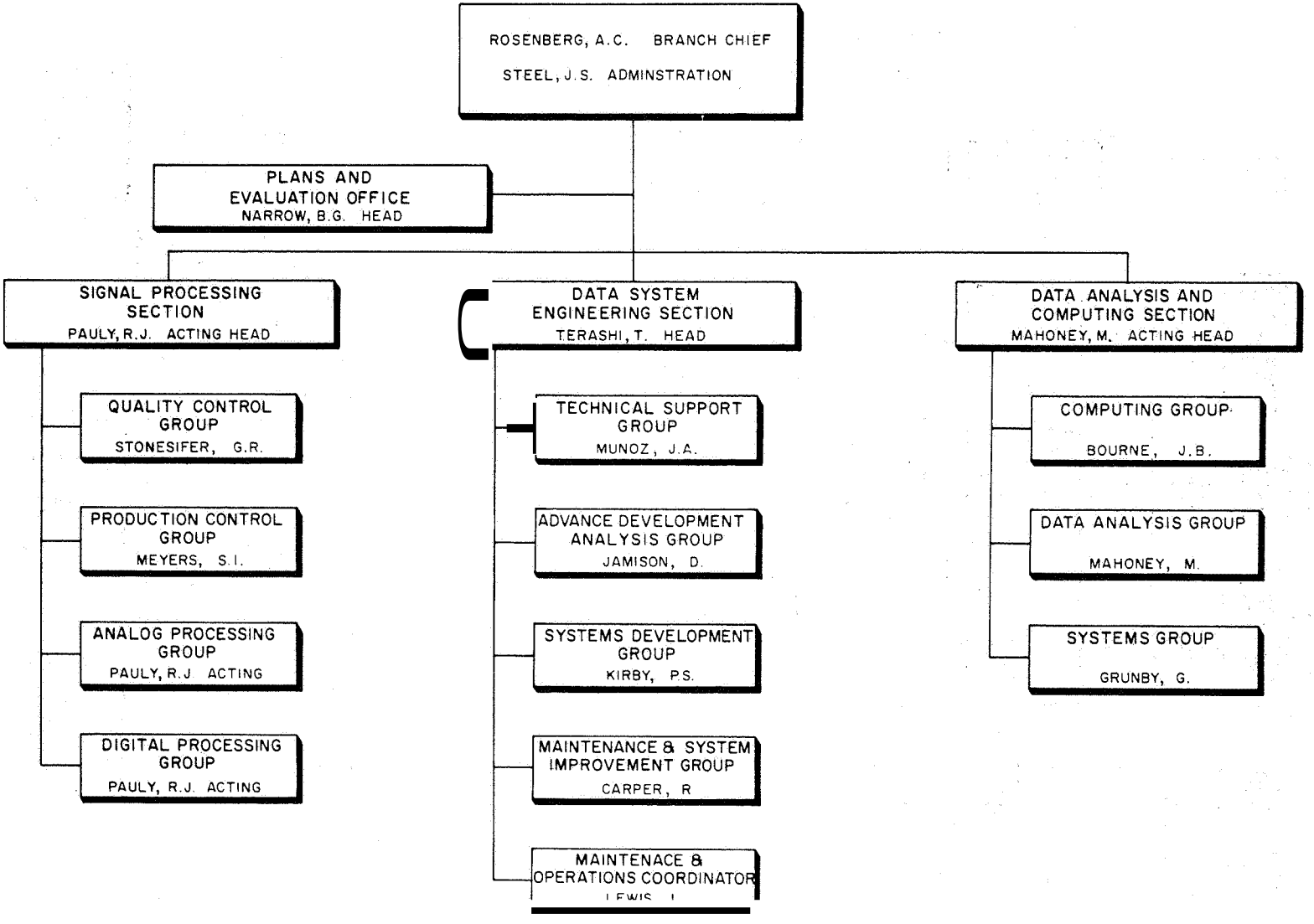


Figure 2-3. Data Processing Branch

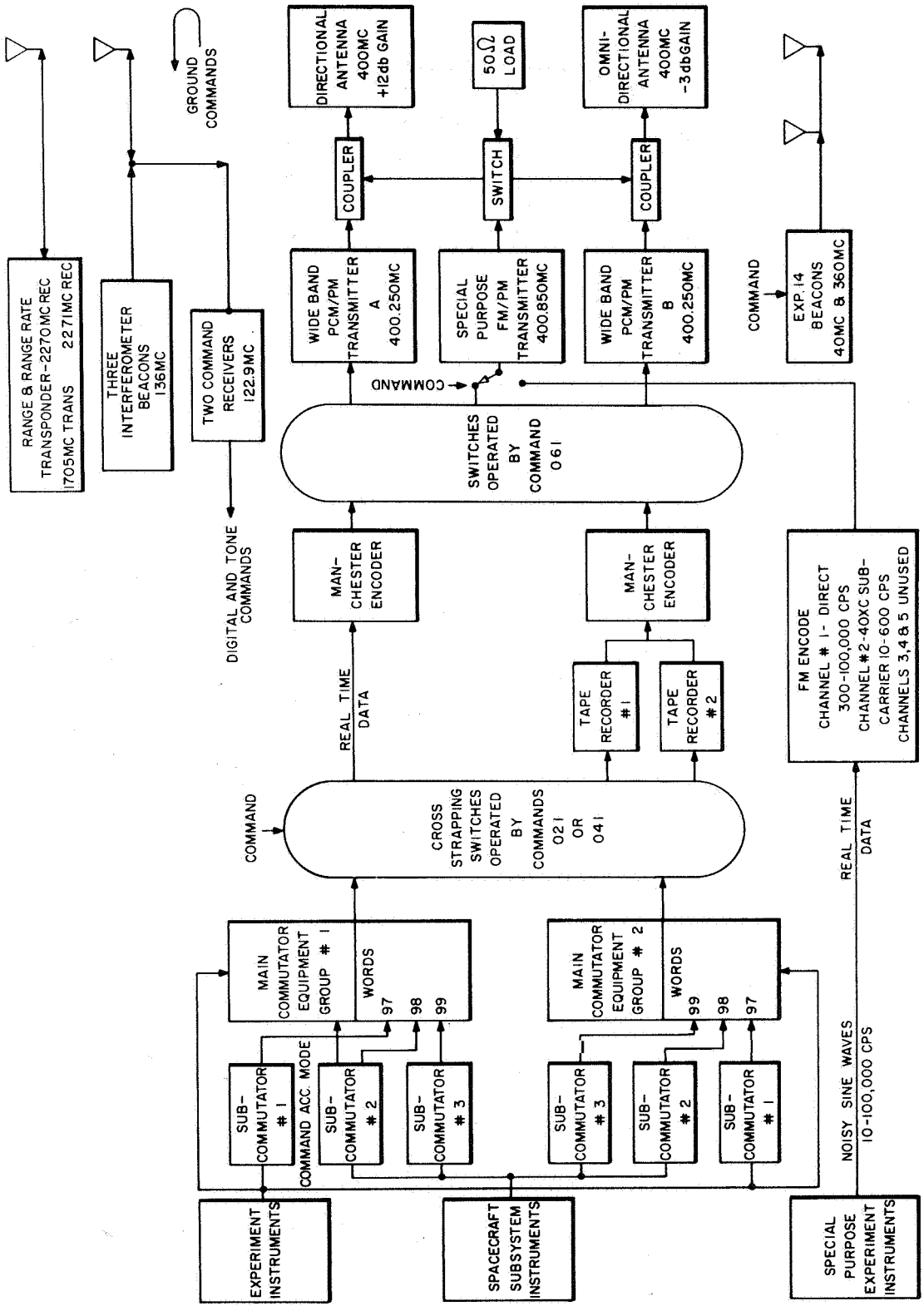


Figure 2-4. OGO-A Communications and Data Handling Subsystem

A single transmission line is the interface from a special purpose or analog experiment output to the data handling and telemetry system. The output of the experiment must remain within a zero to five volt range with an output impedance low enough that the measuring accuracy of the experiment will not be unduly affected by the input impedance of the data system.

The digital data interface also allows various digital experiments to be conducted without requiring modification to the data handling and communications subsystem. All signal conditioning is performed within the experiments. Two types of synchronizing lines carry control pulses from the data system to the experiments. One type provides bit pulses, the other provides word pulses for control of each data multiplexer input. Thus, each experimenter has a choice to divide each experiment word or group of words as desired.

2.3.1 Special Purpose Telemetry

The special purpose, frequency division multiplexed, telemetry system is a wideband telemetry system for use by experiments which are incompatible with the time sharing features of the digital system. The special purpose system can accept five input signals within the frequency range of 300 cps to 100 kc whose amplitudes do not exceed 5 volts peak to peak. These signals are multiplexed and the composite signal amplitude phase modulates a 400.85 mc transmitter having a 0.5 watt power output. Normally, the transmitter radiates continuously, but can be turned on and off by ground command. The waveforms from the experiments which are telemetered by the special purpose system can be of any form as long as all frequency components lie within the bandwidth of 300 cps to 100 kc. Frequency, phase, or amplitude modulation of the signals can be used because it is only necessary that the characteristics of the five input signals be chosen so that they can be separated without interference after acquisition at the ground stations. Therefore, it is recommended that standard IRIG frequencies be used for subcarrier oscillator modulations in the experiment instrumentation. Note that special purpose data are not stored in the spacecraft. These data are acquired only when real time telemetry is being acquired by the ground stations.

2.3.2 Digital Data Processing

Experimental data are sampled, digitized, stored, and transmitted by the wideband telemetry system. Timing pulses are provided for the experiments and other electronic subsystems. A patch panel facilitates connection of the experiments to the wideband telemetry system. All data inputs are sampled sequentially. The analog data is converted to a binary form, and tape recorders store the binary data. Data transmission is performed by appropriate antennas and transmitters.

The communications and data handling subsystem is designed to permit the greatest possible flexibility in the design of experiments. Experiments with essentially analog signal outputs are converted to digital form by signal conditioning equipment; i. e., the varying experiment output voltage is converted to a range of from zero to five volts. Outputs which are essentially digital (Gieger-Muller Counters, etc.) use digital techniques to process and condition the data. These data are transmitted serially in a binary code to the data handling subsystem and synchronized with timing pulses.

A patch panel is used to route the experimental data outputs to the data handling system. The panel contains terminals for all experiment outputs, data system inputs, and data timing signals. The telemetry format is assembled by interconnecting the terminals. Using the patch panel provides ease in initial formatting, a convenient point of access for a format change, and minimum interference with other spacecraft equipment.

Redundant data handling equipment is used to sample the input lines sequentially and convert analog to digital data. Normally, one equipment group provides an output to one of the two digital transmitters for real time transmission, while the other provides an output to one of the two redundant tape recorders for storage. The functions of the two redundant equipment groups can be reversed in case of a partial system failure. Although the analog and digital inputs are gated in separate subassemblies, the operation is the same as though there were five time division multiplexers. Each multiplexer is functionally equivalent to a rotary switch. The main multiplexer sequentially samples 128 inputs. Three of the main multiplex inputs are outputs from three submultiplexers, each of which in turn samples 128 inputs. Each submultiplexer sequences one position whenever the main multiplexer advances 128 positions, or one complete rotation. Thus, the main multiplexer is used for rapidly varying data, while the submultiplexers are useful for sampling more slowly varying data. Subcommutator 2 can be operated at the main multiplexer rate when the data from its inputs are needed frequently, for example during appendage development and initial attitude acquisition. In this case, subcommutator 2 provides data directly to the transmitter or tape recorder, and the inputs to the other multiplexers are not processed.

A flexible format multiplexer can be substituted for the other multiplexers on command. This device permits the time division multiplexing of 32 different data lines in 32 different sampling formats as selected by ground command. It is provided for use when a few experiments require high sampling rates for relatively short periods of time.

Each multiplexer contains both analog and digital gates, appropriately interspersed. Whenever an analog gate is energized, the analog voltage is converted by the eight-bit analog-to-digital converter. A digital signal bypasses this converter.

The pulse code modulated data from the data handling equipment groups are in the form of a non-return to zero or split phase code in which binary zeros are represented by 01 and ones by 10. The code provides at least one level transition for every bit regardless of the bit pattern to aid in bit synchronization during ground data processing.

A sequence (a certain organized arrangement of data) in the digital data format consists of one cycling of the three submultiplexers and thus 128 cyclings of the main multiplexer. Each cycle of the main multiplexer, or frame, results in the processing of 128 words, or input samples. Each word consists of nine binary bits. Thus, one sequence includes one submultiplexer cycle, 128 main multiplexer cycles or frames, 16,384 words, and 147,456 binary bits. The data handling bit rates can be set by ground command at 1000, 8000, or 64,000 bits per second. Tape recording in the observatory is always done at 1000 bits per second and tape recorder readout occurs at 64,000 bits per second. Depending on the requirements of the experiments, any of the three bit rates apply to real time digital telemetry.

2.3.3 Digital Data Storage

Two redundant tape recorders store the digital data so that continuous data can be recovered from the OGO-A by a small number of ground receiving stations. Each of the recorders has a storage capacity of 43.2 million binary bits. The recording bit rate is 1000 binary bits per second, depending on the mission; thus, the recorders can record for 12 hours. The two recorders can store sequentially to provide times up to 24 hours between readouts. Readout of one recorder can occur while data are being stored on the other to provide continuous coverage. Readout time is 11.25 minutes per recorder. The recorder tapes are reversed for readout, resulting in time reversal of data. During processing on the ground, time is returned to its correct sequence.

2.3.4 Digital Data Telemetry Transmission

The digital outputs of either of the two data handling equipment groups or either of the two tape recorders are telemetered on ground command by either of the transmitters. Provision of command-controlled cross-strapping allows the full use of the extensive parallel redundancy to enhance reliability of the data handling system.

One of the two digital wideband transmitters is energized upon receipt of a ground command. The telemetry system is automatically turned off by a timer approximately 23 minutes after loss of the command carrier. One of the transmitters drives the omnidirectional antenna, which is circularly polarized and has a gain of -3db. The other digital transmitter drives the directional antenna which is circularly polarized and has a gain of +12 db. Normally the transmitter driving the directional antenna is used only when the transmission distance is greater than three earth radii. When the observatory is near the earth the omnidirectional antenna with its greater beam width is used. It is not possible to operate both digital transmitters simultaneously, but one digital transmitter and the special purpose transmitter may transmit simultaneously. If both digital transmitters should fail, or if a lower transmitter power is desired, then the digital data can be transmitted by the special purpose transmitter. The special purpose transmitter drives either the directional or the omnidirectional antenna through a command-operated switch.

The power outputs of the digital wideband transmitters are four watts. The 400.250 mc carriers are bi-phase modulated by the pulse code modulated data. The angle between the two phases is adjusted to leave approximately 10 percent of the radiated power at the carrier frequency. This simplifies lock-on and tracking of the carrier by the ground receivers.

2.3.5 Observatory Synchronization and Timing

A central timing system provides high accuracy timing and synchronization for the entire observatory. The basic timing sources are two redundant 256kc crystal oscillators having long term stabilities of one part in 10^5 per year and short term stabilities of one part in 10^6 per hour. Only one oscillator is used at a time so that all timing is derived from a single source. Countdown circuits provide signals for synchronizing the data handling subsystem and the tape recorders, for time reference in the experiments, and for synchronizing all power converters to minimize interference to VLF experiments. An additional register generates observatory accumulated time, which is recorded and telemetered with all digital data to serve as a prime data time reference.

2.4 OGO-A COMMAND RECEPTION

Two redundant AM command receivers operating at approximately 120mc are fed from dipole omnidirectional antennas (see Figure 2-4). The dipoles are crossed in a single assembly, thus providing polarized diversity reception. The receivers have 33.15 mc and 7.3 mc intermediate frequencies and bandwidths of 40 kc. The bandwidths of the audio sections are 11 kc. The basic receiver noise figures are 4db. With an antenna noise temperature of 1000° K, the command noise power is -121 dbm. The receivers are set to unsquelch at -115 dbm and, at the same point, relays operate to indicate the presence of a radio frequency carrier. Each receiver contains two AGC loops to permit operation over a wide range in signal strengths.

The outputs of the two command receivers feed, in a parallel redundant fashion, two digital decoders and a single tone decoder. The squelch or failure detection circuits in the receivers maintain the input to the decoders at a constant level, regardless of the number of receivers which are operating.

The digital decoders permit the reception and proper routing of 254 separate commands. They operate on a frequency shift keying signal in which one frequency represents a binary one. Each digital decoder can be addressed separately, but the output from a single decoder provides complete digital command capability. Outputs from the digital decoder operate relays arrayed in a 16 by 16 matrix. Two types of relays are used, power command and impulse command. Of the 254 commands, 104 are used to control the data handling, communications, power, attitude control, and thermal systems, and initiate deployment of the appendages. The other 150 commands are reserved for the experiments. Fifty power relays, requiring separate on and off commands, provide electrical power to the various experiments. Fifty impulse relays provide grounding of 50 control lines for approximately 50 milliseconds following execution of the proper commands.

The digital command words contain 24 binary bits. The first bit is always a binary one to provide synchronization. The next three bits contain the satellite and decoder addresses. The next two bits designate the mode of operation of the decoder, while the next eight bits contain the command and select the proper relay in the command distribution unit. The complement to the two mode bits and eight command bits is retransmitted as a parity check. If the parity check succeeds, a command execute signal is generated to energize the proper command relay, and command execution is indicated in the telemetered data.

A limited number of important commands can be received as tone commands and decoded in the relatively simple and highly reliable tone decoder. This sequential tone command system permits reception of real time digital data from the observatory at secondary receiving stations without requiring that they have the complex digital command generator. In addition, the tone command system permits limited observatory operation and data recovery if the digital command system fails.

2.5 OBSERVATORY TRACKING EQUIPMENT

Tracking and data acquisition will be accomplished by the STADAN network special primary and secondary data acquisition stations and range and range-rate tracking stations. Established computation programs will be used in the OGO-A program.

The observatory tracking system components are shown in Figure 2-4. Three 136 mc interferometer beacon transmitters will provide a continuous tracking signal for the STADAN stations. One of the two redundant low power (100 mw) transmitters operates continuously except when the high power (10 watt) transmitter is energized. The high power transmitter, utilized only on missions with apogee distances greater than approximately two earth radii, is controlled by a timer which turns the transmitter off 45 seconds after it is energized. The STADAN transmitters use the same crossed dipole omnidirectional antenna as the command receivers. A diplexer-coupler provides the necessary isolation between the beacon transmitters and the receivers. The antenna is circularly polarized for beacon transmission.

The OGO-A range and range-rate system utilizes a diplexed antenna, receiver, frequency multiplier, and transmitter. Signals at frequencies of approximately 2270 and 2271 mc are received from two ground stations simultaneously, converted, and retransmitted as 1.4 and 3.2 mc sidebands on a 1705 mc carrier. The received signals are phase modulated by range tones at frequencies of (500 kc, 100 kc, or 20 kc), 4 kc, 800 cps, and (160 cps, 32 cps, or 8 cps). The ground stations determine the range of the observatory by comparing the phases of the transmitted and received modulating frequencies. The range rate is ascertained by measuring the doppler shifts of the radio frequency signals. The use of two ground tracking stations simultaneously permits high accuracy trilateration of the observatory.

The overall goal of the tracking program is the determination of the observatory position at all times within a sphere of uncertainty having a radius of one km or less at radial distances of less than 1000km and of 100km at radial distances of 17 earth radii.

SECTION 3
OBSERVATORY TELEMETRY AND COMMUNICATIONS

3.1 OBSERVATORY TELEMETRY SYSTEMS

Data are collected by the 060-A Observatory from both scientific experiments and spacecraft subsystems. (See Figure 2-4.) The majority of data thus collected are sequenced, recorded or encoded, and transmitted to the earth over wideband PCM/PM telemetry. The remainder, called special purpose data, is transmitted over special purpose FM/PM telemetry.

The majority of data collected by the OGO-A Observatory are sampled in the time division multiplex sequence of the wideband PCM/PM data transmission path. The sampled data may be analog or digital in form. Analog data are converted to digital form in order that all sampled data will be digital. The sampled data are then either recorded for command playback or encoded for pulse code modulation of the wideband transmitters.

Real time data are applied to one encoder and stored data from the tape recorders are applied on command to the other encoder. All data, whether stored or real time, are digitized before being applied to the encoders. The encoders, which are identical, convert digitized data, by means of a non-return-to-zero code, into transmitter modulations to change the phase of the carrier by 180 degrees in accordance with the coded data. A series of encoded data changes is shown in Figure 3-1.

The outputs of the encoders are applied through command-controlled switching circuits to either or both of two redundant wideband transmitters. These all solid state devices operate at an output power of 4 watts and transmit a frequency of 400.850 mc. Either transmitter may be selected by ground command. Also either transmitter may be connected to either antenna as the circumstances require. A high gain directional antenna is used at apogee while a turnstile array provides sufficient gain at perigee.

The FM special purpose data transmission uses frequency division time multiplexing to handle experiments not adapted for digital sampling techniques. Five input signals within the range of 300 to 100,000cps may be accommodated. (Two of these channels are used for Experiment 8, See Appendix B.) Sinusoidal real time experiment data are applied continuously to the wide band special purpose transmitter which can be commanded on or off. A high gain directional antenna is used at apogee while a turnstile array provides sufficient gain at perigee.

3.2 PCM MULTIPLEXING

Multiplexing of spacecraft PCM data is accomplished by two redundant equipment groups. One of these groups is normally connected to the real time communication system and the other is normally connected to the command playback portion of the spacecraft recording system, In each group, the data format consists of a main frame of 128 words and three subcommutator frames of 128 words each. Each word contains 9-bits. One subcommutator is for scientific experimental data and the other two are for spacecraft subsystem data.

In the OGO-A, main frames can be commanded to operate at 1, 8, or 64 kilobits per second (kbs). The subcommutator frames operate at 1/128th of these rates except during launch, when one spacecraft subcommutator is accelerated to occupy main frame channels. During this accelerated mode of operation, all data other than that in the accelerated subcommutator are excluded from the telemetry.

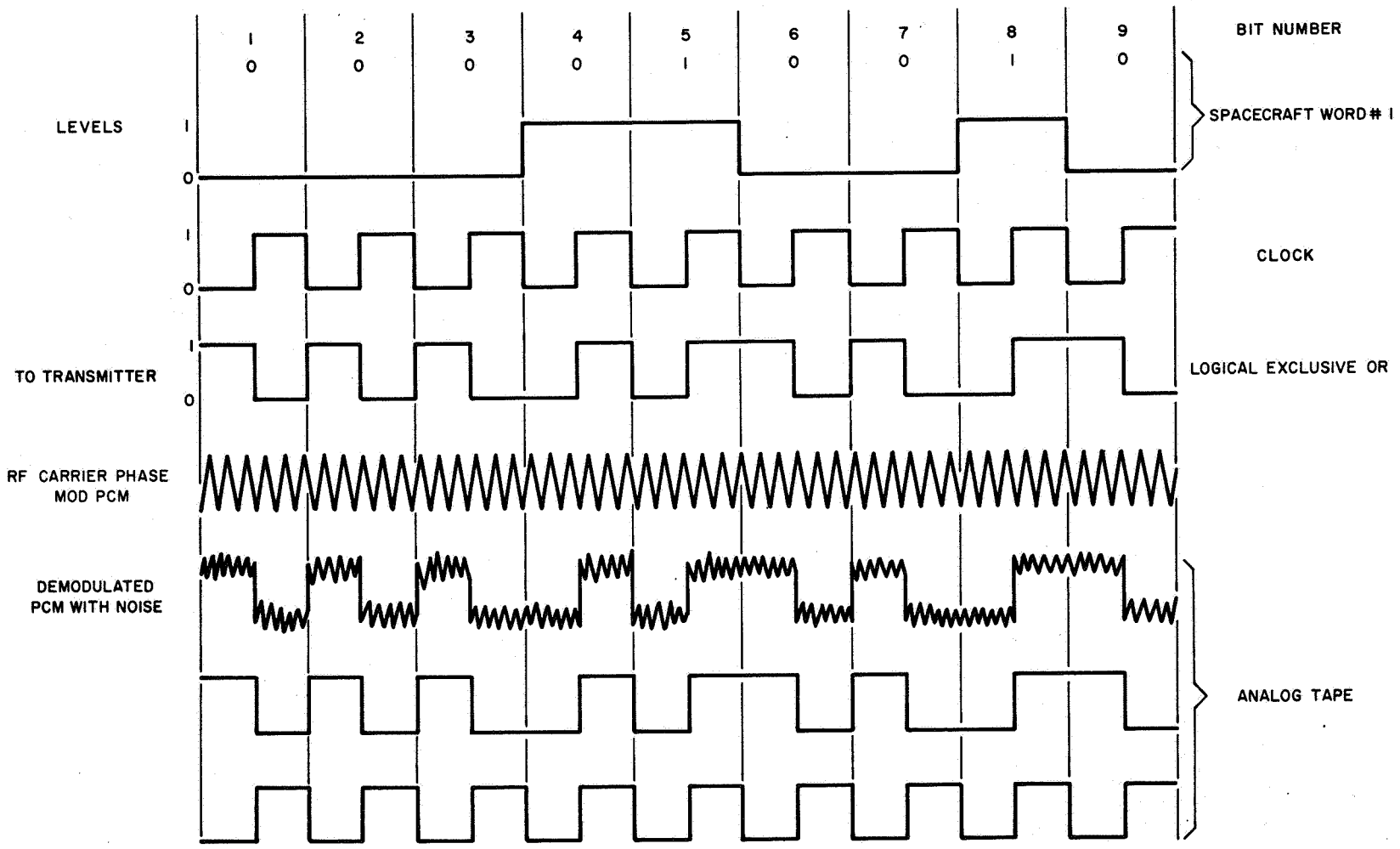


Figure 3-1. PCM Sequence of Spacecraft Word 1

As indicated in Figure 2-4, equipment groups may be commanded to operate interchangeably with the real time or the command playback systems. Also, either system may be commanded to operate interchangeably with either of the two wideband transmitters or the special purpose transmitter.

3.2.1 Main Frame Format

The basic 128-word data format, or main frame format, is the format for the two redundant major equipment groups. The format of equipment group 1 is identical with equipment group 2 except that word 101 is unused (blank) in equipment group 1 and contains data from experiment 15 in equipment group 2. Figures 3-2 and 3-3 illustrate the difference.

An examination of the main frame format in Figure 3-2 or 3-3 will reveal that there are two classes of words: (1) words containing experimental data, and (2) housekeeping data words. These words may be either digital or analog in character depending on the nature of the experiment. As shown in Figure 3-2, the housekeeping word groups consist of (1) synchronization words, (2) accumulated time words, (3) identification words, and (4) subcommutator words.

3.2.2 Analog and Digital Data Words

The majority of experiments and spacecraft subsystems require that the analog of the quantity under measurement be converted to digital form as a prerequisite to be telemetered. Some experiments are such that sampled data may be obtained directly in digital form. For convenience such data are referred to as digital data while analog data converted to digital form are called analog data. Analog data words can be distinguished in Figures 3-2 and 3-3 where only eight of the nine bits in the telemetry word are used. The unused bit (marked in black) is the most significant bit. Digital data words use all nine bits.

3.2.3 Synchronization Words

The first three word positions (words 1, 2, and 3) of the main frame are reserved for the synchronization word in each data frame. The synchronization word consisted of a 27-bit truncated autocorrelation code. (See Figure 3-4.) This code is placed in the first three word positions of the main frame for ready recognition by ground processing equipment. This word establishes frame and bit synchronization.

3.2.4 Accumulated Time Words

Word positions 33, 34, and 35 in the main frame format are reserved for accumulated time words. (See Figures 3-2 and 3-3.) These words contain a flag bit, an unused bit, and 25 bits in sequence for accumulated time in seconds. (See Figure 3-5.)

The flag bit, when present, appears as a binary 1 and signifies that the time recorded in the flagged frame is accurate within known limits. This bit occurs in a frame when a 1-second pulse updates the spacecraft clock register during its readout period in bits 2 through 9 of word 32. The 25-bit sequence is capable of recording more than 33 million seconds, a time period exceeding 1 year by several weeks. If the second bit position were used, double this amount of time could be accumulated. This sequence changes with each frame at the 1 kilobit rate but repeats itself for a given number of frames at the 8 and 64 kilobit rates. The appearance of flags during a sequence of frames presents a pattern of reoccurence in the number of frames between flags. This pattern is called a repeat pattern. Repeat patterns are used in data reduction to identify more accurate clock readouts.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
SYNC	HRONIZATION	WORDS	2	2	2	2	18	13	3	20	13	5	10	10	10
17	18	19 INDEX 3	20	21	22	23	24	25 INDEX 3	26	27	28	29	30	31	32
20	20	7	7	2	2	2	15	5	18	15	7	7	11	11	11
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
ACCUMULA	TED TIME	WORDS	3	10	10	10	15	13	3	9	13	18	17	17	7
49 INDEX 17	50	51	52	53	54	55	56	57 INDEX 3	58	59	60	61	62	63	64
7	7	7	7	7	15	4	4	4	6	6	6	10	10	10	18
65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
IDENTI	FICATION	WORDS	15	15	15	15	15	13	3	SCANNING OPEP	13	5	19	19	10
81	82	83	84	85	86	87	88	89 INDEX 3	90 INDEX 3	91	92	93	94	95	96
1	1	1	1	18	10	10	10	5	9	11	11	11	11	11	11
97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112
SUBCOM	MUTATOR	WORDS	9	ENTIRE WORD UNUSED	11	18	5	13	3	3	13	15	17	17	17
113 INDEX 8	114	115	116 INDEX 17	117	118	119	120	121 INDEX 3	122	123	124	125	126	127	128
9	8	8	9	10	10	10	18	9	9	9	9	12	12	12	12

NOTE: EACH WORD CONSISTS OF NINE BITS;
UNUSED BITS ARE SOLID.

Figure 3-2. Main Frame Format for Equipment Group 1

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
SYNCHRONIZATION		WORDS	2	2	2	2	18	13	3	20	13	5	10	10	10
17	18	19 INDEX 3	20	21	22	23	24	25 INDEX 3	26	27	28	29	30	31	32
20	20	7	7	2	2	2	15	5	18	15	7	7	11	11	11
33	34	35	36	37	38	39	40	41 INDEX 2	42	43	44	45	46	47	48
ACCUMUL	ATED TIME	WORDS	3	10	10	10	15	13	3	9	13	18	17	17	17
49 INDEX 17	50	51	52	53	54	55	56	57 INDEX 3	58	59	60	61	62	63	64
7	7	7	7	7	15	4	4	4	6	6	6	10	10	10	18
65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
IDENTI	FICATION	WORDS	15	15	15	15	15	13	3	SCANNING OPEP	13	5	19	19	10
81	82	83	84	85	86	87	88	89 INDEX 3	90 INDEX 3	91	92	93	94	95	96
1	1	1	1	18	10	10	10	5	9	11	11	11	11	11	11
97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112
SUBCOM	MUTATOR	WORDS	15	15	11	18	5	13	3	3	13	15	17	17	17
113 INDEX 8	114	115	116 INDEX 17	117	118	119	120	121 INDEX 3	122	123	124	125	126	127	128
9	9	8	9	10	10	10	18	9	9	9	9	12	12	12	12

NOTE: EACH WORD CONSISTS OF NINE BITS;
UNUSED BITS ARE SOLID.

Figure 3-3. Main Frame Format for Equipment Group 2

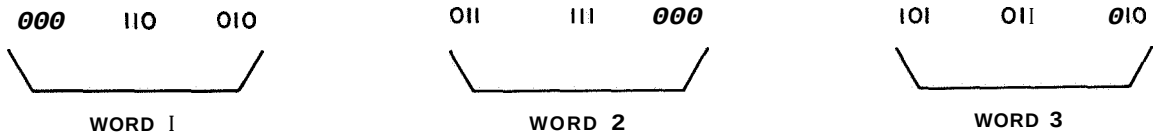
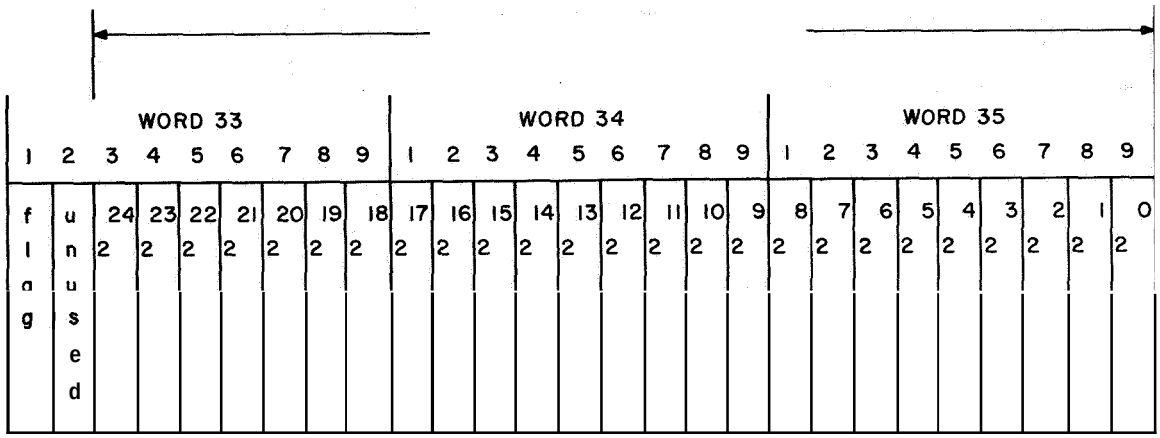


Figure 3-4. Format for Synchronization Words



The second, third, and fourth columns in Table **3-1** provide descriptions of repeat patterns at each data rate, the accuracy in milliseconds of the time in the flagged frame, and the probability of occurrence of the pattern.

Another set of patterns (interference patterns) occurs because the two equipment groups could operate out of synchronism with each other. The interference occurs when the two equipment groups operate nearly in synchronism. Interference is caused by the time overlap of the inhibit pulses when both equipments try to read the accumulated time word from the spacecraft clock. The interference may cause false flags at **1,** 8, and **64** kbs rates, and may cause a **12** millisecond inaccuracy at the **1** kbs rate. Accuracy **of** the clock readings, however, are not affected at the **8** and **64** kbs rate. Descriptions of the interference patterns, their occurrence in conjunction with repeat patterns at each data rate and the probability of occurrence **of** each are given in the last two columns of Table **3-1.**

3.2.5 Identification Words

Main frame word positions **65, 66,** and **67** are identification words. Words **65** and **66** identify the equipment group currently processing main frame data. Word **67** identifies the other equipment group (See Figure **3-6).**

Table 3-1

REPEAT AND INTERFERENCE PATTERNS

Bit Rate	Repeat Pattern	Accuracy Millisec	Probability	Interference Pattern	Probability
	Flag every 125 frames	±3.508	.877	No pattern	.953
1	Flag every 79, 46*, 79, 46... frames	±.492	.123	Flag every 33, 46, 46 frames	.047
	Every 125 frames	±.539	.137	No pattern	.789
8	Clock repeats readout for 6**, 7, 7, 7, ... for a total of 17-7's frames	i3.453	.863	Flag every 264, 368, 368 frames	.211
	Flag every 500 frames	±.094	.055	Flag every 2112, 2944, 2944 frames	1.000
64	Clock repeats readout for 55, 56, 55, 56***, 56 55, 56,... frames	±.946	.945		

* Flag at readout following 46-frame interval between flags
** First new readout after 6th repeat sequence
*** Last readout in second 56 repeat sequence

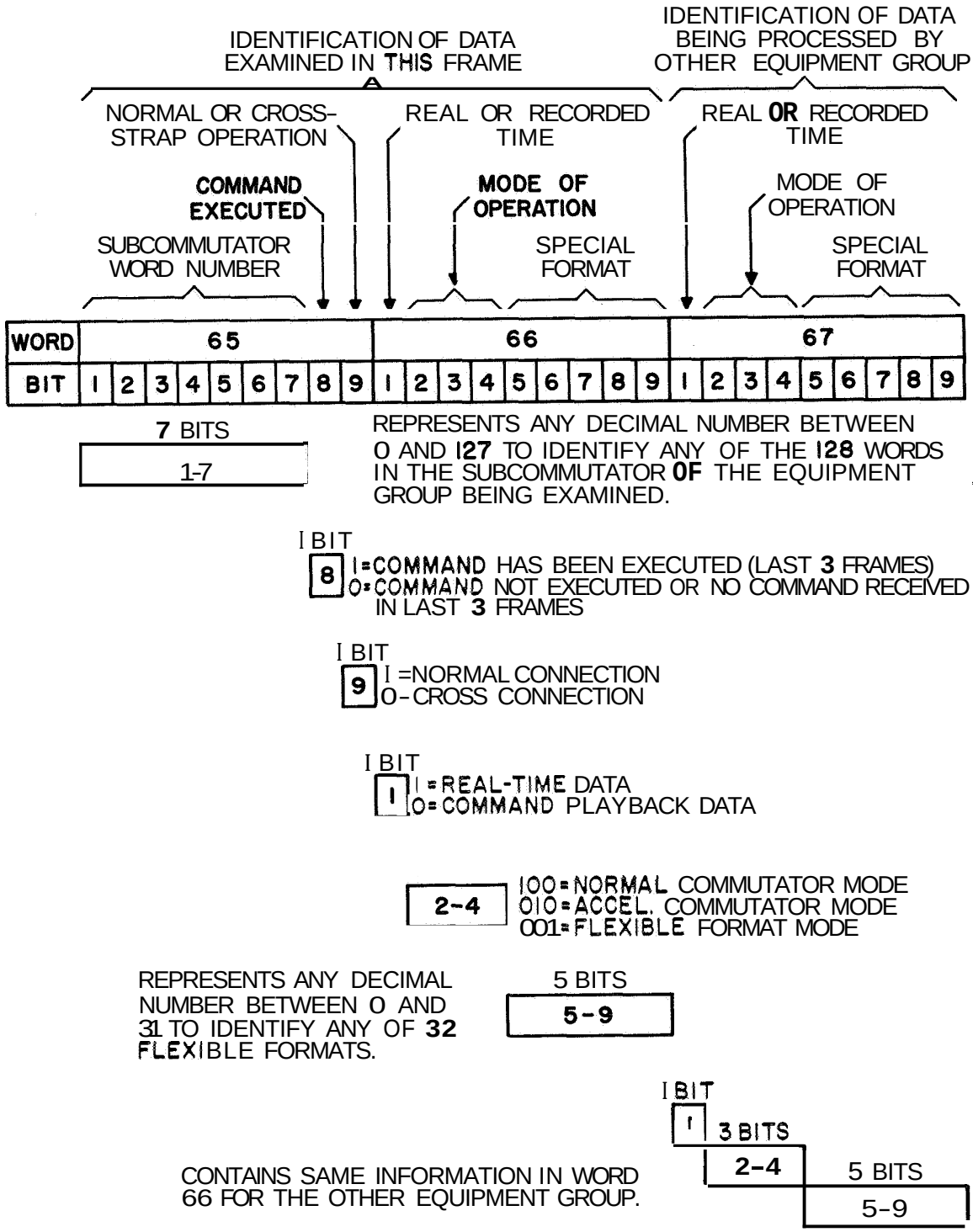


Figure 3-6. Format for Identification Words

When the equipment groups are operating in the normal mode, the first 7 bits in word 65 identify the number of the subcommutator word being sampled in that frame. When the equipment is operated in the accelerated mode, the first 7 bit positions always contain the number 65. When the equipment is operated in the flexible format mode, the first 7 bit positions contain either the number 65 or the number 66. These facts are summarized as follows:

Mode	Decimal Equivalent of Binary Word	Subcommutator Word Identified
Normal	0 - 127	1 - 128
Accelerated	64	65
Flexible Format	65 or 66	66 or 67

Bit position 8 in word 65 contains a 1 through the operation of the execute relay when a command has been executed. This number appears for a period of three frames of the main commutator. Bit position 9 in word 65 contains a 1 when the equipment groups are in normal connection, that is, when equipment group 1 is connected for real time transmission and equipment group 2 is connected for command playback recording. This position contains zero when the connections are crossed. In word 66 bit position, 1 contains a 1 if the data in the main frame is real time data. It contains a 0 if the data is command playback data.

Bit positions 2 through 4 of word 66 contain a code indicating the mode of operation of the commutators. For the normal mode the code is 100, for the accelerated mode the code is 010, and for the flexible format mode the code is 001.

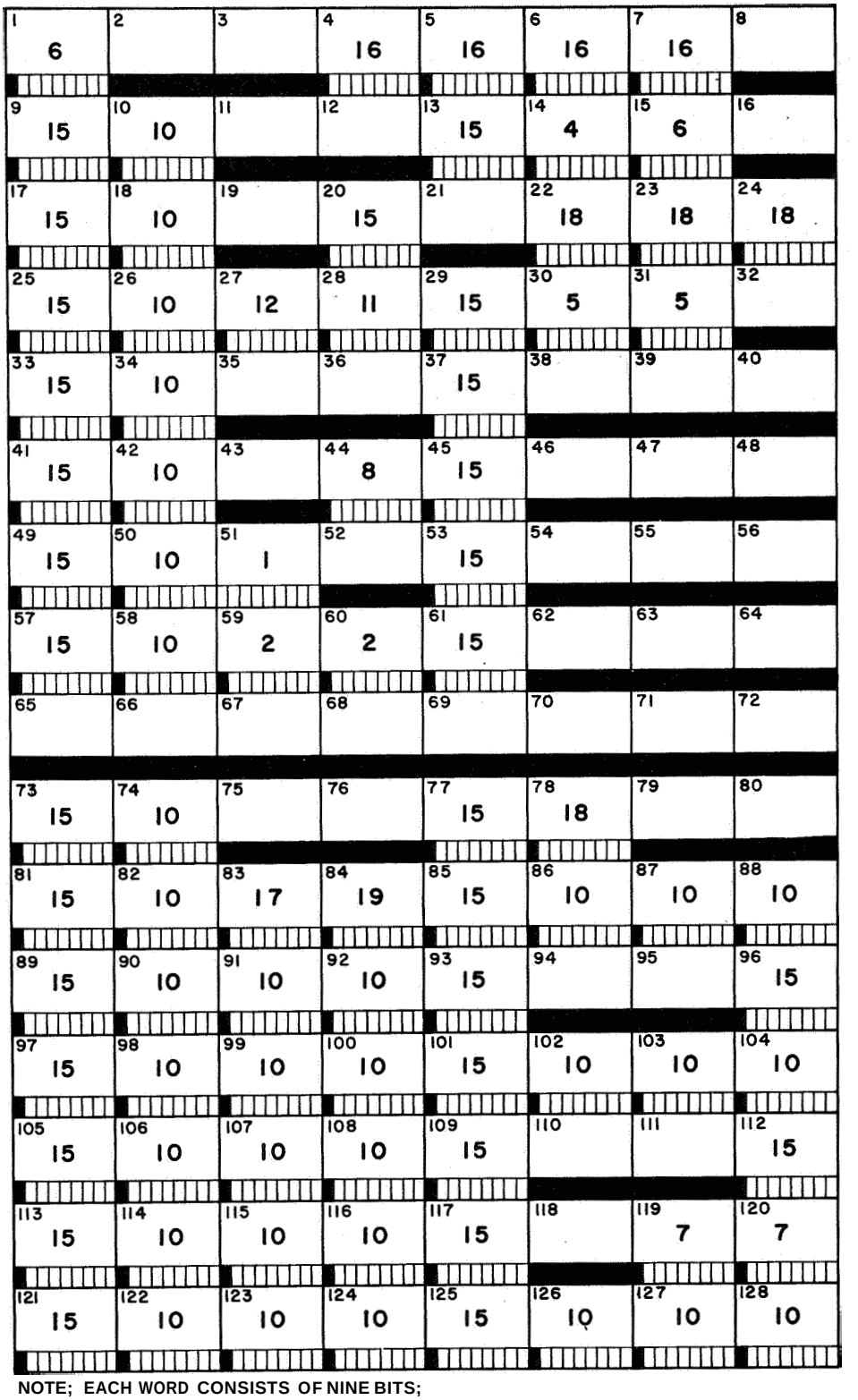
Although the flexible format mode is built into the OGO-A commutating equipment, it is not expected to be used except possibly to test the operation in that mode. Bit positions 5 through 9 of word 66 contain a five digit binary number which will identify any of 32 special formats chosen when the flexible format mode is used in later OGO missions. The use of bit positions in word 67 is the same as that in word 66 except that the entire word identifies data being processed by the equipment group not identified in the current frame; that is, whatever bit configuration is seen in word 66 of the other equipment group - will be seen in word 67 of the current equipment group.

3.2.6 Subcommutator Words

Main frame word positions 97, 98, and 99 are subcommutator words. Through these words the main commutator samples the three subcommutators. Each time the main commutator goes through a cycle of operation (frame), each subcommutator samples one word in its 128-word frame, therefore 128 main frames must pass. The main commutator must sample main frame words 97, 98, and 99 one hundred and twenty eight times in order to sample all subcommutator words. Words 97, 98, and 99 contain data from subcommutators 1, 2, and 3 respectively.

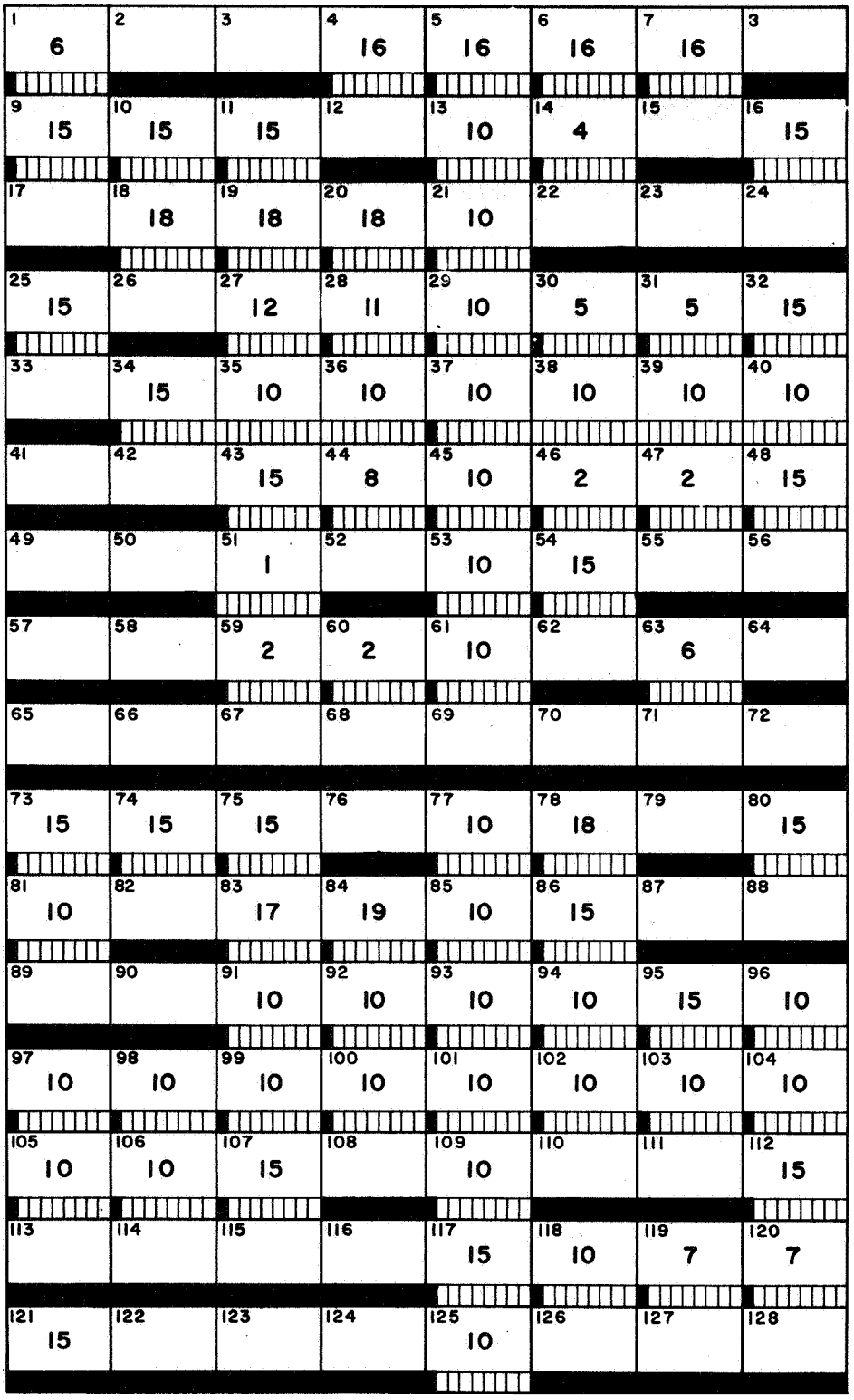
3.3 SUBCOMMUTATOR 1 (EXPERIMENTS)

Subcommutator 1 in each equipment group contains experiment data which does not require as fast a sampling rate as that furnished by the main commutator. The two experiment subcommutators have different data formats as shown in Figures 3-7 and 3-8. Some redundancy exists between equipment groups.



NOTE; EACH WORD CONSISTS OF NINE BITS;
UNUSED BITS ARE SOLID.

Figure 3-7. Format for Subcommutator 1 (Equipment Group 1)



NOTE; EACH WORD CONSISTS OF NINE BITS;
UNUSED BITS ARE SOLIDS.

Figure 3-8. Format for Subcommutator 1 (Equipment Group 2)

3.4 SUBCOMMUTATORS 2 AND 3 (SPACECRAFT SUBSYSTEMS)

Subcommutators 2 and 3 in each equipment group contain data gathered from the subsystems of the spacecraft. The formats of data for the two subcommutators for equipment group 2 are shown in Figures 3-9 and 3-10. Mainly, there is redundancy between equipment groups. See Appendix C for further details.

3.5 DATA TRANSMISSION AND STORAGE RATES

Data produced for transmission on a real time basis may be commanded to transmit at either 1, 8, or 64 kbs. Data produced for storage is recorded on magnetic tape at 1 kbs. During playback the stored data is transmitted at 64 kbs in reverse order as the tape rewinds. Each recorder has a capacity of 43.2 million bits which, at the 1 kbs rate, is equivalent to 12 hours recording time, or a total of 24 hours using each recorder successively. Playback at the 64 kbs rate requires 11-1/4 minutes per recorder.

3.6 DATA ACQUISITION DURING OBSERVATORY LIFE

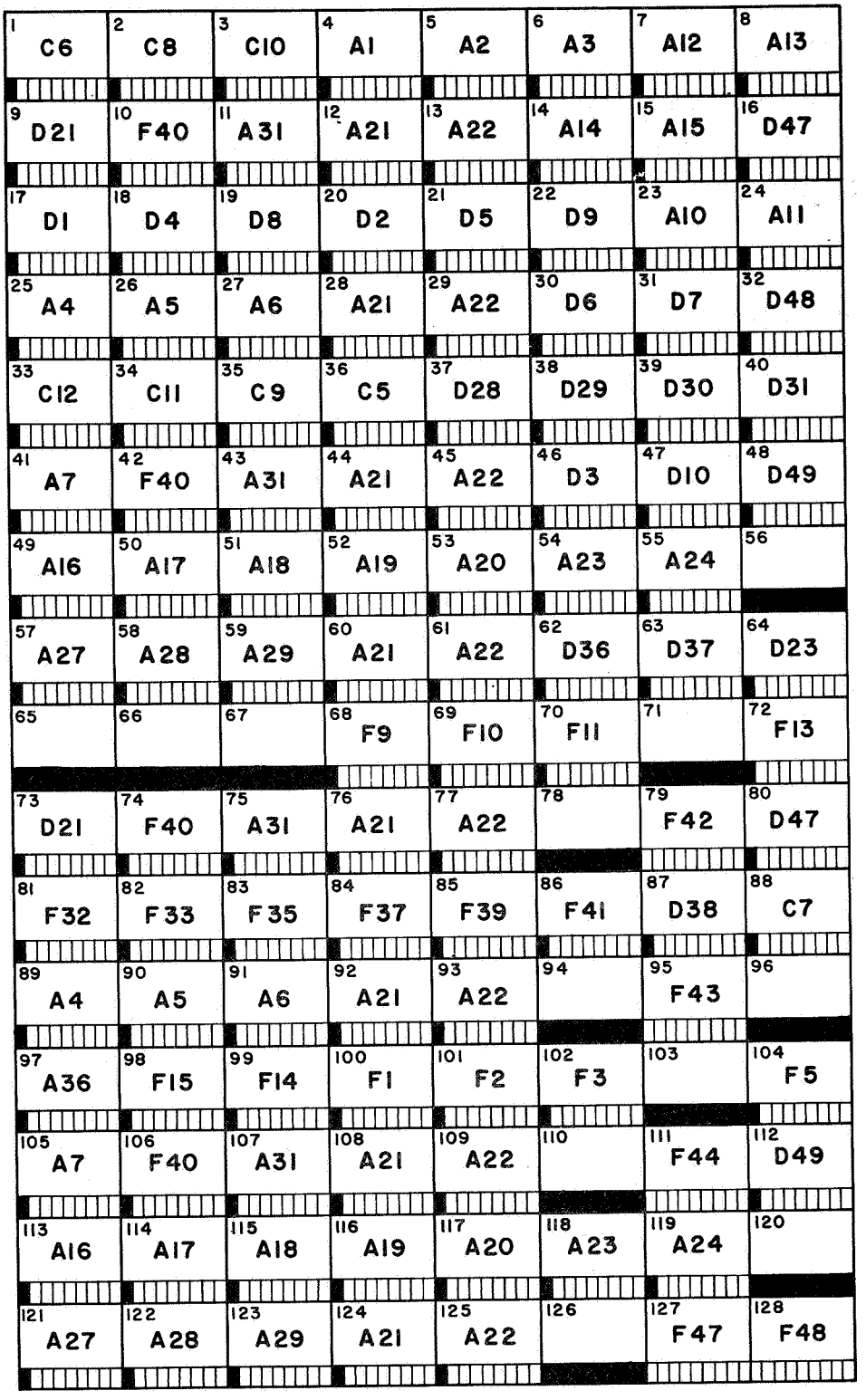
The data acquisition lifetime of OW-A consists of a pre-orbit period, or launch and acquisition phase, and an orbit life phase lasting 1 year, The orbit life is divided into the first month and the last eleven months. During the launch and acquisition phase, only real time data from subcommutator 1 are transmitted to ensure complete subsystem coverage. These subsystem data are transmitted in the accelerated mode at 64 kbs. The format for subcommutator 1 in the accelerated mode is shown in Figure 3-11.

During orbit both stored and real time data are produced. During the first month real time data are transmitted at 64 kbs for 10 percent of the time and at 8 kbs for 30 percent of the time. This means that during the first orbit month, real time data are transmitted 40 percent of the time. During the last eleven months, real time data are transmitted at 64 kbs for only 5 percent of the time and, at 8 kbs, for only 20 percent of the time, so that the total real time data transmission time is only 25 percent. Stored data during orbit may be produced up to 100 percent of the time. (See Table 3-2.)

TABLE 3-2

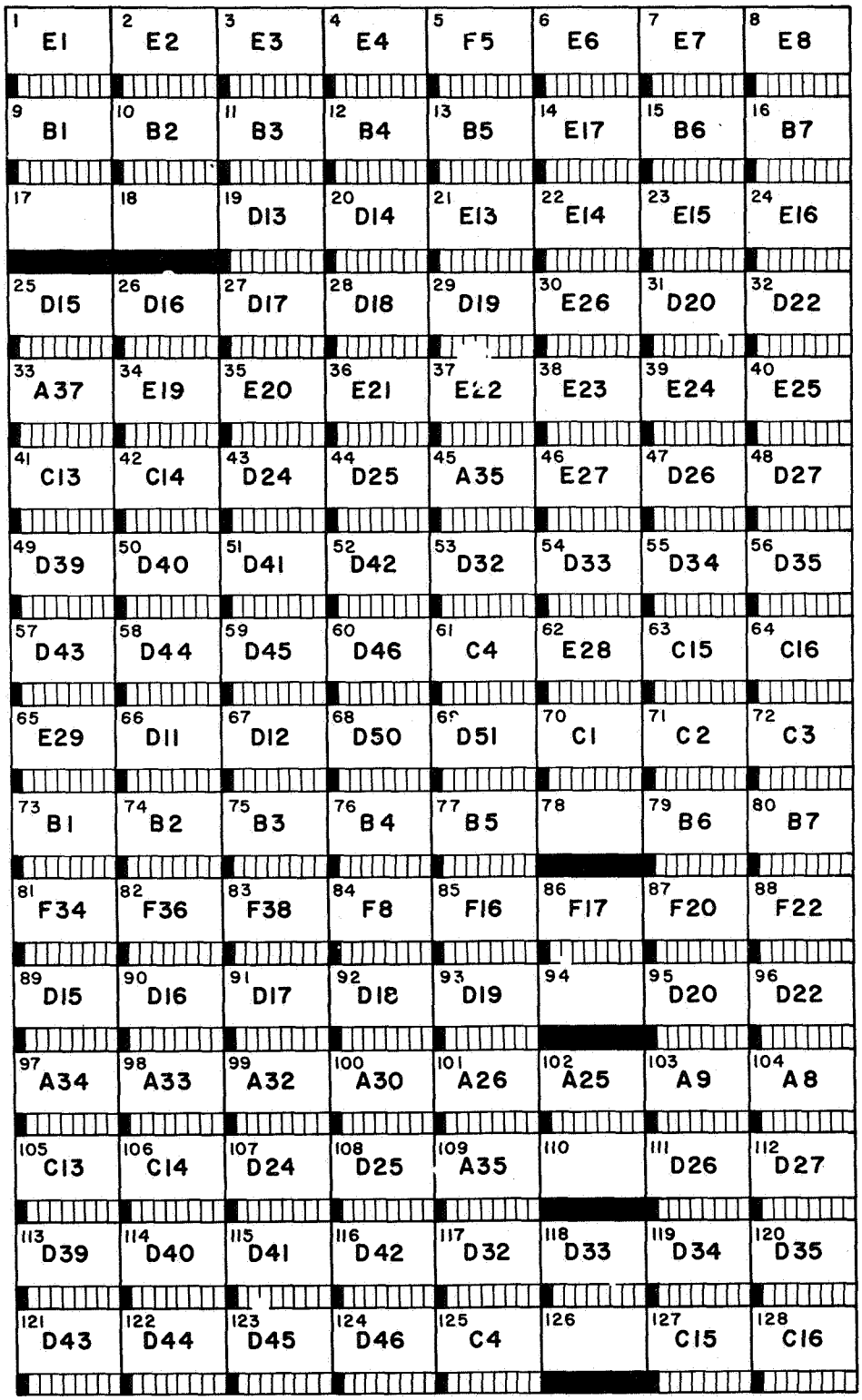
ESTIMATED PERCENT OF TIME OW-A ACQUIRES DATA AT EACH COMMUTATION RATE

Period of OGO-A Life	PCM Data Acquisition Rates		
	1 kbs	8 kbs	64 kbs
	Percent of Time		
Launch and acquisition	0	0	100(a)
Orbit: first month	100*	30	10
Orbit last eleven months	100**	20	5
Alerts over entire orbit life	0	6	0.5



NOTE; EACH WORD CONSISTS OF NINE BITS;
UNUSED BITS ARE SOLID.

Figure 3-9. Formot for Subcommutator 2 (Equipment Group 2)



NOTE: EACH WORD CONSISTS OF NINE BITS;
UNUSED BITS ARE SOLID.

Figure 3-10. Format for Subcommutator 3 (Equipment Group 2)

1 FRAME	2 SYNCHRONI	3 ZATION	4 A1	5 A2	6 A3	7 A12	8 A13
9 D21	10 F40	11 A31	12 A21	13 A22	14 A14	15 A15	16 D47
17 D1	18 D4	19 D8	20 D2	21 D5	22 D9	23 A10	24 A11
25 A4	26 A5	27 A6	28 A21	29 A22	30 D6	31 D7	32 D48
33 TIME ACCU	34 MULATION	35	36 C5	37 D28	38 D29	39 D30	40 D31
41 A7	42 F40	43 A31	44 A21	45 A22	46 D3	47 D10	48 D49
49 A16	50 A17	51 A18	52 A19	53 A20	54 A23	55 A24	56
57 A27	58 A28	59 59	60 A21	61 A22	62 D36	63 D37	64 D23
65 IDEN	66 TIFICATION	67 WORDS	68 F9	69 10	70 F11	71	72 F13
73 D21	74 F40	75 A31	76 A21	77 A22	78	79 F42	80 D47
81 F24	82 F25	83 F27	84 F29	85 F31	86 F41	87 D38	88 C7
89 A4	90 A5	91 A6	92 A21	93 A22	94	95 F43	96
97 EXP. SUB-COMM.	98 SPACE CRAFT SUB-COMM. NO.1	99 SPACE CRAFT SUB-COMM. NO.2	100 F1	101 F2	102 F3	103	104 F5
105 A7	106 F40	107 A31	108 A21	109 A22	110	111 F44	112 D49
113 A16	114 A17	115 A18	116 A19	117 A20	118 A23	119 A24	120
121 A27	122 A24	123 A29	124 A21	125 A22	126	127 F45	128 F46

NOTE: EACH WORD CONSISTS OF NINE BITS; UNUSED BITS ARE SOLID.

Figure 3-11. Accelerated Mode Format for Subcommutator 2

During orbit life as many as **24** alerts, two per month, are performed. In an alert the observatory is commanded to transmit for **1** hour at **64** kbs and for **11** hours at 8kbs for a total of 12 continuous hours of real time **data** transmission. The estimated percent of the orbit lifetime consumed by alerts is about **6.5** percent. (See Table **3-2.)**

SECTION 4
GROUND DATA ACQUISITION SYSTEM

4.1 DATA ACQUISITION NETWORK

Tracking and data acquisition are accomplished by the Space Tracking and Data Acquisition Network (STADAN). This network consists of special primary and secondary data acquisition stations and range rate tracking stations. The STADAN stations are equipped for interferometer tracking and, according to established tracking priorities, track spacecraft such as the OGO-A. Scientific data is acquired on analog tapes and sent to the Data Processing Branch for evaluation, reduction, and further processing.

The main differences between primary and secondary stations are the antennas and the command capabilities. The antennas at primary stations are 85 feet in diameter while the secondary station antennas are 40 feet in diameter. Primary stations have digital command as well as tone command capabilities, while secondary stations have tone command capabilities only.

For the OGO-A mission, the primary station functions are as follows: Receive, demodulate, and record on analog tapes wideband PCM/PM and special purpose FM/PM telemetry data transmitted by the OGO-A. Receive from WWV the scientific standard time code signals and generate from them the NASA serial decimal and BCD time code signals for recording on analog tapes. Send the satellite data recorded on analog tapes to the Data Processing Branch. Command the satellite by means of digital or tone commands to playback stored data; use the appropriate data handling system; change the data bit rate; change the commutation (accelerated subcommutator, normal, or flexible format), command antennas, transmitters, commutator equipment groups, and experiments. Communicate with Goddard Space Flight Center by means of teletype. Prepare analog tape station logs (see Figure 4-1), and a cumulative analog tape report (see Figure 4-2).

The general functions of the secondary stations are the same as the primary stations except for not having a digital command capability. The main functions of the mobile stations are to track the observatory during the launch and injection into its orbit.

4.2 STANDARDS FOR DATA ACQUISITION

Since the amount of space data suitable for processing is directly affected by the recording techniques of the ground station, a set of NASA standards for magnetic tape recordings has been established. The following rules for ground stations shall be adhered to in recording OGO-A data.

There shall be no gaps in telemetry data on any analog tape, and no attempt shall be made to conserve tape by recording data from another pass on a partially filled reel. If a satellite pass ends and the reel is only partially filled, no further recording is to be made on that tape.

There shall be no mixing of data rates, or real time data, or command-playback data on one tape, unless the mixture happens during the one-minute overlap period that occurs when a new tape is started. As an example, it would be proper to command the satellite to change from the 64kbs data rate to the 8kbs data rate under the following conditions: (1) the first recorder has only one minute of recording time left, (2) the second recorder has been started, and (3) at thirty seconds before the duration of recording time ends the satellite is commanded to change rates. Thus, there would be 30 seconds of 8kbs data on

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: AMPLIFIER	RECORD PLUG-IN: CENTER FREQUENCY	RECORD PLUG-IN: BANDPASS FILTER	LINK (RF) FREQUENCY	TRACK FUNCTION: DETECTED SIGNAL	TRACK FUNCTION: CONVERTED SIGNAL	TRACK FUNCTION: SIGNAL LEVEL	TRACK FUNCTION: TIMING	TRACK FUNCTION: REFERENCE	TRACK FUNCTION: SPEED CONTROL	TRACK FUNCTION: LOCAL	TRACK FUNCTION: SPECIAL	RECORDER INPUTS: 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	LLNK (RF) FREQ.	MINS DATA	EQUIP. PARA.	OPER. PARA.	TAPE MAILED

EQUIPMENT PARAMETERS	OPERATIONS PARAMETERS
3	3

ADDITIONAL REMARKS

GSFC 22-30 (9/61)

Figure 4–1. Analog Tape Station Log

STSØ28

RR GNET GPRK GSTS
DE GLGE Ø19
15/18542
INFO GSTS/CODE 536

REF 1963 38C CUMULATIVE TAPE REPORT.
3758 Ø5Ø3Ø7 625755 031635 3383M144 55555 136.652 19 BCFGJ 2 GSFC
3779 061627 161860 163655 3383M145 55555 136.652 18 BCFGJ 2 GSFC
3785 Ø7Ø326 Ø31745 Ø33635 3383M145 55555 136.652 19 BCFGJ 2 GSFC
3798 Ø8Ø243 Ø23355 Ø249ØØ 3383M145 55555 136.652 11 BCFGJ 2 GSFC
3812 Ø9Ø346 Ø3373Ø Ø35615 3383M146 55555 136.652 19 BCFGJ 2 GSFC
3832 1Ø1519 151ØØØ 152Ø5 3383M146 55555 136.652 19 BCFGJ 2 GSFC
3839 11Ø4Ø6 Ø35715 Ø4154Ø 3383M146 55555 136.652 17 BCFGJ 2 GSFC
3845 111436 142645 14453Ø 3383M147 55545 136.652 18 BCFGJ 2 GSFC
3865 13Ø238 Ø23ØØ3 Ø2482Ø 3383M147 55555 136.652 18 BCFGJ 2 GSFC
39ØØ 1517Ø3 165510 17123Ø 3383M147 55555 136.652 17 BCFGJ 2 GSFC
REMARKS:
REV 3758 WWVH 15MC
REV 3798 DATA DEGRADED FROM Ø2454ØZ TO Ø249ØØZ DUE TO ERRATIC OPERATION OF TAPE RECORDER. WWVH 15MC
REV 3832 WWVH 1ØMC
REV 3839 WWVH 15MC
REV 3845 WWVH 5MC
REV 3865 AND 39ØØ WWVH 15MC

15/19Ø1Z JUL GLGE

Figure 4-2. Teletyped Cumulative Analog Tape Report

the 64kbs reel and 30 seconds of 64kbs data on the 8kbs reel. There shall be no recording of command playback data on more than one reel of tape. (The exception to this is that more data are recorded when both spacecraft recorders are commanded to playback in sequence than can be recorded on one reel of station magnetic tape.) There shall be no changing of the tape-speed switch during the recording of any one tape. There shall be a limit to the amount of data recorded on original analog tapes. The duration of recording time per reel shall be recorded. Both points are vital to efficient operation of the analog-to-digital conversion process. Tape speeds and the maximum duration of recording time at each data rate shall remain constant for the life of the satellite. Recommended values are listed in Table 4-1.

TABLE 4-1

	Analog Tape Speed	Maximum Duration of Recording Time
Command Playback	30 ips	11.25 minutes
64kbs (PCM/PM real time)	30 ips	14 minutes
8kbs (PCM/PM real time)	3.75 ips	112 minutes

Furthermore, there shall be no mixing of PCM and FM data. Analog tapes made from special purpose (FM/PM) data are treated at the Data Processing Branch as if they were obtained from a separate satellite. It is important that no attempt be made to interleave data from special purpose (FM/PM telemetry and wideband PCM/PM) telemetry on the same tape.

The magnetic tape used by the data acquisition stations and the Data Processing Branch shall consist of oxide coated mylar material that is 1.5 mil thick, 0.5 inch wide, and 2400 feet long, mounted on 10.5 inch reels. Ampex, model FR-607, tape recorders were selected for the recording of data. Table 4-2 contains the OGO-A schedule for the analog tape recording.

TABLE 4-2

ANALOG TAPE RECORDING SCHEDULE

Operation	Orbital Coverage (%)	Telemetry System	Data Rate (kbs)	Analog Tape Speed (ips)	Max. Duration of Recording Time for Analog Tapes (Minutes)
Launch		PCM/PM	64	30	14
Storage Playback 1 year (Data presented in reverse order)	100	PCM/PM	64	30	11.25
Real time (First Month)	30	PCM/PM	8	3.75	112
	10	PCM/PM	64	30	14
	36	FM/PM		15	32
	4	FM/PM		30	16
Real time (last eleven months)	20	PCM/PM	8	3.75	112
	5	PCM/PM	64	30	14
	22 1/2	FM/PM		15	32
	2 1/2	FM/PM		30	16
Alerts (an average of 12 hrs alerts per month for one year) 12 hrs. of continuous acquisition	1 hr.	PCM/PM	64	30	14
	11 hr.	PCM/PM	8	3.75	112
	1.2 hr.	FM/PM		30	12
	10.8 hr.	FM/PM		15	16

Table 4-3 shows the estimated total number of analog tapes recorded by each station.

TABLE 4-3

Station	10-1/2 Inch Reels per Mission (1 Year)
Rosman	2404
Fairbanks	2404
Quito	1980
Johanneburg	1980
Darwin	848

4.3 ANALOG DATA

The data acquisition stations record four general types of data on analog tapes: (1) satellite data which includes experimental and subsystem data from the satellite and AGC information from the telemetry receivers; (2) time data, which includes 10kc reference, BCD, SD, and WWV times; (3) command data which consists of encoded commands, both digital and tone; and (4) operations voice commentary, which consists of db calibration, end of tests, data interruptions, end of data, satellite and tape identification, etc. These data, their track assignments, and format are discussed in following paragraphs.

4.3.1 Satellite Data

The satellite data is transmitted to the data acquisition stations as shown in figure 4-3. Wideband PCM/PM and special purpose FM/PM telemetry signals are acquired from the satellite, demodulated, and recorded on analog tapes. AGC is also recorded along with the satellite data which is used during tape evaluation to determine the signal-to-noise ratios of the received telemetry signals.

4.3.2 Time Data

Time data is obtained by means of a station time standard which is calibrated from WWV's international scientific time standard radio transmission. Calibrations are made once per day to minimize time variations caused by the ionospheric changes. The time delay caused by radio propagation from the transmitter at Goddard Space Flight Center to the data acquisition station is included in the time data recorded on the analog *tape.* The delay, however, is later compensated for by the time correction program when the data is processed at the Data Processing Branch on the Univac 1107. The station time standard produces a 10kc reference signal, the NASA binary coded decimal (BCD) time, and the NASA serial decimal (SD) time. These three times and the WWV time are sent to the analog tape recorders.

4.3.2.1 NASA Binary Coded Decimal and Serial Decimal Times

Shown in Figure 4-4 are the NASA serial decimal (SD) and the NASA binary coded decimal (BCD) time codes. These codes are generated at the ground stations from station

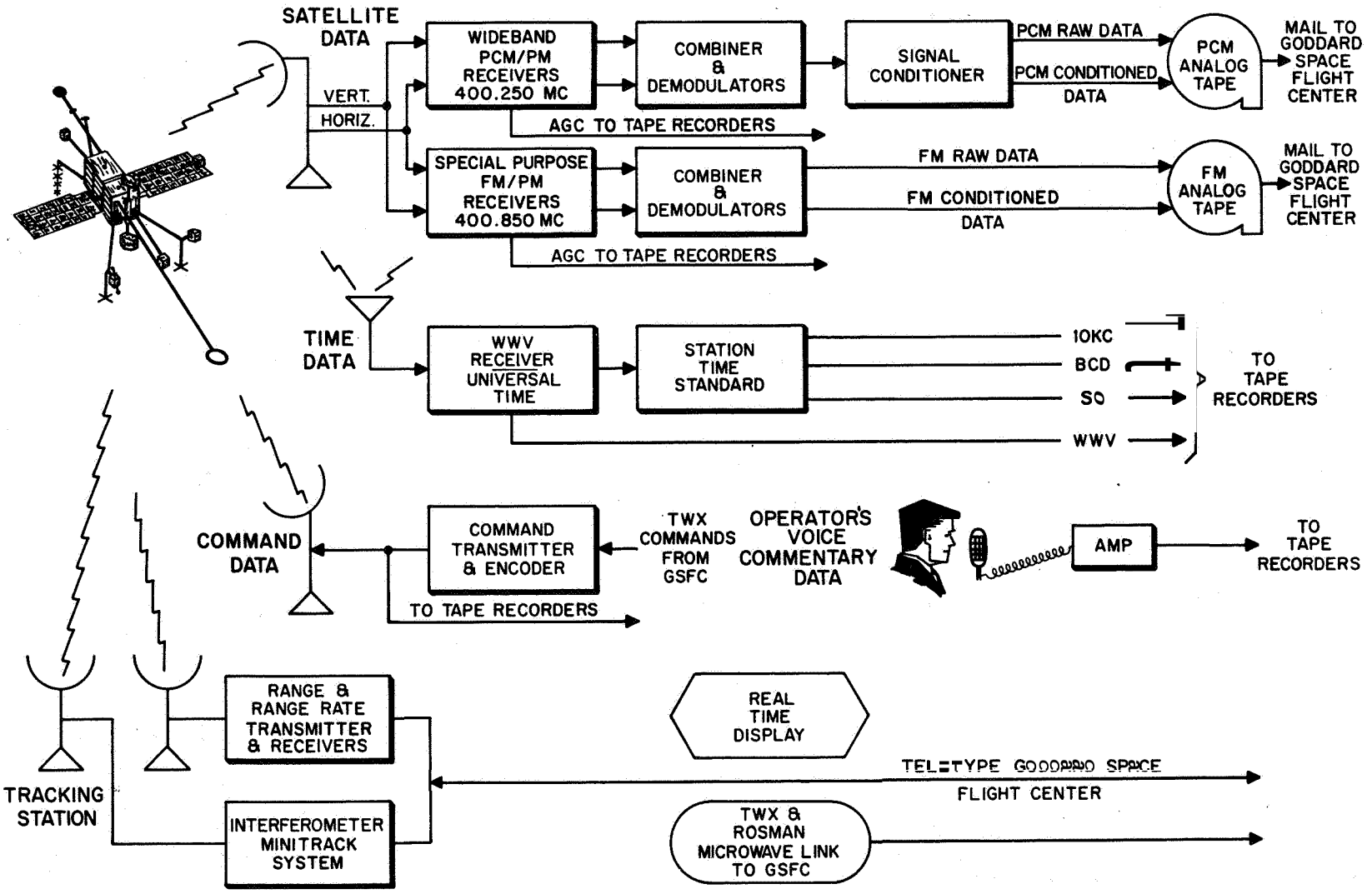


Figure 4-3. Data Acquisition and Tracking Stations Flow Chart

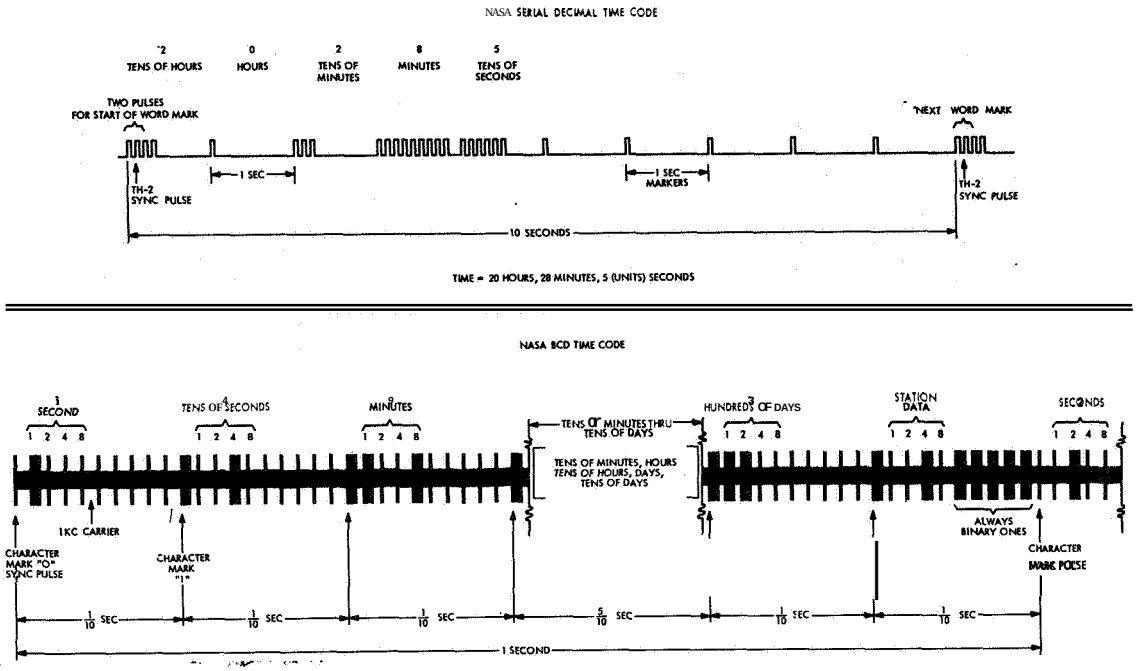


Figure 4-4. NASA Time Codes

time standards. In the BCD time code, special attention is called to the tape identification and station data word. Through this word are subcommutated 20 characters of BCD. These characters identify the tape and the station at which it was recorded by means of the format shown in Table 4-4.

TABLE 4-4

FORMAT OF ANALOG TAPE IDENTIFICATION AND STATION DATA

Character number	Name of Word
1 - 5	Satellite Project Number
6 - 7	Year of Recording, starting from 1900
8 - 10	Station Number, where recording was made
11 - 14	Analog Tape Number
15 - 18	Spares
19 - 20	Binary Zeros

4.3.2.2 WWV's Special Standard Time Code

The special WWV time code propagated by the National Bureau of Standards for use in worldwide scientific observations is recorded as a standard for checking the other time contained on the analog tape. As shown in Figure 4-5, WWV signals are in the form of a 36-bit 100 pulse per second time code, carried on 1000 cps modulation, on all WWV's carrier frequencies of 2.5, 5, 10, 15, 20, and 25 mc. The code is broadcast for 1-minute intervals, ten times each hour. Time of year information (Universal Time) given in seconds, minutes, hours, and day of year (which is locked in phase with the frequency and time signals) is given. The code is binary coded decimal, consisting of 9 binary groups each second in the following order: 2 groups for seconds, 2 groups for hours, and 3 groups for day of year. Code digit weighing will be 1, 2, 4, and 8 for each group, multiplied by 1, 10, or 100. The code will be a space code format; that is, a binary group follows each of the 10 per second index markers. The last index markers are followed by a presently unused 4-bit group of zero pulses just preceding the 1-second reference marker. The zero pulses are 2 milliseconds wide; that is, 2 cycles at 1000 cps.

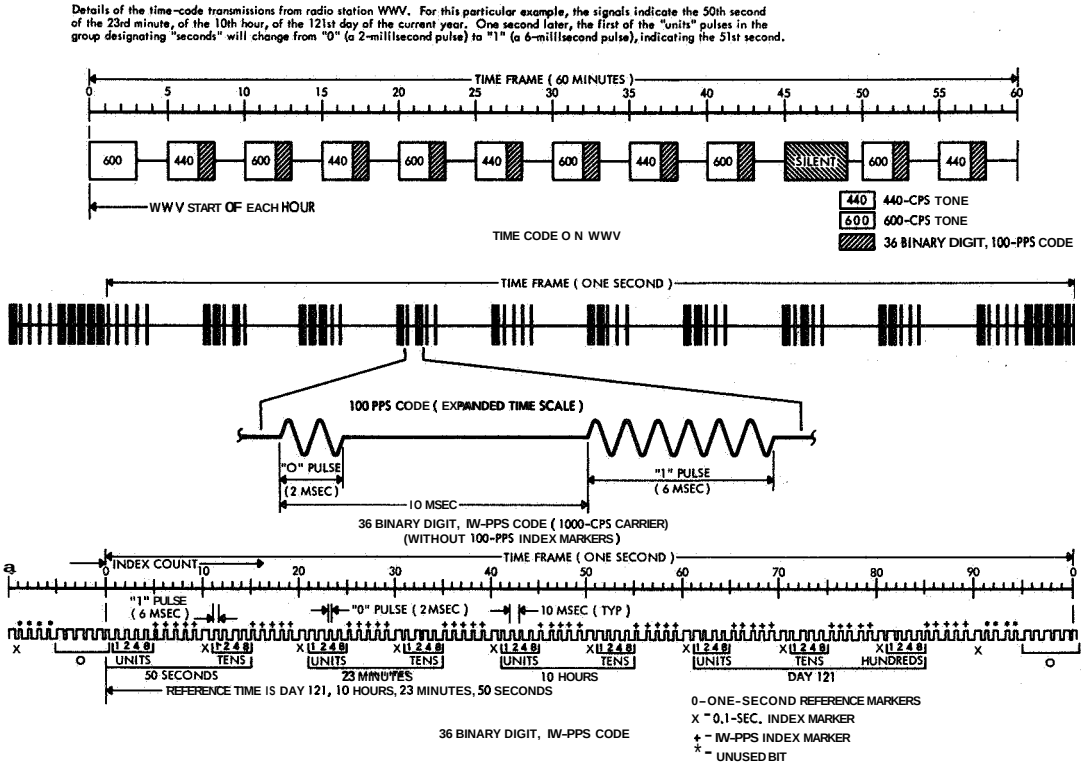


Figure 4-5. WWV Scientific Standard Time Code

4.3.3 Command Data

The two primary data acquisition stations receive commands from Goddard Space Flight Center via teletype. These stations then transmit the commands to the satellite and simultaneously record them on the wideband PCM/PM analog tape. (Appendices B and C provide additional information on digital and tone commands.) - Those commands which cause a transition of data mode, or cause a change in telemetry format are programmed by the station to occur during the one-minute overlap period, which is when the primary tape being recorded is within one minute of its maximum duration of recording

time and the second tape has just been started. There may be occasions, however, when a command must be sent before a tape is filled. Then the tape must be interrupted and a new tape started to comply with the requirement of recording only one mode or one format on a reel of tape.

4.3.4 Voice Commentary Data

At the data acquisition station, the tape recorder is equipped with a microphone for use by the station operator. The operator can instruct the processor of the analog tape by voice commentary about breaks in the data, calibrations, identification, starts and ends of data, etc.

4.3.5 Format of Analog Tape

The track assignments for recording the OGO-A analog data are shown in Table 4-5. The unusually high amount of data required by OGO-A required the use of 8 tracks on the analog tape, the eighth track is a special adaptation that uses the edge of the analog tape. Table 4-6 shows the track assignments for special purpose data.

All analog tapes recorded by the data acquisition stations shall be given a serial number in accordance with the following: (1) all command playback (PCM/PM) analog data tapes shall be numbered consecutively starting with number 0001; (2) all real time PCM/PM analog tapes shall be numbered consecutively starting with number 1001; and (3) all special purpose FM/PM analog tapes shall be numbered consecutively starting with number 5001.

TABLE 4-5

TRACK ASSIGNMENTS FOR RECORDING
OF OW-A PCM DATA

Track	Information
1	Receiver AGC Multiplexed with 10Kc
2	PCM Detected Output of Tracking Filter
3	PCM Conditioned Signal
4	Binary Coded Decimal Time
5	PCM Clock
6	Serial Decimal Time Code
7	Commands
8 (Side Track)	Voice Commentary and WWV

TABLE 4-6

TRACK ASSIGNMENTS FOR SPECIAL PURPOSE DATA

Track	Information
1	Receiver AGC
2	BCD Time
3	FM Detected Output of Tracking Filter
4	Standard 10Kc Reference Signal
5	Standard 10 Kc Reference Signal
6	SD Time
7	Voice Commentary and Commands
8 (Side Track)	WWV

SECTION 5
OGO-A DATA PROCESSING

5.1 DATA PROCESSING BRANCH

The Data Processing Branch receives analog data tapes from the acquisition stations and processes these data according to requirements. The major data processing functions performed at the facility are as follows: Analog tapes are received and evaluated. The evaluation results are reported to the Operations Branch as a check on station recording techniques. Data are converted from analog to digital on buffer tapes in a form which is compatible for further computer processing. The digital data are checked on the Univac 1107 with specially suitable quality control programs. Universal time is corrected on the same computer with time correction programs. Master binary edit tapes are also generated and decommutated into separate decommutated tapes for experimenters and spacecraft engineers. Special purpose data is also processed on special processors and quality checked on the IBM 7010. Orbit-attitude tapes are generated. Satellite command information is extracted from data tapes and stored on punch cards for further processing. Analog tapes and master binary edit tapes are stored, and decommutated tapes, command cards, orbit attitude tapes, and special purpose tapes are shipped to the experimenters.

The Data Processing Branch has undergone more than a twofold increase in size to handle the large volume of OGO data. The three major channels of the data processing flow are shown in Figure 5-1. With experiment data as inputs, the outputs are information on punch cards, magnetic tapes, printouts, and plots. Orbit data, consisting of interferometer, range, and range rate data from the tracking stations are received and processed separately from the PCM analog data. Special purpose data are also processed separately from the PCM analog data. The PCM analog tapes are first evaluated to determine the quality of the information recorded, then converted to digital tapes in the Satellite Telemetry Automatic Reduction System (STARS). The digital buffer tapes are further processed on large-scale computers.

5.2 PCM ANALOG DATA PROCESSING

Within the Data Processing Branch are the Analog Data Accounting Office and the Production Control Center. Raw PCM analog tapes sent from the ground stations are received by the Analog Data Accounting Office which supervises the handling of tapes and all operations performed on them during processing from the time of receipt to the time of retirement to the OGO-A archives. The Production Control Center coordinates and schedules workloads for the processing lines. Its primary functions in analog accounting are: (1) to schedule analog tapes for processing and storage, and (2) to maintain current records on all tapes received, processed, and stored.

For quick look processing of the OGO-A data, microwave links transmit real time data from Rosman and Fairbanks to the Goddard Space Flight Center. The function of quick look processing is for quick evaluation of the spacecraft and its subsystems. This service provides information which permits rapid issuance of commands so as to allow experimenters to take advantage of temporary phenomena and to permit subsystem engineers to optimize control of the subsystem functions. Details of the quick look program are given in Section 7.

The essentials of PCM analog processing are illustrated in Figure 5-2. The tapes, either real time or command playback, are first evaluated to determine whether the recorded information is acceptable and to what extent it is suitable for processing. After

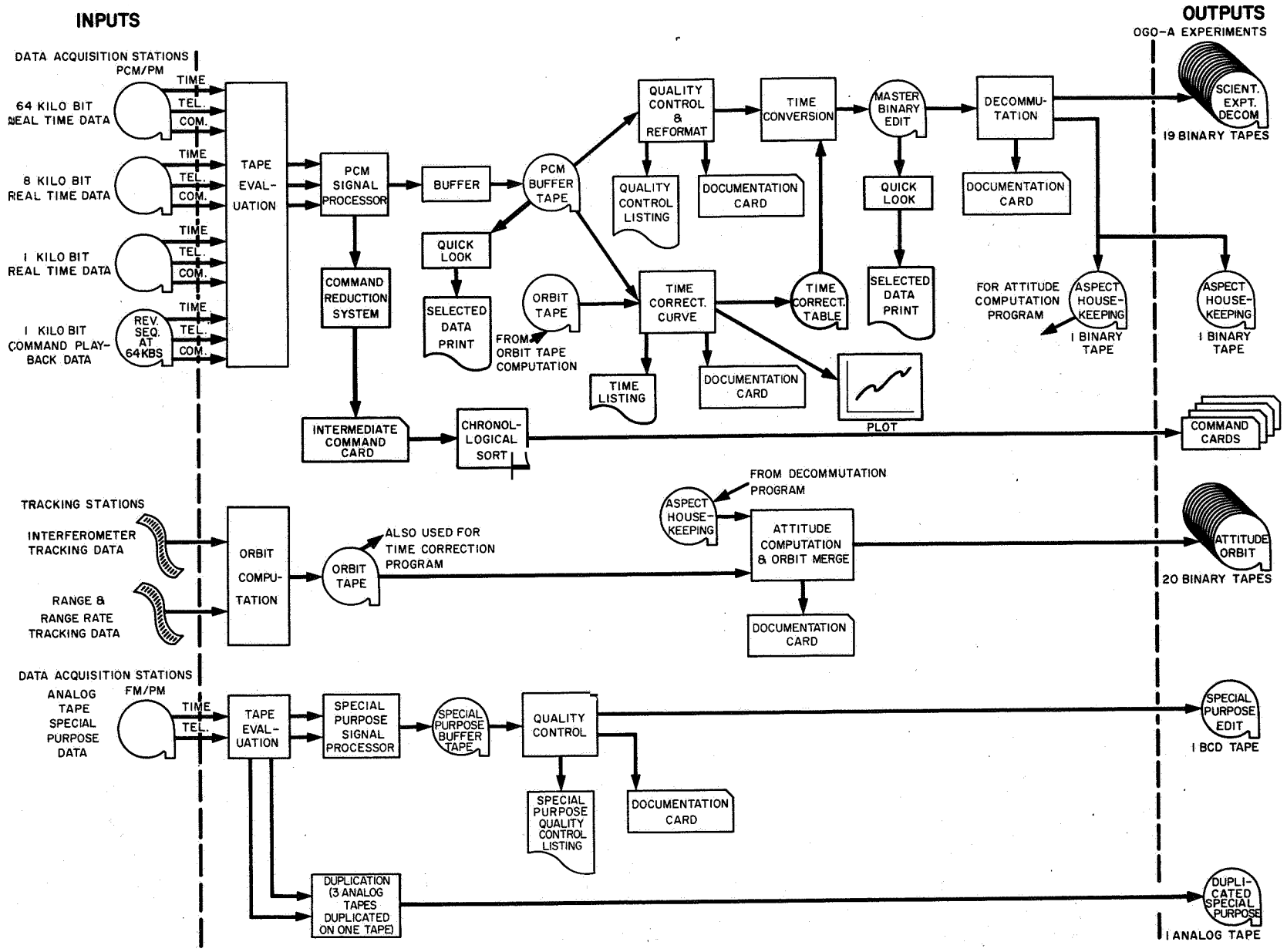


Figure 5-1. OGO-A Data Processing Flow Chart

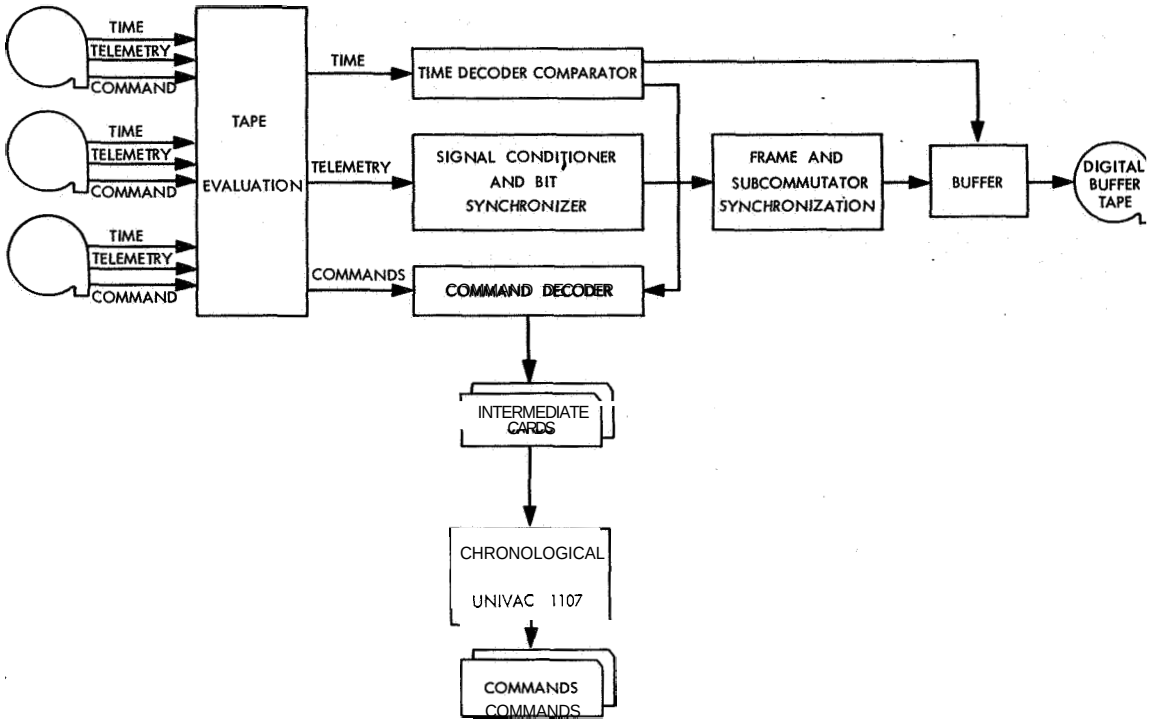


Figure 5-2. Analog Data Processing Flow Chart

evaluation, time data, command data, and experiment and subsystem data are extracted for separate processing actions. Command data are separately processed in the command reduction system. Time data and experiment and subsystem data are merged again in the buffer which produces the digital buffer tape.

5.2.1 Handling of Analog Tapes

At the data acquisition stations, each analog tape is identified and packaged prior to being mailed to Goddard Space Flight Center for processing. An alphanumeric code is punched into both ends of the tape and the tape is wound on a reel identified by the adhesive backed label shown in Figure 5-3. The reel is then placed inside of a can similar to that used for motion picture film. A magnetic tape log form (Figure 4-2) is filled out and placed inside the can with the reel. This form always stays with the tape. The mating halves of the can are then closed and sealed around the rim with pressure sensitive tape. Each can is separately packaged in a reusable corrugated cardboard carton. Large quantities of tapes are packaged by the dozen in corrugated cardboard boxes. Smaller quantities, however, may be placed in their individual cartons in mail bags. All are addressed to the Analog Data Accounting Office, Code 545, Goddard Space Flight Center, Greenbelt, Maryland 20771.

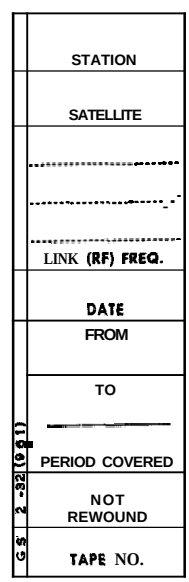


Figure 5-3. Reel Identification and Carton Label

Upon receipt, analog tapes are inspected by the Analog Data Accounting Office. This inspection consists of

removing the cans from the cartons, opening the cans, and checking the magnetic tape log form against the reel label, the carton label, the teletyped cumulative analog tape report (Figure 4-2) and the teletyped equator crossing report (Figure 5-4). When the inspection is complete, an analog tape documentation card (Figure 5-5) is punched,

During data processing, the analog tapes are stored in the analog tape storage area adjacent to the Analog Data Accounting Office. When all phases of processing have been completed for a particular set of analog tapes, and after shipment of the associated end data to the experimenters, the analog tapes are sent to the Federal Records Center in Alexandria, Virginia where they are kept as OGO-A archives. Retrieval of tapes from the archives can-be accomplished in a week or less.

STSØ16

RR AOBK AOOM GAGO GAPU GBPT GBUR GFLD GLGE GNTP GPRK GQUI GRKS GSAO
GSPE GSTS GULA GYRS JAVE LWNK
DEGPUT 004G
BK
18/Ø445Z
FM SPACECONN NASA GREENBELT MD
TO GSPE/NAVSPASUR DAHLGREN VA

SECTION TWO OF TWO EQUATOR CROSSINGS FOR 64151 640720
EPOCH 64 Ø7 07 ØØ ØØ ØØØØØ

DA	HRMNSC	LONG	HEIGHT	PASSNR
25	005004	145.44	Ø12Ø94	Ø1699
25	Ø231Ø5	119.83	Ø121Ø8	Ø17ØØ
25	Ø412Ø5	094.22	012121	Ø17Ø1
25	055306	068.62	Ø12134	Ø17Ø2
25	073406	043.01	012147	01763
25	Ø915Ø7	017.40	012161	01704
25	1Ø56Ø7	- 008.21	012174	Ø17Ø5
25	123708	- 033.81	012187	01706
25	141868	- 059.42	Ø122ØØ	Ø17Ø7
25	155969	- 085.03	012213	01708
25	174ØØ9	- 110.64	612226	Ø17Ø9
25	1921Ø9	- 136.25	612239	01710
25	21Ø21Ø	- 161.86	012251	Ø1711
25	224310	172.52	Ø12264	Ø1712
26	ØØ2411	146.92	Ø12276	Ø1
26	Ø2Ø511	121.3Ø	Ø12	
26	Ø34611	Ø95.7		Ø174Ø
26	Ø52712		Ø126Ø3	Ø1741
26		.28	Ø12613	Ø1742
		Ø98.67	Ø12624	Ø1743
28	Ø43517	C73.06	012635	01744
28	Ø61617	847.46	812645	Ø1745
28	Ø75717	Ø21.85	012655	61746
28	Ø93817	- ØØ3.75	012665	01747
28	111917	- 829.35	012676	Ø1748
28	13ØØ17	- 054.96	012686	Ø1749
28	144117	- 080.57	Ø12696	01756
28	162216	- 1Ø6.18	Ø127Ø6	81751
28	180316	- 131.78	Ø12716	01752
28	194416	- 157.39	012726	01753
28	212516	177.ØØ	Ø12736	01754

Figure 5-4. Teletyped Equator Crossing Report

5.2.2 Analog Data Accounting

Analog data accounting begins with the inspection of incoming analog tapes by the Analog Data Accounting Office. This inspection results in the preparation of a key record, the analog tape documentation card (Figure 5-5). This card provides all necessary information to identify, locate, and determine the status of processing of each analog tape. After inspection the first 53 columns are punched (excluding unused columns) and the last column which identifies the card. These columns provide all necessary information for positive identification of the tape and other information used during processing. When the tape is sent through the evaluation process, the next seven columns (columns 54 through 62 excluding unused columns) are punched to add the code and date of the evaluation. Next, when the tape goes through the conversion process to produce a digital buffer tape, the next seven columns (columns 63 through 70 excluding unused columns) are punched to add the date of conversion and the conversion line used. Finally the tape is stored and the next seven columns (columns 71 through 77) are punched to give the location and date of storage.

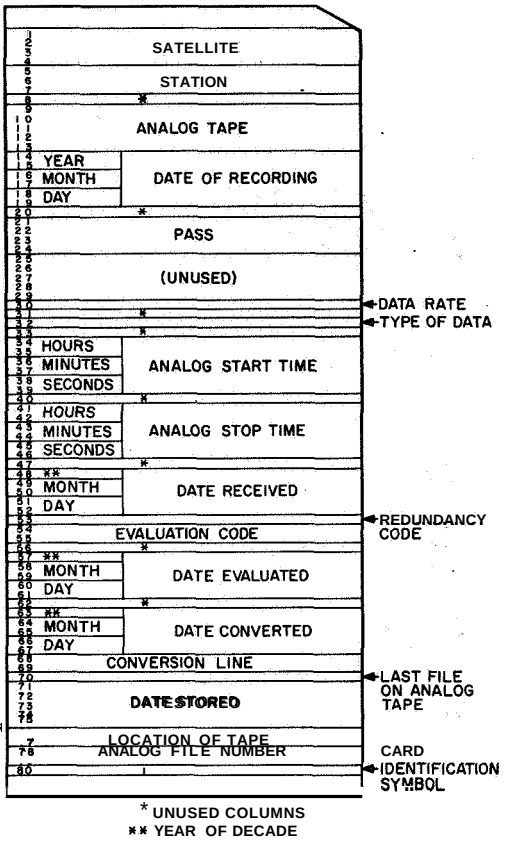


Figure 5-5. Analog Jape Documentation Card (Card 1)

The Analog Data Accounting Office processes daily accumulations of analog tape documentation cards to produce an analog tape listing. This listing is in the order of the code names of the source ground stations and, within that order, in the numerical order of the tape numbers. The analog tape daily listing is prepared for the Production Control Center for use in production scheduling.

To monitor incoming shipments of analog tapes, the Analog Data Accounting Office maintains a status board, (See Figure 5-6). The ordinates on this board are three-letter codes for each of the ground stations and the abscissae are code designations for each of the projects. The number of the latest tape received from each station for each project is entered as each shipment of tapes arrives. This display helps the Analog Data Accounting Office to discover gaps in tape numbers which may occur between shipments of tapes.

To provide weekly and monthly listings of analog tapes received, a master tape is prepared from analog tape documentation cards and digital tape documentation cards. (Digital tape edit and decommutation cards are explained in Sections 6 and 7.) The master tape is updated weekly and is processed on a computer to produce weekly and monthly listings. The weekly listing, the analog tape station-by-station listing (Figure 5-7), is arranged in the format of the daily analog tape listing; that is, alphabetically by station code and numerically by tape number. It is prepared for use by the Production Control Center and the Analog Data Accounting Office. The monthly listing, the combined analog tape and digital tape chronological listing (Figure 5-8) is arranged in the chronological order of the universal time of recording. This listing is prepared for distribution to the satellite project office, the Production Control Center, and the Analog Data Accounting Office.

ANALOG DATA ACCOUNTING

	TRS2	S51	S27	A41	A15	S52	EGR	S74	SR2	SN39	A16	A12
BPO		1014	1553	0	48	56	13	122	272	0	72	93
COL		391	1757	7	36	81	1	0	714	147	39	216
FTM		894	177	2	22	72	0	139	199	56	18	30
GFO		621	556	1	25	68	22	0	154	154	10	52
JOB	10	630	1	193	52	178	0	404	28	0	75	63
LIM		389	0	107	9	54	1	9	265	0	14	34
MQJ		773	0	17	44	142	20	33	362	61	22	91
NFL		922	537	0	22	147	0	0	0	0	12	108
OOM	6	723	318	165	42	208	28	561	295	162	97	80
QUI		352	670	160	9	82	0	0	79	110	9	22
SNT		1247	372	20	29	138	2	455	38	191	108	65
SPO	7	0	172	0	0	0	0	18	0	0	0	28
WNK	2	735	600	13	9	170	1	0	374	130	103	116
BAR		0	0	0	418	0	0	0	0	0	178	0
MAJ		0	0	0	0	0	0	0	0	0	0	8
SNP		829	0	0	0	0	0	0	0	0	0	0
SOL		1360	0	0	0	0	0	0	0	0	0	0
CPK		0	0	0	0	0	0	14	0	0	0	0
ROS	15	0	0	0	0	0	0	28	0	0	0	0

	REC	FRC	SHIP
S30	1355	1355	
P14	905	905	
S15	955	955	
S16	4267	3185	923
S 3	5981		
A40	921		921
L2A	88		88
MIS	387	387	
S 6	436		
S3B	3333	3333	
S55B	393		785
A26	122		85
DT1	299		299
DT2	329		329
TR2	14		14
IN3	927		927

LATEST TAPE RECEIVED AS OF 0800 JULY 31

Figure 5-6. Analog Accounting Office Status Board

SAT	STA	TAPE NO	GATE RECORU	PASS NO	INTRNAL COOL		START TIME	STOP TIME	DATE RECO	QTL	DATE EVAL	DATE DIGIT	DATE S/S	CC CT
549	RCS	1471	650321	0075	2	R	124940	130350	50326			50402		401
549	ROS	1473	650321	0075	2	a	130240	131640	50326			50405		*01
S49	ROS	1474	650321	0075	2	R	131540	132940	50326			50405		*01
549	ROS	1476	650321	0075	2	R	132840	133700	50326			50405		*01
549	ROS	1477	650321	0075	1	R	133500	143500	50326			50405		401
544	ROS	1480	650321	0075	1	R	143400	153400	50326			50405		*01
S44	RCS	1482	650321	0075	1	R	153300	163300	50326			50405		401
549	ROS	1483	650321	0075	1	R	163200	173200	50326			30405		*01
S49	ROS	1484	050321	0075	1	R	173100	103100	50326			50405		*01
S49	ROS	1461	650321	0075	1	R	183000	184000	50326			50405		401
549	RCS	1486	650322	0075	0	R	072500	091800	50326			50405		*01
S49	ROS	1487	650322	0075	0	R	091600	110900	50325			50405		401
549	ROS	1488	650322	0075	0	R	110700	130000	50326			50405		*01
549	ROS	1489	650322	0075	0	R	125900	145100	50326			50405		*01
S49	ROS	1490	650322	0075	a	R	145000	164200	50326			50405		401
549	ROS	1491	650322	C075	0	R	164100	183300	50326			50405		*01
544	ROS	1492	650322	0075	0	R	183200	195100	50326			50405		*01
549	ROS	1495	650324	0076	1	R	025300	031600	50331			50402		401
549	ROS	1498	650324	0076	2	R	031500	032900	50331			50402		*01
S49	ROS	1500	650324	0076	2	R	032800	034200	50331			UD20		*01
S49	ROS	1501	650324	0076	2	R	034100	035500	50331			DECET		*01
549	RCS	1502	650324	0076	2	R	035400	040800	50331			50402		*01
S49	ROS	1504	650324	C076	2	R	040700	041120	50331			DELET		*01
S49	ROS	1506	650324	0076	2	R	043900	045200	50331			50402		401
549	ROS	151%	650324	C076	1	R	045100	054600	50331			50402		*01
549	ROS	1511	650324	C076	1	R	054500	065100	50331			50402		*01
S49	ROS	1514	650324	0076	1	R	065000	074600	50331			50492		401
S49	ROS	1517	650324	0076	1	R	074500	084500	50331			50402		*01
S49	ROS	1518	650324	C076	1	R	084400	094000	50331			50402		*01
549	ROS	1519	650324	0076	1	R	093900	103500	50331			50402		*01
S49	ROS	1520	650324	0076	1	R	103400	113000	50331			50402		*01
S49	ROS	1521	650324	0076	1	R	112900	122500	50331			50402		*01
S49	ROS	1522	650324	0076	1	R	122400	132004	50331			50402		*01
549	RGS	1523	650324	0076	1	R	131900	141500	50331			50402		*01
S49	ROS	1524	650324	0076	1	R	141400	151000	50331			50402		*01
549	ROS	152%	650324	0076	1	R	150900	160500	50331			50402		*01
549	ROS	1526	650324	0076	1	R	160400	170000	50331			50402		*01
549	ROS	1527	650324	C076	1	R	165900	175500	50331			50402		*01
549	ROS	1528	650324	0076	1	R	175400	185200	50331			50402		*01
S49	ROS	1529	650324	0076	1	R	184900	191000	50331			50402		*01
S49	ROS	1538	650325	0076	0	R	074700	094300	50331			50406		*01
S49	ROS	1531	660325	0076	0	A	094200	113600	50331			50402		*01
549	ROS	1532	650325	0076	0	R	113400	132600	50331			50402		*01
549	ROS	1533	650326	0074	0	R	105900	125000	50331			50402		*01
S49	ROS	1534	650326	0076	0	R	124900	144100	50331			50402		*01
549	ROS	1531	650326	0076	0	R	143800	163200	50331			50402		401
549	ROS	1540	650326	0076	0	R	163100	171500	50331			50402		*01
S49	ROS	1542	650327	0077	1	R	061800	071500	50407			50408		401
549	ROS	1543	640127	0077	1	R	071400	081100	50407			50408		*01
S49	ROS	1544	650327	0077	1	R	081000	090700	50407			50408		401
549	ROS	154%	650321	0077	1	R	090600	100300	50407			50408		*01
349	ROS	1546	650327	0077	1	R	100200	105900	50407			50401		*01
549	ROS	1547	650327	0077	1	R	105800	115300	50401			50408		*01
549	ROS	1548	650327	0077	1	R	115400	125200	50407			50408		*01
549	ROS	1549	650327	0077	0	R	125000	144300	50407			40408		*01
S49	ROS	1556	E50321	EO77	0	R	144100	163400	50407			50401		*01

Figure 5-7. **Analog** Tape Station-by-Station Listing

S49 SATELLITE PROCESSING

STA	TAPE NO	FILE NO	DATE RECORD	PASS NO		START TIME	STOP TIME	BUK NO	L	EDIT TAPE	B T	RECVD DATE	EDIT DATE	B T	BC STS	SHIP DATE	COMMENTS	
JOB	0541	01	650326	0076	D	183216	190013	0724	C4	1461	01	50407	50409	85 I	50526	505 2		•
DAR	0112	01	650326	0077	D	193424	195517	0746	C4	1462	01	50406	50409	[illegible]	50526	505 2		•
SKA	0865	01	650326	0077	A	195500	200700					50405	DELET					•
SKA	0868	01	650326	0077	A	202900	212100					50405	DELET					•
SKA	0870	01	650326	0077	D	212057	221120	0623	C4	1465	01	50405	50406	50521	50526	50527		•
SKA	0873	01	650326	0077	D	221120	230315	0624	C4	1466	01	50405	50407	50521	50526	50527		•
SKA	0876	01	650326	0077	D	230315	235910	0625	C4	1467	01	50405	50407	50521	50526	50527		•
SKA	0877	01	650326	0077	D	235928	005057	0626	C4	1468	01	50405	50407	50521	50525	50526		•
JOB	0542	01	650327	0077	A	004800	014730					50407	UD23					•
JOB	0543	01	650327	0077	D	014617	033919	0725	C4	1470	01	50407	50409	50521	50525	50526		•
JOB	0544	01	650327	0077	D	040849	052727	0726	C4	1471	01	50407	50409	50521	50525	50526		•
JOB	0545	01	650327	0077	D	052900	062131	0727	C4	1472	01	50407	50409	50521	50525	50526		•
ROS	1542	01	650327	0077	D	062145	071512	0661	C4	1473	01	50407	50408	50521	50525	50526		•
ROS	1543	01	650327	0077	D	071435	081107	0662	C4	1474	01	50407	50408	50521	50525	50526		•
ROS	1544	01	650327	0077	D	081048	090701	0663	C4	1475	01	50407	50408	50521	50525	50526		•
ROS	1545	01	650327	0077	D	090643	100333	0664	C4	1476	01	50407	50408	50521	50525	50526		•
ROS	1546	01	650327	0077	D	100333	105909	0665	C4	1477	01	50407	50408	50521	50525	50526		•
ROS	1547	01	650327	0077	D	105851	115522	0666	C4	1478	01	50407	50408	50521	50525	50526		•
ROS	1548	01	650327	0077	D	115427	125212	0667	C4	1479	01	50407	50408	50021	50525	50526		•
ROS	1549	01	650327	0077	D	125057	144359	0668	C4	1480	01	50407	50408	50521	50525	50526		•
ROS	1550	01	650327	0077	D	144132	163434	0669	C4	1481	01	50407	50408	50521	50525	50526		•
ROS	1551	01	6503,7	0077	D	163208	182737	0670	C4	1482	01	50407	50408	50521	50525	50526		•
ROS	1552	01	650327	0077	D	182243	192141	0671	C4	1483	01	50407	50408	50521	50525	50526		•
SKA	0878	01	650327	0077	D	191152	210722	0627	C4	1484	01	50405	50407	50521	50525	50526		•
SKA	0879	01	650327	0077	D	210723	230025	0628	C4	1485	01	50405	50407	50521	50525	50526		•
JOB	0543A	01	650329	0077	A	070420	090000					50407	UD22				RECD OUT OF SEQ	•
JOB	0546	01	650329	0077	A	090000	095600		C4			50407	50409					•
JOB	0549	01	650329	0077	D	095425	101918	0729	C4	1488	01	50407	50409	50521	50525	50Z 6		•
ROS	1556	01	650329	0078	A	110100	120300					50407	DELET					•
SKA	0880	01	650329	0078	D	111604	112703	0629	C4	1489	01	50405	50407	50521	50525	50Z 6		•
SKA	0882	01	650329	0078	A	112645	113900					50405	DELET					•
ROS	1554	01	650329	0078	A	113200	114700		C4			50407	50408					•
ROS	1555	01	650329	0078	A	114600	120100					50407	DELET					•
ROS	1558	01	650329	0078	D	120016	121419	0674	C4	1495	01	50407	50408	50521	50525	50526		•
ROS	1559	01	650329	0078	A	121400	122100					50407	UD20					•
ROS	1563	01	650329	0078	D	124438	125603	0677	C4	1496	01	50407	50409	50521	50525	50526		•
ROS	1564	01	650329	0078	D	125512	131003	0678	C4	1497	01	50407	50409	50521	50525	50526		•
ROS	1566	01	650329	0078	D	130913	132246	0679	C4	1498	01	50407	50409	50521	50525	50526		•
ROS	1567	01	650329	0078	D	132311	133708	0680	C4	1499	01	50407	50409	50521	50525	50526		•
ROS	1569	01	650329	0078	A	133700	134600					50407	DELET					•
ROS	1570	01	650329	0078	A	134600	144300					50407	DELET					•
ROS	1573	01	650329	0078	A	144200	153900					50407	DELET					•
ROS	1575	01	650329	0078	D	153810	163519	0684	C4	1503	01	50407	50409	50521	[illegible]	50526		•
ROS	1576	01	650329	0078	D	163405	173113	0685	C4	1504	01	50407	50409	50521	[illegible]	50526		•
ROS	1577	01	650329	0078	D	173018	175911	0686	C4	1505	01	50407	50409	50521	50525	50526		•
SKA	0886	01	650329	0078	A	175400	185105					50405	DELET					•
SKA	0887	01	650329	0078	D	185143	194719	0632	C4	1507	01	50405	50407	50521		50526		•
SKA	0888	01	650329	0078	D	194719	204313	0633	C4	1508	01	50405	50407	50521	[illegible]	50526		•
SKA	0889	01	650329	0078	D	204313	213908	0634	C4	1509	01	50405	50407	50521		50526		•
SKA	0890	01	650329	0078	D	213926	223521	0635	C4	1510	01	50405	50407	50521	[illegible]	50526		•
SKA	0891	01	650329	0078	D	223539	233118	0636	C4	1511	01	50405	50407	50521		50526		•
SKA	0892	01	650329	0078	D	233134	002710	0743	C4	1512	01	50405	50409	50521	50525	50526		•
SKA	0893	01	650330	0078	A	002700	005200					50405	DELET					•
JOB	0551	01	650330	0078	D	011619	031149	0730	C4	1514	01	50407	50409	50525	50 50	860 1		•
JOB	0552	01	650330	0078	D	030654	050224	0747	C4	1515	01	50407	50409	50525	50 50	860 1		•

Figure 5-8. Combined Analog and Digital Tape Chronological Listing

5.3 PRODUCTION CONTROL

The Production Control Center receives a copy of the advanced telemetry report from the project office and a copy of the daily analog tape listing from the Analog Data Accounting Offices. The two records are used to prepare the production control chart (Figure 5-10) which is the key record for production control. Each line of the chart provides production scheduling and status information for one analog tape. The processing of analog tapes cannot begin until they are listed on this chart, after which an analog tape library request form (Figure 5-9) consisting of an original and one carbon copy is prepared. The original is retained by the Analog Data Accounting Office upon release of the tapes. The carbon copy accompanies the tapes through the scheduled production.

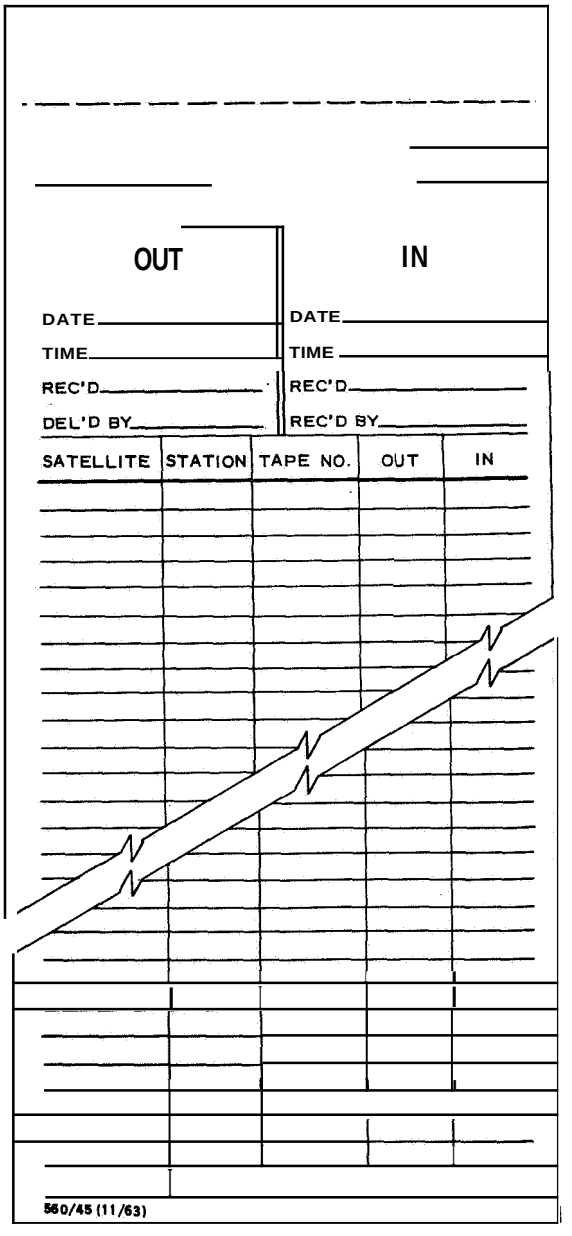


Figure 5-9. Analog Tape Library Request Form

PRODUCTION CHART FOR SATELLITE_____ DIGITIZING LINE(S)_____

DATE ORD.	STA.	TAPE NO.	DATE REC.	DATE REC'D	ANALOG		DIGITAL		DATE EVAL &/OR STRIPCHT	DATE DIGITIZED	BUFFER TAPE & FILE NO.	DATE EDITED	EDIT & FILE NO.	PLOTTER ACTION	QUALITY CONTROL ACTION	DATE REORDER	DECOM RUN NO.	DATE DECOMMED	DATE DECOM SENT TO EXP.	REMARKS
					START	STOP	START	STOP												

540-17 (2/64)

Figure 5-10. Production Control Chart

5.4 TAPE EVALUATION

As analog tapes are received from data acquisition stations, their data are evaluated for inherent quality and excellence of recording. Since recording affects the quality of data to a large degree, primary emphasis is placed on evaluating the recording technique of the ground station. For this purpose two evaluation lines are used. (See Figure 5-11). Both are capable of handling all three types of analog data. PCM real time data, PCM command playback data, and FM special purpose data. For OGO-A data, the lines are fitted with two Monroe printout devices in addition to the regular Visicorder and Sanborn strip chart recorders. Thus most evaluation data is automatically written by machines. It is analyzed, however, by data inspectors who compare it to established standards and report their findings on the tape evaluation log form (Figure 5-12). Further analysis is made when the graded performance data from the logs are summarized into two weekly reports: the station telemetry report, and the summary of magnetic tapes received and evaluated. These reports are used by the Operations Branch to check the recording technique of the station operator and the efficiency of station equipment.

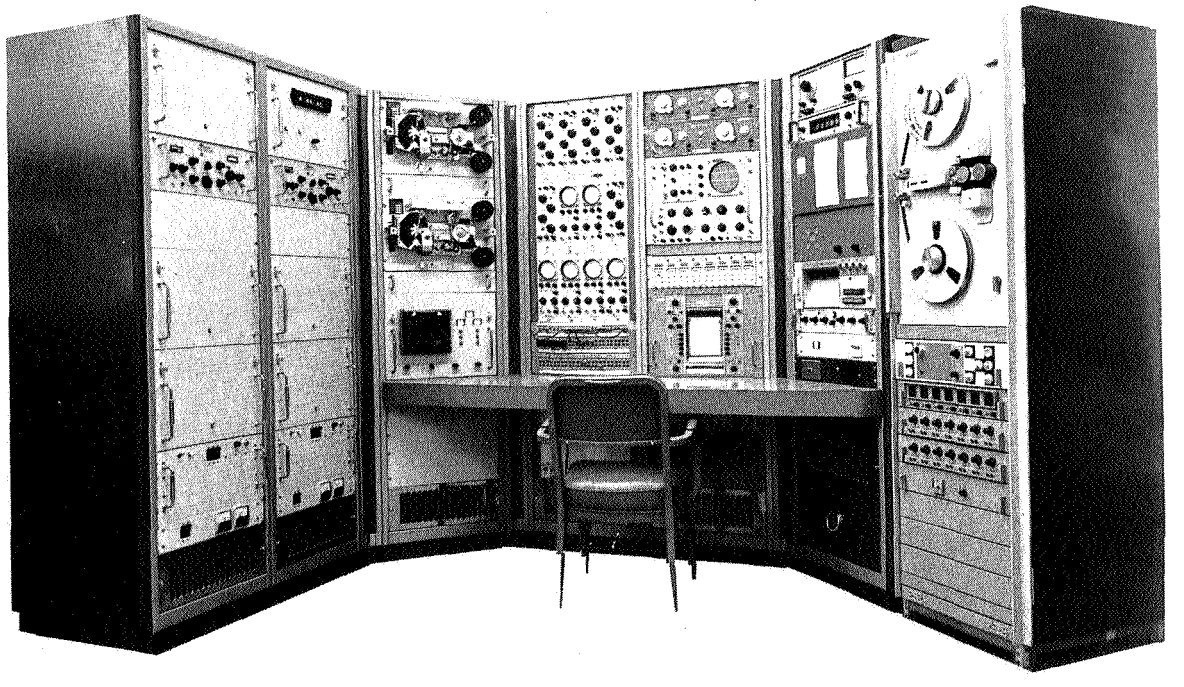


Figure 5-11. Tape Evaluation Unit

(TENTATIVE)

SUPPLEMENT TO TAPE EVALUATION LOG

	RAW PCM	RECONDITIONED PCM
Total Running Time	_____	_____
Running Time in Lock	_____	_____
No. Times in and out of Lock	_____	_____

Plus Identification Information

TAPE EVALUATION LOG

DATA PROC. BRANCH
OPS. SECT. – EVAL. UNIT

Station _____ Date of Recording _____

Tape Number _____ Date Received _____

Pass Number _____ Date Evaluated _____

TIME AS RECORDED ON

Tape Log	Tele. Meag.	Tape	Playback	Command
start _____	start _____	start _____	start _____	☐ Yes ☐ No
stop _____	stop _____	stop _____	stop _____	Time _____
				Real Time Data Only ☐

Are the tape log, carton, can, reel, and punch markings consistent and correct? Yes ☐ No ☐

Remarks: _____

Are assigned signals on proper tracks? Yes ☐ No ☐

Are the signals on the tracks listed below of proper frequency, amplitude and/or modulation?

(1)	(2)	(3)	(4)	(5)	(6)	(7)
yes ☐	yes ☐	yes ☐	yes ☐	yes ☐	yes ☐	yes ☐
no ☐	no ☐	no ☐	no ☐	no ☐	no ☐	no ☐

Limitations: _____

QUALITY EVALUATION

DATA QUALITY
☐ 1 Good ☐ 2 Questionable ☐ 3 Unusable

TAPE QUALITY
☐ A Processable ☐ B Limited ☐ C Questionable ☐ D Useless

General Remarks: _____

Evaluated by _____

Evaluation log by _____

FR _____ _____ i.p.s.

Date sent to O. B. _____

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Figure 5-12. Tape Evaluation Log and Supplement

5.5 ANALOG TO DIGITAL CONVERSION

After data contained on the analog tapes are evaluated, they are converted to digital form and recorded on a separate tape. Conversion is accomplished on the STARS lines (Figure 5-13). A block diagram showing functional interrelations is given in Figure 5-14. Formats of input and output data are given in Figure 5-15 and 5-16 respectively. The output data are recorded on a buffer tape which is arranged in a format compatible with computer operation. Another output is produced in the form of punched cards containing data taken from the analog tape. The data recorded on each card is from a separate command. Buffer tapes and command cards produced in the conversion process are sent to the Digital Data Accounting Office for temporary storage prior to digital computer processing.

During conversion, the data patterns displayed on an oscilloscope are monitored and notes are made of audible signals denoting a change from the lock-on mode to the search mode. As the digital buffer tape is produced, the analog-to-digital processing log (Figure 5-17) is completed. On this form is logged the amount of intermittent data, the duration of dropouts, and other such information relevant to the condition of data recorded on the buffer tape. At the same time, the analog-to-digital summary form for each buffer tape is completed (Figure 5-18).

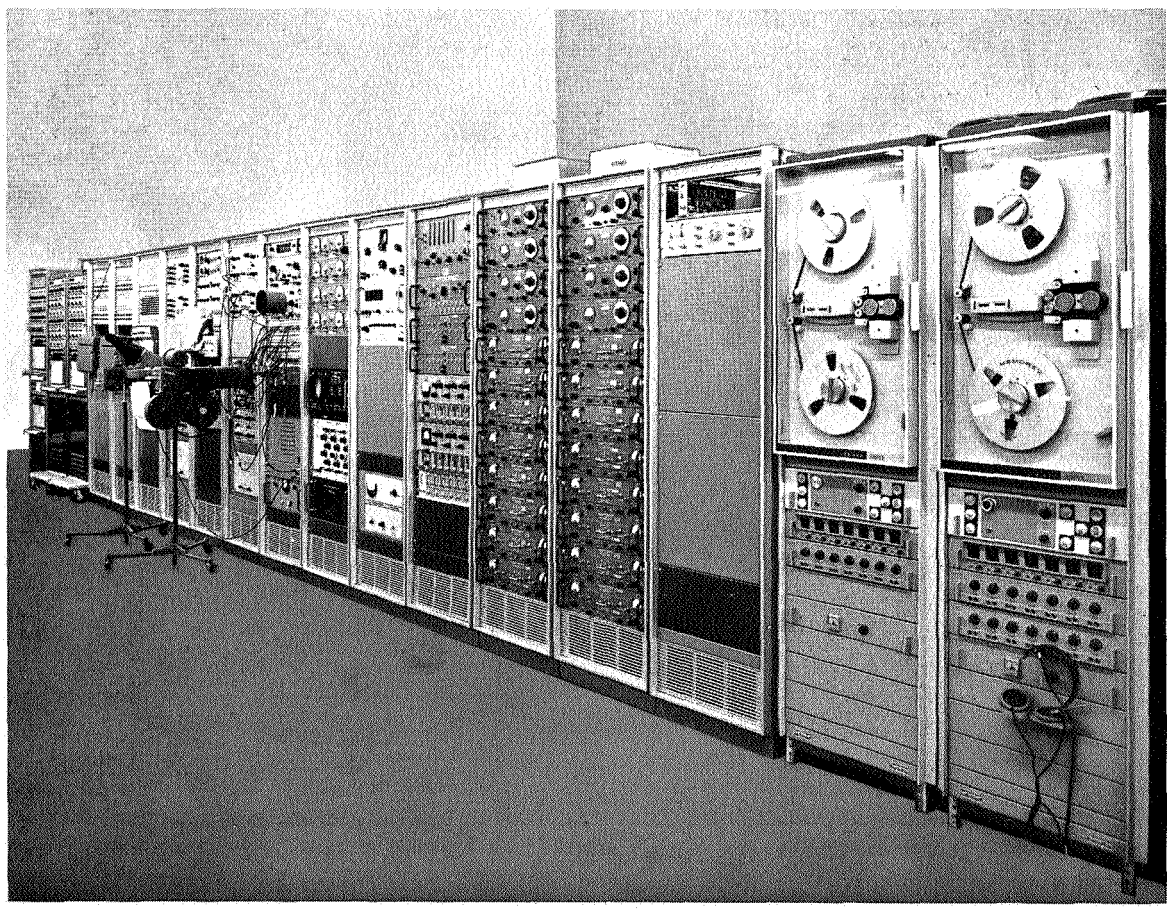


Figure 5-13. Satellite Telemetry Automatic Reduction System Conversion Line (STARS)

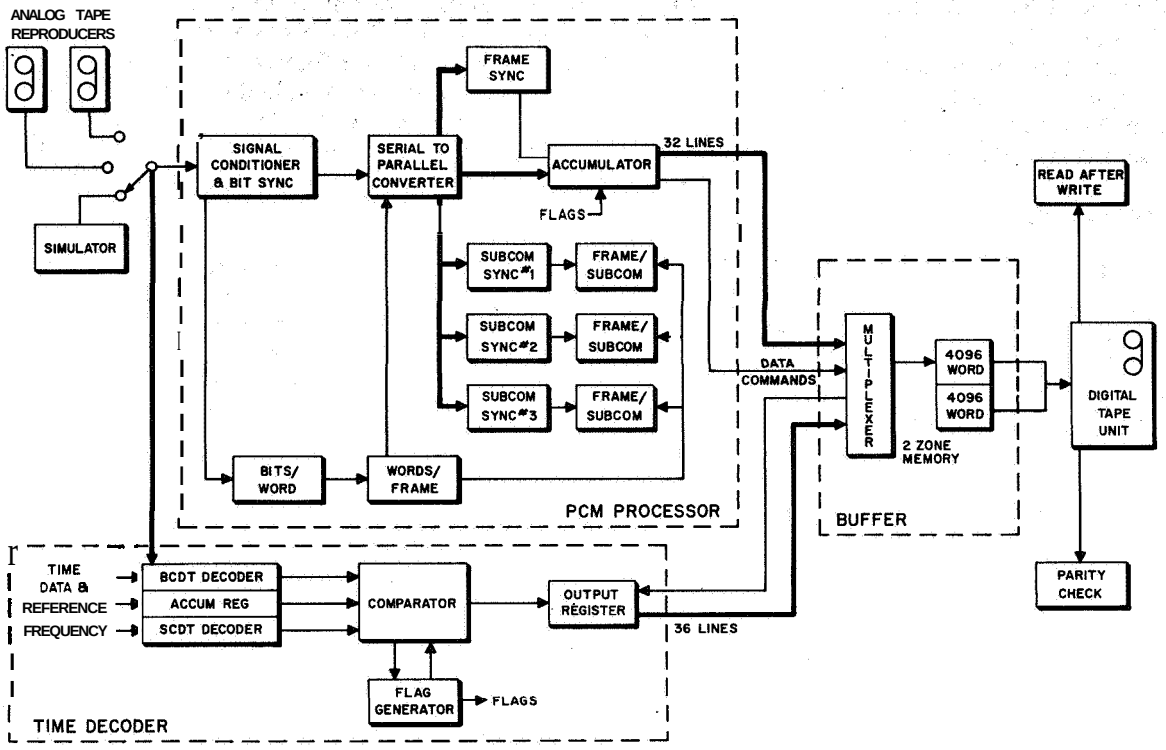


Figure 5-14. Block Diagram of Conversion Equipment

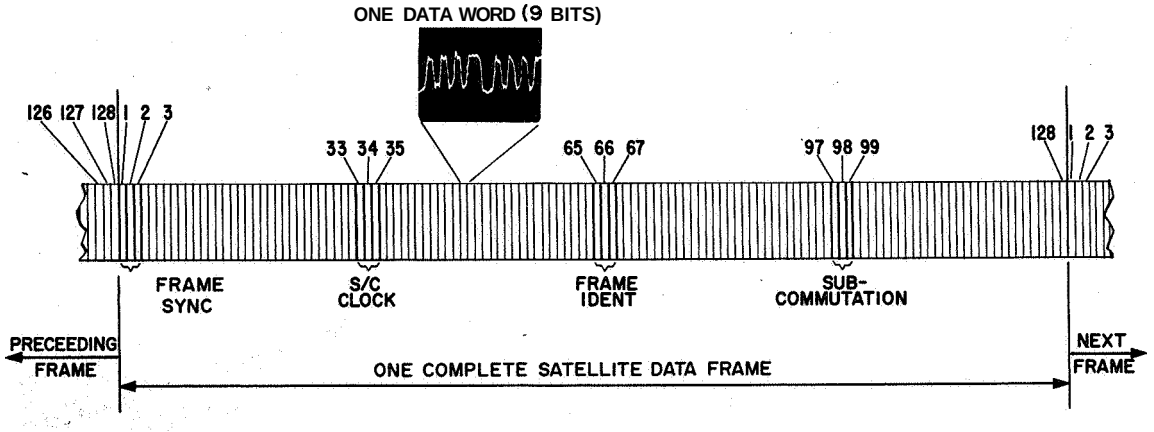
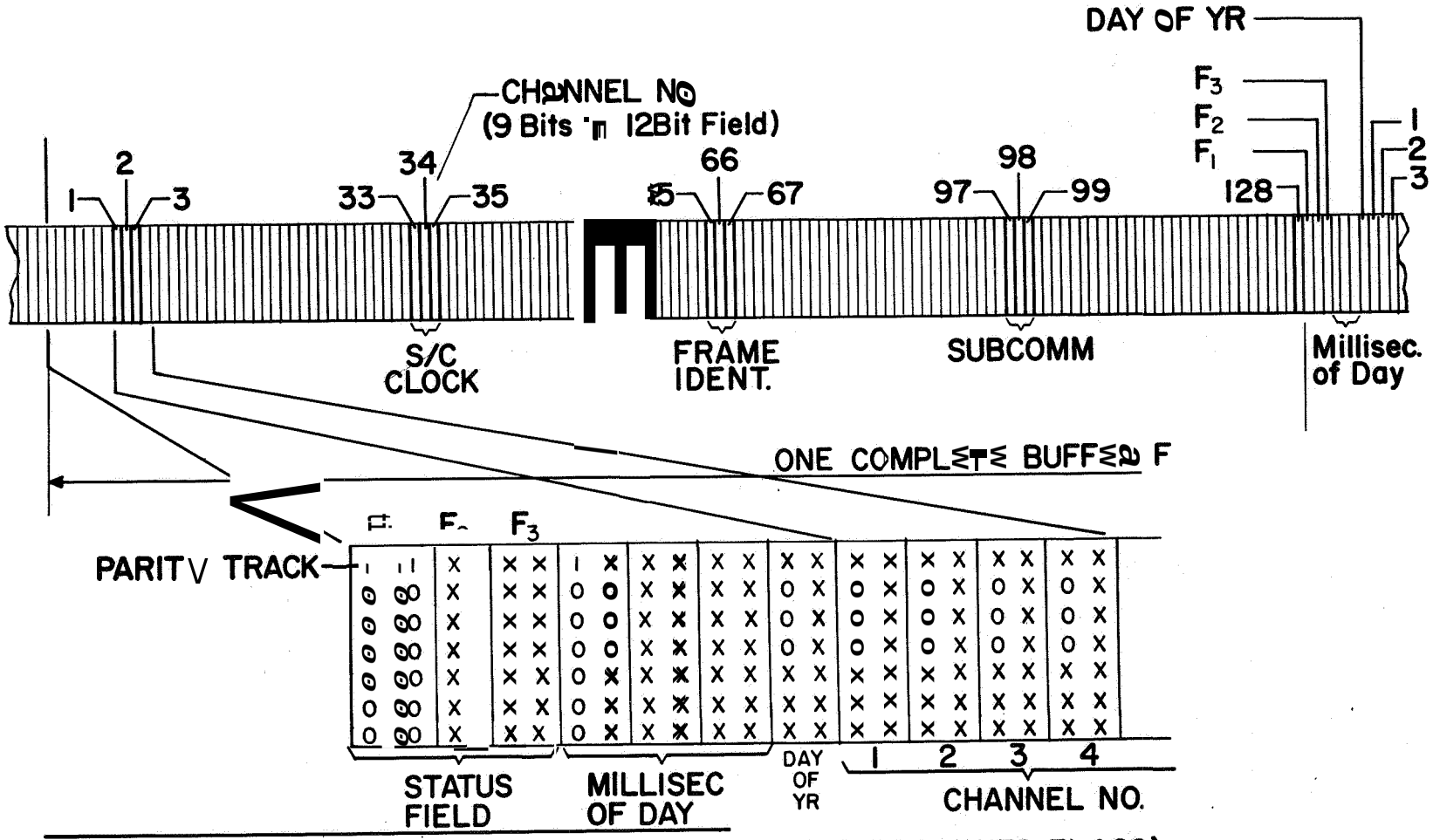


Figure 5-15. Format of Analog Data



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 5-16. Format of Digitized Buffer Data

DARSEL GRAPHIC ART SERVICES, INC.

ANALOG TO DIGITAL PROCESSING LOG

SATELLITE _____

Station: **Tape #** **Date** / /

A/D Line # **Buffer Tape #** **File #**

Date Processed: / / **Orbit #**

Elect. Tech. in Charge:

TAPE SPEED	1 7/8	3 3/4	7 1/2	15	30	60	120
FR-600							
FR-100							

Recorder					Sync.			Servo			Telemetry Signal				HF-3 Sw. Pos.			Frame Sync.			
Track	Direct	F. M.	P. D. M.		Recorder	Comb Filter AGC	Voltage Level	Line	Channel No. 2	Voltage Level	Good	Questionable	Poor	Voltage Level	10 K.C.	100 K.C.	Voltage Level	Stable	Unusable	Change of Servo	
1																					
2																					
3																					
4																					
5																					
6																					
7																					

Recorder & Time Mode		Playback Quality of Tape						Equipment Failure												
Analog Tape Time Stop _____ Start _____ ELAPSE		Loss of Signal	Fading of Signal	Poor Signal	Noisy	Loss of Sync.	Interference	Tracking Filter	A. D Converter	Buffer	Transports and associated electronics	Comb Filter	Sync. Equipment	Phase Lock Osc.	Time Decoder	Minitrack Station		Time Difference	Remarks
Digital Time _____ ELAPSE																				
Start Time:																				
Stop	Start																			

Remarks from Analog Tape Log:

Remarks from Evaluation Tape Log:

Remarks from A D Operation:

emarks from D/D Editing:

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Figure 5-17. Analog-to-Digital Processing Log

ANALOG TO DIGITAL SUMMARY

BUFFER TAPE # LINE # SATELLITE #

FILE NUMBER	ANALOG TAPE NUMBER	STATION NAME	DATE DIGITIZED	DATE RECORDED	TIME STARTED	TIME STOPPED				

860-15 (11/62)

Figure 5-18. Analog-to-Digital Summary Form

The two forms (Figures 17 and 18) are distributed to the Analog Data Accounting, Quality Control, and Computer Operations Offices. The analog-to-digital summary is used to compile a weekly report (Figure 5-19) which enables management to assess the productivity, efficiency, and available capacity of the processing system.

5.5.1 Command Reduction System

A part of the conversion line, the command reduction system, produces command cards for intermediate use in processing. The outputs of three separate command reduction systems are applied to a single IBM summary punch (Figure 5-20). Each system stores command data until the punch is available, and each system stores only the data from one analog tape until that tape has passed through the conversion operation. After conversion of the analog tape, the system storing command data taken from the tape, punches a set of intermediate command cards (Figure 5-21) and a set of identification cards (Figure 5-22) for each file of data. The intermediate command card contains the time of the command, the command address, and the command data. These cards are later processed on an IBM computer which sorts the data chronologically, reformats it, and punches a master deck of end-data command cards. (See Section 7.) From the master deck, 21 duplicate decks are punched. One duplicate deck is for use by the Space Technology Laboratories. The other 20 decks are distributed to experimenters and their representatives.

WEEKLY PRODUCTIVITY, EFFICIENCY AND AVAILABLE CAPACITY REPORT

PROCESSING SYSTEM_____ DATE_____

PROJECT	Processing System Scheduled (Hours)	Non-Production (Hours)	Production (Hours)	Data Files Processed (Files)	Data Files Rejected (Files)	Total Data Processed Files Per Hour/Prod. (Files/Hrs.)	Target Data Files Per Hour Production (Files/Hrs.)	Processing Efficiency Total Files/Hour / Target Files/Hr. (%)

Hours in week = 168

Hours Processing System Scheduled = ____

Hours Available Capacity =

Figure 5-19. Weekly Processing Report

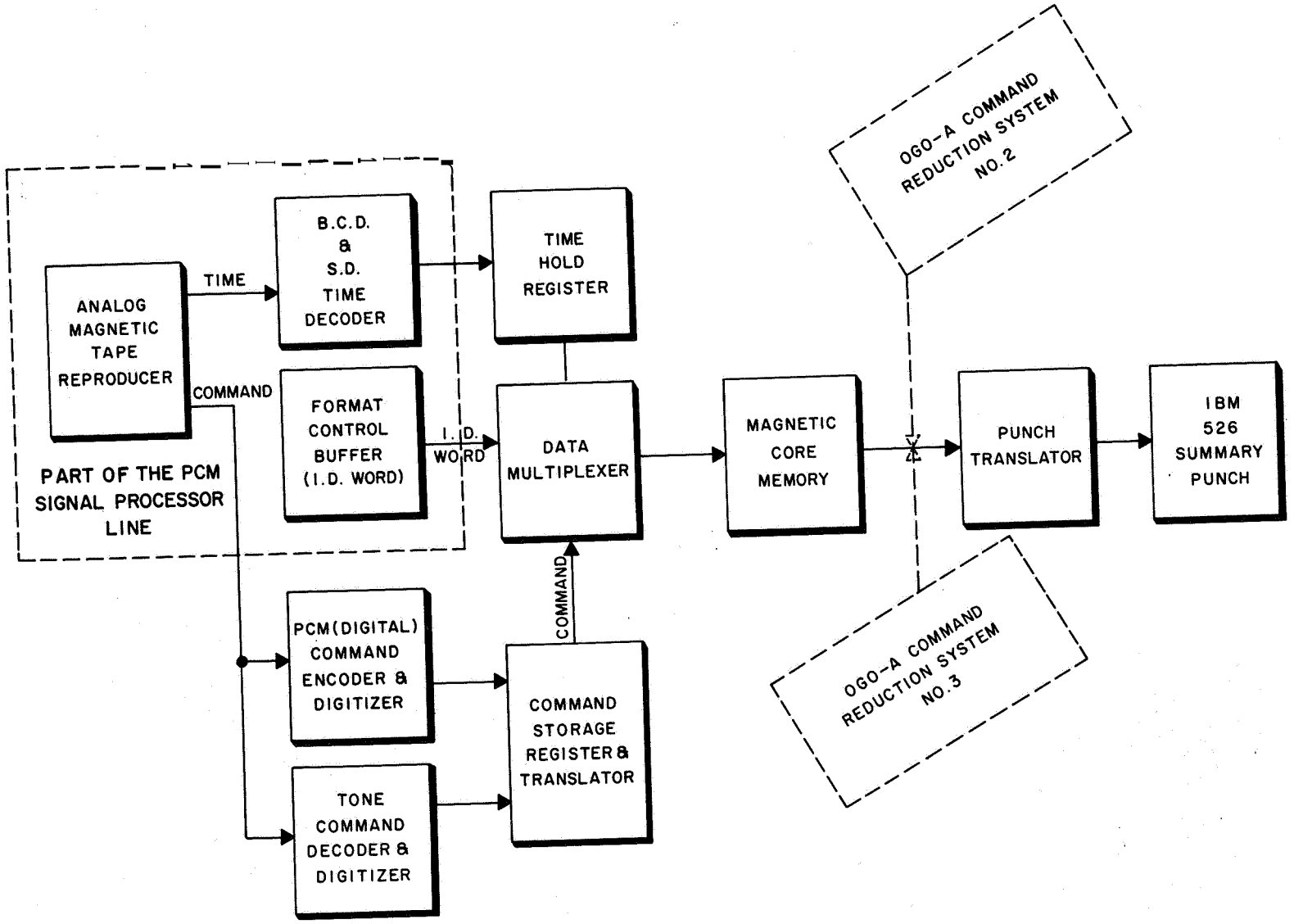

Figure 5-20. Command Reduction System

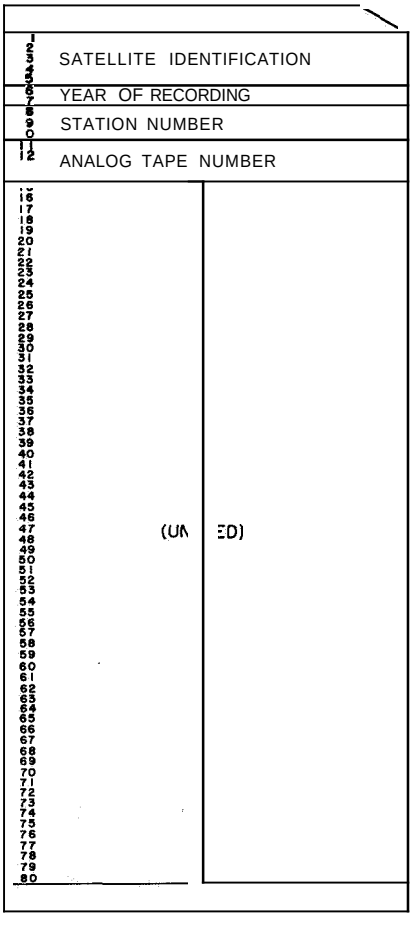

Figure 5-21. Intermediate Command Card

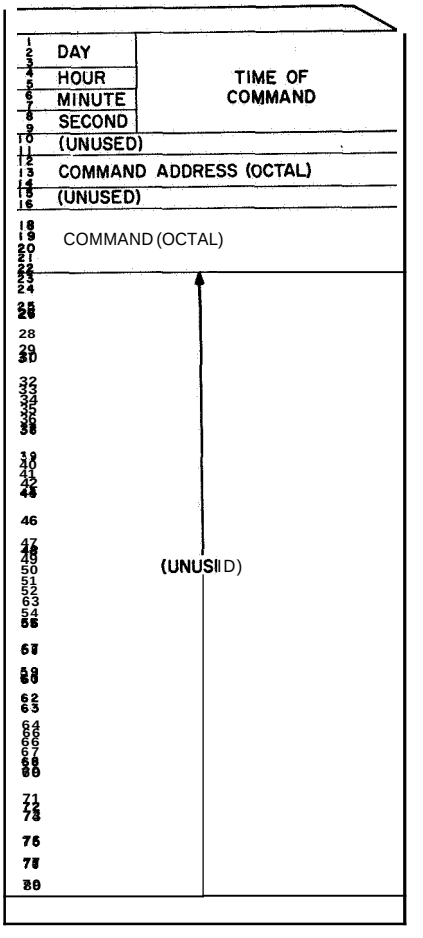

Figure 5-22. Identification Card

5.5.2 Conversion Process

Four types of buffer tapes are generated from four types of PCM analog data recorded. These tapes separately contain the types of data shown in Table 5-1. It will be noted that all types of data are played back in the conversion operation at the same rate, 30 inches per second. Thus one- and eight-kilobit real time data are played back at eight times or greater than the rate at which they are recorded and 64-kilobit real time and command playback data are played at the same rate or at a greater rate than that at which they were recorded.

Special problems occur with command playback data. This data is recorded in the spacecraft at a one-kilobit rate, transmitted to ground in reverse order at 64 kilobits, recorded in reverse order, and reversed with respect to the time information added by the ground station. In conversion, this data is first played forward to convert the ground time data and then reversed to restore the chronological order of the spacecraft data. This special treatment of command playback analog data allows it to be placed in the same format as real time analog data so that the buffer tape format is the same for both types of data.

TABLE 5-1

COMPARISON OF TAPE SPEEDS FOR PCM DATA

Type of Data	Tape Speeds (inches per second)	
	Analog Recording (Maximum)	Conversion Playback
1-Kilobit Real Time Data	3 3/4	30
8-Kilobit Real Time Data	3 3/4	30
64-Kilobit Real Time Data	30	30
64-Kilobit Command Playback Data	30	30

5.5. 3 Synchronization Cycle

In the spacecraft a clock pulse signal and a data signal are applied to the encoder which modulates the carrier. Examples of waveforms for these signals are given in Figure 5-23. The ground station receives and demodulates the transmitted carrier to produce a raw information signal. The raw signal is presented to the ground-station conditioner which produces a clock signal and a conditioned data signal. The raw signal, the clock signal, and the conditioned signal are each recorded on separate tracks of the station analog tape.

Depending on the results of the analog tape evaluation, either the raw signal or the conditioned signal is chosen for conversion. If the raw signal is to be converted, this signal is applied to a signal conditioner which produces a clock signal and a conditioned signal which, in turn, are applied to the processor of the conversion equipment (Figure 5-15). If the conditioned signal is to be converted, the conditioned signal and the clock signal are applied directly to the processor of the conversion equipment. In either case, the clock signal must be shifted 90 degrees with respect to the data signal in order to obtain optimum conditions for detecting the data bit level in the processor. The processor operates in a search mode seeking proper frame synchronization and will not pass data to the buffer until such synchronization is obtained.

After bit synchronization is established, the processor operates in a search mode reading binary ones and zeros from main frame data until the synchronization words are recognized. When these words have fewer than n bit errors and are recognized for m successive frames, frame synchronization is established, and the processor shifts to operation in the frame synchronization mode. In this mode, which is the normal mode of operation, the processor passes data frames to the buffer. Eight frames per record are passed, each beginning with frame word one. Should the synchronization word bit errors momentarily increase above n, the processor will not revert to the search mode until this increase has persisted for m successive frames. This flywheel effect lessens the number of changes of mode due to momentary degradations of data and, hence, lessens the number of gaps in data recorded on the buffer tape.

After frame synchronization is established, the processor searches for subcommutator synchronization by examining main frame word 65. When the processor recognizes subcommutator word 1 in main frame word 65, it establishes subcommutator synchronization and ceases to pass spacecraft data to the buffer for the remainder of the record in

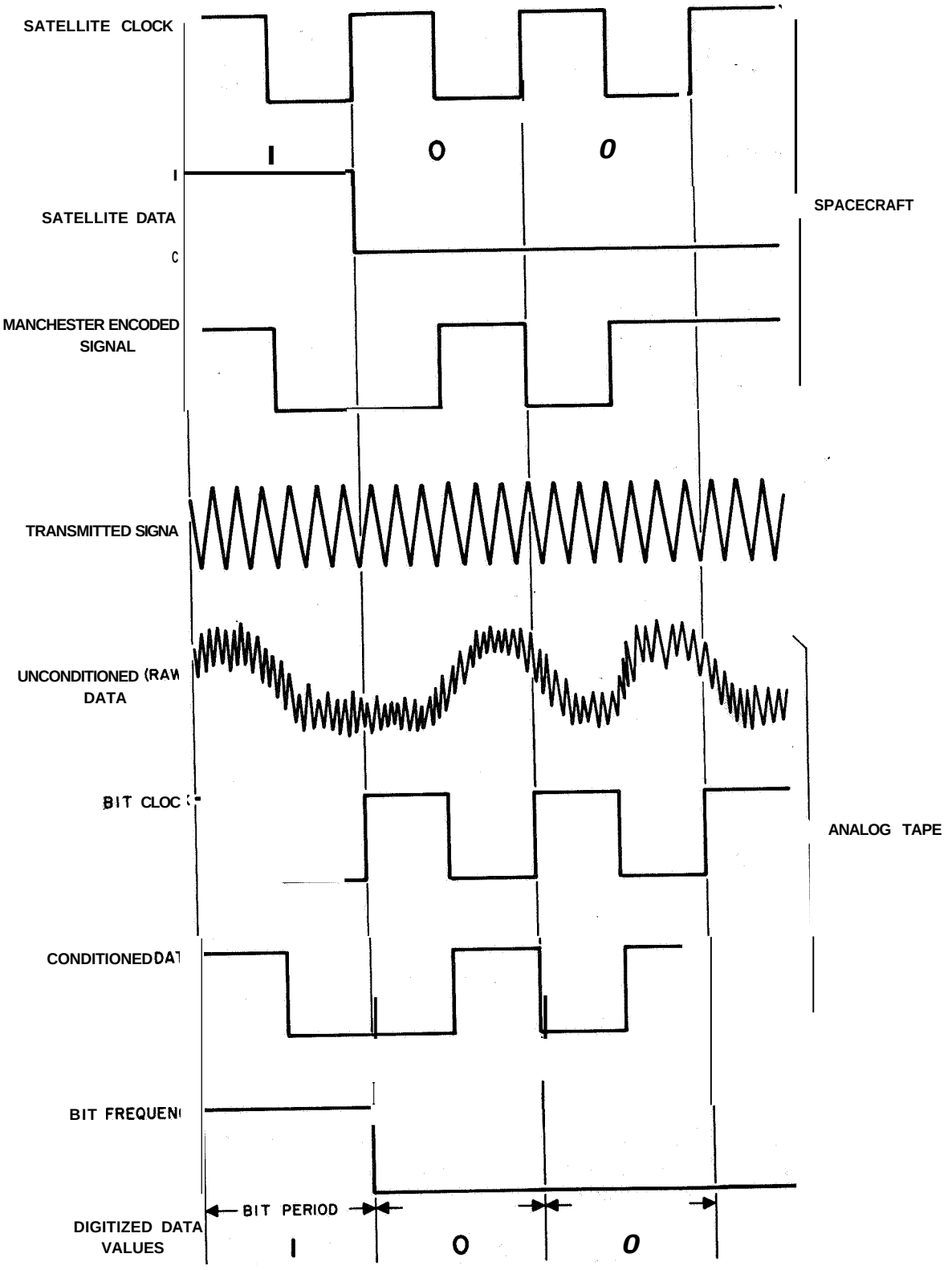

Figure 5-23. Waveforms Involved in Synchronization

which the recognition occurred. For the remainder of the record, the processor passes fill data. With the next record, the processor again passes spacecraft data to the buffer. This data begins with the first frame of the subcommutator sequence. The first record contains subcommutator frames zero through 7 (which contain subcommutator words zero through 7), and the second record, frames 8 through 15, and so on.

5.5.4 Buffer Tape Format

The buffer tape format for the OGO-A consists of a tape identification record, a file identification record, approximately 6000 data records, and an end of file. The buffer tape data are recorded at 556 bits per inch, and written on the tape in binary characters of six bits plus parity in a 1, 2, 4, 8, A, B, P configuration. The format of the buffer tape is shown in Figure 5-24.

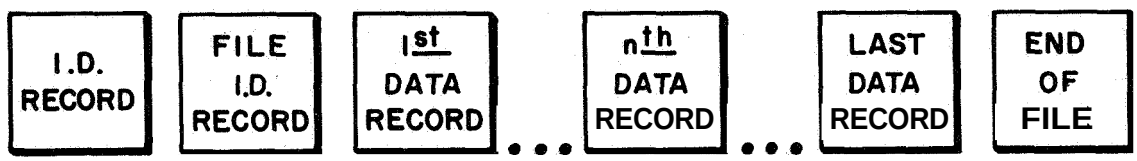

Figure 5-24. OGO Buffer Tape Format

The first record, the tape identification record, consists of 18 binary coded decimal characters. having odd parity and arranged in the following format:

Character	Information
1 - 4	Buffer Tape Number
5 - 6	Year of Digitization (e. g., 64)
7 - 9	Day of Digitization (e. g., Feb. 2 = 033.)
10 - 11	A/D Operator Identification (0-99 Insert 99 if missing)
12 - 13	A/D Line Used. (Insert 00 if missing)
14 - 18	(Unused)

The second record, the file identification record, also consists of 18 binary coded decimal characters having odd parity and arranged in the following format:

Character	Information
1 - 5	Satellite Identification (e. g. , 64 021.)
6 - 7	Year of Recording
8 - 10	Station Number
11 - 14	Analog Tape Number
15 - 16	Analog File Number
	(Unused) BUFFER FILE B

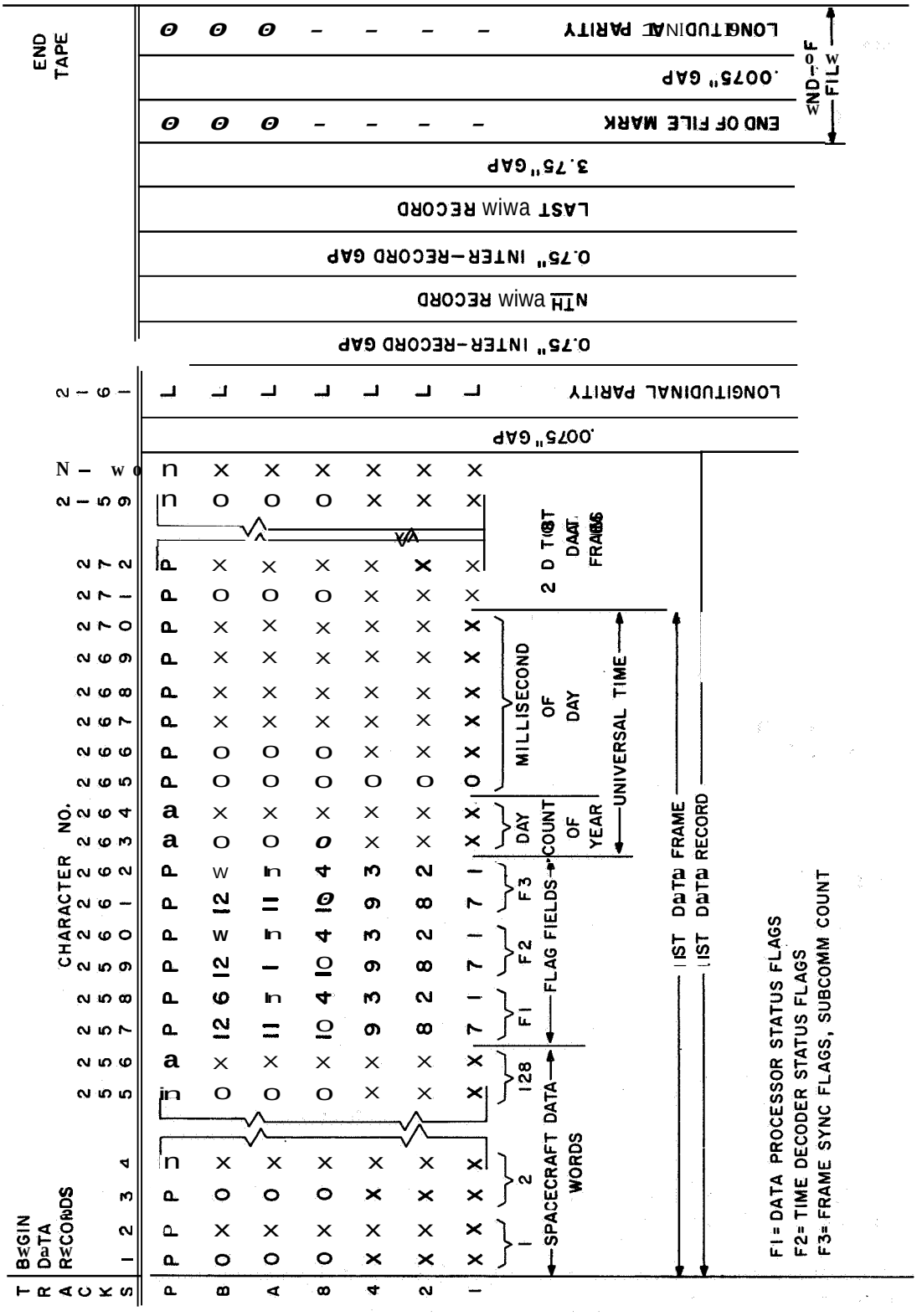

Figure 5 25. Format of Buffer Tape Data Record

day of the year, and 6 six-bit characters for the time of day in milliseconds. This makes a total of 270 characters per frame. Since each data record contains 8 frames, there are 2160 six-bit characters per record.

The following comprise a summary which points out particulars of the frames and records of the buffer tape: A data frame of the buffer tape begins with spacecraft main frame words 1, 2, 3, and 4 and ends with word 126, 127, and 128. Main frame words 1, 2, and 3 contain the 27 bits of frame synchronization words. In the F 1 status field of the buffer tape data frame, the flag bits are recorded as a binary zero, if the processor cannot hold frame synchronization. Flag bits are recorded as a binary one, if the processor is locked to frame synchronization. The significance of flags in the F 2 status field is given in Table 5-2.

The content of the F 3 status field is as follows:

Bits	Representation
1 - 7	Subcomm count (0 - 127)
8 - 11	Frame sync bit error count (15)
12	Subcomm sync flag

P	(Parity)
B	O
A	1
8	0
4	0
2	0
1	0

Time is associated with the last bit of channel 128. Time is present for real time data in all three bit rates. It is not present in this field with command playback data.

5.5.5 OGO-A Processing Schedule

For the first two weeks after launch, data are processed by the conversion lines as they are received, and selected buffer tapes are further processed for quick look. After this initial period, data are processed in chronological order. The time correction curve is established when sufficient data have been accumulated. Preparation of the curve requires about two weeks. During this two-week period, the Universal Time associated

with command playback data is made accurate. After the initial two-week period, all processed tapes are reprocessed to include accurate time corrections. From then on all tapes are processed regularly and arranged chronologically. Tapes decommutated from the time corrected data are shipped to experimenters on a routine basis.

TABLE 5-2

SIGNIFICANCE OF FLAGS IN THE F2 STATUS FIELD

Bit	Digit	Representation
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 SD 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 the 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.
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 the 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	1	BCD to binary converter is in error. The experimenter should not have confidence in this time.
12	0 or 1	Not used at present.

and, since this arrangement does not lend itself to ready correlation, the table must first be established to provide the necessary correlation. This table is established in the time correction program from real time data and works equally well on either real time or command playback data, since both contain time information from the same spacecraft clock. After the time correction table has been established for the period contained in the run, buffer data are processed by the quality control program. Here the data are checked for errors, reformatted, and corrected to reflect the universal time of recording in the spacecraft, The computer determines whether the quality of the data has deteriorated, and, if it has, whether the source of the deterioration is in the spacecraft, in the ground station recording, or in the conversion operation. It verifies the buffer tape format by checking multiple labels in a file, record lengths, and frame lengths.

Additional checks are made which involve the form of the data. The synchronization word is checked for bit errors, the subcommutator count is checked for proper sequencing, and data words are checked to ensure that the first three bits of the 12-bit field are zero. A representative sampling of analog channels are checked to ensure that the first bit of the 9-bit field is zero. Additional checks are made of certain channels in the data frame which maintain at a nearly constant level.

The computer accepts the 8-frame buffer data records and reformats them into 128-frame edit records. It adds a special frame to the 128 data frames so that the edit record actually carries a total of 129 frames. Label records, however, are carried over from the buffer format to the edit format intact.

With the time conversion routine, the computer looks in the time correction table for corrected universal times and inserts them in the universal time fields of the master binary edit tape. The output from the quality control program is the master binary edit tape, which is the input to the decommutation program as well as the input to subsidiary off-line programs which printout selected raw data requested by experimenters and engineers. After the decommutation program stores satellite data in memory, a record at a time, it selects data chronologically from each experiment and writes them on separate decommutation tapes.

6.2 DIGITAL DATA ACCOUNTING

The Digital Data Accounting Office performs the function of a central clearing house and storage agency for all converted magnetic tapes, printouts, and cards used or produced in the Data Processing Branch. Its record room, which is sometimes referred to as the dispatching office, is located adjacent to the computer rooms and is connected to them by windows through which tapes, etc. are passed to and from the computers. Final storage of digital tape is at the Goddard Space Flight Center tape storage area.

Following are the general functions of the Digital Data Accounting Office. All incoming tapes, cards, and documents are received and logged. A punched card is maintained for each file of data entered in the tape library. The card file is updated by entering the date of each step of the processing. Data tapes, cards, and programs are dispatched for processing and retrieved after processing. In addition to operating electronic accounting machines, new tapes and computer supplies are stocked. Decommutated tapes are shipped to the experimenters. Weekly reports are also prepared which provide quantitative information such as the number of processed tapes on hand, the number of data files processed, the number of tapes shipped, etc.

The general flow of digital tapes into and out of the Digital Data Accounting Office is illustrated in Figure 6-2. The flow is voluminous and complicated. Control of the flow

requires that careful and accurate records be maintained at each step of the processing operation. How this flow proceeds during each step of the digital data operation is described in the paragraphs which follow.

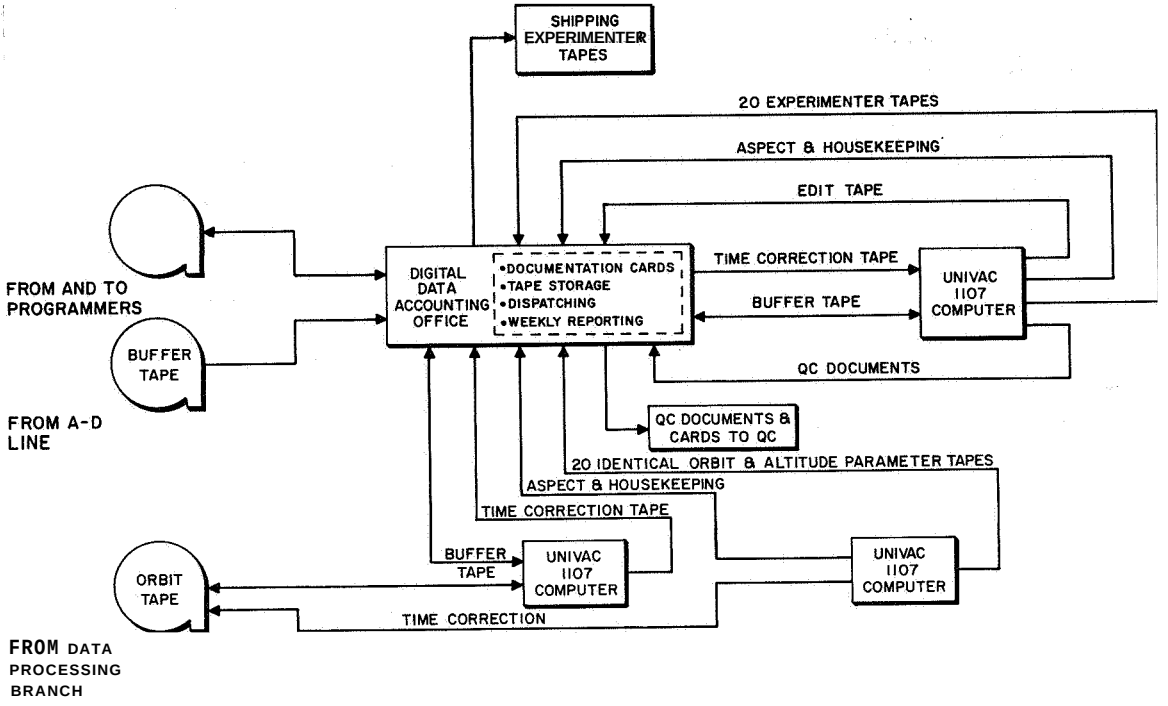

Figure 6-2. Digital Tape Flow Chart

6.2.1 Receipt of the Buffer Tapes

The conversion line operator submits buffer tapes, together with one completed copy of the Analog to Digital Processing Log form (Figure **5-17**) for each tape, to the dispatcher in the Digital Data Accounting Office. He also sends duplicate copies of the forms to the Production Control Center. The Production Control Center then schedules edit runs and requests the dispatcher to supply the required tapes and logs to the computer room at the prescribed time. The dispatcher, upon receipt of the tapes and logs, makes an entry for each tape in the buffer tape log book (Figure **6-3**).

6.2.2 Edit Run

Prior to release of the tapes and logs to the computer room, the dispatcher makes an entry in the buffer tape log for each tape released. After processing an edit tape, the buffer tapes and analog to digital processing logs are returned to the digital data accounting office by the computer operator along with the following edit output: the edit tape, three copies of the edit listing, and three copies of the elapsed time report. Machine produced edit cards (Figure **6-4**) for each file on the edit tape, and a keypunch instruction sheet (Figure **6-5**).

The dispatcher notes in the buffer tape log book the date the buffer tapes were processed, retains one copy of the analog to digital conversion log, and then distributes the edit output as follows: Buffer and edit tapes to the digital data tape storage area. One copy of the edit listing, one copy of the elapsed time report, and one copy of the analog to digital conversion log to data inspection. One copy of the edit listing and elapsed time

DATA PROCESSING BRANCH
PRODUCTION LOG

SATELLITE _____ SYSTEM _____ DATE _____

INPUT

TELEMENTRY ACPU. DATA

Station _____ No, _____
Date Recorded _____ Telementry Format _____
Tape No, _____ Satellite Format _____
Pass No. _____ Bit Rate _____
Tape Speed – 1 7/8 3 3/4 7 1/2 15 30 60 120

TIME INFORMATION

Start _____ : _____ : _____
Stop _____ : _____ : _____
Elapsed _____ : _____ : _____

ANALOG MEDIA

Film No. _____ Size _____
Strip Chart No. _____ Speed _____
Graph No. _____ Size _____
Photo No, _____ Size _____
Other _____

DIGITAL MEDIA

Punched Paper Tape No. _____
Card Type _____ File No. _____
Magnetic Tape No, _____ File No, _____
Other _____

OUTPUT

ANALOG MEDIA

Film No. _____ Size _____
Strip Chart No, _____ Speed _____
Graph No, _____ Size _____
Photo No, _____ Size _____
Other _____

DIGITAL MEDIA

Punched Paper Tape _____
Cord Type _____ File No. _____
Magnetic Tape No, _____ File No, _____
Tope Serial No. _____
Other _____

DUPLICATION MEDIA

Film – No. Copies _____
Strip Chart – No. Copies _____
Graph – No. Copies _____
Photo – NO. Copies _____
Tope No. Copies _____

TIME INFORMATION

Start _____ : _____ : _____
Stop _____ : _____ : _____
Elapsed _____ : _____ : _____

OPERATION RECORD

REPRODUCE TRANSPORT

A Tape Tronspori Speed–1 7/8 3 3/4 7 1/2 15 30 60 120 I.P.S.
B. Servo Control–Prec. Freq. ☐ Line ☐ Cotl Track ☐ Other ☐
C Servo Performance–Excellent ☐ Good ☐ Fair ☐ Poor ☐

TELEMENTRY PROCESSING SYSTEM

A. Sync Source–Rec. Age ☐ C.F. Age ☐ Telementry Sip. ☐ Other ☐
B, Sync Counter– In _____ Out _____
C Sync Performance–Excellent ☐ Goad ☐ Foir ☐ Poor ☐
D. Telementry Signal Quality–Excellent ☐ Good ☐ Foir ☐ Poor ☐
E. Discriminator Used–210 ☐ 97 ☐ 189 ☐ Other _____
F. Tape Speed Compensation in Use? Yes ☐ No ☐
G System Calibrated Prior to this Run? Yes ☐ No ☐

TIME SYSTEM

A Linearizing Freq. In Use? Yes ☐ No ☐
B. Time Code Used–BCD ☐ SD ☐ BCD&SD ☐ Accum. ☐ None ☐ Other ☐
C. Time Quality–Excotlent ☐ Good ☐ Fair ☐ Poor ☐

COMPUTER SYSTEM

A Tape Density–High ☐ Low ☐ Other _____
B. I.D. Error–Yes ☐ No ☐
C Tape Parity Errors–Yes ☐ No ☐ Est. No. _____
D. Block Lenpth–Standard ☐ Other _____
E Record Length–Standord ☐ Other _____
F. Output Tope Unit–729 ☐ 906 ☐ Other _____

OPERATORCOMMENT

OPERATOR _____ CODE _____

560-4 (11/64)

Figure **6-3.** Buffer Tape Log Form

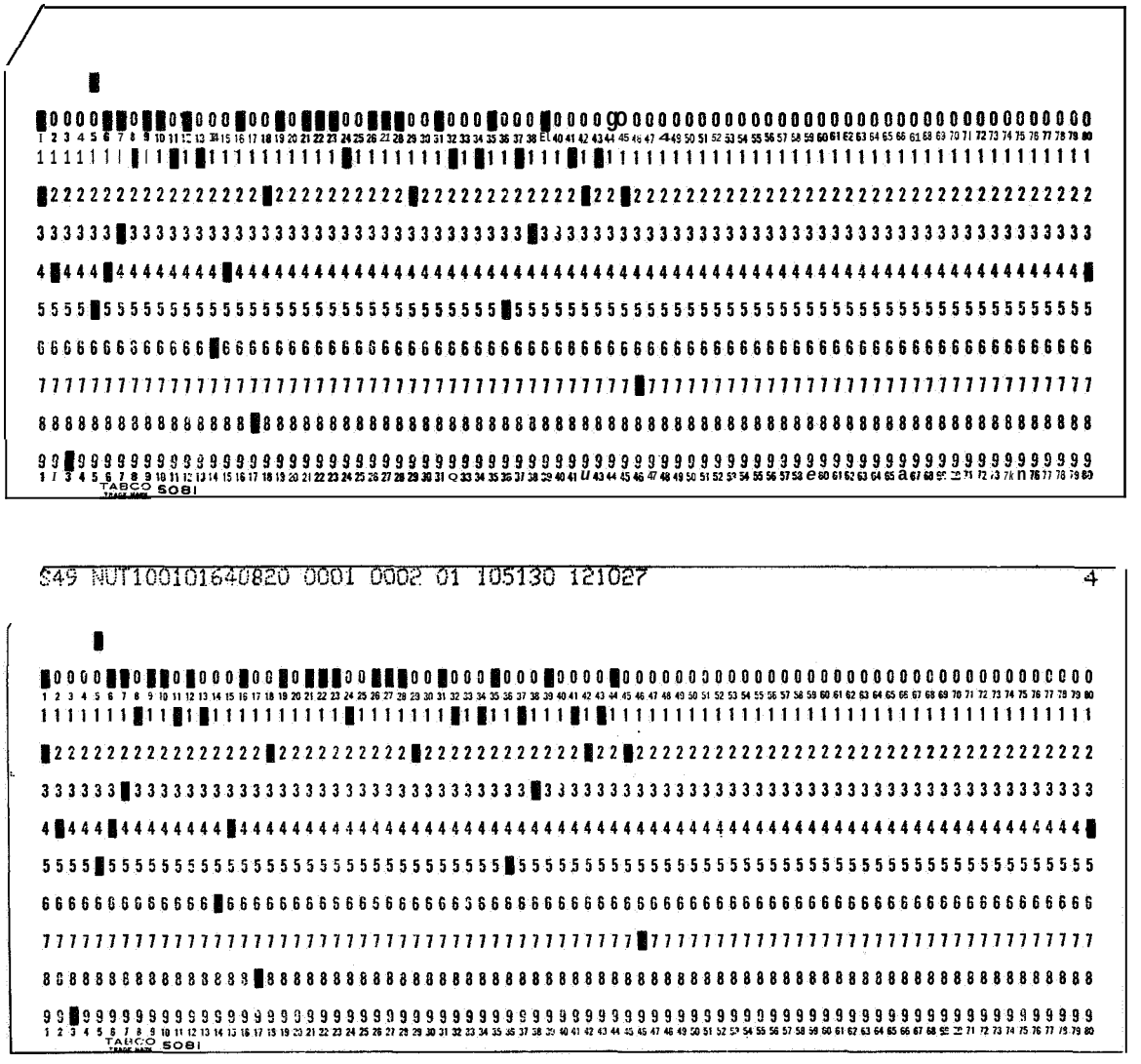

Figure 6-4. Machine Produced Edit Card and Keypunch Copy with Printed Line Added

report to the data controller. The keypunch instruction sheet and machine-produced edit cards for updating to the electronic accounting machine. One copy of the edit listing and one copy of the elapsed time report to the Production Control Center.

Upon receiving the third copy of the elapsed time report for an edit, the data controller in the Production Control Center notes on a weekly elapsed time of edit tapes processed form (Figure **6-6)** the number of the edit and the elapsed time. The copy of the edit listing remains on file in the Digital Data Accounting Office.

When the electronic accounting machine operators receive the machine-produced edit cards and the key punch instruction sheet, they process the cards in the following manner: Update the machine edit cards from the information shown on the keypunch instruction sheet; that is, enter the edit tape number, the orbit number, the sequence number of the file on each card, the buffer tape number and the dates converted and edited. Verify the updated cards and list them on the **IBM** Printer.

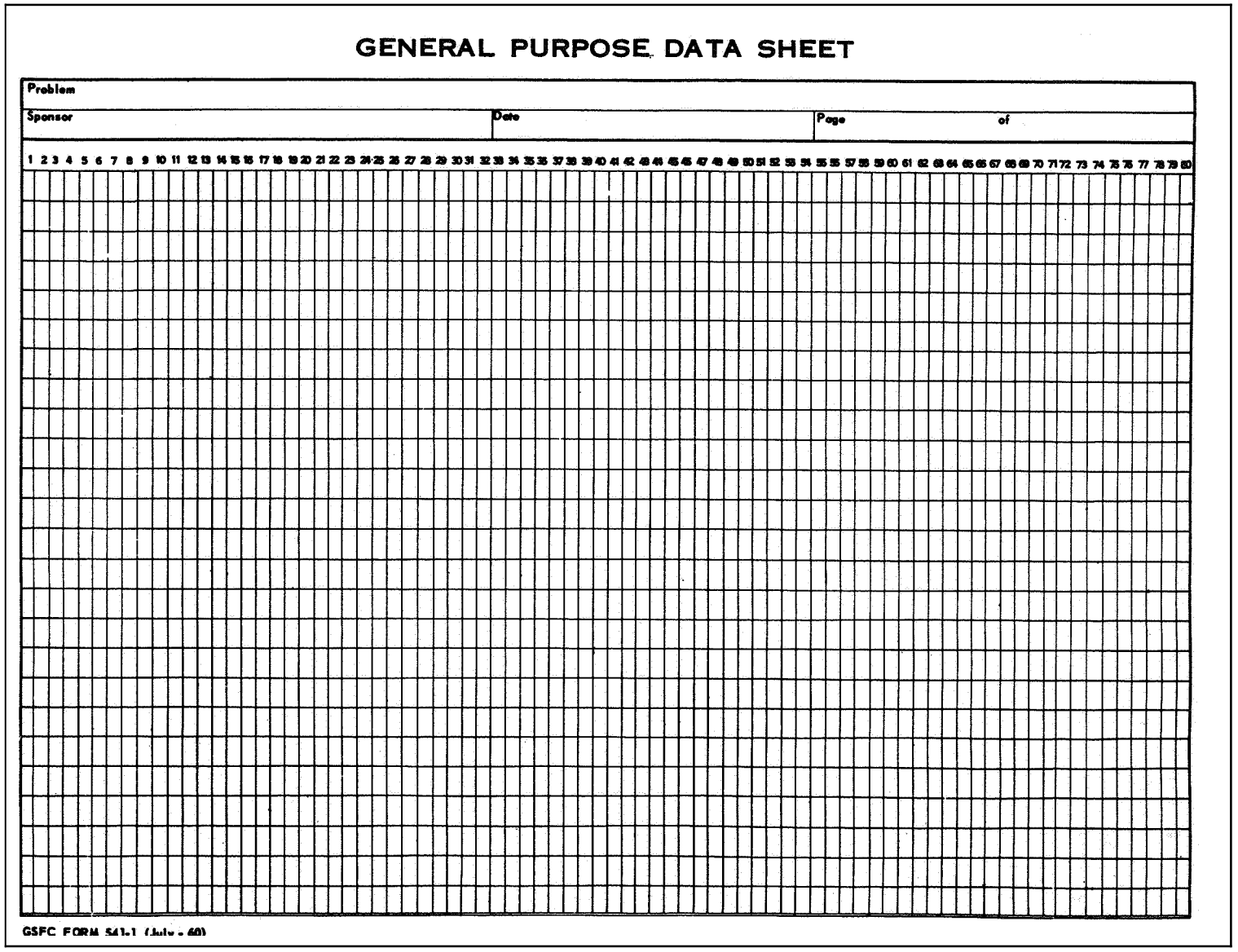

Figure 6 5. Keypunch Instruction Sheet

WEEKLY ELAPSED TIME RECORD OF EDIT TAPES PROCESSED

SATELLITE _____ WEEK ENDING _____

NUMBER	EDITED			DECOMMUTATED			DELETED			RELEASED		
	HRS	MIN	SEC	HRS	MIN	SEC	HRS	MIN	SEC	HRS	MIN	SEC
TOTAL TIMES												

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Figure 6-6. Weekly Elapsed Time Record of Edit Tapes Processed

The electronic accounting machine operator returns the two listings, the updated edit cards (Figure 6-7) and keypunch instruction sheet to the data controller. The data controller reviews the listings for any possible editing discrepancies or keypunch errors before returning these items to the dispatcher. The dispatcher then: Files the updated edit cards in a suspense file maintained in the Digital Data Accounting Office. Retains the keypunch instruction sheet for future reference. Sends the listing of the updated edit cards to the Production Control Center.

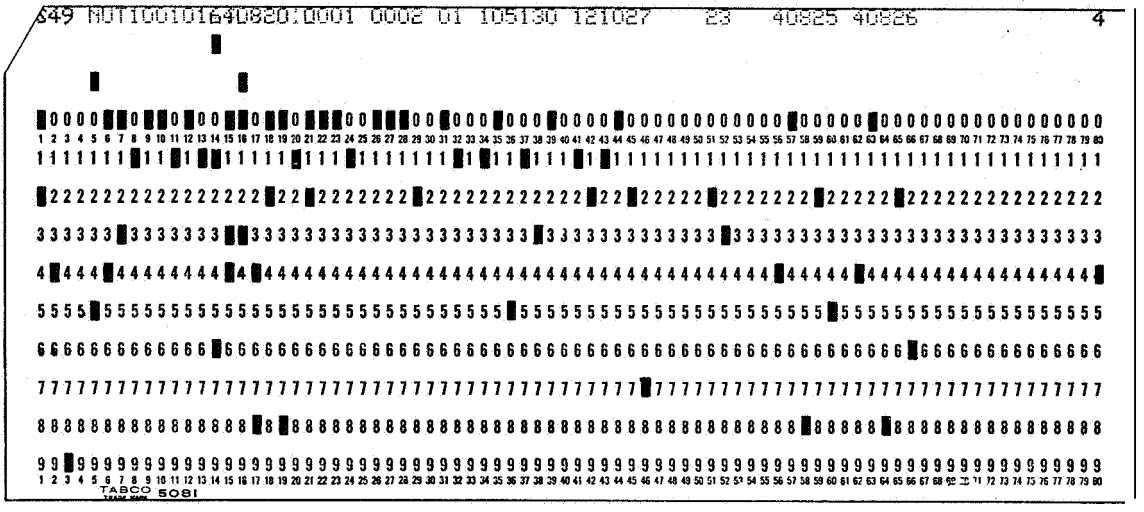

Figure 6-7. Updated Edit Card Through the Edit Field

6.2.3 Preparation for Decommutation of Edit Tapes

The data inspection group certifies the edit files for decommutation or rejects the edit files on the basis of established quality standards. One copy of the edit release form (Figure 6-8) certified or rejected by data inspection is sent to the Production Control Center. The Production Control Center will then inform the Digital Data Accounting Office of the file rejected and schedule the files for reprocessing on the conversion lines as required. The Production Control Center will also schedule the decommutation runs and request the dispatcher to supply the required edit tapes to the computer room at the prescribed time. The edit card for those data files deleted are marked deleted by the dispatcher. The dispatcher files the edit cards in the suspense file until the weekly updating of the master accounting tapes is performed.

6.2.4 After Decommutation

After the decommutation process, the computer operators return the edit tapes along with the following decommutation output to the Data Accounting Office: Decommutation tapes for each designated experimenter, and a decommutation printout for each decommutation tape. An elapsed time report, and an experimenter documentation card. Upon receiving the decommutation output, the dispatcher then proceeds as follows: Returns the edit tape together with the decommutation tapes to the digital tape storage area where the edit tape is filed according to project and retained indefinitely. (The decommutation tapes are filed temporarily in the experiment tape shipping area pending release by the data inspection group.) Inserts the decommutation printout in envelopes addressed to each experimenter and forwards the printouts to the data inspection group. Sends the elapsed time record to the Production Control Center. Updates and lists the experimenter documentation cards and retains them for updating the master accounting tape files.

EDIT RELEASE FORM

Project	Date	Edit No.	File No.	ID of Rejected File	Start Time	Reason for Rejection	Date Ship'd	Remarks

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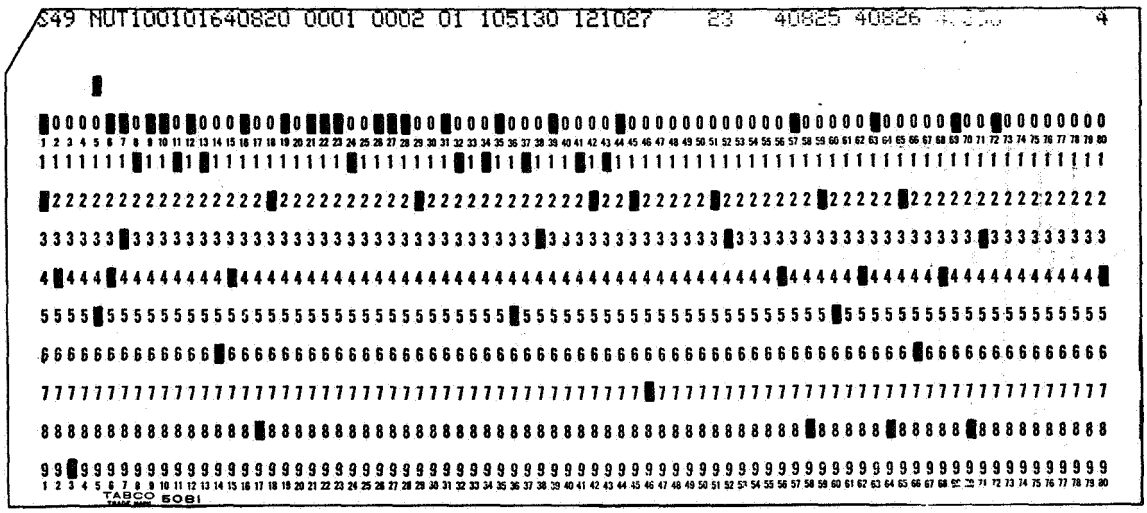


Figure 6-9. Updated Edit Card Through the Decommutation Field

The dispatcher then removes the edit cards from the master file for further updating. (The decommutation data is punched in each edit card as shown in Figure 6-9 except for these cards which may have been previously noted by the dispatcher as being deleted from decommutation as shown in Figure 6-10.) The edit cards are returned to the suspense file where they remain until the weekly updating of the master file tape.

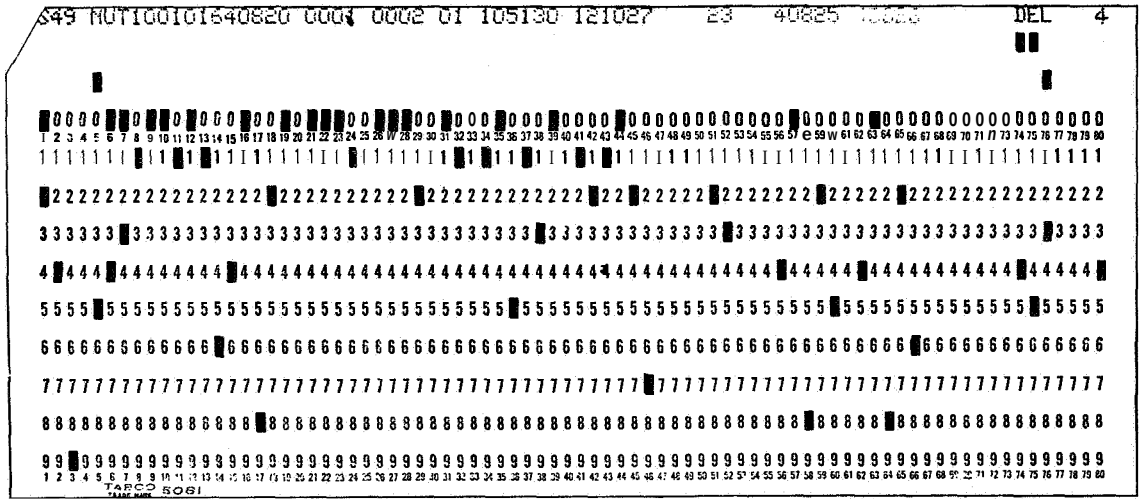


Figure 6-10. Deleted File Edit Card

When the data inspection group releases the decommutation tapes for shipment to the experimenters, a report is submitted to the Production Control Center. A copy of the report is forwarded from the Production Control Center to the Digital Data Accounting Office along with the schedule for shipping the tapes. The edit cards are removed from the master edit card file and the shipping data are entered in the cards, as shown in Figure 6-11.

The edit cards are then used to make up three copies of a shipping letter (Figure 6-12) which gives each file on the decommutation tapes. (One copy of the shipping letter is retained by the experimenter, one copy is receipted and returned to the Digital Data

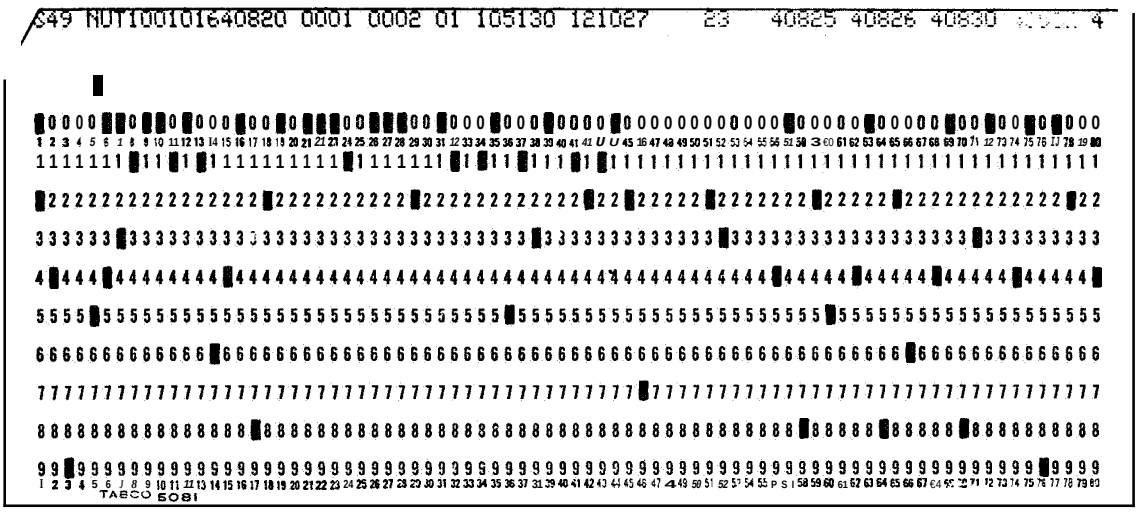


Figure 6-11. Updated Edit Card Through the Released Field

Accounting Office and the third copy is sent to the Production Control Center upon shipment of the tapes. The dispatcher then gives the decommutation output and shipping letter to the Tech Aid with instructions to ship the tapes to the proper experimenters.

The Tech Aid prepares the tape for shipment in the following manner: Prepares receipt for magnetic tapes (Figure **6-13)** in duplicate for each of the tapes to be shipped. When the tapes are picked up for delivery, the driver signs the tape inventory receipts. One copy of the receipt is taken by the driver for the signature of the person receiving the tapes and is returned to the Digital Data Accounting Office. The other copy is retained by the Digital Data Accounting Office for updating the inventory card file and is later destroyed when the signed copy is returned by the driver. Next the tapes are placed in boxes along with the decommutation printouts, shipping letters, and preaddressed franked envelopes. After addressing the boxes to each experimenter, the dispatcher is notified that the tapes are ready for shipment. The decommutated tapes are then shipped to the experimenter. When the signed copies of the shipping letters are returned they are filed in the proper file and retained indefinitely. After shipment of experimenter decommutation tapes, the buffer tapes, from which they were made, are erased for reuse.

6.2.5 Activities for Quick Look Requests

A quick look buffer tape and analog to digital conversion log are submitted to the dispatcher. The tape is logged in the buffer tape log book and sent to the proper computer area. When completed, the tape and the analog to digital conversion log are returned to the dispatcher along with the quick look printout. The tape is logged out and retained for several days in the Digital Data Accounting Office and then erased. The analog to digital conversion log is filed in the proper file and retained indefinitely while the printout is sent to bursting and binding. When the printouts are released from bursting and binding, they are forwarded to the Production Control Center.

6.2.6 Activities for Test Tapes

The conversion lines submit test tapes to the dispatcher accompanied by a request for technitrol printer operation (Figure **6-14).** However, in some instances the test tapes are run against certain programs on the IBM computers. In such instances a standard request for computer operation form (Figure **6-15),** is used to dispatch the tape

PLEASE ACKNOWLEDGE RECEIPT OF THE FOLLOWING AND

DIGITAL DATA ACCOUNTING OFFICE
DIGITAL DATA CONTROLLER
NASA GODDARD SPACE FLIGHT CENTER
CODE 545
GREENBELT,MD. (20771)

1

OGO EXPERIMENTER DATA TAPES

STA	TAPE	FILE	RECORDED YR	MO	DY	PASS	EDIT TAPE	EDIT FILE	START HR	MN	SC	DECOM RUN	EXP 1	EXP 2	EXP 3	EXP 4	EXP 5	EXP 6	EXP 7	EXP 8	EXP 9	EXP 10
ROS	010	01	64	08	01		2301	01	15	53	35	05	10 01	10 01	10 01	10 00	10 01	10 01	10 01	10 01	10 01	10 01
ROS	010	02	64	08	01		2302	01	15	59	01	05	10 02	10 02	10 02	10 00	10 02	10 02	10 02	10 02	10 02	10 02
ROS	010	03	64	08	01		2303	01	16	02	19	05	10 03	10 03	10 03	10 00	10 03	10 03	10 03	10 03	20 01	10 03
ROS	010	04	64	08	01		2304	01	16	16	47	05	10 04	10 04	10 04	10 00	10 04	10 04	10 04	10 04	20 02	10 04
ROS	010	04	64	08	01		2305	01	18	12	03	05	10 05	20 01	10 05	10 00	10 05	10 05	10 05	10 05	30 01	10 05
ROS	010	05	64	08	01		2306	01	18	21	18	05	20 01	20 02	10 06	10 00	20 01	10 06	20 01	10 06	30 02	20 01
ROS	010	06	64	08	01		2307	01	18	34	49	05	20 02	20 03	10 07	10 00	20 02	20 01	20 02	20 01	40 01	20 02

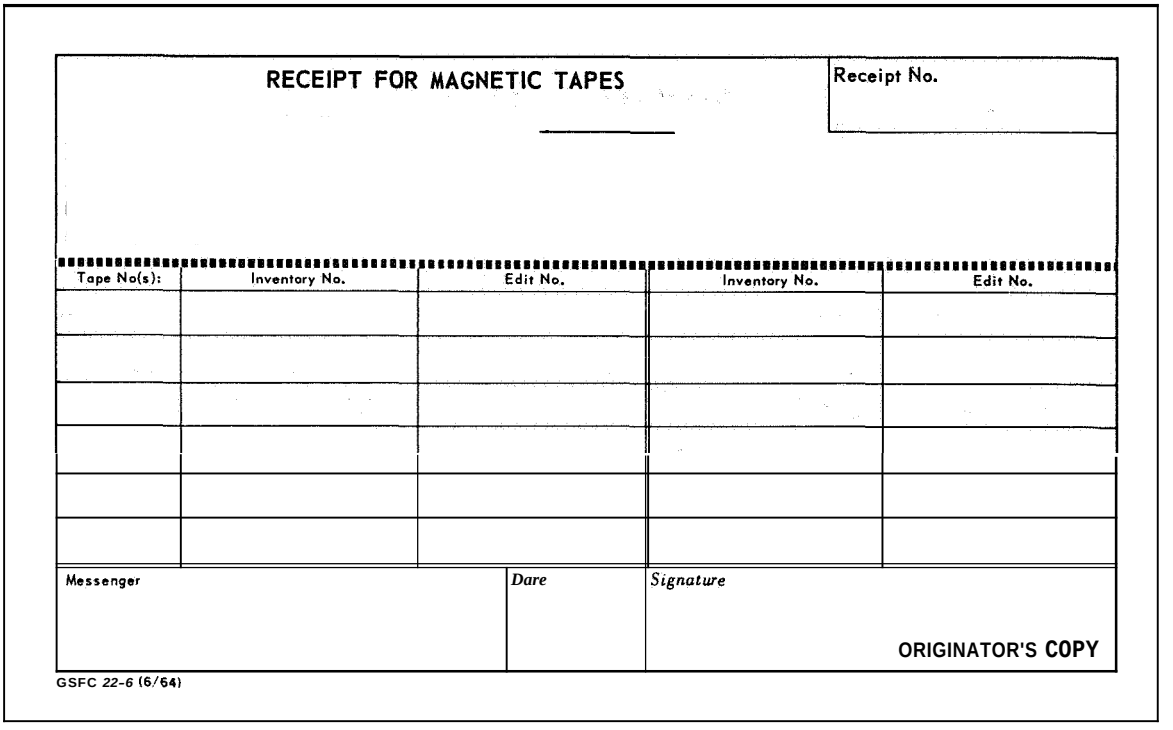
X

NO OF FILES 7

DATE RECEIVED

SIGNATURE

Figure 6-12. Shipping Letter Sent to Experimenters



RECEIPT FOR MAGNETIC TAPES

Receipt No.

Tape No(s):	Inventory No.	Edit No.	Inventory No.	Edit No.

Messenger	Dare	Signature
		ORIGINATOR'S COPY

GSFC 22-6 (6/64)

Figure 6-13. Receipt for Magnetic Tapes

to the computer room. In either case, after the test tapes are processed and returned, the tapes and printouts are returned to the conversion lines.

6.2.7 Activities for Programmer Requests

The programmer may submit to the dispatcher programs for processing on any of the computers. When the submitted program is to be processed on the Univac 1107, the programmer submits a tape setup card (Figure 6-16) and a Univac 1107 setup card (Figure 6-17). Table 6-1 lists the symbols used in computer operation requests.

Upon receiving the program and setup cards, the dispatcher clocks the program in on a prenumbered job order card (Figure 6-18), and makes an entry in the incoming programs log record form (Figure 6-19). The program is then sent to the computer and is processed according to an established priority schedule. When returned to the dispatcher, the program setup cards and output are inspected to determine that the request is complete. The program is then logged out and held until picked up by the programmers.

When use of either of the IBM computers is desired, the programmers submit their programs and an IBM 1401/7010 computer setup card (Figure 6-20) to the dispatcher. These programs are logged in and sent to the computer area at 8:00 A. M. and at 1:00 P. M. daily. When returned to the dispatcher, the programs are logged out and held until picked up by the programmers. See Figure 6-21 for part of the IBM 1401/7010 Computer Complex.

GODDARD SPACE FLIGHT CENTER

REQUEST FOR TECHNITROL PRINTER OPERATION

NAME	DATE	TELEPHONE NUMBER
LINE	SATELLITE	

1. NUMBER OF FILES TO BE PRINTED OUT

2. FORM IN WHICH TAPE IS WRITTEN
☐ BCD ☐ BINARY

4. DENSITY
☐ LOW ☐ HIGH

5. TYPE OF PRINTOUT
A. SPACING ☐ SINGLE ☐ DOUBLE
B. CHARACTER LINES ☐ 120 ☐ 160

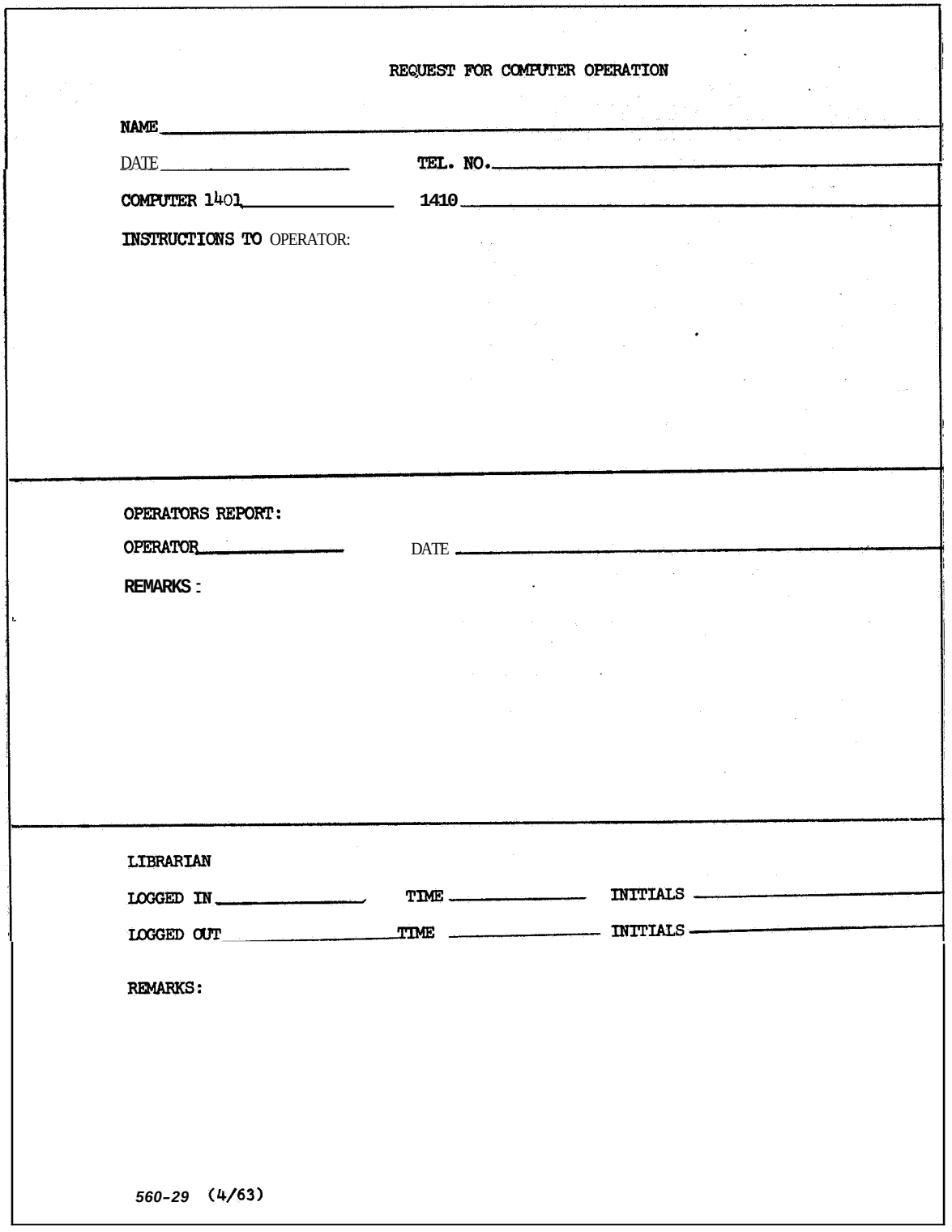
OPERATORS REPORT

LIBRARIAN

LOGGED IN	TIME	INITIALS
LOGGED OUT	TIME	INITIALS

540-40(2/64)

Figure 6-14. Request for Technitrol Printer Operation



REQUEST FOR COMPUTER OPERATION

NAME _____

DATE _____ TEL. NO. _____

COMPUTER 1401 _____ 1410 _____

INSTRUCTIONS TO OPERATOR:

OPERATORS REPORT:

OPERATOR _____ DATE _____

REMARKS :

LIBRARIAN

LOGGED IN _____ TIME _____ INITIALS _____

LOGGED OUT _____ TIME _____ INITIALS _____

REMARKS:

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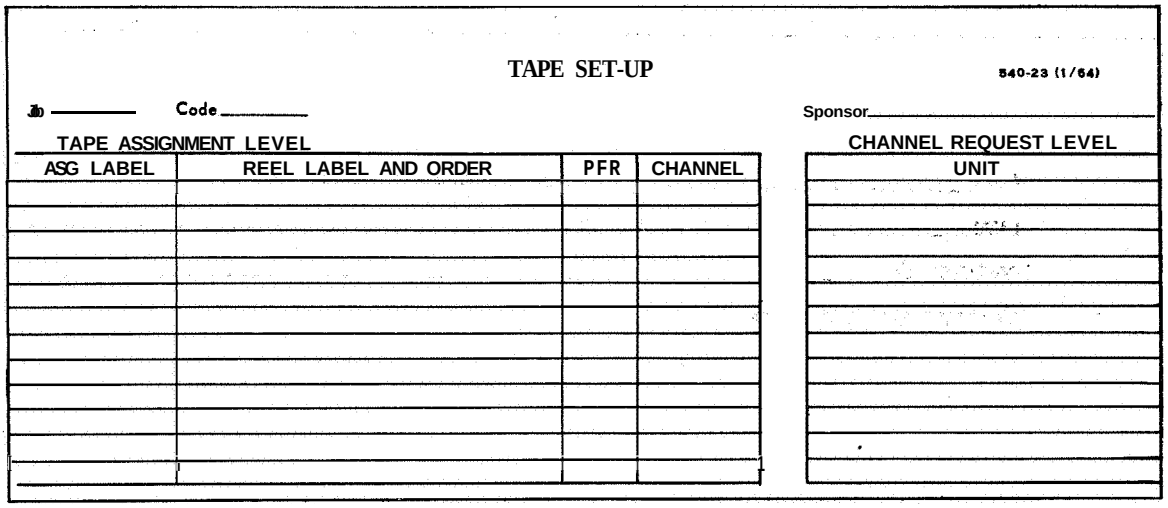
Figure 6-15. Standard Request for Computer Operation



TAPE SET-UP

540-23 (1/64)

Job _____ Code _____ Sponsor _____

TAPE ASSIGNMENT LEVEL				CHANNEL REQUEST LEVEL
ASG LABEL	REEL LABEL AND ORDER	PFR	CHANNEL	UNIT

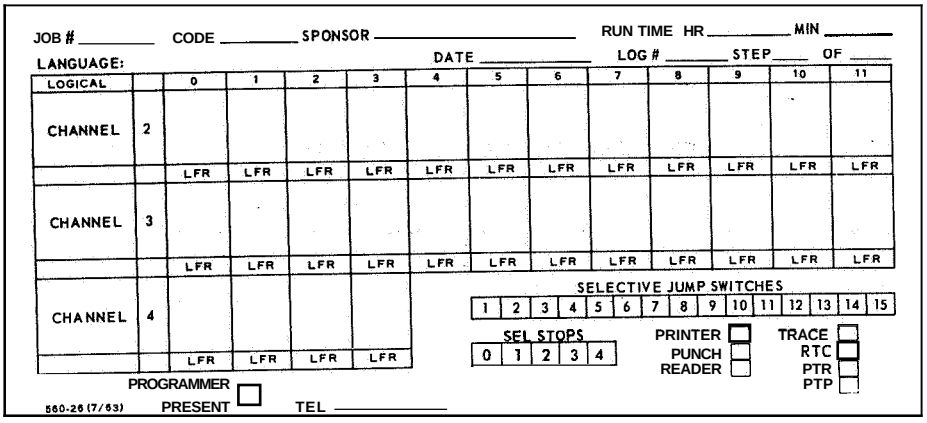
SAME COLUMNS ARE CONTINUED ON BACK SIDE OF CARD.

Figure 6-16. Tape Setup Card

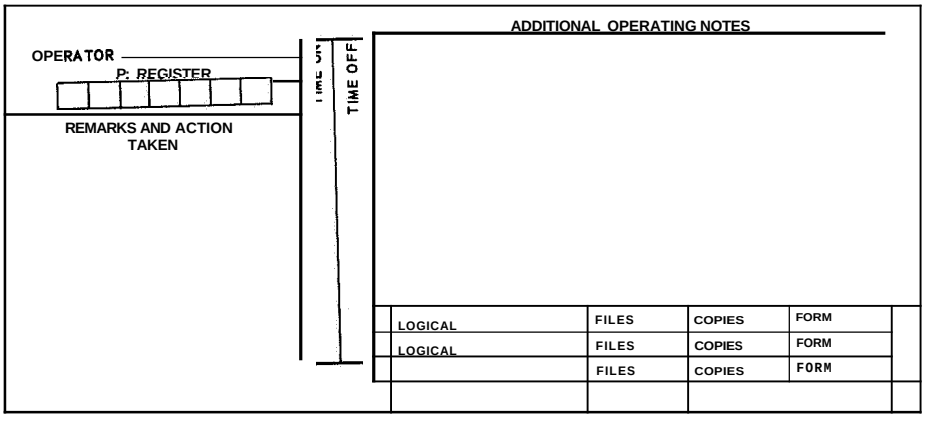
TABLE 6-1

SYMBOLS USED WHEN REQUESTING COMPUTER OPERATION

SYMBOL	SIGNIFICANCE
SL I	Sleuth I
SL 11	Sleuth 11
Fort 11	Fortran 11
COB	Cobol
ALG	Algol
PFR	Print file release (Refers to tape servo unit)
S. J. L.	Selective jump switch
SEL. ST, P.	Selective stop
MASTER CL	Master clear
COMP Cl	Computer clear
RTC	Real time clock
I/OCL	Input/output clear
PRINTER	Printer
TRACE	A hardware debugging aid
READER	Card reader
PUNCH	Card punch
PTR	Paper tape reader
PTP	Paper tape punch
LOC	Location where error occurred



FRONT



BACK

Figure 6–17. Univac 1107 Setup Card

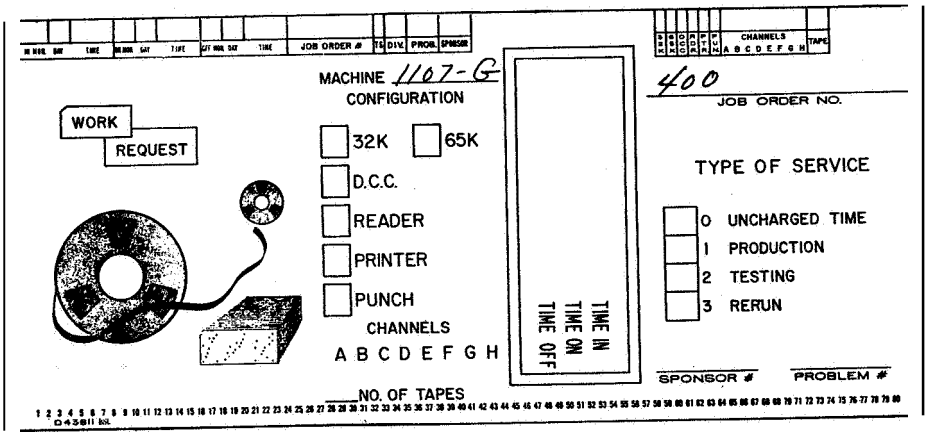


Figure 6–18. Prenumbered Job Order Card

COMPUTER OPERATION - DIGITAL LIBRARY LOG

DATE _____

JOB NUMBER	SPONSOR	SYSTEM	TIME IN	TIME OUT

560-31 (4/63)

Figure 6-19. Incoming Programs Log Record Form

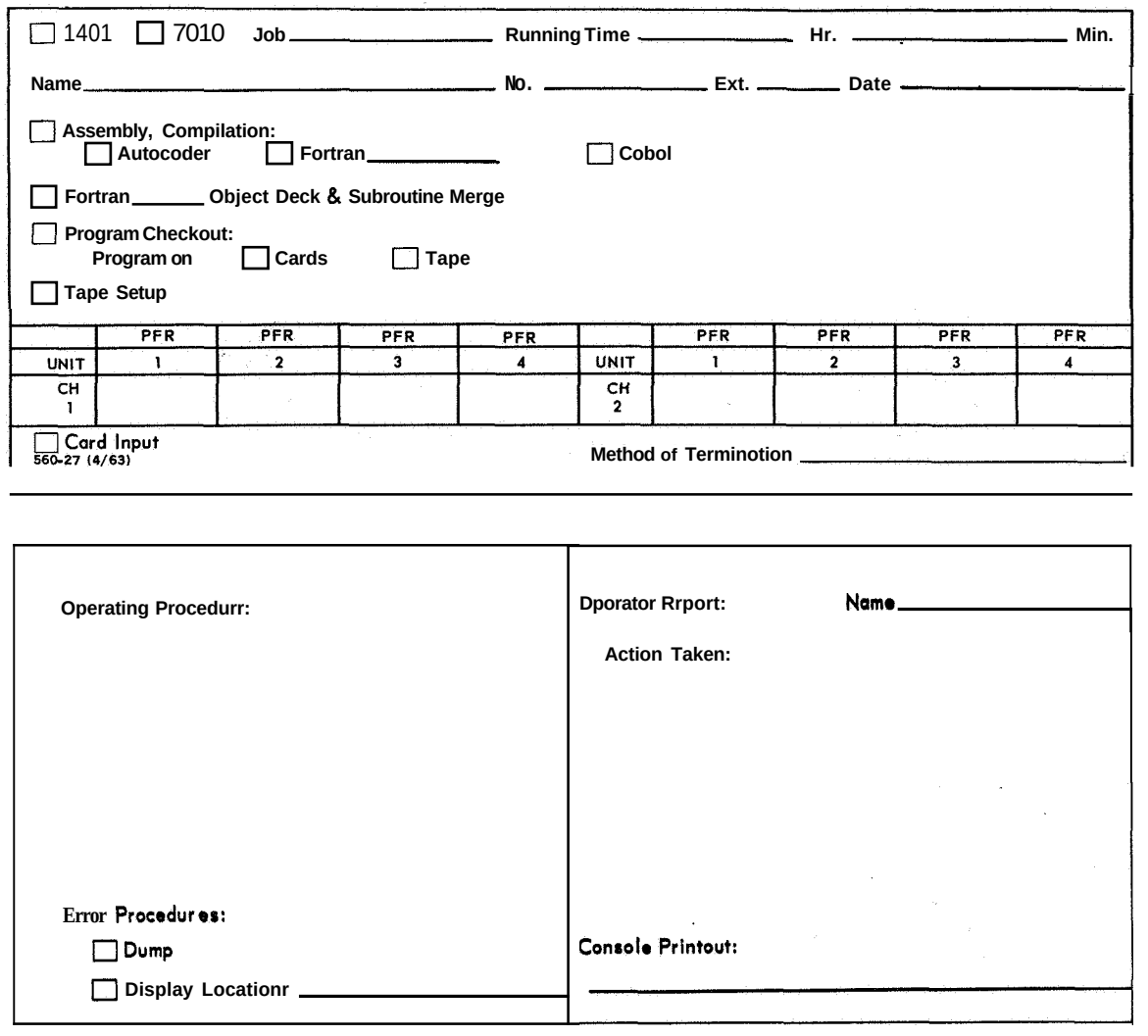


Figure 6-20. IBM 1401/7010 Computer Setup Card

6.2.8 Digital Chronological Listing

A typical page from the combined analog and digital chronological listing report is shown in Figure 5-8. The report is updated weekly and contains all files of data that have been digitized and processed through at least the edit tape processes. The format is that of a digital documentation card in a direct printout.

6.2.9 Satellite Color Codes

Pressure sensitive tapes are color coded by satellite to identify digital tape reels and plastic containers. Each tape is color coded according to its satellite and may be written on with a pencil or pen to further identify the digital tape. The color code is applied universally to all digital tapes at this facility. The color assigned to all OGO-A digital tapes is brown.

Figure 6-21. IBM 1401/7010 Computer System

SECTION 7
FOUR MAJOR INTERMEDIATE PROGRAMS FOR PCM DIGITAL DATA

Approximately forty programs are involved in processing OGO-A data on the Univac 1107 and the IBM 1401 and 7010 computers. Some of these yield end data sought by the experimenters. Others yield data which is intermediate to the total OGO-A processing operation and is not usable by the experimenters, but is, nevertheless, vital to the overall operation. The four major intermediate programs are described in the paragraphs that follow. The programs are (1) buffer tape print, (2) time correction, (3) quality control, and (4) the quick look. The major end data programs are described in Section 8.

7.1 BUFFER TAPE PRINT PROGRAM

The purpose of the buffer tape print program is to obtain, by means of IBM 1401 printouts, selected data from each frame of the buffer tape for examination by the data inspectors so that they may constantly monitor and evaluate the performance of the conversion equipment. Values in the following portions of the buffer tape are of special interest to the data inspectors. The status and time fields. The synchronization word, the spacecraft clock, and subcommutator position number. The equipment group number, the spacecraft telemetry mode number, and the subcornmutated data. In addition, the buffer tape print program causes the number of data records processed to appear in the printout. Also, when a parity error occurs, the computer prints an asterisk next to the last character in the frame in which the error occurs.

Portions of buffer tape printouts from the IBM 1401 computer are given in Figures 7-1 through 7-3. Figure 7-1 shows the first 120 characters, in binary coded decimal digits, of the buffer tape identification record as they were printed in a test run. Figure ?-2 shows the same characters from the file identification record. The last fourteen frames of a subcommutator sequence of a typical data record are given in Figure 7-3.

Since no change in the order of bits as they appear on the buffer tape has been made in the program to cause the computer to print them in a different order, a special interpretation must be placed on the data listed under the S/C IDENT column. Spacecraft data word 65 contains nine bits, but only the seven most significant of these indicate the subcommutator position number. Thus, the first entry, 0441, which is in octal, looks like this in binary notation: 000 100 100 001. The three most significant bits are not used, and the two least significant bits do not apply to the subcommutator position number. The seven remaining bits indicate the subcommutator position number, thus: 1001000. These bits represent subcommutator position 110 in octal or 72 in decimal.

7.2 TIME CORRECTION PROGRAM

Time correction is accomplished in two passes through the computer. (See Figure 7-4). The buffer tape and the orbit tape serve as inputs in the first pass which produces an intermediate tape as an output, The intermediate tape and an initialization card, obtained from the preceding run and containing information from the preceding file, serve as inputs to the second pass which produces as outputs the time-correction table tape and an initialization card for the next run. In the first pass, spacecraft clock readings are taken from the buffer tape and checked for accuracy in a quality control subroutine listing. The format for this listing is given in Table 7-1.

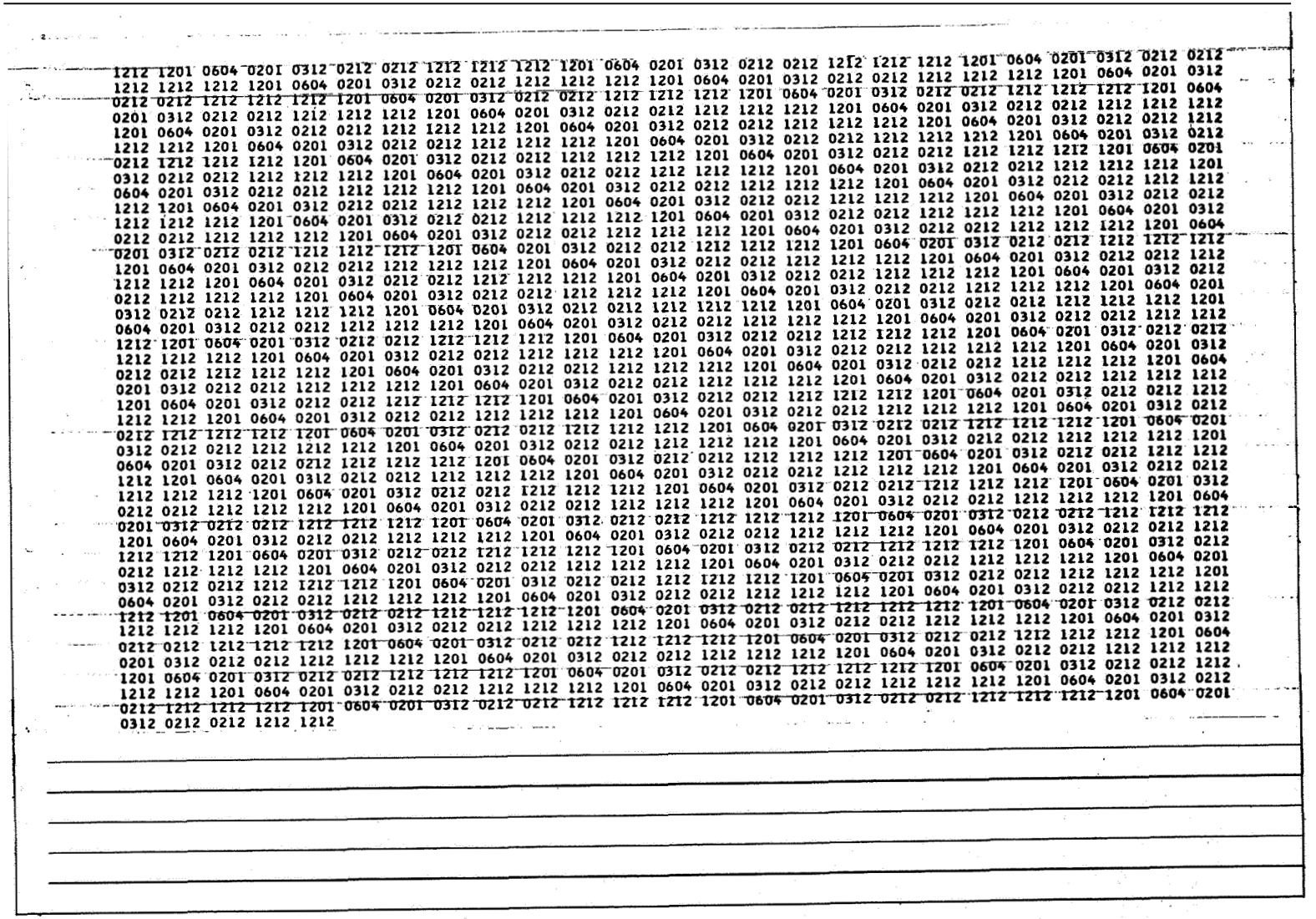
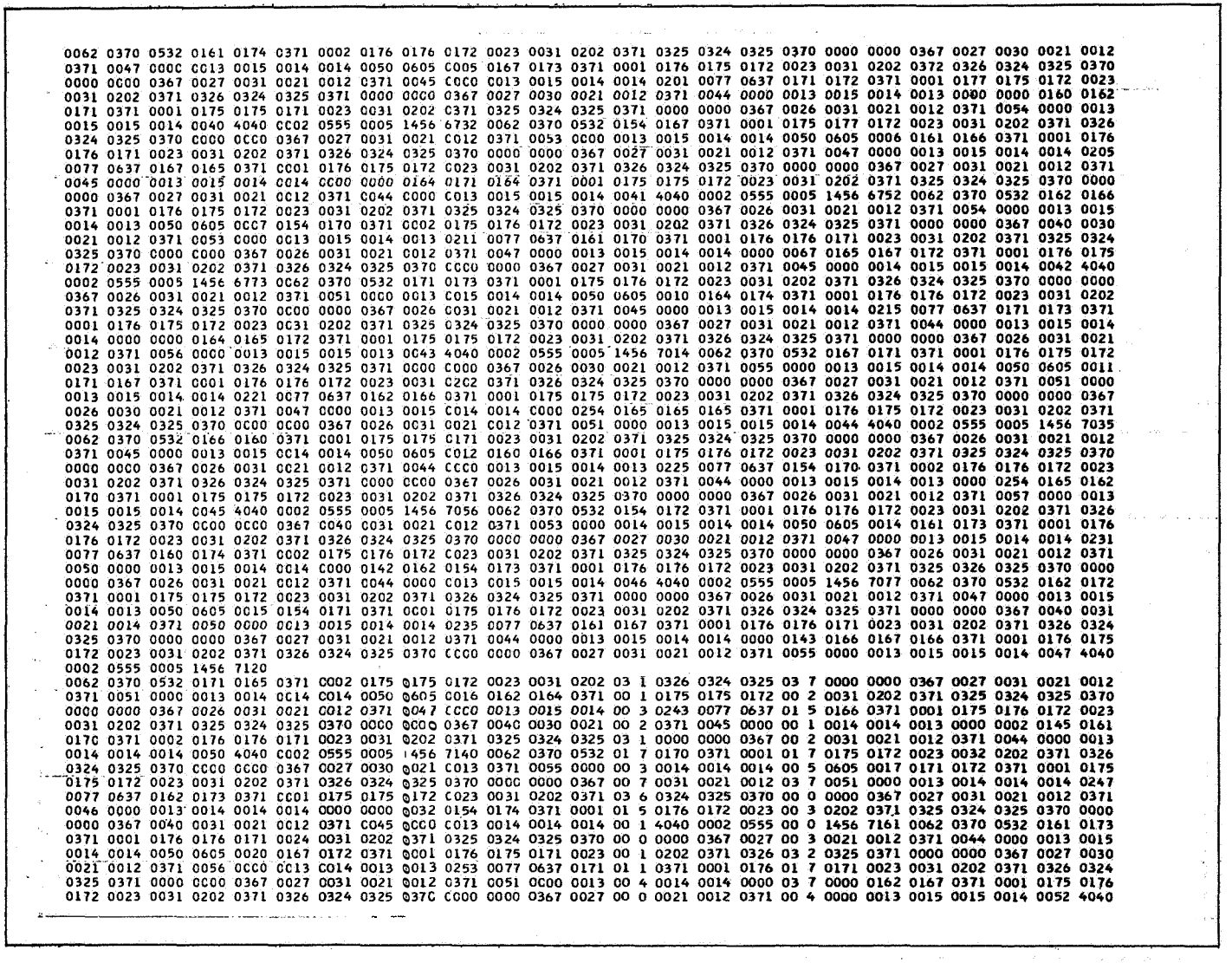


Figure 7-1. Buffer Tape Identification Record Printout

```
0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201
1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212
1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106
0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604
0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201
1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212
1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412
0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411
0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212
0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201
1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212
1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106
0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604
0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201
1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212
1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412
0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411
0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212

0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201
1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212
1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106
0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604
0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201
1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212
1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412
0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411
0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212
0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201
1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212
1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106
0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604
0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201
1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212
1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412
0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411
0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212
0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201
1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212
1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106
0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604
0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201
1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212
1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412 0212 1212 1201 1201 1212 0604 0411 0106 0412
0212 1212 1201 1201 1212 0604 0411 0106
```

Figure 7-2. Buffer Tape File Identification Record Printout



```
0062 0370 0532 0161 0174 0371 0002 0176 0176 0172 0023 0031 0202 0371 0325 0324 0325 0370 0000 0000 0367 0027 0030 0021 0012
0371 0047 000C 0013 0015 0014 0014 0050 0605 C005 0167 0173 0371 0001 0176 0175 0172 0023 0031 0202 0372 0326 0324 0325 0370
0000 0C00 0367 0027 0031 0021 0012 0371 0045 C0C0 0013 0015 0014 0014 0201 0077 0637 0171 0172 0371 0001 0177 0175 0172 0023
0031 0202 0371 0326 0324 0325 0371 0000 0000 0367 0027 0030 0021 0012 0371 0044 0000 0013 0015 0014 0013 0000 0000 0160 0162
0171 0371 0001 0175 0175 0171 0023 0031 0202 0371 0325 0324 0325 0371 0000 0000 0367 0026 0031 0021 0012 0371 0054 0000 0013
0015 0015 0014 0040 4040 CC02 0555 0005 1456 6732 0062 0370 0532 0154 0167 0371 0001 0175 0177 0172 0023 0031 0202 0371 0326
0324 0325 0370 C000 0CC0 0367 0027 0031 0021 C012 0371 0053 0C00 0013 0015 0014 0014 0050 0605 0006 0161 0166 0371 0001 0176
0176 0171 0023 0031 0202 0371 0326 0324 0325 0370 0000 0000 0367 0027 0031 0021 0012 0371 0047 0000 0013 0015 0014 0014 0205
0077 0637 0167 0165 0371 CC01 0176 0175 0172 0023 0031 0202 0371 0326 0324 0325 0370 0000 0000 0367 0027 0031 0021 0012 0371
0045 0000 0013 0015 0014 0014 0C00 0000 0164 0171 0164 0371 0001 0175 0175 0172 0023 0031 0202 0371 0325 0324 0325 0370 0000
0000 0367 0027 0031 0021 0C12 0371 0044 C000 C013 0015 0015 0014 0041 4040 0002 0555 0005 1456 6752 0062 0370 0532 0162 0166
0371 0001 0176 0175 0172 0023 0031 0202 0371 0325 0324 0325 0370 0000 0000 0367 0026 0031 0021 0012 0371 0054 0000 0013 0015
0014 0013 0050 0605 0CC7 0154 0170 0371 0C02 0175 0176 0172 0023 0031 0202 0371 0326 0324 0325 0371 0000 0000 0367 0040 0030
0021 0012 0371 0053 0000 0C13 0015 0014 0013 0211 0077 0637 0161 0170 0371 0001 0176 0176 0171 0023 0031 0202 0371 0325 0324
0325 0370 0000 C000 0367 0026 0031 0021 0012 0371 0047 0000 0013 0015 0014 0014 0000 0067 0165 0167 0172 0371 0001 0176 0175
0172 0023 0031 0202 0371 0326 0324 0325 0370 CCC0 0000 0367 0027 0031 0021 0012 0371 0045 0000 0014 0015 0015 0014 0042 4040
0002 0555 0005 1456 6773 0C62 0370 0532 0171 0173 0371 0001 0175 0176 0172 0023 0031 0202 0371 0326 0324 0325 0370 0000 0000
0367 0026 0031 0021 0012 0371 0051 0000 0013 C015 0014 0014 0050 0605 0010 0164 0174 0371 0001 0176 0176 0172 0023 0031 0202
0371 0325 0324 0325 0370 0C00 0000 0367 0026 C031 0021 0012 0371 0045 0000 0013 0015 0014 0014 0215 0077 0637 0171 0173 0371
0001 0176 0175 0172 0023 0C31 0202 0371 0325 0324 0325 0370 0000 0000 0367 0027 0031 0021 0012 0371 0044 0000 0013 0015 0014
0014 0000 0000 0164 0165 0172 0371 0001 0175 0175 0172 0023 0031 0202 0371 0326 0324 0325 0371 0000 0000 0367 0026 0031 0021
0012 0371 0056 0000 0013 0015 0015 0013 0043 4040 0002 0555 0005 1456 7014 0062 0370 0532 0167 0171 0371 0001 0176 0175 0172
0023 0031 0202 0371 0326 0324 0325 0371 0000 C000 0367 0026 0030 0021 0012 0371 0055 0000 0013 0015 0014 0014 0050 0605 0011
0171 0167 0371 0001 0176 0176 0172 0023 0031 C2C2 0371 0326 0324 0325 0370 0000 0000 0367 0027 0031 0021 0012 0371 0051 0000
0013 0015 0014 0014 0221 0C77 0637 0162 0166 0371 0001 0175 0175 0172 0023 0031 0202 0371 0326 0324 0325 0370 0000 0000 0367
0026 0030 0021 0012 0371 0047 0000 0013 0015 C014 0014 C000 0254 0165 0165 0165 0371 0001 0176 0175 0172 0023 0031 0202 0371
0325 0324 0325 0370 0C00 0C00 0367 0026 0031 0021 C012 0371 0051 0000 0013 0015 0015 0014 0044 4040 0002 0555 0005 1456 7035
0062 0370 0532 0166 0160 0371 0001 0175 0175 0171 0023 0031 0202 0371 0325 0324 0325 0370 0000 0000 0367 0026 0031 0021 0012
0371 0045 0000 0013 0015 0C14 0014 0050 0605 C012 0160 0166 0371 0001 0175 0176 0172 0023 0031 0202 0371 0325 0324 0325 0370
0000 0000 0367 0026 0031 0021 0012 0371 0044 CCC0 0013 0015 0014 0013 0225 0077 0637 0154 0170 0371 0002 0176 0176 0172 0023
0031 0202 0371 0326 0324 0325 0371 0000 CC00 0367 0026 0031 0021 0012 0371 0044 0000 0013 0015 0014 0013 0000 0254 0165 0162
0170 0371 0001 0175 0175 0172 0023 0031 0202 0371 0326 0324 0325 0370 0000 0000 0367 0026 0031 0021 0012 0371 0057 0000 0013
0015 0015 0014 0045 4040 0002 0555 0005 1456 7056 0062 0370 0532 0154 0172 0371 0001 0176 0176 0172 0023 0031 0202 0371 0326
0324 0325 0370 0C00 0CC0 0367 C040 C031 0021 C012 0371 0053 0000 0014 0015 0014 0014 0050 0605 0014 0161 0173 0371 0001 0176
0176 0172 0023 0031 0202 0371 0326 0324 0325 0370 0000 0000 0367 0027 0030 0021 0012 0371 0047 0000 0013 0015 0014 0014 0231
0077 0637 0160 0174 0371 0002 0175 0176 0172 C023 0031 0202 0371 0325 0324 0325 0370 0000 0000 0367 0026 0031 0021 0012 0371
0050 0000 0013 0015 0014 0014 C000 0142 0162 0154 0173 0371 0001 0176 0176 0172 0023 0031 0202 0371 0325 0326 0325 0370 0000
0000 0367 0026 0031 0021 0012 0371 0044 0000 C013 0015 0015 0014 0046 4040 0002 0555 0005 1456 7077 0062 0370 0532 0162 0172
0371 0001 0175 0175 0172 0023 0031 0202 0371 0326 0324 0325 0371 0000 0000 0367 0026 0031 0021 0012 0371 0047 0000 0013 0015
0014 0013 0050 0605 0015 0154 0171 0371 0C01 0175 0176 0172 0023 0031 0202 0371 0326 0324 0325 0371 0000 0000 0367 0040 0031
0021 0014 0371 0050 0000 0013 0015 0014 0014 0235 0077 0637 0161 0167 0371 0001 0176 0176 0171 0023 0031 0202 0371 0326 0324
0325 0370 0000 0000 0367 0027 0031 0021 0012 0371 0044 0000 0013 0015 0014 0014 0000 0143 0166 0167 0166 0371 0001 0176 0175
0172 0023 0031 0202 0371 0326 0324 0325 0370 CCC0 0000 0367 0027 0031 0021 0012 0371 0055 0000 0013 0015 0015 0014 0047 4040
0002 0555 0005 1456 7120
0062 0370 0532 0171 0165 0371 C002 0175 0175 0172 0023 0031 0202 03 1 0326 0324 0325 03 7 0000 0000 0367 0027 0031 0021 0012
0371 0051 0000 0013 0014 0C14 C014 0050 0605 0016 0162 0164 0371 00 1 0175 0175 0172 00 2 0031 0202 0371 0325 0324 0325 0370
0000 0000 0367 0026 0031 0021 C012 0371 0047 CCC0 0013 0015 0014 00 3 0243 0077 0637 01 5 0166 0371 0001 0175 0176 0172 0023
0031 0202 0371 0325 0324 0325 0370 0000 0000 0367 0040 0030 0021 00 2 0371 0045 0000 00 1 0014 0014 0013 0000 0002 0145 0161
0170 0371 0002 0176 0176 0171 0023 0031 0202 0371 0325 0324 0325 03 1 0000 0000 0367 00 2 0031 0021 0012 0371 0044 0000 0013
0014 0014 0014 0050 4040 C002 0555 0005 1456 7140 0062 0370 0532 01 7 0170 0371 0001 01 7 0175 0172 0023 0032 0202 0371 0326
0324 0325 0370 CCC0 0CC0 0367 0027 0030 0021 C013 0371 0055 0000 00 3 0014 0014 0014 00 5 0605 0017 0171 0172 0371 0001 0175
0175 0172 0023 0031 0202 0371 0326 0324 0325 0370 0000 0000 0367 00 7 0031 0021 0012 03 7 0051 0000 0013 0014 0014 0014 0247
0077 0637 0162 0173 0371 CC01 0175 0175 0172 C023 0031 0202 0371 03 6 0324 0325 0370 00 0 0000 0367 0027 0031 0021 0012 0371
0046 0000 0013 0014 0014 0014 0000 0000 0032 0154 0174 0371 0001 01 5 0176 0172 0023 00 3 0202 0371 0325 0324 0325 0370 0000
0000 0367 0040 0031 0021 0012 0371 C045 0CC0 C013 0014 0014 0014 00 1 4040 0002 0555 00 0 1456 7161 0062 0370 0532 0161 0173
0371 0001 0176 0176 0171 0024 0031 0202 0371 0325 0324 0325 0370 00 0 0000 0367 0027 00 3 0021 0012 0371 0044 0000 0013 0015
0014 0014 0050 0605 0020 0167 0172 0371 0001 0176 0175 0171 0023 00 1 0202 0371 0326 03 2 0325 0371 0000 0000 0367 0027 0030
0021 0012 0371 0056 0CC0 0C13 C014 0013 0013 0253 0077 0637 0171 01 1 0371 0001 0176 01 7 0171 0023 0031 0202 0371 0326 0324
0325 0371 0000 0C00 0367 0027 0031 0021 0012 0371 0051 0C00 0013 00 4 0014 0014 0000 03 7 0000 0162 0167 0371 0001 0175 0176
0172 0023 0031 0202 0371 0326 0324 0325 0370 C000 0000 0367 0027 00 0 0021 0012 0371 00 4 0000 0013 0015 0015 0014 0052 4040
```

Figure 7-3. Typical Buffer Tape Data Record Printout

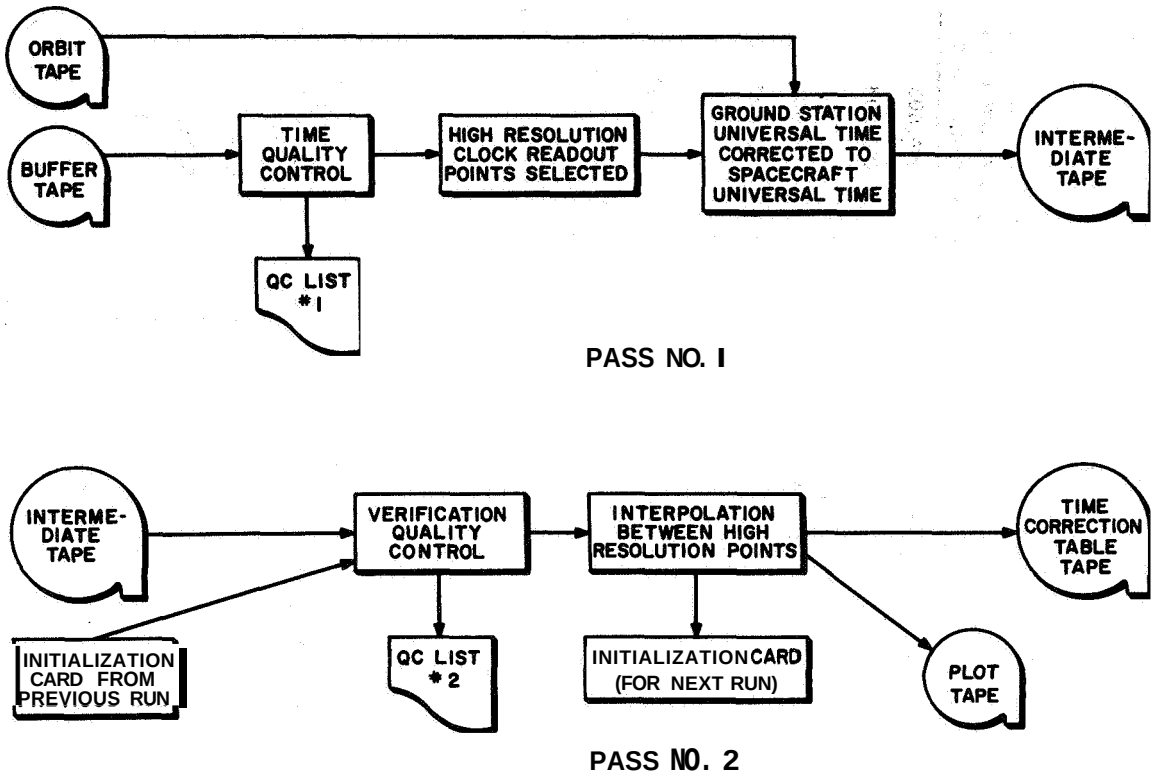


Figure 7-4. Flow Chart for Time Correction Program

TABLE 7-1

FORMAT OF QUALITY CONTROL LISTING 1 (FIRST PASS)

1. Buffer tape identification
2. Cardimage
3. Universal time, ground time, spacecraft clock time t_1, t_2, and t_3 of the first good reading to 0.1 millisecond
4. Universal time, ground time spacecraft clock time t_1, t_2, and t_3 of the last good reading to 0.1 millisecond
5. Number of good readings found
6. If tape is rejected, which test it failed

To be of acceptable quality, the spacecraft clock readings must be within limits specified for maximum allowable drift of the clock. Readings having the greatest accuracy, as indicated by the sensing flags and skip and repeat patterns presented in Table 7-2, are then selected in the high resolution subroutine. In the last step of the first pass, universal time, recorded by the ground station, is extracted from the buffer tape, and correction factors are applied to the ground station universal time to convert it to spacecraft universal time. These correction factors are derived from the known propagation delays between WWV and the ground stations and from propagation delays and

TABLE 7-2

FLAG, REPEAT, AND INTERFERENCE PATTERNS

Case Number	Bit Rate	Signature	Probability	Accuracy Millisec	Accuracy Millisec	1-sec. Pulse Ref Word 32	1-sec. Pulse Ref to Frame Start
1	1	Flag every 125 frames	0.877	+1.00, -8.016	±3.508	4.508	284.508
2	1	Flag every 79, 46[1], 79, 46, . . . frames	0.123	+0.01, -1.000	±0.492	0.508	280.508
3	8	Flag every 125 frames	0.137	+0.016, -1.094	±0.539	0.555	35.555
4	8	Clock repeats readout for 6[2], 7, 7, 7, 7 (total of seventeen 7s) frames	0.863	+1.094, -8.000	±3.453	4.547	39.547
5	64	Flag every 500 frames	0.055	+0.016, -0.109	±0.094	0.063	4.438
6	64	Clock repeats readout for 55, 56, 55, 56, 56[3], 55, 56, 55, 56, . . . frames	0.945	+0.109, -2.00	±0.946	0.837	5.212

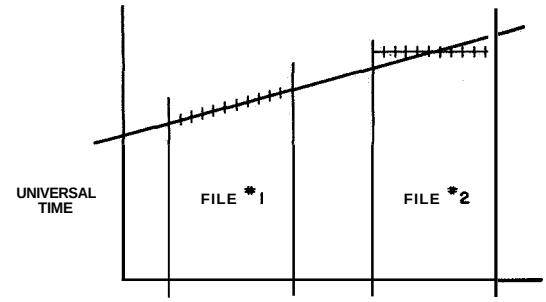
1. Flag at readout following 46-frame interval between flags.
2. First new readout after 6 repeat sequences.
3. Last readout in second 56 repeat sequences.

Interference Patterns

Case Number	Bit Rate	Interference Signature	Probability
1	1	No interference	0.953
2	1	Flag every 33, 46, 46 frames	0.047
3	8	No interference	0.789
4	8	Flag every 264, 368, 368 frames	0.211
5	64	Flag every 2112, 2944, 2944 frames	1.000

Interference patterns will be superimposed on flag and repeat patterns.

doppler effects between the ground stations and the spacecraft. Data for the propagation delay and doppler effects between the spacecraft and ground are extracted from the orbit tape.



7-3. In the second pass, the intermediate tape **data** file is verified by comparison with data of the preceding file inserted **by** means of the initialization card of the

TABLE **7-3**

FORMAT OF THE INTERMEDIATE TAPE

IDENTIFICATION	DATA RECORD	SCANNING **OPEP** RECORD
Quality control listing of No. **1** image	**1,** 2, **3** day of year, **e e e** millisecond of day, **e o e** and spacecraft clock **e e e** (1200 maximum) ● ● ● ● ● ●	**1,** 2, **3** day of year, **e o e** millisecond of day **e e e** channel **75** ***o*** **e e** (1200 maximum) ● ● ● ● ● ● ● ● ●

The time coordinates for both files are found by the straight line equation $y = ax + b$, where y values are in universal time, x values are in spacecraft clock time, a is the slope, and b is the y intercept. The format of data in the initialization card is as follows:

Field	Data
1	a
2	**b**
3	x'

Thus the values a, b, **and x'** define the straight line equation to which time values of the next file are compared. The output of the verification program, a second quality control listing is given in Table 7-4.

Next in the interpolation routine, the selected high resolution spacecraft clock readings are extracted from the intermediate tape. Values between readings are interpolated to form a continuous series of highly accurate spacecraft clock readings. These readings, which are accurate to within ±4 milliseconds, together with corresponding spacecraft universal time values are recorded on the time correction table tape. The format

of the identification record of this tape is given in Table 7-5, and the format of the data record in Table 7-6. Two other outputs of the second pass are the initialization card for the second pass, and a plot tape.

TABLE 7-4

FORMAT OF QUALITY CONTROL LISTING 2 (SECOND PASS)

1. Buffer tape identification,
2. Card image.
3. Universal time and spacecraft clock time of first item.
4. Universal time and spacecraft clock time of last item.
5. Predictor time equation.
6. Time equation of file, root mean square value of deviations, differences between predicted value and actual value at start and end of file, value of E_{max}, and file is verified or rejected.

TABLE 7-5

FORMAT OF IDENTIFICATION RECORD OF TIME-CORRECTION-TABLE TAPE

Character	Significance
1	First clock count of this day
2	Universal time corresponding to first clock count
3	Day of year
4	Last clock count of this day
5	Universal time corresponding to last clock count
6 to 127	Comments (Binary coded decimal with odd parity)

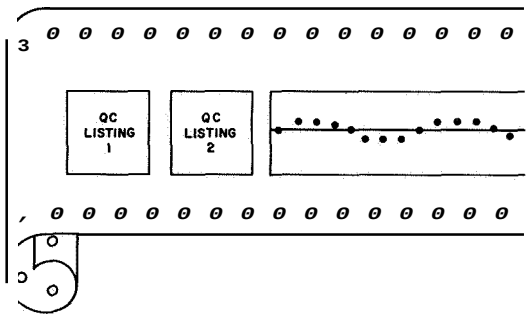


Figure 7-6. Output Format of the SC 4020 Microfilm Plotter

The plot tape output is from the SC4020 microfilm plotter. This equipment is operated in the BUT frame mode to produce a microfilm in the format shown in Figure 7-6. Quality control listing 1 from the first pass is reproduced next to quality control listing 2 from the second pass. The quantities on the plot reflect changes in spacecraft universal time and spacecraft clock time according to the straight line equation in the form $xy = y - ax - b$.

TABLE 7-6
FORMAT OF DATA RECORD OF TIME-CORRECTION-TABLE TAPE

Character	Significance
1	Clock time for XXX2000 (octal)
2	Universal time for XXX2000
3	Universal time for XXX2001
4	Universal time for XXX2002
105	Universal time for XXX2777

Each file of the time correction table tape contains spacecraft universal times for all spacecraft clock readings for the day indicated in the identification record (Table 7-5). Only one file of data is recorded on a tape. The first data record (Table 7-6) contains the first clock reading and universal time for the day indicated.

These values are not usually the first words in the record, since the first words are the selected high resolution spacecraft clock readings. The last ten bits of these readings must be zeros. In octal notation the first word ends in either 2000, 4000, or 6000. The last data record in a file of the time correction table tape contains the last clock reading and universal time for the day indicated, but, as in the first record, the last reading of the day is not necessarily the last word in the last record. To be complete, the last record must contain 1024 entries. The last data record in a file is followed by an end of frame.

7.3 QUALITY CONTROL PROGRAM

In the quality control program, data from the buffer tape are processed on the Univac 1107 computer. After the computer produces a printout (Figure 7-7) for evaluating the validity of the buffer tape data and placing these data in the format of the master binary edit tape (Figure 7-8), it extracts from the time correction table tape correct spacecraft universal time and inserts it in the time field of the edit tape. Thus the 8-frame records of the input buffer tape are reformatted to the 129-frame records of the output edit tape which contains valid data with correct universal time.

The validity of data on the buffer tape is tested by means of a series of checks performed by the computer. The computer determines the accuracy and uniformity of the data by checking such items as parity, code words, bit rate, type of data (real time or command playback), spacecraft operation mode (normal, accelerated, or flexible format), and the data format. The data format is checked by counting the number of characters in identification records, data records, and data frames. Errors discovered in the data are traced to their point of occurrence. If the errors are traced to the ground stations or to the spacecraft, the data are set aside until the end of observatory life, after which they are culled. If the errors are traceable to the conversion equipment,

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S49 QUALITY CONTROL AND EDIT PROGRAM

S49 EDITED LABEL

 SAT  YR STA AN  AN  BU  BU  DAT  SAT  YR STA AN  AN  BU  BU  DAT K DAY  SEC            E BINA BI OP LI
  ID  RE  NO FI  TA  FI  TA  DIG   ID  RE  NO FI  TA  FI  TA  DIG R  YR  DAY            G TAPE FI ID ID
64491 64 020 02 0001 01 0001 225 64491 64 020 02 0001 01 0001 225                        2302 01 02 02

      000001    TIME DECODER STATUS FLAGS (F2)
    42560153   EQUAL MILLISECONDS OF DAY

S49 EDITED LABEL

 SAT  YR STA AN  AN  BU  BU  DAT  SAT  YR STA AN  AN  BU  BU  DAT K DAY  SEC            E BINA BI OP LI
  ID  RE  NO FI  TA  FI  TA  DIG   ID  RE  NO FI  TA  FI  TA  DIG R  YR  DAY            G TAPE FI ID ID
64491 64 020 02 0001 01 0001 225 64491 64 020 02 0001 01 0001 225 2 125 42560         1 2302 01 02 02

    27      SYNC BIT ERRORS (PROGRAM DETERMINED)              .       11   SYNC BIT ERRORS (BUFFER DETERMINED)
    42997642   EQUAL MILLISECONDS OF DAY

    16      SYNC BIT ERRORS (PROGRAM DETERMINED)              .        0   SYNC BIT ERRORS (BUFFER DETERMINED)
    42997678   EQUAL MILLISECONDS OF DAY

      000000    TIME DECODER STATUS FLAGS (F2)
    43400176   EQUAL MILLISECONDS OF DAY

      000002    TIME DECODER STATUS FLAGS (F2)
    43400734   EQUAL MILLISECONDS OF DAY

      004002    TIME DECODER STATUS FLAGS (F2)
    43401004   EQUAL MILLISECONDS OF DAY

      000002    TIME DECODER STATUS FLAGS (F2)
    43402012   EQUAL MILLISECONDS OF DAY

LOSS OF FRAME SYNC  THE LAST TIME WAS        43402340

LOSS OF FRAME SYNC  THE LAST TIME WAS      17452565520

END OF FILE

   100  PER CENT OF FRAMES WITH ZERO SYNC BIT ERRORS
     0  PER CENT OF FRAMES WITH ONE SYNC BIT ERRORS
     0  PER CENT OF FRAMES WITH TWO SYNC BIT ERRORS
     0  PER CENT OF FRAMES WITH THREE OR MORE SYNC ERRORS
```

A7209

THE LAST EDIT TAPE NUMBER USED WAS 12303

5-49 QUALITY CONTROL AND EDIT SUMMARY

SATELLITE IDENT	YEAR	STATION NUMBER	PASS NO	ANALOG TAPE NUMBER	UNCORRECTED START TIME	UNCORRECTED STOP TIME	CORRECTED START TIME	CORRECTED STOP TIME	DAY OF YEAR	EDIT TAPE NO
64 49 1	64	020	0001	0001	42560693	43400248	42560693	43400248	125	12301
64 49 1	64	020	0001	0001	42560153	43402340	42560153	43402340	125	12302
64 49 1	64	020	0001	0001	42560207	43400248	42560207	43400248	125	12303

S-49 END OF JOB

Figure 7-7. OGO-A Quality Control Printout and Summary

Figure 7-8. Format of the Master Binary Edit Tape

the analog data are re-run after the equipment malfunction is corrected. Culled data tapes are processed individually by means of special techniques not suitable for regular production runs. Culling retrieves at least 75 percent of the data.

7.3.1 Input Buffer Data

The input data to the quality control program is taken from the buffer tapes. The buffer tape formats are given in Figures 5-24 and 5-25. These tapes have double identification records, each containing 18 characters, and regular data records, each containing eight frames of 270 characters to make a data record of 2160 characters.

TABLE 7-7

CONTENTS OF THE MASTER-BINARY-EDIT TAPE IDENTIFICATION RECORD

Character	Representation
1-5 +Space	Satellite identification. Example: 64021 where 64 = year of launch, 02 = Beta, 1 = object
7-8 +Space	Year of recording
10-12 +Space	Station number. Example 001 = Blossom Point
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	Data of data digitization (day of year)
34-36	Will be identical to characters 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 = 1 kilobit real time, 1 = 8 kilobits real time, 2 = 64 kilobits real time, 3 = command storage playback.

TABLE 7-7 (Continued)

CONTENTS OF THE MASTER-BINARY-EDIT
TAPE IDENTIFICATION RECORD

Character	Representation
69-71 +Space	Day of year Start time of data
73-77 +Space	Seconds of day
79-87 +Space	Spares
89	Spacecraft equipment group number
90	Spares
91-94 + Space	Master binary tape number
96-97 +Space	Master binary file number
99-100 + Space	Operator ID
102-103	Line used
104-120	Blanks

7.3.2 Master Binary Edit Tape

The master binary edit tape contains the data output from the quality control program including complete status information and correct universal time. The content of the tape identification record is given in Table 7-7. The data records (Figure 7-9) have been reformatted from 8 data frames to 128 data frames, and a special time record was added making a total of 129 frames in each data record.

Where gaps in data have occurred, fill data is inserted to complete the record so that all data records will be the same length. (See Table 7-8). Time fields and status fields are associated with the data in the same frame whether the frame contains useful data or fill data. Status field F-1 contains the status of the data as determined by the quality control program. (See Tables 7-9 through 7-11.)

7.3.3 Quality Control Listing

The quality control listing (Figure 7-7) provides information about the condition of data contained on the master binary edit tape. The listings of quality control data are printed out immediately after the completion of the edit tape. The letter code in the listing is explained in Table 7-12. All possible messages which may appear on a quality control printout are given in Table 7-13. (The format of a documentation card for the master binary edit tape is given in Figure 7-10.)

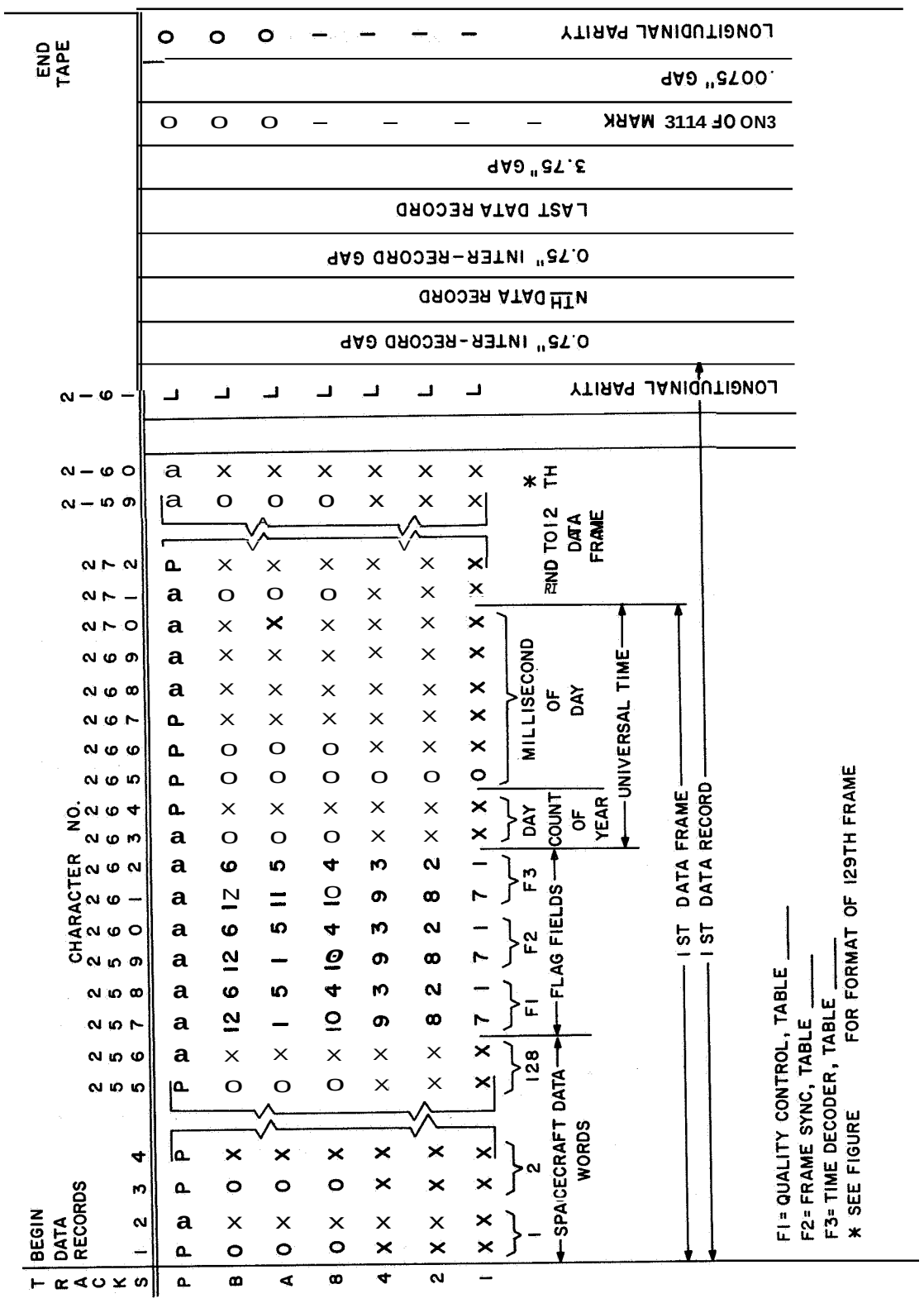


Figure 7-9. Format of the Master Binary Edit Tape Data Records

TABLE 7-8

FORMATS OF **FILL** DATA WORDS AND NORMAL DATA WORDS COMPARED

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

* 2 characters/word

TABLE 7-9

MASTER-BINARY-EDIT-TAPE STATUS FIELD F1

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 subcom sequence
9 10	0 0	This frame contains 1 kilobit real time data
9 10	1 0	This frame contains 8 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 playback 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

TABLE 7-10

SIGNIFICANCE OF FLAGS IN THE F2 STATUS FIELD

Bit	Digit	Representation
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 the 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.

TABLE 7-11

MASTER-BINARY-EDIT-TAPE STATUS FIELD F3

Bits	Representation
1-7	Remain the same on both buffer and edit
8	Will be a "1" if the "F" bits on the buffer field F1 are "1". It will be a "0" if the "F" bits are "0".
9	Will be a "1" if bit number 12 in the buffer field is a "1". It will be a "0" if the corresponding buffer field is "0".
10-12	In this field, we are limited to 7 bit errors while in buffer field 8-11 there may be held up to 15 bit errors. Otherwise the fields are the same.

TABLE **7–12**

LETTER CODES USED IN QUALITY CONTROL PRINTOUTS

Actual Buffer Tape Identification		AN FI	Analog File Number
SAT ID	Satellite Identification	AN TA	Analog Tape Number
Satellite Transmitter Number			
YR RE	Year Recorded	BU	Buffer Tape File Number
STA NO	Station Number	BU TA	Buffer Tape Number
AN FI	Analog File Number	DAT DIG	Data Digitized
AN TA	Analog Tape Number	K R	Kilobit Rate
BU FI	Buffer File Number	DAY YR	Day of Year
BU TA	Buffer Tape Number	SEC DAY	Milliseconds of Day
DAT DIG	Data Digitized	E G	Equipment Group Number
Analog Card		BINA TAPE	Binary Edit Tape Number
SAT ID	Satellite Identification Number	BI FI	Binary Edit Tape File Number
YR RE	Year Recorded	OP ID	Conversion Line Operator's Number
STA NO	Station Number	LI ID	Conversion Line Number

TABLE 7-13

ALL POSSIBLE MESSAGES WHICH **MAY** APPEAR
ON A QUALITY CONTROL PRINTOUT

1.	Parity error time is_____
2.	Unrecoverable read error tape rejected,
3.	OGO-A end of job.
4.	_____time decoder status flags (F2).
5.	_____equal millisecond of day.
6.	OGO-A rejection due to invalid day of year comparison.
7.	_____previous day of year.
8.	_____invalid day of year.
	_____equal milliseconds of day.
9.	Rejection due to loss of leading zeros.
	_____equal milliseconds of day.
10.	OGO-A invalid comparison of buffer subcomm/count.
11.	_____equal channel subcomm/count.
12.	_____equal F3 subcomm count.
	_____equal milliseconds of day.
13.	OGO-A invalid data type change detected.
	_____equal milliseconds of day.
14.	OGO-A rejection due to invalid data type change.
	_____equal milliseconds of day.
15.	OGO-A invalid mode change detected.
	_____equal milliseconds of day.
16.	060-A rejection due to invalid mode change.
17.	Invalid mode_____
18.	Previous mode_____
	_____equal milliseconds of day.
19.	OGO-A non-existent kilobit rate detected.
	_____equal milliseconds of day.
20.	OGO-A rejection due to non-existent kilobit rate.
21.	Invalid character.
	_____equal milliseconds of day.
22.	060-A invalid kilobit rate comparison.
	_____equal milliseconds of day.
23.	OGO-A rejection due to invalid kilobit comparison.
	_____equal milliseconds of day.
24.	Invalid or non-existent kilobit rate (character).
25.	Previous kilobit rate (rate).
26.	Invalid time comparison detected.
27.	_____equal previous milliseconds of day.
28.	_____equals F1 status.
29.	_____equals F2 status.
30.	_____equals F3 status.
	_____equal milliseconds of day.
31.	Equipment groups change detected - current file terminated.
	_____equal milliseconds of day.
32.	Input record is padded with binary zeros, but sync subcomm flag is missing.
33.	_____sync bit errors (determined by program).

TABLE **7-1.3** (Continued)

ALL POSSIBLE MESSAGES WHICH **MAY** APPEAR
ON A QUALITY CONTROL PRINTOUT

34.	_____ sync bit errors (determined by buffer equipment). _____ equal milliseconds of day.
35.	Wrong length record first time is _____
36.	This file has been rejected, edit tape number is _____
37.	Edit tape _____ should be marked rejected.
38.	Excess amount of documentation cards.
39.	OGO–A make necessary corrections then reload program.
40.	OGO–A invalid satellite number, documentation card number _____
41.	OGO–A invalid international code, documentation card number _____
42.	OGO–A invalid comparison of analog tape number, document card number _____
43.	OGO–A invalid comparison of station number, document card number _____
44.	OGO–A illegal station number, check document card number _____
45.	OGO–A type, go to verify and process buffer tape number _____
46.	OGO–A incorrect buffer number (tape number).
47.	Type from console correct buffer number, then carriage return.
48.	OGO–A invalid year of recording detected.
49.	OGO–A year of recording - less than year of launch.
50.	OGO–A year of digitization, less than year of recording.
51.	OGO-A quality control year, less than year of digitization.
52.	OGO–A invalid buffer line number detected.
53.	OGO–A invalid space (zero) comparison detected in tape and file ID.
54.	OGO–A invalid satellite identification detected check file ID.
55.	OGO–A quality control and edit program (Heading).
56.	Error while reading label, file rejected.
57.	Error while reading EOF on output tape, file marked rejected.
58.	Error when back–spacing input tape, file marked rejected.
59.	Output tape now rewinding to interlock label and file.
60.	Second equipment group change detected file rejected.
61.	Equipment group change in first output record - data discarded.
62.	End of file reached before kilobit rate is found.
63.	_____% class 0 data.
64.	_____% class **1** data.
65.	_____% class **2** data.
66.	_____% class **3** data.

7.3.4 Time Conversion Subroutine

A part of the quality control program is the time conversion subroutine. In this subroutine, correct universal time from the time correction table tape is inserted in the time field of the master binary edit tape.

7.3.5 Production Run

Approximately 16 buffer tapes are used as the input to a production run. The following is the sequence of operator events in a production run:

1. Load all input tapes
2. Load 2 output tapes
3. Place cards in punch
4. Read in analog library cards
5. Read first record of first tape
6. Tape label check
7. Print tape label
8. Should encounter an end-of-file
9. Read first record of new file
10. File label check
11. Print file label
12. Do not punch card until the end of the pass is reached. At this time the end time of the pass can be obtained.

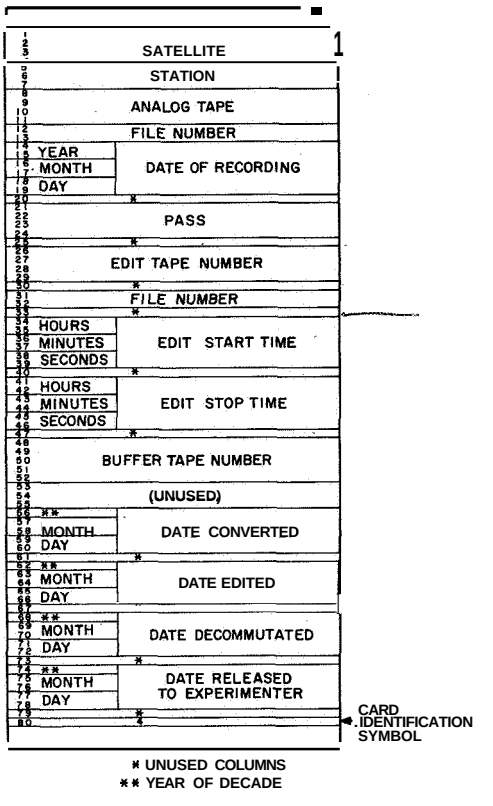


Figure 7-10. Documentation Card for the Master Binary Edit Tape

7.3.6 Quality Control Program

Figures 7-11 through 7-14 present the sequence of quality control operations.

The following ground rules are basic to the quality control program.

1. A file of data will be terminated and a new file begun when either (a) a new input file is entered, or (b) equipment groups, modes, or bit rates are changed. A new file will not be started, however, unless it contains more than one minute of data.
2. There will be only one edit file per edit tape.
3. Buffer tapes will be erased when shipments of decommutated data tapes are made to the experimenters.

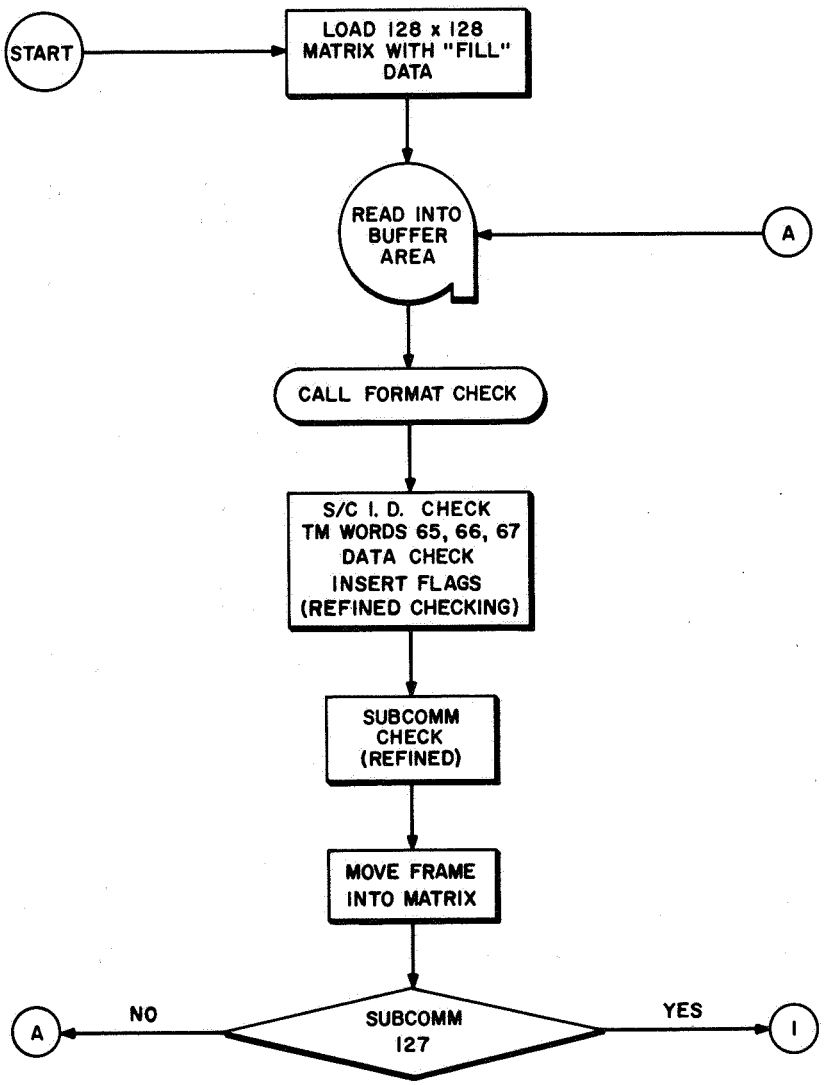


Figure 7-11. Flow Chart for Quality Control Processing, Chart 1

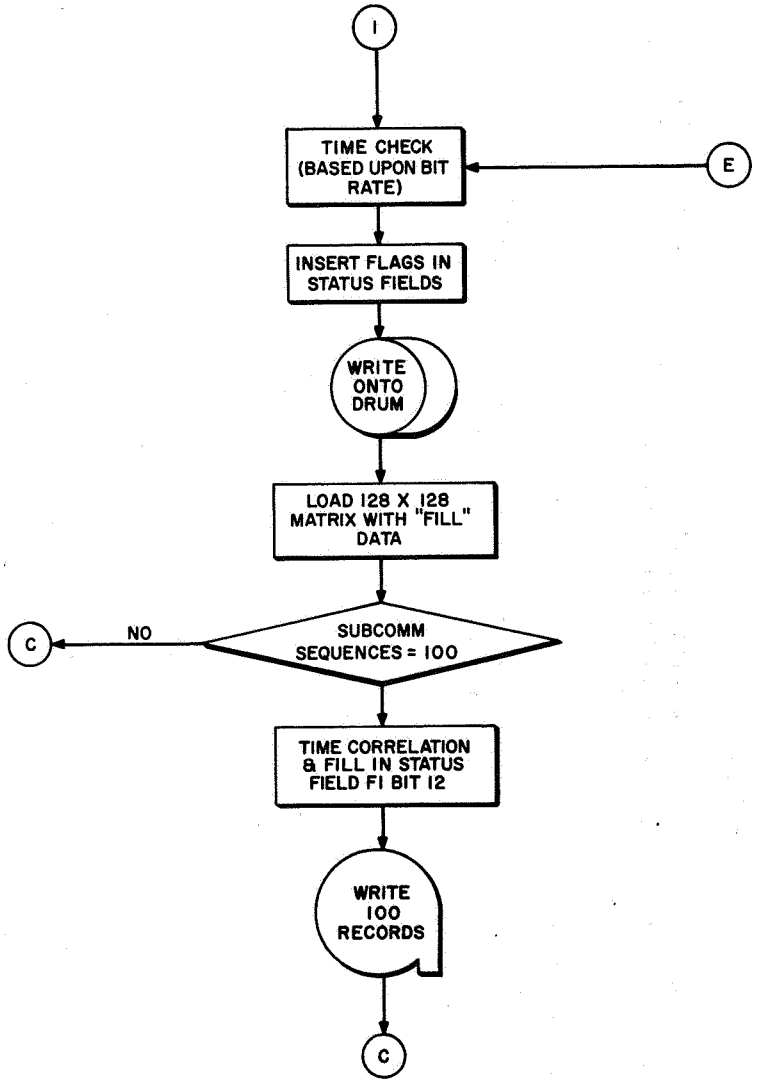


Figure 7-12. Flow Chart for Quality Control Processing, Chart 2

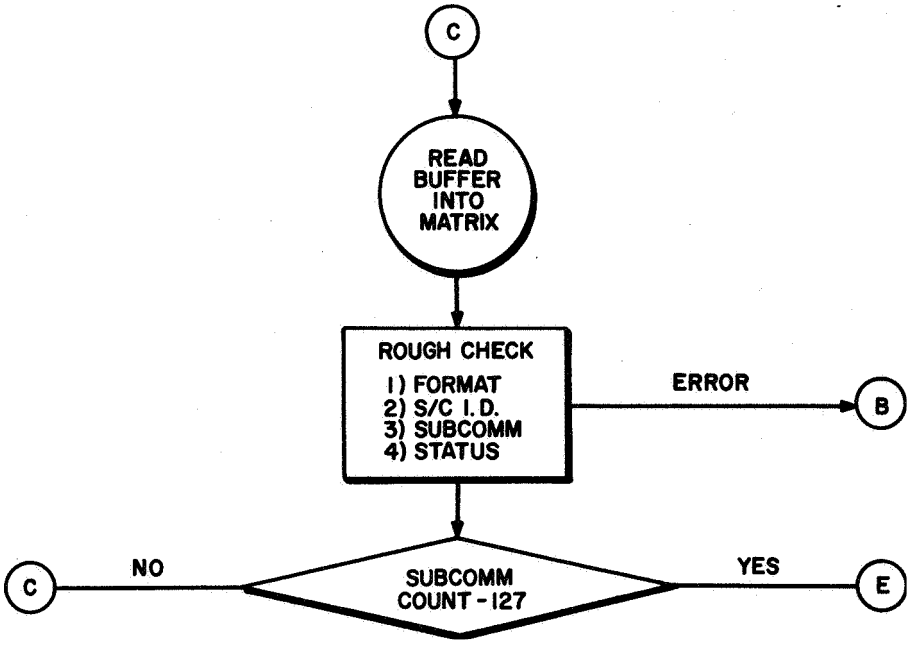


Figure 7-13. Flow Chart for Quality Control Processing, Chart 3

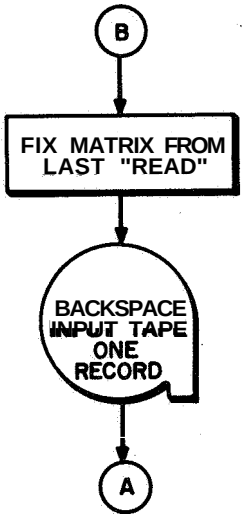


Figure 7-14. Flow Chart for Quality Control Processing, Chart 4

4. Edit tapes will be kept as permanent records and are, therefore, referred to as master binary edit tapes.

5. For every edit file, a corresponding documentation card will be punched.

6. Production on the Univac 1107 will be on a run basis. Each run will consist of approximately 16 buffer tapes.

7. Decommutated data tapes will be arranged in two groups, each in chronological order: one group being real time data, and the other being stored data. Real time data will be written on separate tapes from the stored data.

8. For every tape processed, a corresponding quality control listing will be printed on-line.

7.3.7 Quality Control Checks

The quality control program causes checks to be performed on the tape identification record, the file identification record, and the data records provided by the buffer tape. Indications of the validity of the data are written into status field F1 of the master binary edit tape, and errors found during checks are printed out.

7.3.7.1 Buffer Tape Identification Record Checks

The computer processes the buffer-tape-identification record as follows:

1. Writes in and verifies the buffer tape number.

2. Checks year of digitization by the formula A - B - C - D, where A = year of launch, B = year of recording, C = year of digitization - not included in edit label, and D = year of Q. C. - not included in edit label.

3. Checks day of digitization by: day of digitization, day of quality control check.

4. Checks the legality of the buffer line used.

5. Checks the legality of the operator identification.

6. Checks spares for being in proper place.

The tape identification record will be followed by one end of file. The first record after the end of file will be in the file identification record.

7.3.7.2 Buffer Tape File Identification Record Checks

The computer processes the buffer tape file identification record as follows:

1. Reads and checks validity of analog documentation card. (See 4 below.)

2. Checks validity of file identification record. (See 4 below.)

3. Checks documentation card against file identification. If everything checks, assumes file identification is good. If 1 and 2 are valid, but 3 does not compare, assumes documentation card is correct and places data in field 34-66 in edit identification. If 3 does compare, places edit fields 1-33 into edit fields 34-66.

4. If documentation card is not valid, but file identification is valid, rejects card. If library card is valid but file identification is not valid, places the card information in edit field **34-66.** If both library card and file identification are not valid, rejects data.

5. If in any of the above cases an error exists, prints out message.

6. Prints out the entire file identification record on the quality control listing.

7.3.7.3 Buffer Tape Data Record Checks

The computer performs checks on the following items of the buffer tape data records: format, spacecraft identification, subcommutator, status, and time. When an error in format occurs, the computer:

1. Prints time of frame.

2. Prints indication of trouble.

3. Prints subcommutator position.

4. Prints spacecraft time (word **33,** 34, **35).**

5. Prints entire frame and status.

6. Dumps.

Note that when subcommutator synchronization has been established, the data records must start **1,** 9, **17,** etc.

The computer performs the spacecraft identification (main frame words **66** and **67)** check as follows:

1. If a change occurs in spacecraft identification:

   a. Prints, terminates the file, and starts a new file.

   b. Makes certain that the change (not caused by bit error) remains constant,

   c. Checks by using the bit errors in the frame synchronization word. If three bit errors occur, assumes transmission errors responsible for change.

2. Checks bit rate: 001 = 64 kbs, 000 = 8 kbs, and 100 = 1 kbs. First time places respective flag in status field F1 bits 9, 10. At this time also places flag in identification field character 67. Every other time through, check for change.

3. Checks data type; **1** = real time, and zero = data storage.

4. Checks data mode; 100 = main commutator, 010 = accelerated subcom, and 001 = flexible format.

The computer performs the subcommutator check as follows:

1. If the subcommutator position advances between frames by more than **1,** it can mean either of three things:

a. Apparent jump due to bit errors.

b. Loss of frame synchronization.

c. Error in telemetry.

Both a. and c. can easily be determined to be the case by looking at the following data and the bit errors in the frame synchronization word and status field F3. If b. is the case, however:

a. Prints item and time.

b. Re-initializes matrix addresses.

c. Places fill data in respective locations in the matrix.

d. Places proper flow in the respective status fields F1 bit 7.

The computer performs the status check as follows:

1. Obtains total number of bit errors in frame synchronization word. If three errors occur, places **flag** in F1 bit 11. Compares against F3 bits 10-12. If a non-comparison results (within 7 since we only have 3 bits in this case) prints. Places total number of bit errors in F1 bits 1-6.

2. If frame occurs in the beginning of subcommutator reference, fills in F1 bit 8.

3. Checks F2 and initially prints the case. Prints again when F2 changes.

The computer performs the time check as follows: At the 8-kilobit rate, time should be advancing at 144 milliseconds. At the 64-kilobit rate, time should be advancing at 18 milliseconds. If the clock advance does not fulfill the above requirements within ± 1 millisecond, the computer prints and stops processing, and it will be necessary to redigitize the buffer tape. (NOTE: Ignore time at 1-kilobit command playback.)

7.4 QUICK LOOK PROGRAM

The quick look program produces a quick look listing in octal for use by experimenters and others who wish to examine specific data points as early as possible. The program takes data on a record by record basis from either buffer or edit tapes and places these data in core memory. From the console the computer operator indicates which data points in a record are to be examined. From these inputs, the program then prints out a listing which allots a single spaced line to each data point and a blank line between records to separate them. (See Figure 7-15.) Examples of identification and data record printouts for individual experiments are shown in Appendix B. Note that experiment 14 has no PCM telemetry (thus no printout) and the data points for experiment 16 are subcommutated from channel 97, the experiment subcommutator channel.

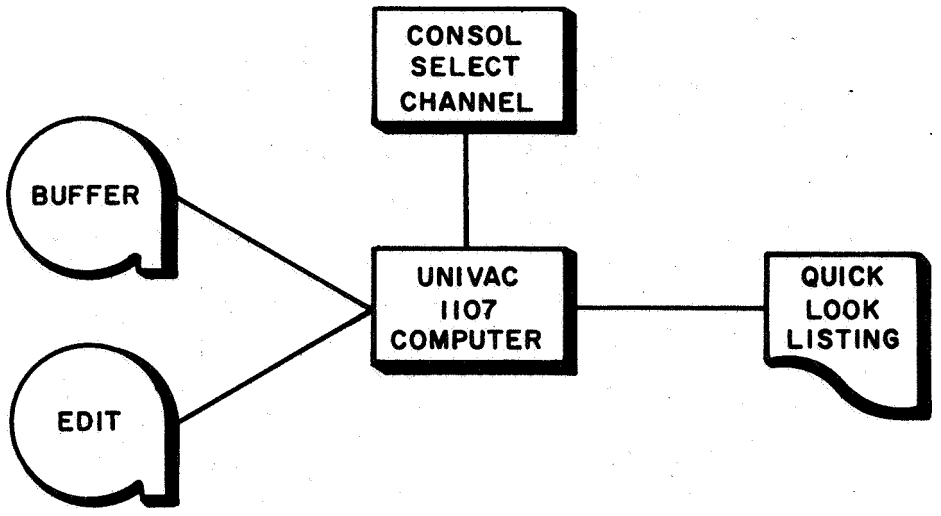


Figure 7-15. Program Flow Chart for Quick Look

In addition to selected data points, each line in the listing contains the following items:

1. Day of year, columns ——— through 3 .
2. Milliseconds of year, columns 5 through 12 .
3. Status field F1, columns 14 through 17 .
4. Frame synchronization, columns 19 through 27 .

SECTION 8
FOUR MAJOR END DATA PROGRAMS

The four major end data programs for PCM digital data are: (1) the command sort and reformat program, (2) the decommutation program, (3) the spacecraft subsystems program, and (4) the attitude orbit program. These programs are described in the following paragraphs.

8.1 COMMAND SORT AND REFORMAT PROGRAM

The command sort and reformat program (Figure 8-1) is performed on-line on the IBM 1401/7010 computers. Intermediate command cards from the command reduction system (paragraph 5.5.1) are read into the computer memory. The computer sorts the data chronologically, reformats them, and punches a master deck of end data command cards. The format of the command card is shown in Figure 8-2. From the master deck 21 duplicate decks are punched. One duplicate deck is for use by the Space Technology Laboratories. The other 20 decks are distributed to experimenters and their representatives.

The decommutation program is accomplished in two steps on the Univac 1107 (Figure 8-3). In the first step, Phase I, three sets of program cards are applied as inputs to the processing equipment which generates a program tape. The first set of program cards uses a special decommutation language program to define the formats for each decommutated experiment. The second and third sets of cards use Slueth 11 assembler language, one to establish tape handling facilities in the program and the other to establish the format of the decommutation program punched card output.

Phase 11, which is the production phase, uses the decommutation program tape generated in Phase I to decommutate satellite data supplied from master binary edit tapes.

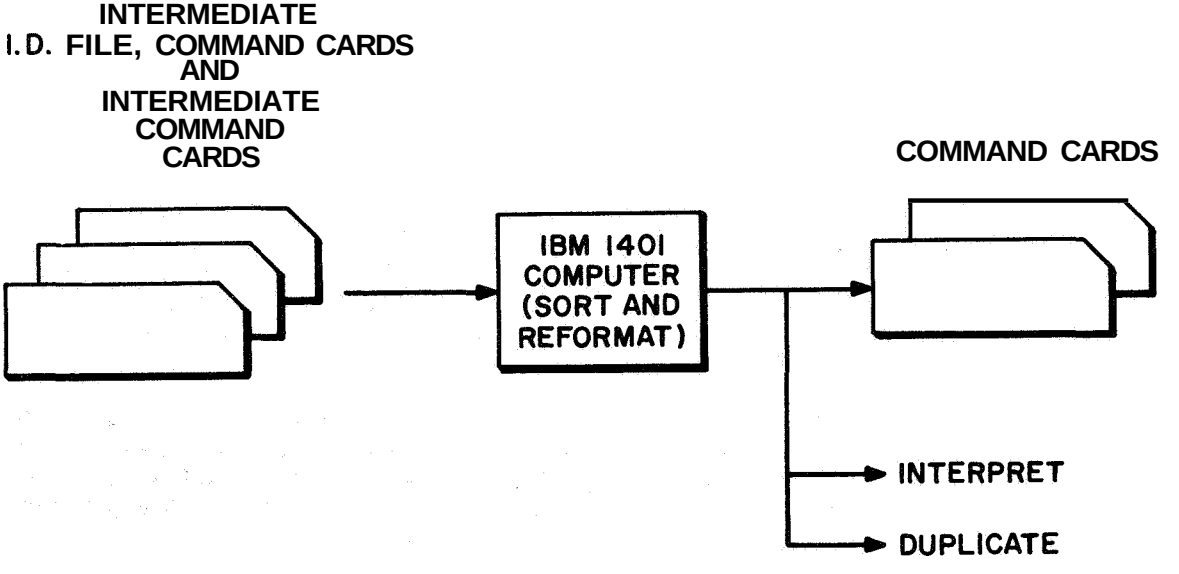


Figure 8-1. Flow Chart for Command Sort and Reformat Program

The format for the decommutation tape is shown in Figure 8-4. The program is executed on the Univac 1107 on a production run basis, each run consisting of approximately 16 edit tapes of data. The program consists of the following eight routines: buffered input tape handler, pack and unpack routine, selective decommutation controls, 19 experimenter format routines, buffered output tape handler, recovery routines (normal), label subroutines, and recovery routine (abnormal).

A processing run generates the decommutated tapes for the experimenters listed in Table 8-1. Experiments 4 and 14 are marked void since experiment 4 is combined with experiment 6. Experiment 14 contains no data from the PCM (or from the FM special purpose) telemetry systems. The table lists the number of words and characters per data record and the maximum number of files per decommutation tape along with other related items for each experimenter.

Each decommutated tape consists of a maximum number of files as indicated in Table 8-1 and a second end-of-file mark. The format of a file (Figure 8-5) consists of an identification record (Table 8-2), data records as specified by the experimenter, and an end-of-file mark. Each decommutation tape is written by a subroutine which extracts those data points specified by the experimenter from a defined matrix of 135 words and 129 frames.

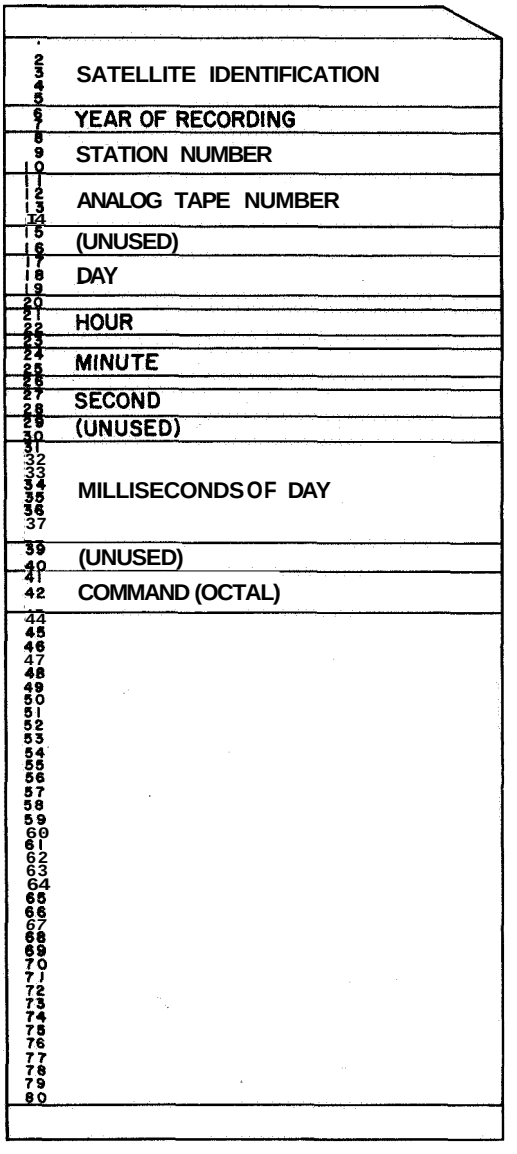


Figure 8-2. Format of the Command Card

Fill data may be inserted for either or both of the following reasons: first, it may be used to fill out a data record where valid data is missing, and second, it may be used to fill out the format for convenience in reading, handling, and the like. Any symbol may be specified and any desired format may be specified by the experimenter for use on his decommutation tapes.

In addition to the 19 decommutation tapes, the program generates the documentation card shown in Figures 8-6 through 8-9. The program also generates a printout which contains: (1) a verbatum-printout of the identification record from each tape, and (2) a verbatum printout of every documentation card punched by the program. The printout and the documentation cards serve as records of each run.

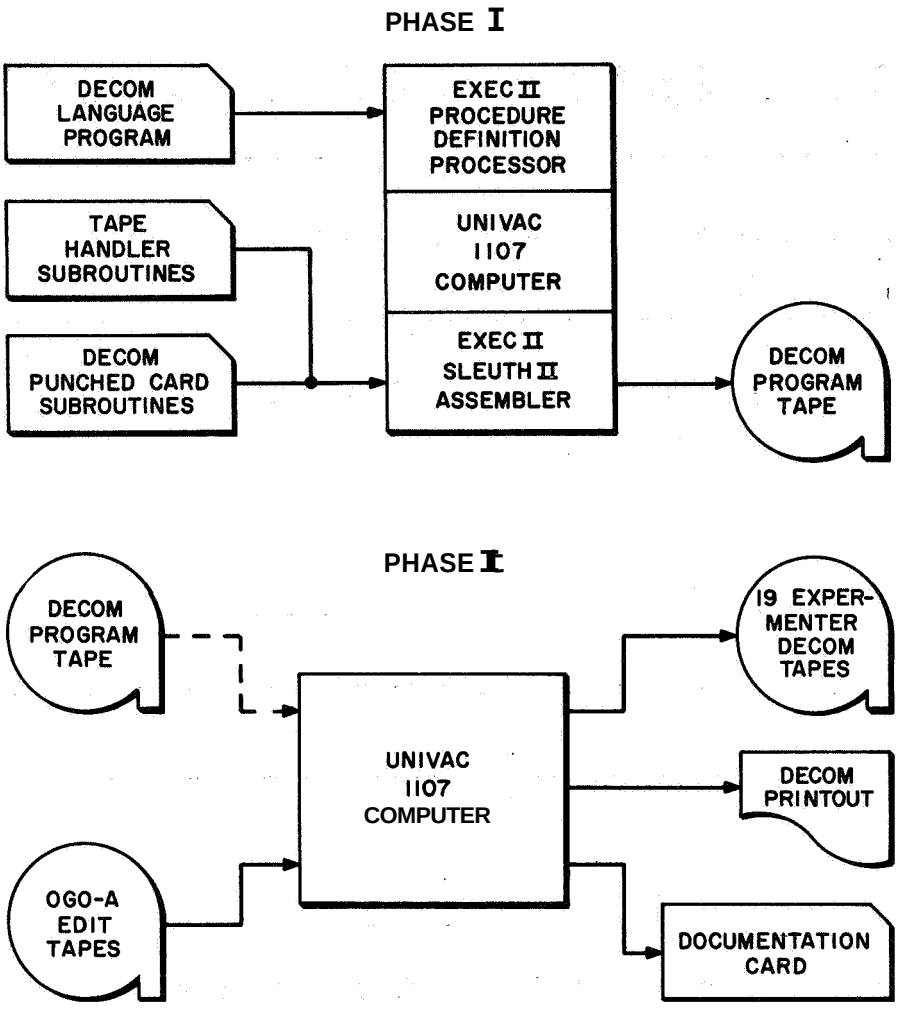


Figure 8-3. Decommutation Program

Figure 8-4. Format for the Decommutation Tape

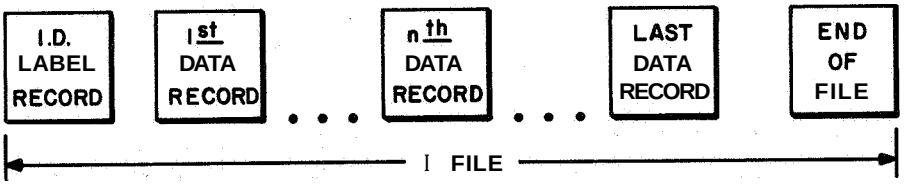


Figure 8-5. Format for a Decommutated Tape File

TABLE 8-1

CHARACTERISTICS OF DECOMMUTATION TAPES

Name	Exp. No.	World Length	Char. Length	Output Input Ratio	[illegible]	Order of Write	Logical Unit	Servo
U. of Calif.	1	901	5406	1		5	E	3/2
Ames	2	1163	6984	1		2	B	2/1
MIT	3	392	2352	1		14	N	2/7
(Void)	4					(20)	T	
Davis (GSFC)	5	168	1006	4		17	Q	3/8
Ludwig (GSFC)	6	775	4650	1		10	J	2/5
U. of C.	7	167	1002	4		18	R	2/9
Iowa	8	512	4638	1		13	M	3/6
Minn.	9	860*	5160	1		1	A	3/0
UCLA	10	1049	6294	1		3	C	3/1
Heppner (GSFC)	11	1029	6174	1		4	D	2/2
AFCRL	12	780	4680	1		9	I	3/4
Whipple (GSFC)	13	768	4608	1		12	L	2/6
(Void)	14					(21)	U	
Taylor (GSFC)	15	792	4752	1		7	G	3/3
Alexander (GSFC)	16	16	96	1		19	S	3/9
Stanford	17	773	4638	1		11	K	3/5
Mich.	18	781	4686	1		8	H	2/4
NRL	29	389	2334	1		15	O	3/7
Wolff	20	389	2334	1		16	P	2/8
Housekeeping	21	896	5376	1		6	F	2/3

*When referred to high density record lengths Experiment 9 word length is equivalent to 2391.

TABLE 8-2

CONTENTS OF DECOMMUTATION TAPE
IDENTIFICATION RECORD

Character	Representation
1-5 + Space	Satellite identification Example: 64021 where 64 = year of launch 02 = Beta 1 = object
7-8 +Space	Year of recording
10-12 + Space	Station number. Example 001 = Blossom Point
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	Data of data digitization (day of year)
34-36	Will be identical to characters 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. Repeat after correction
67 + Space	Type of data contained in file 0 = 1 kilobit real time 1 = 8 kilobits real time 2 = 64 kilobits real time 3 = command storage playback
69-71 + Space	Day of year Start time of data
73-77 + Space	Seconds of day
79-87 + Space	Spares
89	Spacecraft equipment group number

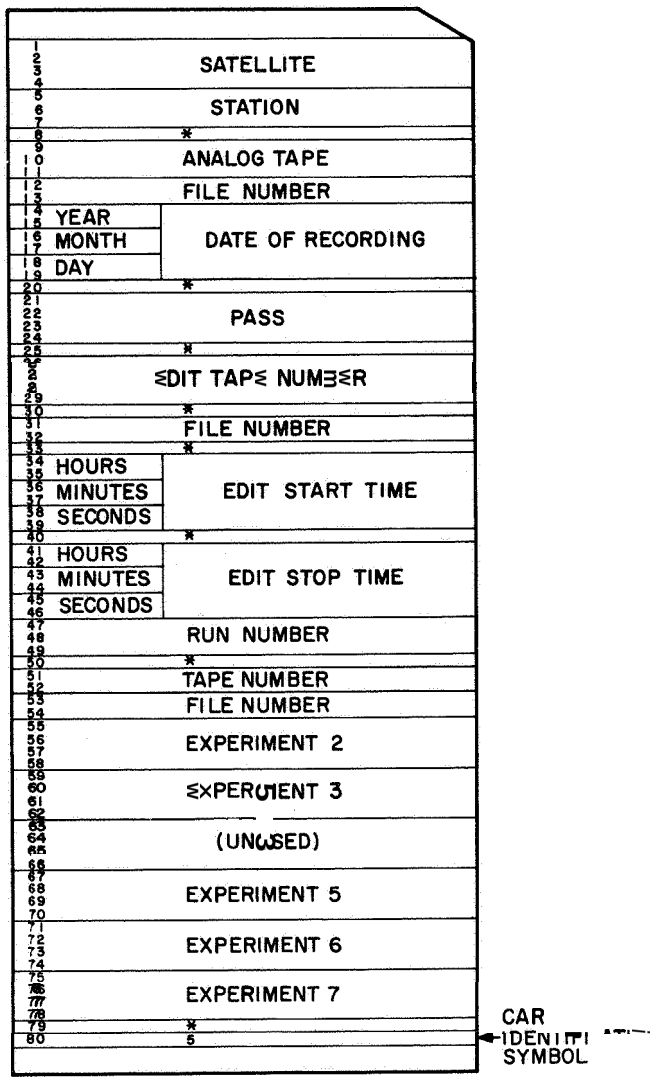


Figure 8-6. Format of Decommutation Card 1

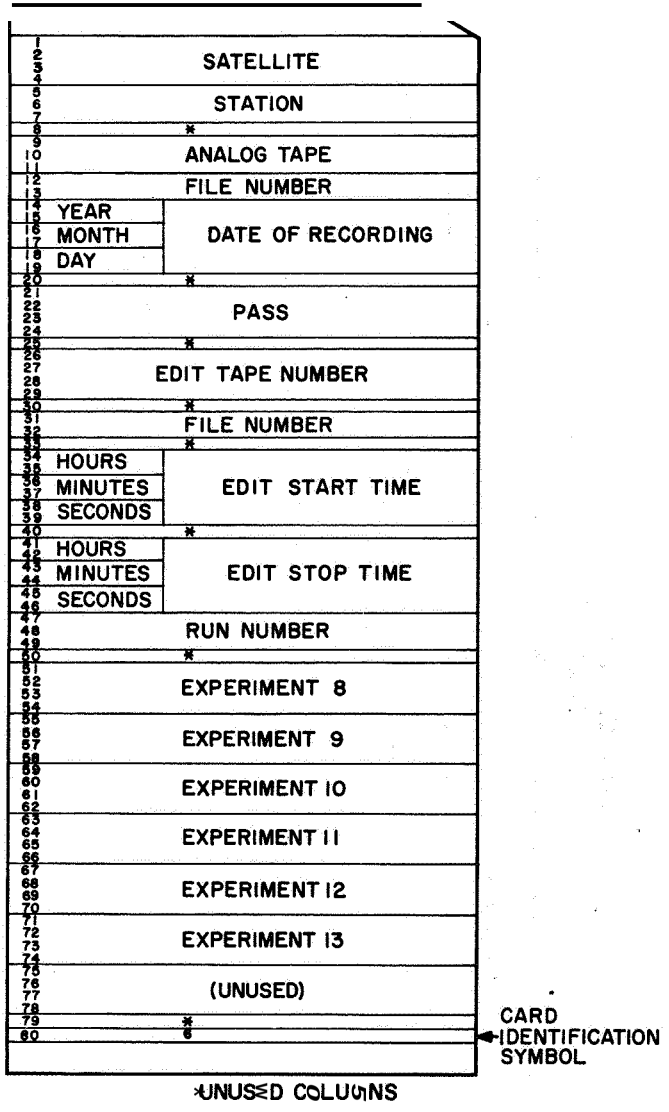


Figure 8-7. Format of Decommutation Card 2

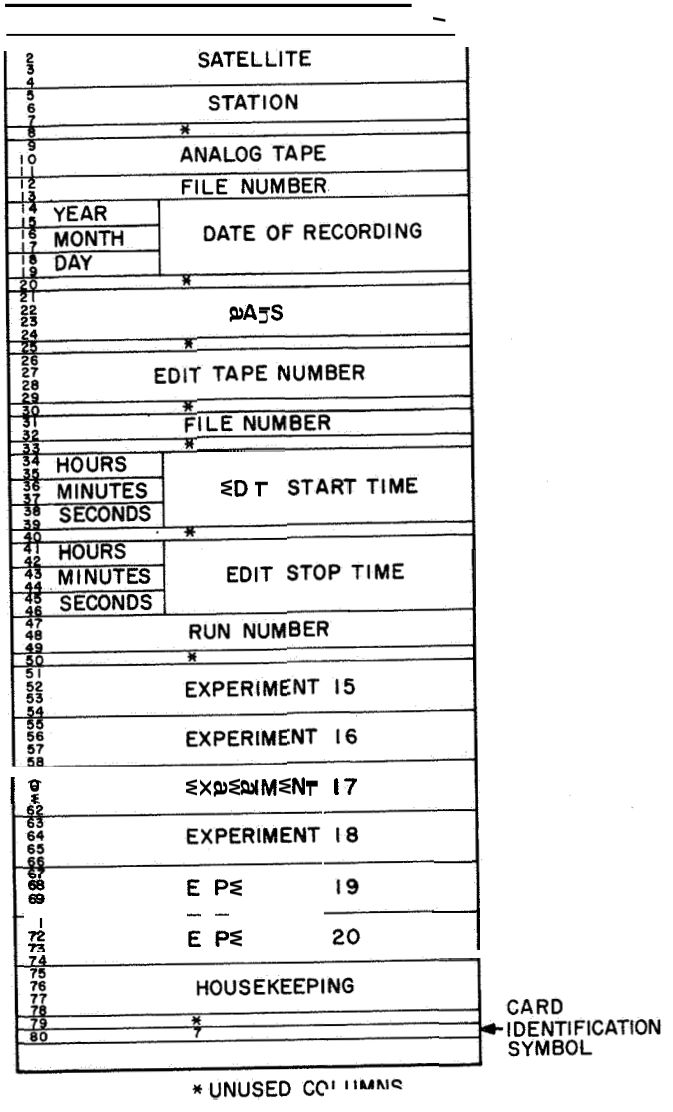


Figure 8-8 Format of Decommutation Card 3

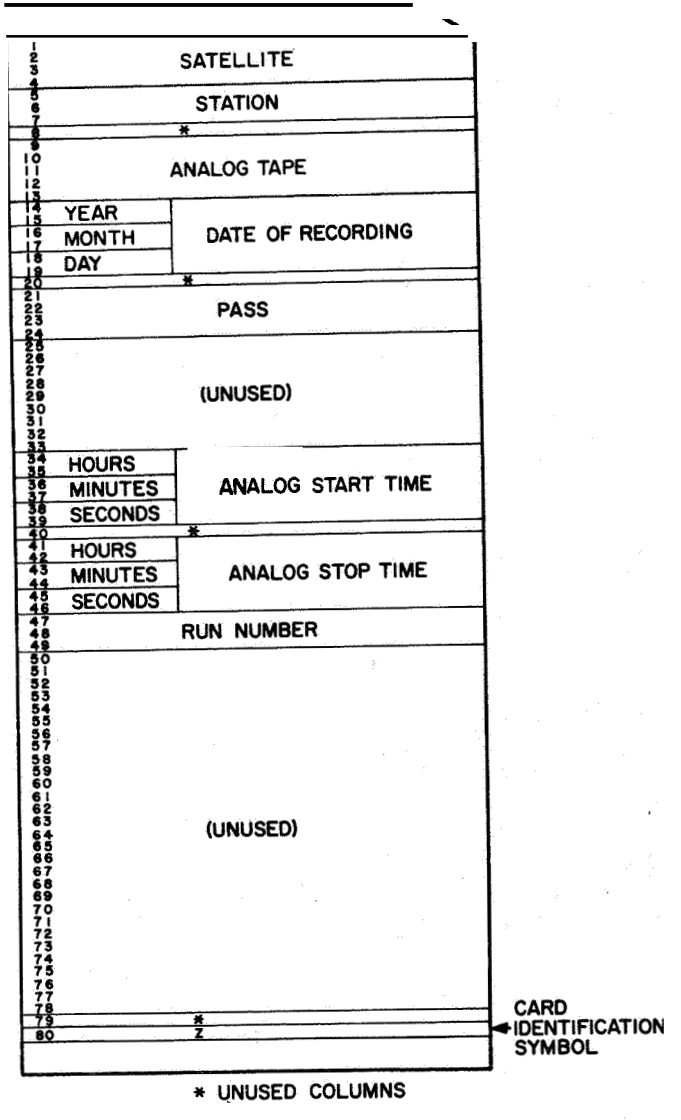


Figure 8-9. Format of Delete Card

8.2 SPACECRAFT SUBSYSTEMS PROGRAM

The spacecraft subsystems program (Figure 8-10) utilizes the Univac 1107 to read the housekeeping tape and extract data pertaining to the six spacecraft subsystems. These housekeeping data are read, one record at a time, into core memory from which the program selects and processes them further by calibrating and converting them to engineering units. These operations are determined by control cards which specify the type of outputs desired (lists, plots, or both) and also specify the time increments desired by the subsystem engineer for selecting data. In addition, by reading the attitude-orbit tape the program extracts times of the following orbital parameters: Ascending node, dawn, noon, dusk, and perigee. These selected data points are extracted from as many attitude-orbit tapes as may be necessary to process one run of housekeeping tapes. All these time data points are read into core memory where they are stored for use by the program.

To accommodate the large amount of data required to generate graphs that plot an entire orbit, the program stores graph data in drum memory. These data are later recovered by the program and are reformatted on tape for the SC 4020 plotter. This plotter then plots the graphs on film (Figure 8-11). The computer operator is instructed by console messages all of which are listed in Table 8-3.

The spacecraft subsystems program generates five other output tapes as follows: communications and data handling, integrated subsystems, thermal, power, and attitude. The Univac 1107 then prints out these tapes on listings which constitute the output of the program to the respective subsystem engineer. Typical examples are shown in Figures 8-12 and 8-13.

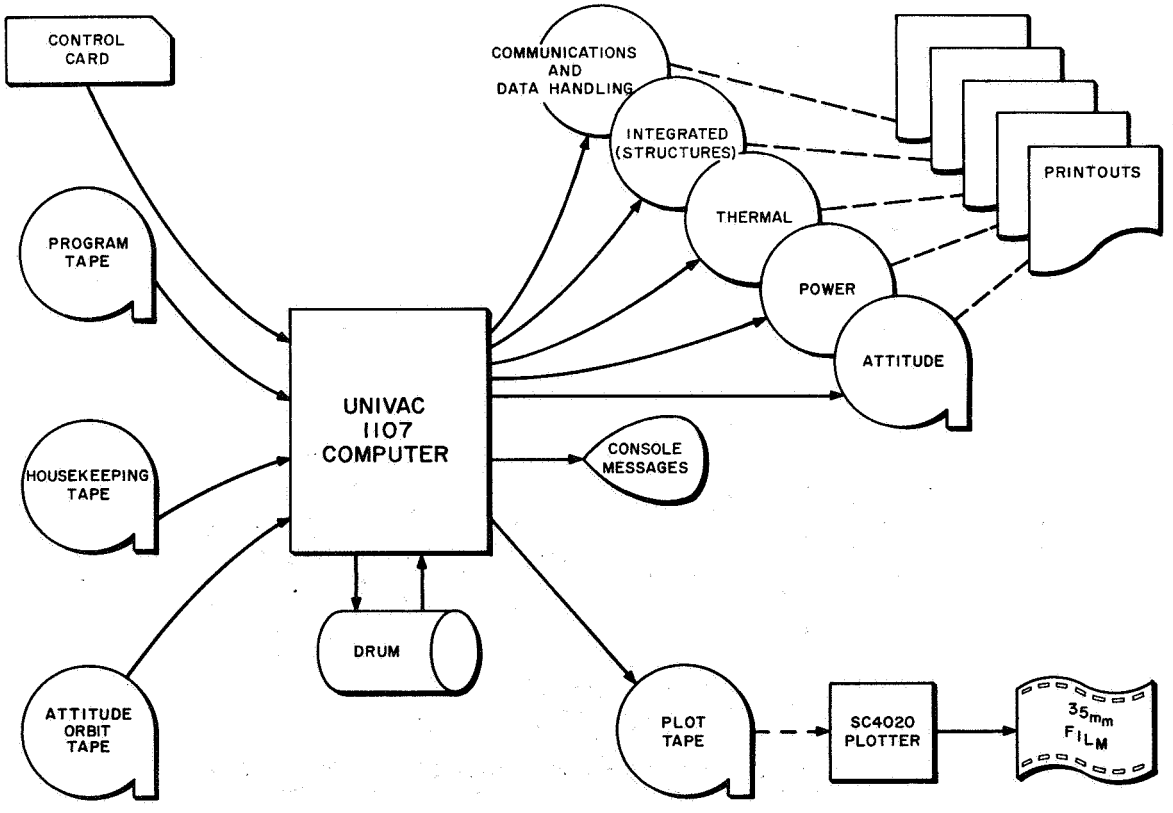


Figure 8-10. Spacecraft Subsystems Program Flow Chart

TABLE 8-3
CONSOLE MESSAGES

1.	Operator, did you do an E key in yes or no? (Tape Mounts)
2. A.	Mount HSK
2. B.	Mount A-SSYS
2. C.	Mount C/F-SS
2. D.	Mount D-SSYS
2. E.	Mount E-SSYS
2. F.	Mount I-SSYS
2. G.	Mount PLOTSS
2. H.	Mount ASPECT
3.	Run complete
4.	End of HSK tape - mount new reel and type go, otherwise type no.
5.	Operator, how many aspect reels-type one digit.
	(In flight calibrations error messages)
6.	More than five consec I/F fill by passes
7.	More than five consec I/F SYNC by passes
8.	More than five consec I/F DIFF by passes
9.	A23 MD CHK (MCDN) has illegal (Can't happen) value of (OCT) xux
10.	A 10 BLT read out has occurred.

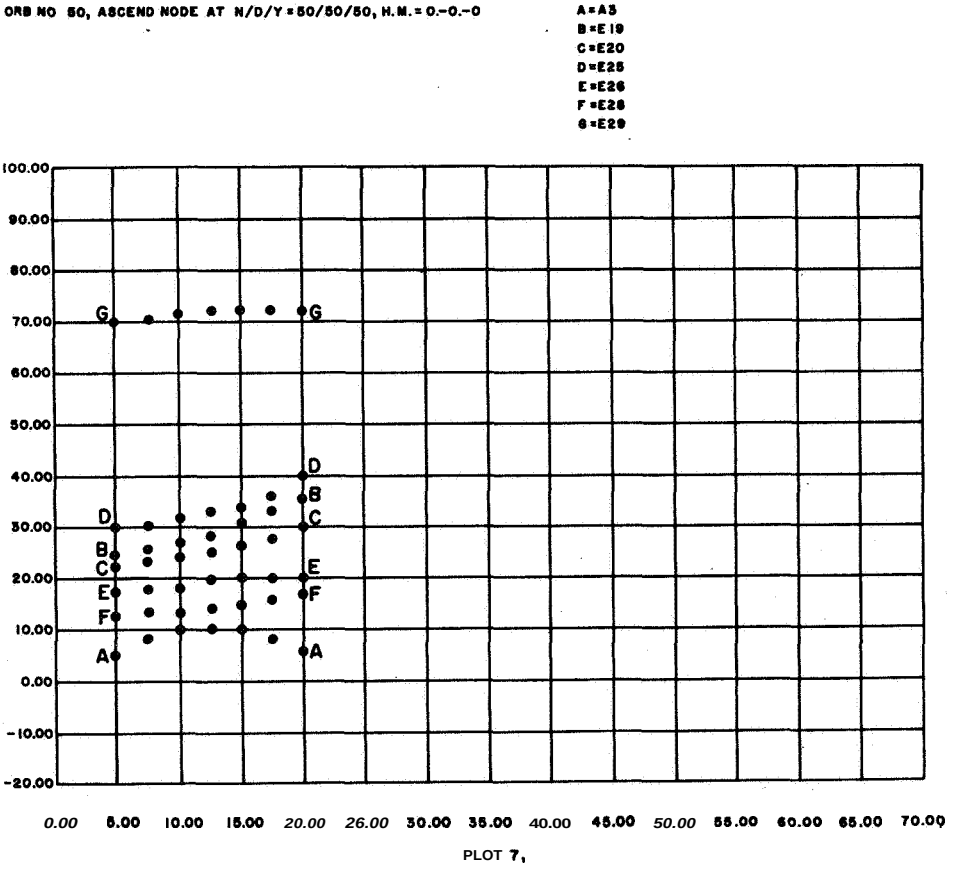
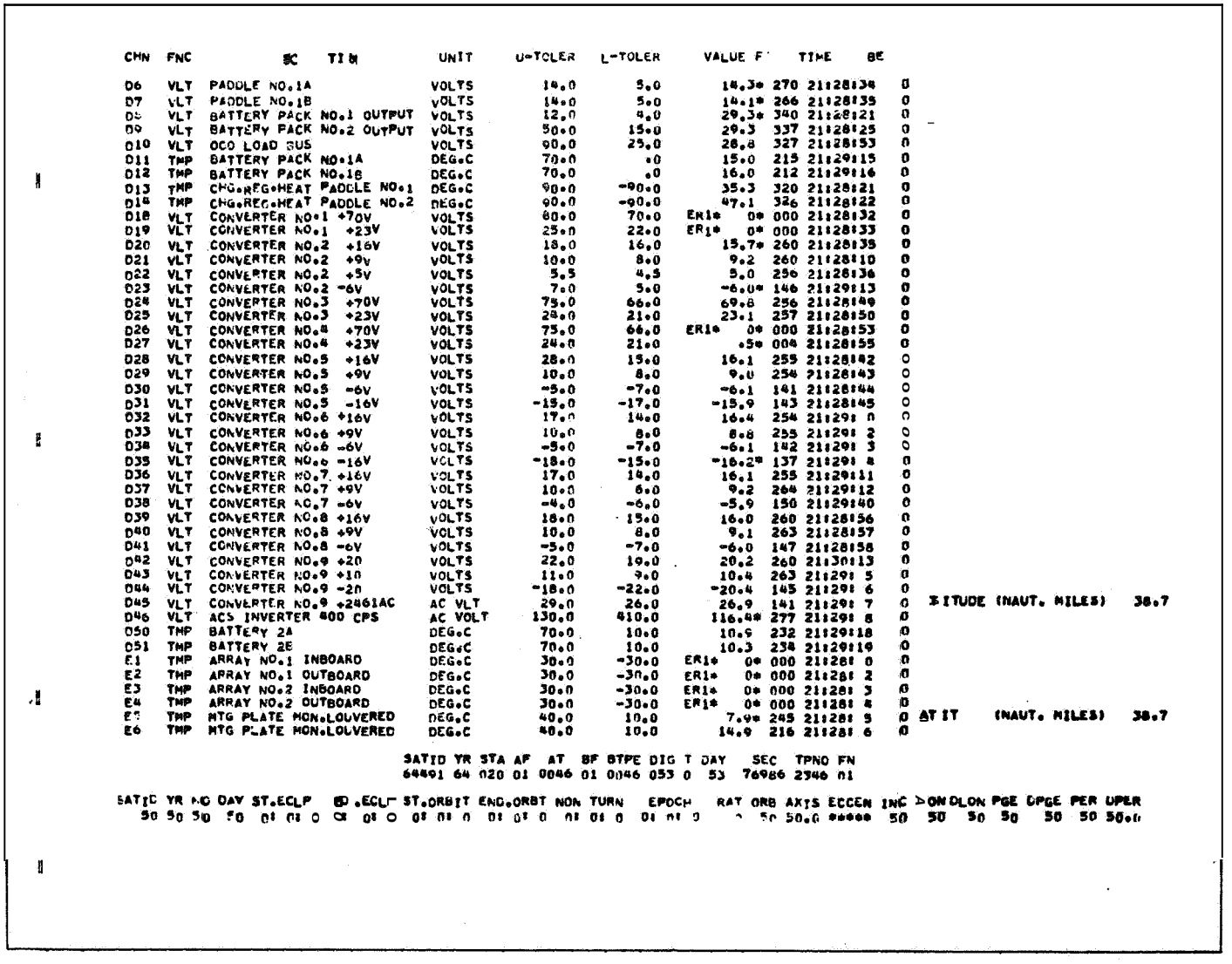


Figure 8-11. Typical Output Plot of Spacecraft Subsystem Program

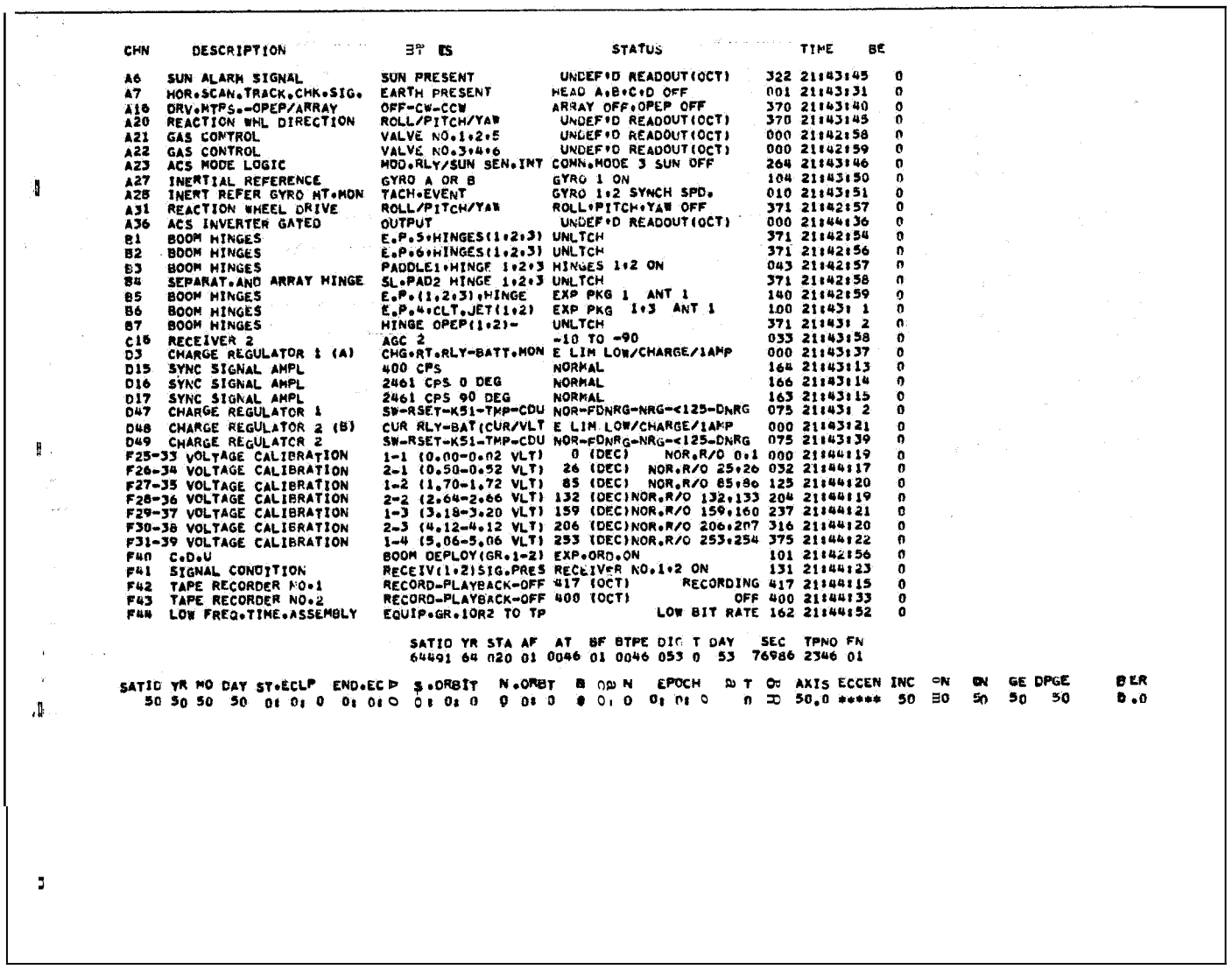


CHN	FNC	SC TI M	UNIT	U-TOLER	L-TOLER	VALUE F	TIME	BE	
D6	VLT	PADDLE NO.1A	VOLTS	14.0	5.0	14.3*	270 21:28:34	0	
D7	VLT	PADDLE NO.1B	VOLTS	14.0	5.0	14.1*	266 21:28:35	0	
D8	VLT	BATTERY PACK NO.1 OUTPUT	VOLTS	12.0	4.0	29.3*	340 21:28:21	0	
D9	VLT	BATTERY PACK NO.2 OUTPUT	VOLTS	50.0	15.0	29.3	337 21:28:25	0	
D10	VLT	OCO LOAD BUS	VOLTS	90.0	25.0	28.8	327 21:28:53	0	
D11	TMP	BATTERY PACK NO.1A	DEG.C	70.0	.0	15.0	215 21:29:15	0	
D12	TMP	BATTERY PACK NO.1B	DEG.C	70.0	.0	16.0	212 21:29:16	0	
D13	TMP	CHG.REG.HEAT PADDLE NO.1	DEG.C	90.0	-90.0	35.3	320 21:28:21	0	
D14	TMP	CHG.REG.HEAT PADDLE NO.2	DEG.C	90.0	-90.0	47.1	326 21:28:22	0	
D18	VLT	CONVERTER NO.1 +70V	VOLTS	80.0	70.0	ER1* 0*	000 21:28:32	0	
D19	VLT	CONVERTER NO.1 +23V	VOLTS	25.0	22.0	ER1* 0*	000 21:28:33	0	
D20	VLT	CONVERTER NO.2 +16V	VOLTS	18.0	16.0	15.7*	260 21:28:38	0	
D21	VLT	CONVERTER NO.2 +9V	VOLTS	10.0	8.0	9.2	260 21:28:10	0	
D22	VLT	CONVERTER NO.2 +5V	VOLTS	5.5	4.5	5.0	256 21:28:36	0	
D23	VLT	CONVERTER NO.2 -6V	VOLTS	7.0	5.0	-6.0*	146 21:29:13	0	
D24	VLT	CONVERTER NO.3 +70V	VOLTS	75.0	66.0	69.8	256 21:28:40	0	
D25	VLT	CONVERTER NO.3 +23V	VOLTS	28.0	21.0	23.1	257 21:28:50	0	
D26	VLT	CONVERTER NO.4 +70V	VOLTS	75.0	66.0	ER1* 0*	000 21:28:53	0	
D27	VLT	CONVERTER NO.4 +23V	VOLTS	24.0	21.0	.5*	004 21:28:55	0	
D28	VLT	CONVERTER NO.5 +16V	VOLTS	28.0	15.0	16.1	255 21:28:42	0	
D29	VLT	CONVERTER NO.5 +9V	VOLTS	10.0	8.0	9.0	254 21:28:43	0	
D30	VLT	CONVERTER NO.5 -6V	VOLTS	-5.0	-7.0	-6.1	141 21:28:44	0	
D31	VLT	CONVERTER NO.5 -16V	VOLTS	-15.0	-17.0	-15.9	143 21:28:45	0	
D32	VLT	CONVERTER NO.6 +16V	VOLTS	17.0	14.0	16.4	254 21:29: 0	0	
D33	VLT	CONVERTER NO.6 +9V	VOLTS	10.0	8.0	8.8	255 21:29: 2	0	
D34	VLT	CONVERTER NO.6 -6V	VOLTS	-5.0	-7.0	-6.1	142 21:29: 3	0	
D35	VLT	CONVERTER NO.6 -16V	VOLTS	-18.0	-15.0	-16.2*	137 21:29: 4	0	
D36	VLT	CONVERTER NO.7 +16V	VOLTS	17.0	14.0	16.1	255 21:29:11	0	
D37	VLT	CONVERTER NO.7 +9V	VOLTS	10.0	6.0	9.2	264 21:29:12	0	
D38	VLT	CONVERTER NO.7 -6V	VOLTS	-4.0	-6.0	-5.9	150 21:29:40	0	
D39	VLT	CONVERTER NO.8 +16V	VOLTS	18.0	15.0	16.0	260 21:28:56	0	
D40	VLT	CONVERTER NO.8 +9V	VOLTS	10.0	8.0	9.1	263 21:28:57	0	
D41	VLT	CONVERTER NO.8 -6V	VOLTS	-5.0	-7.0	-6.0	147 21:28:58	0	
D42	VLT	CONVERTER NO.9 +20	VOLTS	22.0	19.0	20.2	260 21:30:13	0	
D43	VLT	CONVERTER NO.9 +10	VOLTS	11.0	9.0	10.4	263 21:29: 5	0	
D44	VLT	CONVERTER NO.9 -20	VOLTS	-18.0	-22.0	-20.4	145 21:29: 6	0	
D45	VLT	CONVERTER NO.9 +2461AC	AC VLT	29.0	26.0	26.9	141 21:29: 7	0	≡ITUDE (NAUT. MILES) 38.7
D46	VLT	ACS INVERTER 400 CPS	AC VOLT	130.0	410.0	116.4*	277 21:29: 8	0	
D50	TMP	BATTERY 2A	DEG.C	70.0	10.0	10.9	232 21:29:18	0	
D51	TMP	BATTERY 2B	DEG.C	70.0	10.0	10.3	234 21:29:19	0	
E1	TMP	ARRAY NO.1 INBOARD	DEG.C	30.0	-30.0	ER1* 0*	000 21:28: 0	0	
E2	TMP	ARRAY NO.1 OUTBOARD	DEG.C	30.0	-30.0	ER1* 0*	000 21:28: 2	0	
E3	TMP	ARRAY NO.2 INBOARD	DEG.C	30.0	-30.0	ER1* 0*	000 21:28: 3	0	
E4	TMP	ARRAY NO.2 OUTBOARD	DEG.C	30.0	-30.0	ER1* 0*	000 21:28: 4	0	
E5	TMP	MTG PLATE MON.LOUVERED	DEG.C	40.0	10.0	7.9*	245 21:28: 5	0	AT IT (NAUT. MILES) 38.7
E6	TMP	MTG PLATE MON.LOUVERED	DEG.C	40.0	10.0	14.9	216 21:28: 6	0	

SATID	YR	STA	AF	AT	BF	BTPE	DIG T	DAY	SEC	TPNO	FN
64491	64	020	01	0046	01	0046	053	0	53	76986	2346 01

SATID	YR	MO	DAY	ST.ECLP	ED.ECLP	ST.ORBIT	END.ORBT	NON	TURN	EPOCH	RAT	ORB	AXIS	ECCEN	INC	ΔON	DLON	PGE	DPGE	PER	DPER
50	50	50	50	01	01	0	01	01	0	01	01	0	01	01	0	01	01	0		50	50.0	*****	50	50	50	50	50	50	50.0

Figure 8-12. Typical Printout of Spacecraft Subsystems Measurements



CHN	DESCRIPTION	ES	STATUS	TIME	BE
A6	SUN ALARM SIGNAL	SUN PRESENT	UNDEF'D READOUT(OCT)	322 21:43:45	0
A7	HOR.SCAN.TRACK.CHK.SIG.	EARTH PRESENT	HEAD A.B.C.D OFF	001 21:43:31	0
A18	DRV.MTPS.-OPEP/ARRAY	OFF-CW-CCW	ARRAY OFF.OPEP OFF	370 21:43:40	0
A20	REACTION WHL DIRECTION	ROLL/PITCH/YAW	UNDEF'D READOUT(OCT)	370 21:43:45	0
A21	GAS CONTROL	VALVE NO.1.2.5	UNDEF'D READOUT(OCT)	000 21:42:58	0
A22	GAS CONTROL	VALVE NO.3.4.6	UNDEF'D READOUT(OCT)	000 21:42:59	0
A23	ACS MODE LOGIC	MOD.RLY/SUN SEN.INT	CONN.MODE 3 SUN OFF	264 21:43:46	0
A27	INERTIAL REFERENCE	GYRO A OR B	GYRO 1 ON	104 21:43:50	0
A28	INERT REFER GYRO MT.MON	TACH.EVENT	GYRO 1.2 SYNCH SPD.	010 21:43:51	0
A31	REACTION WHEEL DRIVE	ROLL/PITCH/YAW	ROLL.PITCH.YAW OFF	371 21:42:57	0
A36	ACS INVERTER GATED	OUTPUT	UNDEF'D READOUT(OCT)	000 21:44:36	0
B1	BOOM HINGES	E.P.5.HINGES(1.2.3)	UNLTCH	371 21:42:54	0
B2	BOOM HINGES	E.P.6.HINGES(1.2.3)	UNLTCH	371 21:42:56	0
B3	BOOM HINGES	PADDLE1.HINGE 1.2.3	HINGES 1.2 ON	043 21:42:57	0
B4	SEPARAT.AND ARRAY HINGE	SL.PAD2 HINGE 1.2.3	UNLTCH	371 21:42:58	0
B5	BOOM HINGES	E.P.(1.2.3).HINGE	EXP PKG 1 ANT 1	140 21:42:59	0
B6	BOOM HINGES	E.P.4.CLT.JET(1.2)	EXP PKG 1.3 ANT 1	100 21:43: 1	0
B7	BOOM HINGES	HINGE OPEP(1.2)-	UNLTCH	371 21:43: 2	0
C16	RECEIVER 2	AGC 2	-10 TO -90	033 21:43:58	0
D3	CHARGE REGULATOR 1 (A)	CHG.RT.RLY-BATT.MON	E LIM LOW/CHARGE/1AMP	000 21:43:37	0
D15	SYNC SIGNAL AMPL	400 CPS	NORMAL	164 21:43:13	0
D16	SYNC SIGNAL AMPL	2461 CPS 0 DEG	NORMAL	166 21:43:14	0
D17	SYNC SIGNAL AMPL	2461 CPS 90 DEG	NORMAL	163 21:43:15	0
D47	CHARGE REGULATOR 1	SW-RSET-K51-TMP-CDU	NOR-FDNRG-NRG-<125-DNRG	075 21:43: 2	0
D48	CHARGE REGULATOR 2 (B)	CUR RLY-BAT(CUR/VLT	E LIM LOW/CHARGE/1AMP	000 21:43:21	0
D49	CHARGE REGULATOR 2	SW-RSET-K51-TMP-CDU	NOR-FDNRG-NRG-<125-DNRG	075 21:43:39	0
F25-33	VOLTAGE CALIBRATION	1-1 (0.00-0.02 VLT)	0 (DEC) NOR.R/O 0.1	000 21:44:19	0
F26-34	VOLTAGE CALIBRATION	2-1 (0.50-0.52 VLT)	26 (DEC) NOR.R/O 25.26	032 21:44:17	0
F27-35	VOLTAGE CALIBRATION	1-2 (1.70-1.72 VLT)	85 (DEC) NOR.R/O 85.86	125 21:44:20	0
F28-36	VOLTAGE CALIBRATION	2-2 (2.64-2.66 VLT)	132 (DEC)NOR.R/O 132.133	204 21:44:19	0
F29-37	VOLTAGE CALIBRATION	1-3 (3.18-3.20 VLT)	159 (DEC)NOR.R/O 159.160	237 21:44:21	0
F30-38	VOLTAGE CALIBRATION	2-3 (4.12-4.12 VLT)	206 (DEC)NOR.R/O 206.207	316 21:44:20	0
F31-39	VOLTAGE CALIBRATION	1-4 (5.06-5.06 VLT)	253 (DEC)NOR.R/O 253.254	375 21:44:22	0
F40	C.D.U	BOOM DEPLOY(GR.1-2)	EXP.ORD.ON	101 21:42:56	0
F41	SIGNAL CONDITION	RECEIV(1.2)SIG.PRES	RECEIVER NO.1.2 ON	131 21:44:23	0
F42	TAPE RECORDER NO.1	RECORD-PLAYBACK-OFF	417 (OCT) RECORDING	417 21:44:15	0
F43	TAPE RECORDER NO.2	RECORD-PLAYBACK-OFF	400 (OCT) OFF	400 21:44:33	0
F44	LOW FREQ.TIME.ASSEMBLY	EQUIP.GR.1OR2 TO TP	LOW BIT RATE	162 21:44:52	0

SATID	YR	STA	AF	AT	BF	BTPE	DIG	T	DAY	SEC	TPNO	FN
64491	64	020	01	0046	01	0046	053	0	53	76986	2346	01

SATID	YR	MO	DAY	ST.ECLP	END.EC	P	S.ORBIT	N.ORBT	B	ON	EPOCH	D	T	OD	AXIS	ECCEN	INC	ON	GN	GE	DPGE	BER
50	50	50	50	0:	0:	0	0:	0:	0	0:	0:	0	0:	0	0:	0	0	0	0	0	0	0	0	0	0	0	50.0	*****	50	50	50	50	50	0.0

Figure 8-13. Typical Printout of Spacecraft Subsystems Status

8.3 ATTITUDE ORBIT PROGRAM

Basically, the attitude-orbit program computes the attitude of the spacecraft from orbit data and spacecraft sensor data. These data are obtained from orbit and aspect-housekeeping tapes (Figure 8-14). In addition, the program carries over orbital data from the orbit tape directly onto the attitude-orbit tapes.

The formats for these tapes are given in Tables 8-4 through 8-6. The attitude orbit program produces 22 attitude-orbit tapes, made up of three groups: (1) seven tapes in Univac high density, (2) one tape in IBM low density, and (3) fourteen tapes in IBM high density.

In actual operation, the orientation of the OGO-A satellite is maintained with one face of the spacecraft body directed toward the earth, with an orientation such that the solar array may become normal to the sun vector, and that the orbit plane experiment package (OPEP) may become aligned in the orbit plane. It is the orientation of these functions that is computed by the attitude-orbit program. First the program computes ideal spacecraft attitudes in nine coordinate axes in terms expressed in celestial coordinates. It then computes actual attitude by applying corrections telemetered from on-board sensors. These correction factors are listed in Table 8-7 and are supplied from aspect-housekeeping tapes.

Since the orbit tapes come from the advanced orbital programming branch, orbit tapes must first be examined by the Production Control Center for correlating start times with those of the aspect-housekeeping tape as illustrated in Figure 8-15. This operation precedes initial processing on the Univac 1107.

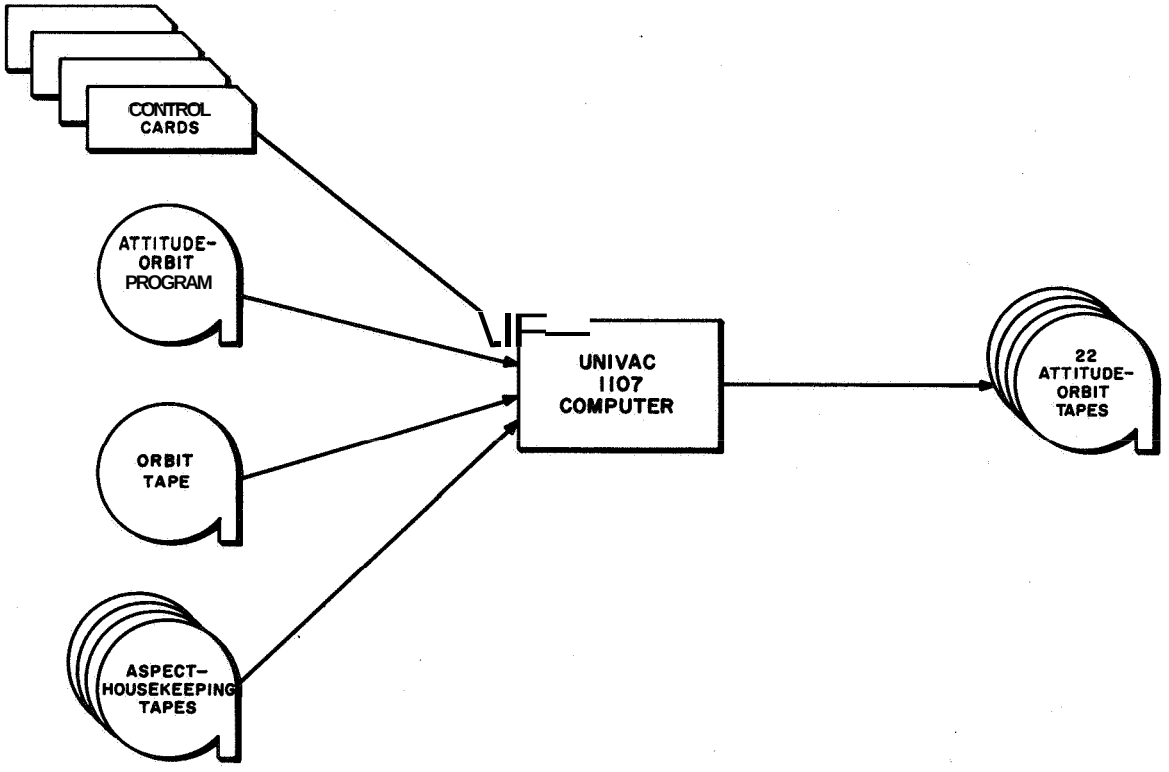


Figure 8-14. Attitude Orbit Program Flow Chart

TABLE 8-4
ORBITAL 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
5	Floating Pt.	Day Count of Year — U. T. Start Time of Satellite Data
6	Floating Pt.	Seconds of Day
7	Floating Pt.	Date
8	Floating Pt.	Day Count of Year — U.T. End Time of Satellite Data
9	Floating Pt.	Seconds of Day
10	Floating Pt.	= Δt 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
28	Floating Pt.	Day Count of Year — Coordinate System
29	Floating Pt.	Apparent Sidereal Time in radians — Reference Data Time and Position
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.)
48	Floating Pt.	Rate of change of R.A. of ascending node, $\dot{\Omega}$ (deg./day)
49	Floating Pt.	Argument of perigee, ω (deg.)
50	Floating Pt.	Rate of change of argument of perigee, $\dot{w}$ (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

TABLE 8-4 (Continued)
ORBITAL TAPE FORMAT

Data Binary Record Format		
Word No.	Form	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.	Date of data
3	Floating Pt.	Day count of Year Time of Data Item
4	Floating Pt.	Second of Day
5	Floating Pt.	X
6	Floating Pt.	Y Satellite Position
7	Floating Pt.	Z Vector in km.
8	Floating Pt.	X
9	Floating Pt.	Y Satellite Velocity
10	Floating Pt.	Z Vector in km./sec.
11	Floating Pt.	Longitude (deg.)
12	Floating Pt.	Latitude (deg.) Geodetic Position
13	Floating Pt.	Height above spheroid (km.)
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	Fixes 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 sentinal 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.

TABLE 8-4 (Continued)

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.

ATTITUDE-ORBIT TAPE FORMAT LABEL RECORD

Word Number	Symbol	Function	units
1		Identification	
2		Date	Year
3			Month
4			Day
5	t_{E1}	Start Time of Eclipse	Day Count
6			Milliseconds of Day
7	t_{E2}	End Time of Eclipse	Day Count
8			Milliseconds of Day
9	t_o	Start Time of Orbit	Day Count
10		(Time of Ascending Node)	Milliseconds of Day
11	t_{o+1}	End Time of Orbit	Day Count
12		(Time of Next Ascending Node)	Milliseconds of Day
13	t_n	Time of Predicted	Day Count
14		Noon Turn	Milliseconds of Day
15	τ	Epoch	Day Count
16			Milliseconds of Day
17	t	Sampling Rate	Milliseconds
18		Orbit Number	
19	a	Semi-Major Axis	Earth Radii
20	e	Eccentricity	Ratio
21	i	Inclination	Degrees
22	Ω	Longitude of Ascending Node	Degrees
23	$\dot{\Omega}$	Rate of Change of Omega	Degrees/Day
24	μ	Argument of Perigee	Degrees
25	$\dot{\mu}$	Rate of Change of Omega	Degrees/Day
26	T	Period	Minutes
27	$\dot{T}$	Rate of Change of T	Minutes/Day
28 to 250		Spares	

TABLE 8-6
FORMAT OF THE ATTITUDE-ORBIT TAPE DATA RECORD

Word Number	Symbol	Function	units
1	T_i	Time	Day Count
2			Milliseconds of Day
3	T_L	Local Time (of Sub-Satellite Point)	Hours
4			Minutes
5			Tenth of Minutes
6	α	Right Ascension of Satellite	Degrees
7	δ	Declination of Satellite	Degrees
8	P_X	Position Vector	Kilometers
9	P_Y		
10	P_Z		
11	V_X	Velocity Vector	Kilometers/Sec
12	V_Y		
13	V_Z		
14	S_X	Solar Vector	Kilometers
15	S_Y		
16	S_Z		
17	ϕ	Latitude	Degrees, North = + South = -
18	λ	Longitude	Degrees, East = + West = -
19	h	Height Above Spheroid	Kilometers
20	v	True Anomaly	Degrees
21	Φ	Sun Earth Satellite Angle	Degrees
22	X_{BXI}	Ideal Main Body Roll Axis	Unit Vector
23	X_{BYI}		
24	X_{BZI}		
25	Y_{BXI}	Ideal Main Body Pitch Axis	Unit Vector
26	Y_{BYI}		
27	Y_{BZI}		
28	Z_{BXI}	Ideal Main Body Yaw Axis	Unit Vector
29	Z_{BYI}		
30	Z_{BZI}		
31	X_{PXI}	Ideal Paddle Roll *Axis*	Unit Vector
32	X_{PYI}		
33	X_{PZI}		
34	Y_{PXI}	Ideal Paddle Pitch *Axis*	Unit Vector
35	Y_{PYI}		
36	Y_{PZI}		
37	Z_{PXI}	Ideal Paddle Yaw *Axis*	Unit Vector
38	Z_{PYI}		
39	Z_{PZI}		
40	X_{EXI}	Opep Ideal Roll *Axis*	Unit Vector
41	X_{EYI}		
42	X_{EZI}		
43	Y_{EXI}	Opep Ideal Pitch *Axis*	Unit Vector
44	Y_{EYI}		
45	Y_{EZI}		
46	Z_{EXI}	Opep Ideal Yaw *Axis*	Unit Vector
47	Z_{EYI}		
48	Z_{EZI}		

TABLE 8-6 (Continued)
FORMAT OF THE ATTITUDE–ORBIT TAPE DATA RECORD

Word Number	Symbol	Function	units
49	X_{BX}		
50	X_{BY}	Actual Main Body Roll	Unit Vector
51	X_{BZ}	Axis	
52			
53	Y_{BZ}	Actual Main Body Pitch	Unit Vector
54		Axis	
55	Z_{BX}		
56	Z_{BY}	Actual Main Body Yaw	Unit Vector
57	Z_{BZ}	Axis	
58	X_{PX}		
59	X_{PY}	Actual Paddle Roll *Axis*	Unit Vector
60	X_{PZ}		
61	Y_{PX}		
62	Y_{PY}	Actual Paddle Pitch Axis	Unit Vector
63	Y_{PZ}		
64	Z_{PX}		
65	Z_{PY}	Actual Paddle Yaw *Axis*	Unit Vector
66	Z_{PZ}		
67	X_{EX}		
68	X_{EY}	Opep Actual Roll Axis	Unit Vector
69	X_{EZ}		
70	EX		
71	EY	Opep Actual Pitch *Axis*	Unit Vector
72	Y_{EZ}		
73	EX		
74	EY		
75	EZ	Opep Actual Yaw Axis	Unit Vector
	GEOMAGNETIC COORDINATES OF SATELLITE REAL FIELD COORDINATES		
76	R_O	Range	Earth Radii
77	ϕ_M	Latitude	Degrees
78	L	McIllwain Parameter	Earth Radii
79	B	Field Strength	Gamma
80	B/B_o		Ratio
81	ϕ_E	Latitude of Intersection of Field Line and Earth Ingress	Degrees
82	λ_E	Longitude of Intersection of Field Line and Earth Ingress	Degrees
83	ϕ_{EI}	Latitude of Intersection of Field Line and Earth Egress	Degrees
84	λ_{EI}	Longitude of Intersection of Field Line and Earth Egress	Degrees
85	B_X		
86	B_Y	Components of B Vector	Unit Vector
87	B_Z		
88	B_{XB}	Local Field (Roll *Axis)* Vector Expressed in terms of the body system	Unit Vector

TABLE 8-6 (Continued)
FORMAT OF THE ATTITUDE-ORBIT TAPE DATA RECORD

Word Number	Symbol	Function	units
89	B_{YB}	Local Field (Pitch Axis) Vector Expressed in terms of the Body System	Unit Vector
90	B_{ZB}	Local Field (Yaw Axis) Vector Expressed in terms of the Body System	Unit Vector
91	B_{XP}	Local Field (Roll Axis) Vector Expressed in terms of the Paddle System	Unit Vector
92	B_{YP}	Local Field (Pitch Axis) Vector Expressed in terms of the Paddle System	Unit Vector
93	B_{ZP}	Local Field (Yaw Axis) Vector Expressed in terms of the Paddle System	Unit Vector
94	B_{XE}	Local Field (Roll Axis) Vector Expressed in terms of the OPEP System	Unit Vector
95	BYE	Local Field (Pitch Axis) Vector Expressed in terms of the OPEP System	Unit Vector
96	B_{ZE}	Local Field (YAWAXIS) Vector Expressed in terms of the OPEP System	Unit Vector
TOPOCENTRIC HORIZONTAL COORDINATES			
97	B_{XO}	Directed towards the East	Gamma
98	B_{YO}	Directed towards the North	Gamma
99	B_{ZO}	Zenith of Observer	Gamma
		(A Bit or any combination of Bits in the Housekeeping Data Flag signifies that the Ideal Value for the Flagged Function was used in the Computation of the actual Attitude)	Roll $= 2^0$ Pitch $= 2'$ Yaw $= 2^2$ $\psi e = 2^3$ $\phi p = 2^4$

Word Number	Symbol	Function	units
		(The same Flagging Method as the Housekeeping Data Flag, except it signifies that the particular Housekeeping Function is **of** a suspect nature)	Roll $= 2^0$ pitch $= 2'$ Yaw $= 2^2$ $\psi e = 2^3$ $\phi p = 2^4$
103 to 125		Spares	
126	T_2	Same Data as Words **1** to **125** at Times T_2	
250		Where $T_2 = T_1 + \Delta t$	

All Data is represented in Floating Point Format

Bits 0 to 8 = Characteristic
Bits 9 to **35** = Mantissa

All Data Flags are represented in Floating Point Notation. Interpretation **of** the Data Flag consists **of** converting the Floating Point Number to its Binary Equivalent and Associating the Resultant Binary Configuration with the Housekeeping Data Flag List as described by the Data Flag, e.g.

Housekeeping Data Flag = $12_{(10)}$ This means that the Computation **of** the Actual Attitude was performed using Ideal Values **of** Yaw and ψe Opep Angles.

$12_{(10)} = 0\ 1\ 1\ 0\ 0$

$2^4\ 2^3\ 2^2\ 2^1\ 2^0$

ψe Yaw

TABLE 8-7
TELEMETRY SIGNALS FROM ASPECT HOUSEKEEPING TAPE

Used In Attitude Computations

FUNCTION	SYMBOL	SOURCE	UNITS	RANGE	SAMPLING RATE	OUTPUT	TELEMETRY IDENTIFICATION	COMMENT
ERROR SIGNALS								
Main Body Pitch Error	ϵ_θ	Horizon Scanner	Degrees	±10 Degrees	1 Sample /73.7 Sec	Analog Voltage	A-4-121-025-25 -089-25	
Main Body Roll Error	ϵ_ϕ	Horizon Scanner	Degrees	±10 Degrees	1 Sample /73.7 Sec	Analog Voltage	A-5-121-026-26 -090-26	
Main Body Yaw Error	ϵ_ψ	Sun Sensor	Degrees	±90 Degrees	1 Sample /147.4 Sec	Analog Voltage	A10-121-023-23	
ANGLES								
Solar Array Angle	ϕ_p	Solar Array Drive	[illegible]	±90 Degrees	1 Sample /147.4 Sec	Analog Voltage	A12-121-007-07 A13-121-008-08	A12 = SIN ϕ_p A13 = COS ϕ_p
OPEP Angle	ψ_e	OPEP Drive	[illegible]	±90 Degrees	1 Sample /147.4 Sec	Analog Voltage	A14-121-014-14 A15-121-015-15	A14 = SIN ψ_e A15 = COS ψ_e

OPEP = Orbital Plane Experiment Package

General Format of Aspect Housekeeping Tape Same as Decom Tape

Complete Contents of Data Records of Aspect Housekeeping Tape Contained in the Instrumentation List (Appendix)

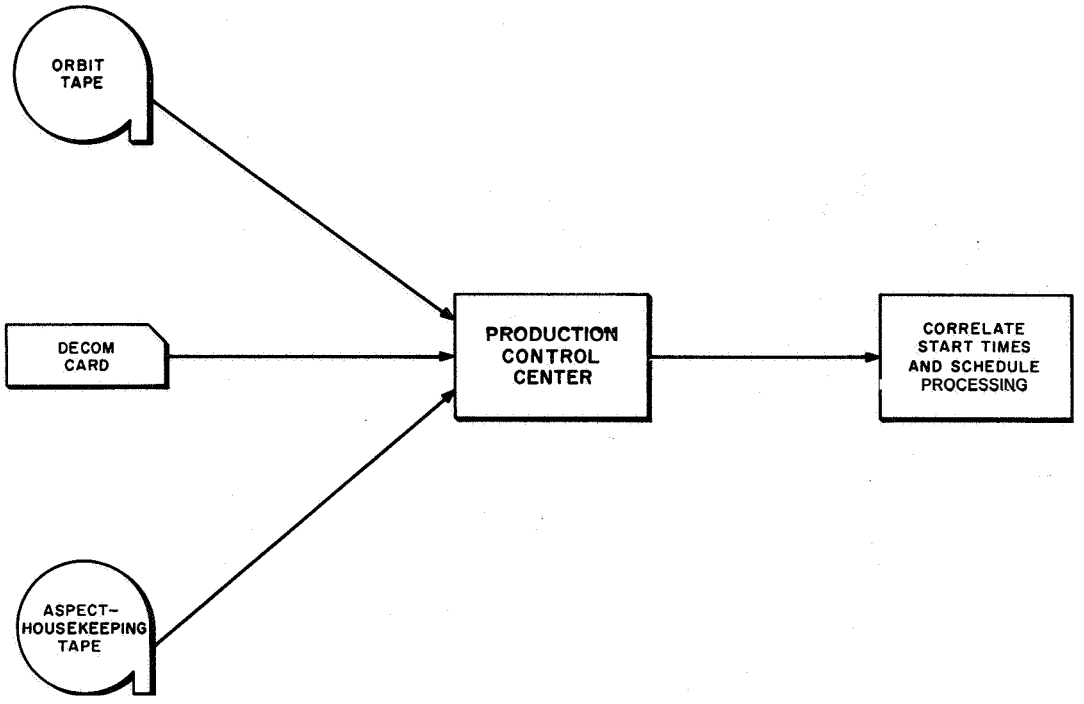


Figure 8-15. Process Scheduling Flow Chart for Attitude-Orbit Program

After the attitude-orbit tapes have been generated, a series of three post-generating operations are performed on attitude-orbit tapes prior to shipment. These post-generating programs (Figure **8-16)** are as follows: (1) Quick look printout program, **(2)** bookkeeping program, and **(3)** plot program.

The quick look printout program prints the label and the data records illustrated in Figures **8-17** and **8-18.** These are typical printouts of desired information that have been selected by key-in instructions which may be included in all or any part of the data desired. The output is intended for use by analysts and the Production Control Center. The bookkeeping program is called so because it records such facts about the data as data gaps, orbit identification, start and stop times, data errors, etc. These processed facts are both printed out for immediate analysis and punched out on cards for further statistical analysis and storage.

The plot program extracts all attitude and orbital functions from attitude-orbit tapes and generates a plot tape for use on the SC **4020** plotter. A typical example of a functional plot is shown in Figure **8-19.**

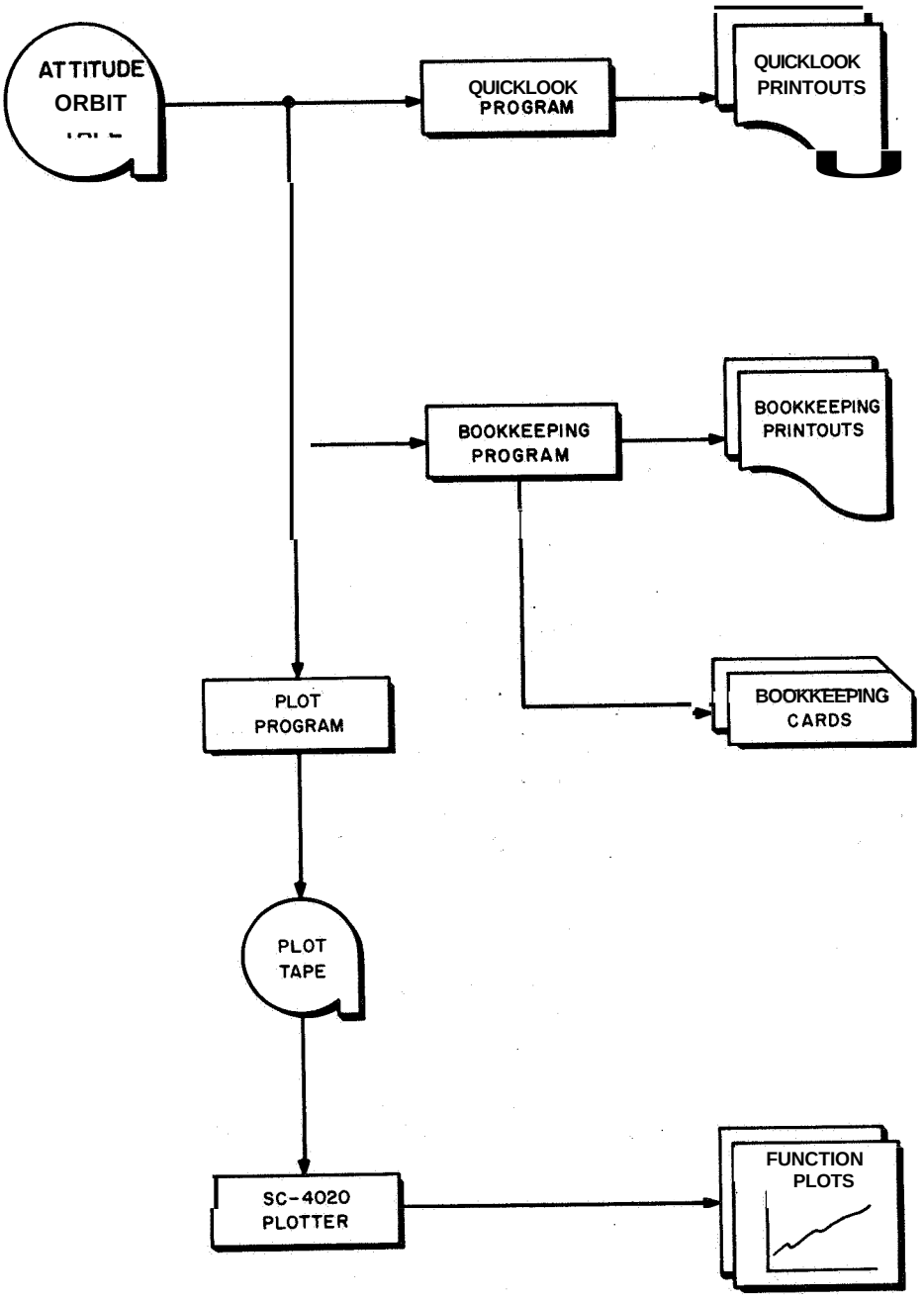
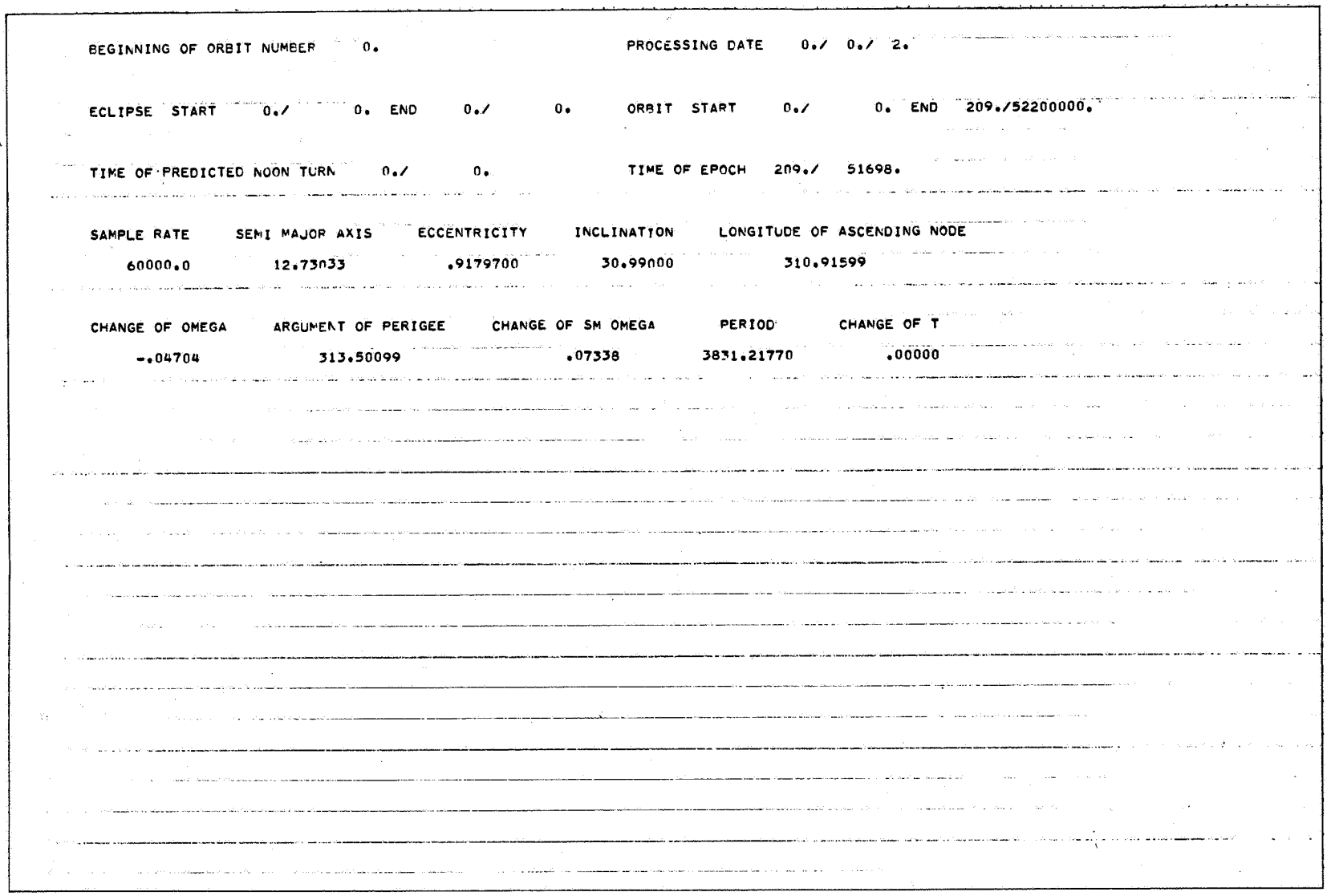


Figure 8-16. Post-Generating Attitude-Orbit Program



BEGINNING OF ORBIT NUMBER 0. PROCESSING DATE 0./ 0./ 2.

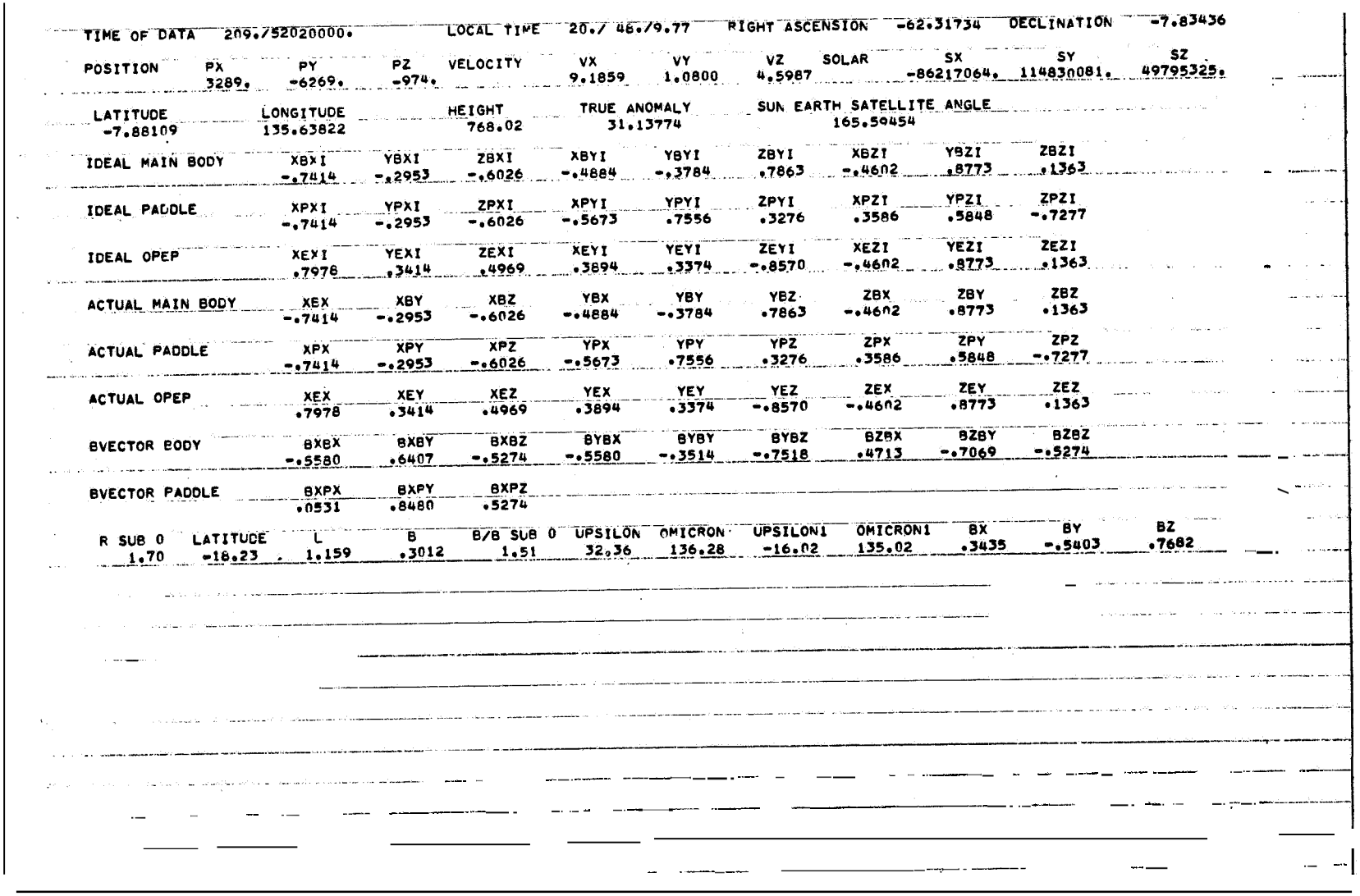
ECLIPSE START 0./ 0. END 0./ 0. ORBIT START 0./ 0. END 209./52200000.

TIME OF PREDICTED NOON TURN 0./ 0. TIME OF EPOCH 209./ 51698.

SAMPLE RATE	SEMI MAJOR AXIS	ECCENTRICITY	INCLINATION	LONGITUDE OF ASCENDING NODE
60000.0	12.73033	.9179700	30.99000	310.91599

CHANGE OF OMEGA	ARGUMENT OF PERIGEE	CHANGE OF SM OMEGA	PERIOD	CHANGE OF T
-.04704	313.50099	.07338	3831.21770	.00000

Figure 8-17. Printout of Identification Record of Attitude Output Tape



TIME OF DATA	209./52020000.		LOCAL TIME	20./ 46./9.77		RIGHT ASCENSION	-62.31734	DECLINATION	-7.83436	
POSITION	PX	PY	PZ	VELOCITY	VX	VY	VZ	SOLAR	SX	SY	SZ
	3289.	-6269.	-974.		9.1859	1.0800	4.5987		-86217064.	114830081.	49795325.
LATITUDE	LONGITUDE		HEIGHT	TRUE ANOMALY		SUN EARTH SATELLITE ANGLE				
-7.88109	135.63822		768.02	31.13774		165.59454				
IDEAL MAIN BODY	XBXI	YBXI	ZBXI	XBYI	YBYI	ZBYI	XBZI	YBZI	ZBZI	
	-.7414	-.2953	-.6026	-.4884	-.3784	.7863	-.4602	.8773	.1363	
IDEAL PADDLE	XPXI	YPXI	ZPXI	XPYI	YPYI	ZPYI	XPZI	YPZI	ZPZI	
	-.7414	-.2953	-.6026	-.5673	.7556	.3276	.3586	.5848	-.7277	
IDEAL OPEP	XEXI	YEXI	ZEXI	XEYI	YEYI	ZEYI	XEZI	YEZI	ZEZI	
	.7978	.3414	.4969	.3894	.3374	-.8570	-.4602	.8773	.1363	
ACTUAL MAIN BODY	XBX	XBY	XBZ	YBX	YBY	YBZ	ZBX	ZBY	ZBZ	
	-.7414	-.2953	-.6026	-.4884	-.3784	.7863	-.4602	.8773	.1363	
ACTUAL PADDLE	XPX	XPY	XPZ	YPX	YPY	YPZ	ZPX	ZPY	ZPZ	
	-.7414	-.2953	-.6026	-.5673	.7556	.3276	.3586	.5848	-.7277	
ACTUAL OPEP	XEX	XEY	XEZ	YEX	YEY	YEZ	ZEX	ZEY	ZEZ	
	.7978	.3414	.4969	.3894	.3374	-.8570	-.4602	.8773	.1363	
BVECTOR BODY	BXBX	BXBY	BXBZ	BYBX	BYBY	BYBZ	BZBX	BZBY	BZBZ	
	-.5580	.6407	-.5274	-.5580	-.3514	-.7518	.4713	-.7069	-.5274	
BVECTOR PADDLE	BXPX	BXPY	BXPZ							
	.0531	.8480	.5274							
R SUB 0	LATITUDE	L	B	B/B SUB 0	UPSILON	OMICRON	UPSILON1	OMICRON1	BX	BY	BZ
1.70	-18.23	1.159	.3012	1.51	32.36	136.28	-16.02	135.02	.3435	-.5403	.7682

Figure 8-18. Printout of Data Record of Attitude-Orbit Tape

A– TRUE ANOMALY
B – SUN-EARTH-SATELLITE (SES) ANGLE

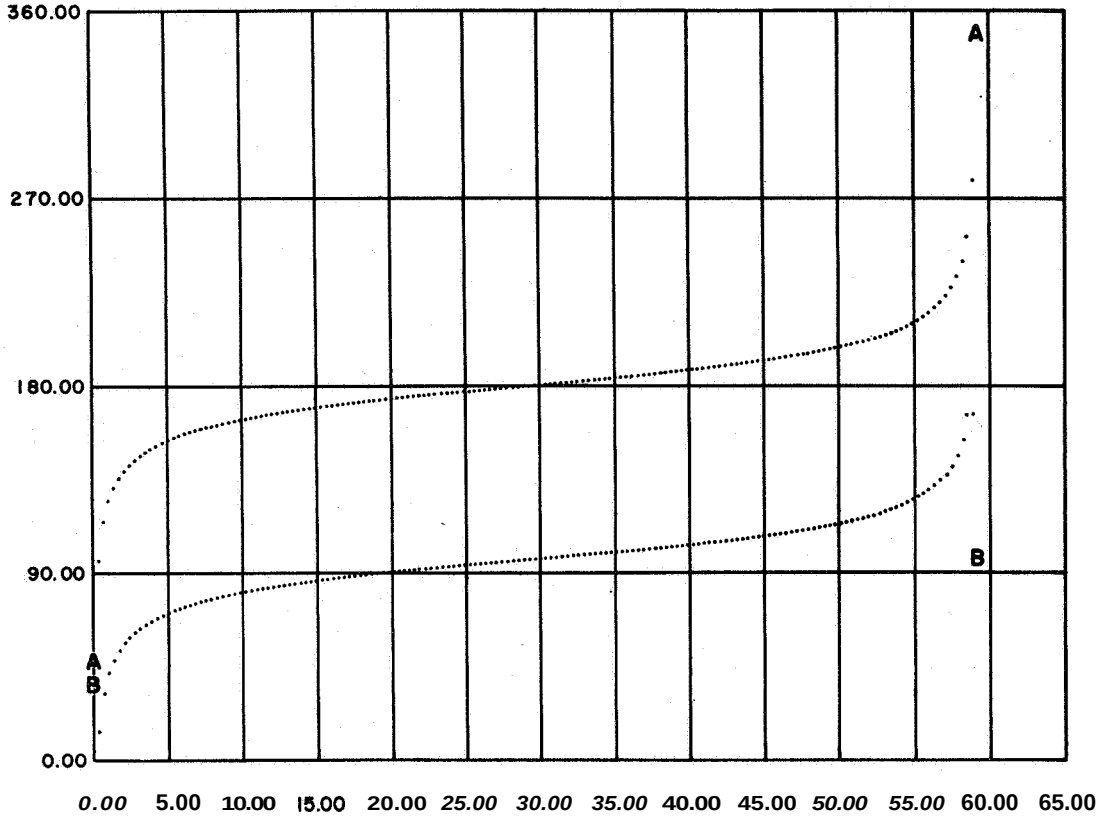


Figure 8-19. Typical Example of a Functional Plot

SECTION 9
SPECIAL PURPOSE DATA PROCESSING

The frequency modulation (FM) special purpose data is processed in an entirely separate operation as shown in the OGO-A data processing flow chart, Figure 5-1. Processing is accomplished on the rubidium vapor magnetometer line. This line receives data from either of two sources. One source is the conventional analog tape, and the other source is real time data supplied from leased lines connected to the Rosman data acquisition station. Analog tapes from FM special purpose telemetry are handled separately as if the data were from a different satellite. FM data from experiment No. 17 is merely evaluated at GSFC and duplicated. Analog FM data for experiment No. 11, however, is processed on the rubidium vapor magnetometer line into a buffer tape. A special purpose quality control program inspects the digitized data, prints out a quality control listing (Figure 9-1), writes a special purpose edit tape, and punches a documentation card (Figure 9-2).

9.1 OGO-A SPECIAL PURPOSE TELEMETRY

The OGO-A special purpose telemetry system is used for the transmission of data from the rubidium vapor magnetometer. The nature of this data is such that it is not well adapted to a PCM telemetry system in which it would have to be multiplexed with other signals. The signal is therefore transmitted separately on two of the five special purpose telemetry channels. The magnetometer output signal is a noisy sine wave with a frequency proportional to the magnetic field intensity. The magnetometer frequency range is from about 10 cps for weak fields at apogee to frequencies above 100kc for the high fields near the earth at perigee. Since the response of the special purpose telemetry system is limited from 300 cps to 100kc, it is necessary to use two channels for the magnetometer signal. Channel 1 is modulated by the signal taken directly from the magnetometer and handles magnetometer frequencies between 300 cps and 100kc. Channel 2 had a 40kc subcarrier which is phase-modulated by the magnetometer signal for frequencies between 10 cps and 600 cps. Figure 9-3 shows the special purpose rubidium vapor magnetometer data processing line.

9.2 SPECIAL PURPOSE DATA PROCESSOR

The special processor for the OGO-A magnetometer data is outlined in Figure 9-4. 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 1kc, 10kc, or 100kc. The tape deck can be made to reproduce the signals at either 1, 2, 4, 8, or 16 times the recorded speed, selectible by pushbutton control. When processing the direct magnetometer signal (channel 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 the time decoder, is multiplied to 5 Mc to be used for the timing in the frequency measuring unit. By using this recorded standard frequency in this manner, compensation is obtained for effects of tape recorder 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

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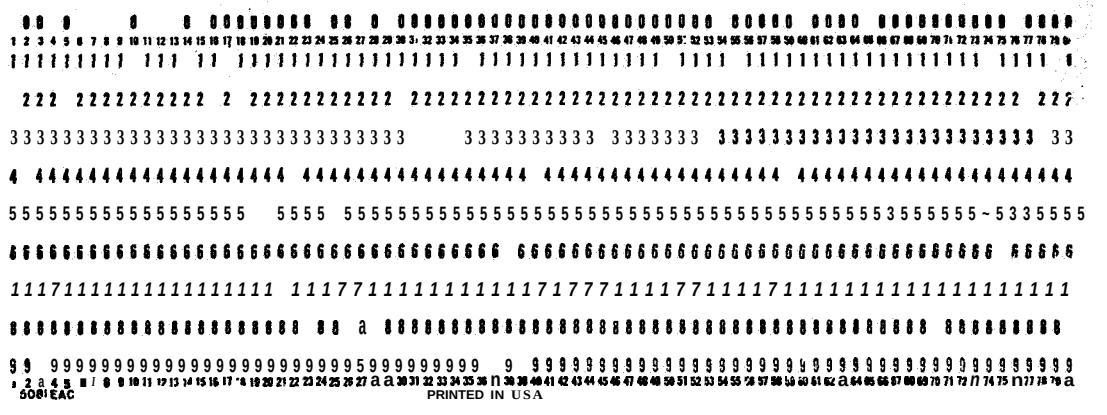
STA	TAPE NO	FILE NO	DATE RECORD	PASS NO		START TIME	STOP TIME	BUF NO	L	EDIT TAPE	EDIT FILE	RECVD DATE	DIGIT DATE	EDIT DATE	BCD M BIE	SHIP DATE	COMMENTS	
SKA	0C01	C1	64C9C6	CC01	A	C1552C	023830					40916						*
QUI	0C09	C1	64C9C7	CCC2	A	190551	192915					40921						*
RDS	0C17	C1	64C9C7	CCC2	A	191615	193115					40909	UD21					*
QUI	0C1C	C1	64C9C7	CCC2	A	19284C	193145					40916						*
SKA	0CC2	C1	64C9C7	CCC2	A	1936CC	19510C					40916						*
RDS	0C28	C1	64C913	CCC4	A	C32700	C41524					40924						*
SKA	0CC5	C1	64C913	CCC4	A	C32705	C34400					40921	UD21					*
SKA	0CC6	C1	64C913	CCC4	A	C34400	C4CC0C					40921	UD20					*
SKA	C007	C1	64C913	CCC4	A	C40000	041500					40921	UD21					*
RDS	0C3C	C1	64C913	CC04	A	041412	04303C					40924						*
SKA	0CC8	C1	64C913	CCC4	A	041500	043100					40921	UD21					*
RDS	CC31	C1	64C913	CCC4	A	042912	044600					40924						*
SKA	0009	C1	64C913	CCC4	A	043100	044300					40921	UD21					*
SKA	CC12	C1	64C913	CCC4	A	060700	062400					40921	UD21					*
RDS	0C32	C1	640913	CCC4	A	060710	062135					40924						*
RDS	0C33	C1	64C913	CCC4	A	0621C3	06264C					40924						*
SKA	0013	C1	640913	CCC4	A	062400	062600					40921	UD21					*
RDS	0C41	C1	64C913	CCC4	A	231110	232410					40924						*
QUI	0C34	C1	64C913	CCC4	A	231845	235020					40924						*
RDS	0C42	C1	64C913	CCC4	A	23231C	23361C					40924						*
RDS	0043	C1	64C913	CCC4	A	233510	23481C					40924						*
RDS	0044	C1	64C913	CCC4	A	234710	23492C					40924						*
RDS	0051	01	640915	CCC5	A	184124	185740					40924						*
RDS	0053	01	64C915	CCC5	A	185540	191042					40924						*
QUI	0C38	C1	64C915	CCC5	A	191332	194545					40928						*
QUI	0040	C1	64C915	CCC5	A	194431	194800					40924						*
RDS	0061	01	640915	CCC5	A	210000	21180C					40924						*
QUI	0045	C1	64C915	CCC5	A	210525	212208					40924						*
QUI	0046	C1	640915	CCC5	A	210828	21131C					40924						*
RDS	0064	C1	640915	CCC5	A	211800	213100					40924						*
QUI	0048	C1	640915	CCC5	A	212115	21322C					40928						*
RDS	0C65	01	64C915	CCC5	A	213CC0	21320C					40924						*
RDS	0C79	01	640918	CCC6	A	211300	212928					40928						*
RDS	008C	01	640918	CCC6	A	212828	214504					40928						*
RDS	0082	C1	640918	CCC6	A	214404	22010C					40928						*
RDS	0083	C1	64C918	CCC6	A	220000	221636					40928						*
RDS	0084	C1	640918	CCC6	A	221536	221805					40928						*
RDS	0094	C1	640923	CCC8	A	183610	184910					40929						*
RDS	0095	01	640923	CCC8	A	184810	19011C					40929						*
RDS	0097	01	640923	CCC8	A	190010	19131C					40929						*
RDS	0098	01	640923	CCC8	A	191210	191512					40929						*
JOB	0030	C1	640926	CCC9	A	123400	12510C					41006						*
JOB	0031	01	640926	CCC9	A	125030	13064C					41006						*
JOB	CC32	C1	640926	CCC9	A	130637	132337					41006						*
JOB	0034	01	640926	CCC9	A	132300	134010					41006						*
JOB	0036	01	640926	CCC9	A	133850	13550C					41006						*
JOB	0037	01	640926	CCC9	A	135533	141224					41006						*
JOB	0038	C1	640926	CCC9	A	141100	14280C					41006						*
JOB	0039	01	640926	CCC9	A	142630	144316					41006						*
JOB	0040	C1	640926	CCC9	A	144143	145835					41006						*
JOB	0041	C1	640926	CCC9	A	145720	151357					41006						*
JOB	CC42	01	640926	CCC9	A	151300	152953					41006						*
JOB	0043	C1	640926	CCC9	A	152820	154518					41006						*
JOB	0044	C1	640926	CCC9	A	154400	15492C					41006						*
JOB	0048	C1	640929	CC1C	A	160110	175810					41008						

Figure 9-1. Special Purpose Quality Control Listing

QUALITY CARD

$490200001000102125574805808023333I 9694 2 1 301 40 0 8 1402310



EDIT CARD

$49 R0S0001 641014 0000 1 01 155800 ⚡40800 0001 4

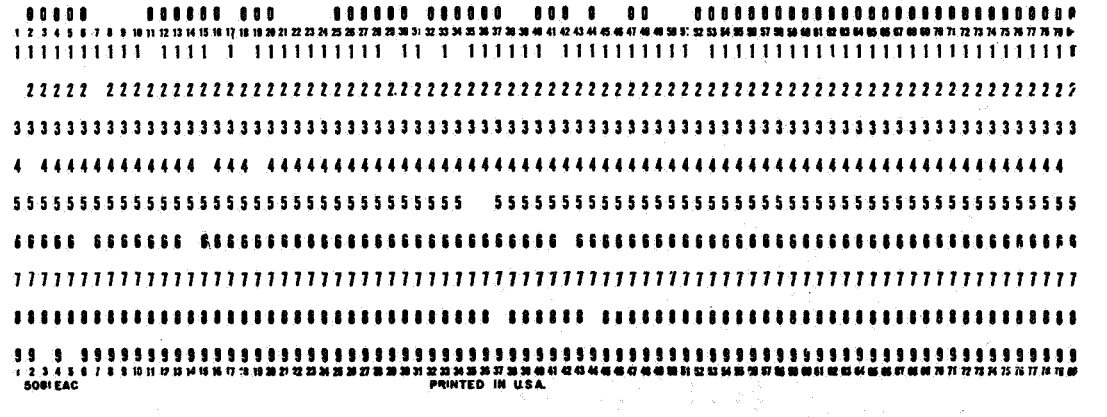


Figure 9-2. Special Purpose Edit Tape and Quality Control Documentation Card

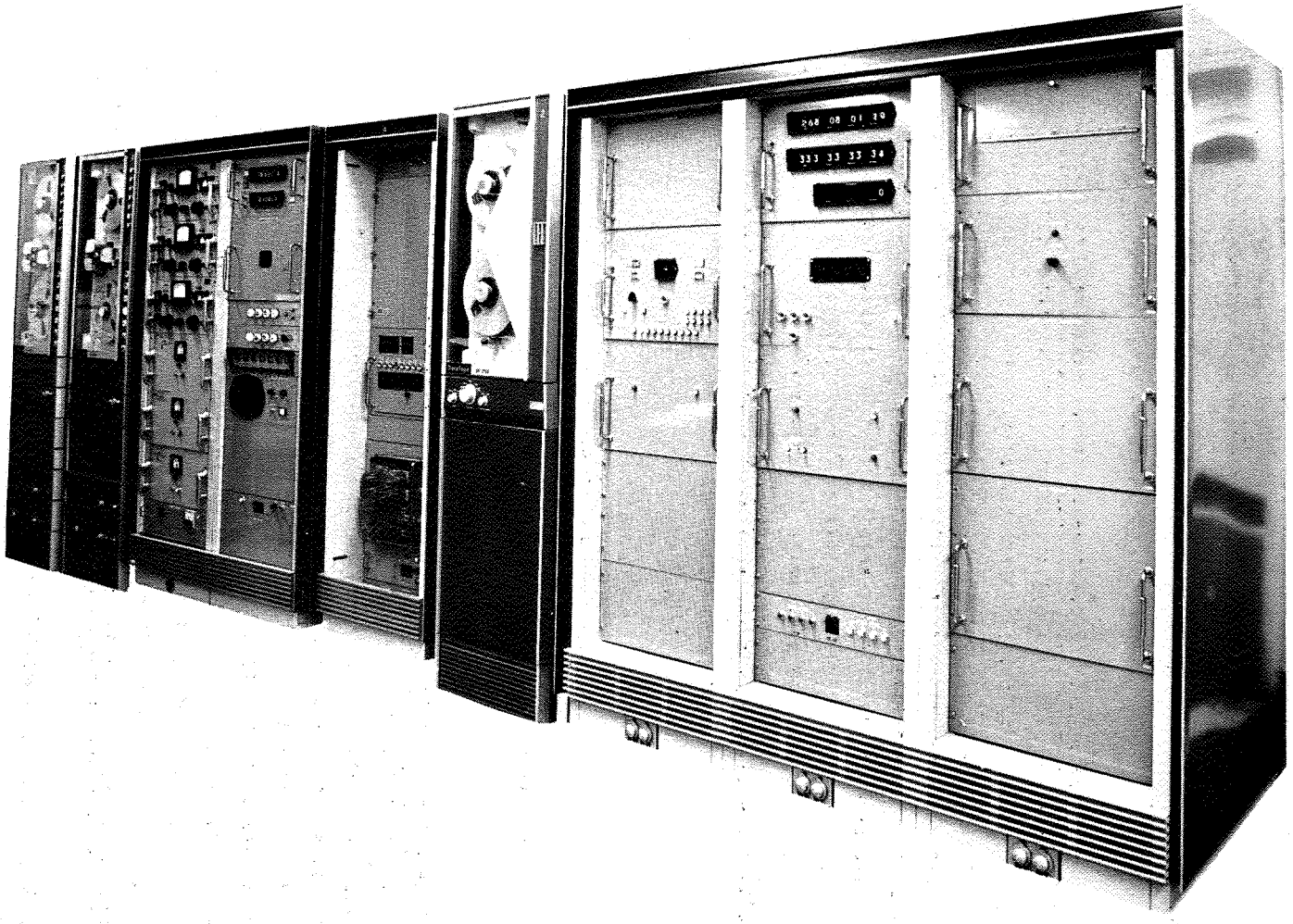


Figure 9-3. Rubidium Magnetometer Data Processing

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 5Mc 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 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-A PCM data processor described earlier and serve similar functions in the special magnetometer processor.

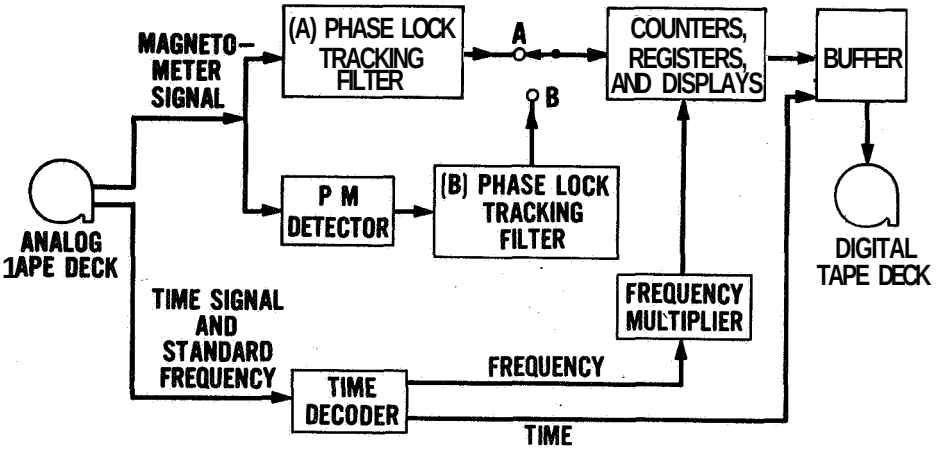


Figure 9-4. Outline of Special Processor for the OGO

APPENDIX A

DISPOSITION OF DATA

APPENDIX A
DISPOSITION OF DATA

A. 1 EXPERIMENTERS

Twelve of the OGO-A experimenters are affiliated with institutions located throughout the United States and must receive experiment data by mail. The remaining eight experimenters are affiliated with Goddard Space Flight Center and receive experiment data through an internal distribution system. The experiment data are transmitted in the form of tapes and cards on a loan basis. After extracting the data the experimenter needs, the tapes and cards are returned for retirement to the OGO-A archives.

Experimenters not located at Goddard receive shipments having a specified content of tapes and cards according to numbered groups. These shipping groups contain data as indicated by an "X" in the following table:

Type of Tape or Card	Shipping Group Number			
	1	2	3	4
Attitude orbit tapes	X	X	X	X
Command cards	X	X	X	X
Decommutation tapes	X		X	X
Special purpose edit tapes			X	
Duplicates special purpose tapes				X

A. 2 SHIPMENT OF TAPES

Experimenters not located at Goddard receive weekly notification of shipment of tapes on the advance shipping notice form (Figure A-1). This letter lists all tapes shipped to the experimenter during the preceding week. Should the listed tapes not arrive within two weeks after receipt of the letter, the experimenter is requested to notify the Digital Data Accounting Office, Code 545, Goddard Space Flight Center, Greenbelt, Maryland 20771. Accompanying each shipment is a duplicate set of the experimenter's letter for receipt of tapes form which lists the files of data on tapes in the shipment. The experimenter retains one copy and signs, dates, and returns the other copy to acknowledge receipt of the shipment.

A. 3 TRANSMITTAL OF TAPES WITHIN GODDARD

Tapes transmitted from the Digital Accounting Office to experimenters or their representatives within Goddard are accompanied by a duplicate set of the receipt for

To _____

_____

_____

_____

Date _____

On this date the following tapes were sent to you. Please notify this office if these tapes are not received within two weeks.

SATELLITE	EDIT NO.	INVENTORY NO.

DIGITAL DATA ACCOUNTING

NASA-GSFC CODE 545

GREENBELT, MD. 20771

Figure A-1. Advance Shipping Notice Form

magnetic tape form. One copy is retained by the recipient and the other is returned to the sender to acknowledge receipt of the tape.

A. 4 DESTINATION AND CONTENT OF DATA

Data from Experiments 1, 2, 3, 7, 8, 9, 10, 12, 14, 17, 18, and 19 are studied by experimenters affiliated with institutions at locations throughout the United States. The following table provides addresses and shipping group numbers defining the content of data to be shipped for each of these experiments:

Experiment Number	Shipping Address	Shipping Group Number
1	Dr. Kinsey Anderson J. Henry Primbach Department of Physics University of California Berkeley, California 94720	1
2	Dr. John W. Wolfe Space Sciences Division Ames Research Center Moffett Field, California	1
3	Dr. Alan Lazarua Room 26-565 Massachusetts Institute of Technology Cambridge, Massachusetts	1
7	Mr. Gordon A. Lentz The Enrico Fermi Institute for Nuclear Studies The University of Chicago Chicago 37, Illinois	1
8	Mr. William Bulgren Physics Department - Satellite Analysis State University of Iowa 13 1/2 E. Washington Street Iowa City, Iowa 32240	1
9	Dr. J. R. Winckler R. L. Arnoldy School of Physics University of Minnesota Minneapolis, Minnesota 55455	1
10	Mr. Robert E. Holzer Institute of Geophysics and Planetary Physics Los Angeles Laboratories University of California Los Angeles, California	1

Experiment Number	Shipping Address	Shipping Group Number
12	Dr. Rita Sagalyn Air Force Cambridge Research Laboratory Geophysics Research Directorate Lawrence G. Hanscom Field Bedford, Massachusetts	1
14	Mr. R. S. Lawrence Ionospheric Radio Astronomy Section National Bureau of Standards Boulder, Colorado	2
17	Stanford Research Institute Bldg. 308A Menlo Park, California Attn: Bud Rorden	1
17	Stanford Electronics Laboratories Stanford University Stanford, California Attn: John Katsufrakie	4
18	Mr. W. J. Lindsay C. Lindahl Department of Astronomy University of Michigan Ann Arbor, Michigan 48104	1
19	Dr. Philip W. Mange Code 7121 U. S. Naval Research Laboratory Washington 25, D. C.	1

Data from Experiments 4, 5, 6, 11, 13, 15, 16, and 20 are studied by experimenters affiliated with Goddard Space Flight Center and are transmitted to them according to an internal distribution plan. The following table provides experimenter names and address codes and shipping group numbers defining the content of data to be transmitted for Experiments 4, 5, 6 and 11:

Experiment Number	Experimenter and Address Code	Shipping Group Number
4	Dr. G. Ludwig/Dr. F. McDonald Dr. T. Cline, Code 611	1
5	Mr. R. L. Davis, Code 611	1
6	Code 611	1
11	Dr. J. Heppner/Dr. M Campbell Code 611	3

APPENDIX B

DESCRIPTIONS AND LOCATIONS OF EXPERIMENTS AND NAMES OF EXPERIMENTERS

APPENDIX B
DESCRIPTIONS AND LOCATIONS OF EXPERIMENTS AND NAMES OF EXPERIMENTERS

DESCRIPTIONS OF EXPERIMENTS

Descriptions of each of the twenty experiments conducted in the OGO-A mission are presented in the order of experiment number. Following each description is the name and professional affiliation and location of the principal experimenter(s) in the subject experiment.

Solar Cosmic Rays (Experiment 1)

The objectives of this experiment are to measure the form and time variations of the energy spectrum from a few Mev up to 30 Mev, to investigate spatial inhomogeneities of the solar-proton flux upon their arrival at the earth, to search for proton fluxes attributable to flares on the back side of the sun, to monitor X-rays from the sun, to measure the flux and energy of photons which arise in proton producing flares, and to measure protons in the galactic cosmic radiation during the approach to solar minimum. The principal experimenter is Dr. Kinsey A. Anderson of the University of California, Berkeley, California.

Plasma Electrostatic Analyzer (Experiment 2)

The objective of this experiment is to further the understanding of the lower energy (a few to a few thousand electron volts) particles and their relationship to other geophysical, solar, and cosmic phenomena. The distribution of plasma particles is particularly important in connection with understanding of the distributions of magnetic fields in space. The principal experimenter is Dr. Michel Bader of the Ames Research Center, Moffet Field, California.

Plasma Faraday Cup (Experiment 3)

This experiment is concerned with properties of the solar plasma in the tens to thousands of electron volts range and their influence on the earth's magnetosphere. The scientific objectives include measurements of the following quantities: proton flux, proton-energy spectrum, and direction of the flux. Temporal and spatial variations of these quantities and correlation of the above data with measurements of the magnetic field are also scientific objectives of this experiment. The principal experimenter is Dr. H. T. Bridge of the Massachusetts Institute of Technology, Cambridge, Massachusetts.

Positron Search and Gamma-Ray Spectrum (Experiment 4)

The objective of this experiment is to 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 earth's magnetic field. This experiment is able to measure over a wide dynamic range, the flux of gamma rays in the energy range from 30 Kev to 1.2 Mev. The principal experimenters are Dr. T. L. Cline and Dr. E. W. Hones of Goddard Space Flight Center, Greenbelt, Maryland.

Trapped Radiation, Scintillation Counter (Experiment 5)

The objective of this experiment is to provide further studies of the temporal and spatial variations of the particle intensities, pitch-angle distributions, energy spectra of

electrons and protons, and to find answers to such questions as: particle lifetimes, processes by which trapped particles are lost, and the sources and accelerating mechanisms of the trapped particles. The principal experimenter is Mr. R. L. Davis of Goddard Space Flight Center, Greenbelt, Maryland.

Cosmic Ray Isotropic Abundance (Experiment 6)

A cosmic ray telescope is used to analyze the charge and energy spectrum of the primary cosmic radiation thereby to assist in the determination of the amount of interstellar material through which primary cosmic rays have passed between their source and the vicinity of the earth and to study the modulation mechanisms which act on the cosmic rays produced by the sun. The principal experimenter is Dr. F. B. McDonald of Goddard Space Flight Center, Greenbelt, Maryland.

Cosmic Ray Spectra and Fluxes (Experiment 7)

The objectives of this experiment are to assist in the search for the acceleration mechanisms acting on cosmic rays and solar particles and to study the electrodynamic processes of solar origin which lead to the modulation of the galactic-ray flux such as the 11-year cycle, the Forbush decreases, and the 27-day variation. The principal experimenter is Dr. J. A. Simpson of the University of Chicago, Chicago, Illinois.

Trapped Radiation, Omnidirectional Counters (Experiment 8)

This experiment monitors the electron component of the outer radiation 'zone of the earth to determine the absolute intensity and energy spectrum as a function of time and of position (electron energies in the range 40 Kev to 2 Mev) in a continuing effort to improve the observational foundations for understanding the dynamics of the outer zone: i.e., acceleration, dumping, replenishment, redistribution in space, and the relationship of the outer zone to magnetic storms and aurorae. The principal experimenter is Dr. J. A. Van Allen of the State University of Iowa, Iowa City, Iowa.

Electron Spectrometer (Experiment 9)

This experiment uses two primary detector systems. A swept magnetic field electron spectrometer will make a precise measurement of the electron energy spectrum in the range 50 Kev to 4 Mev. An ionization chamber and G. M. counter will assist in the determination of the electron, proton, and X-ray fluxes. The objective of this experiment is to assist in the study of the injection, trapping, and loss mechanisms acting in the earth's radiation belts. The principal experimenters are Dr. J. A. Wineklev and Dr. R. Arnoldy of the University of Minnesota, Minneapolis, Minnesota.

Tri-Axial Search Coil Magnetometer (Experiment 10)

The objectives of this experiment are to investigate the nature of extremely low-frequency variations (0.01 to 1000cps) in the terrestrial geomagnetic field, in the interplanetary field, in the vicinity of the interface between them, and to investigate the relationship between the fluctuations in these three regions of space and the simultaneous variations at the earth's surface. The principal experimenter is Dr. E. J. Smith of the Jet Propulsion Laboratory, Pasadena, California.

Rubidium Vapor Magnetometer (Experiment 11)

A combination of component flux-gate sensors and a rubidium vapor magnetometer is intended to provide comprehensive field measurements with a known absolute accuracy. The objectives of this experiment 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 principal experimenter is Dr. J. P. Heppner of Goddard Space Flight Center, Greenbelt, Maryland.

Spherical Ion and Electron Trap (Experiment 12)

This experiment utilizes a spherical electrostatic analyzer to measure the concentration and energy distribution of charged particles having thermal energies in the distance range from 275 to 110,000 km. The principal experimenter is Mrs. R. Sagelyn of the Air Force Research Laboratory, Bedford, Massachusetts.

Planor Ion and Electron Trap (Experiment 13)

The objective of this experiment is to obtain the density and energy distributions of charged particles in the low energy or thermal ranges in the transition region between the ionosphere and interplanetary space, and in interplanetary space which is characterized by low particle densities. The principal experimenter is Mr. E. C. Whipple of Goddard Space Flight Center, Greenbelt, Maryland.

Radio Propagation (Experiment 14)

The objective of this experiment is to make accurate measurements of the electron density along the line of sight by determination of the Faraday rotations of two harmonically related, linearly polarized waves, National Bureau of Standards ground stations are enabled thereby to measure the magnitude of large scale horizontal irregularities in the electron distribution of the ionosphere.and exosphere. The principal experimenter is Mr. R. S. Lawrence of the National Bureau of Standards, Boulder, Colorado.

Atmospheric Mass Spectrum (Experiment 15)

The objective of this experiment will obtain direct measurements of positive ion composition in the mass range 1 to 45 amu throughout the OGO-A orbit by the use of a Bennett RF mass spectrometer. The principal experimenter is Dr. H. Taylor of Goddard Space Flight Center, Greenbelt, Maryland.

Interplanetary Dust Particles (Experiment 16)

This experiment will establish the velocity and mass distributions for interplanetary dust particles of micron size. The findings of this experiment will extend the mass distribution curve out to the radiation pressure limit, and measure the fluctuations in the velocity distribution, mass distribution, and spatial densities. The principal experimenter is Dr. W. M Alexander of Goddard Space Flight Center, Greenbelt, Maryland.

VLF Noise and Propagation (Experiment 17)

This experiment will increase the overall understanding of the VLF phenomena in the earth's magnetosphere. The phenomena to be studied includes a terrestrial noise produced below a height of 70km (such as atmospherics due to lightning noise generated within the earth's ionosphere and magnetosphere), VLF emissions produced by incoming solar particles, and cosmic noise of entirely extraterrestrial origin such as solar and planetary noise. The frequency range to be covered is 200 to 100,000 cps. The principal experimenter is Dr. R. C. Helliwell of Stanford University, Stanford, California.

Radio Astronomy (Experiment 18)

The prime objective of this experiment is the measurement of the dynamic radio spectrum of solar radio noise bursts. The frequency drift rate, frequency bandwidth, and duration of fast drift solar bursts will be observed. This experiment may also observe radio bursts from the planet Jupiter. Additional observations to be made are: cosmic-noise intensity, ionospheric electron densities (50 to 500 electrons/cm^3), atmospherics, auroral noise from the earth to satellite, and radio noise generated in the terrestrial ionosphere and in interplanetary plasmas. The investigations will cover the frequency ranges from 200 to 400 kc and 2 to 4 mc. The principal experimenter is Dr. F. T. Haddock of the University of Michigan, Ann Arbor, Michigan.

Geocoronal Lyman Alpha Scattering (Experiment 19)

The Lyman-Alpha glow in the night sky probably originates from either a geocorona or the interplanetary medium. To distinguish the relative contributions of these two sources, it is necessary to make measurements from great altitudes which will permit separation of the sources of the reasonantly scattered light. The principal experimenter is Dr. P. W. Mange of the Naval Research Laboratory, Washington, D. C.

Gegenschein Photometry (Experiment 20)

The question as to where the Gegenschein (counterglow) originates in space has defied solution by ground observers for nearly two centuries, and is not likely to be solved until an observation is made sufficiently far from the earth to show a parallax. The objective of this experiment is to obtain low resolution images of the sky in the antisolar direction to determine the source location. Also under study is the degree of polarization and the infrared brightness to assist in determining the nature of the scattering centers which produce the Gegenschein. The principal experimenters are Dr. C. L. Wolff and Dr. K. Hallam of Goddard Space Flight Center, Greenbelt, Maryland.

EXPERIMENT LOCATIONS IN THE OGO-A SPACECRAFT

Equipment associated with OGO-A experiments are located both within the mainbody of the spacecraft and externally. Figure B-1 shows experiment equipment mounted externally on the spacecraft appendages, and Figure B-2 indicates how experiment equipment is arranged when the main body panels are opened. Figures B-3 through B-7 present identification and data record printouts for experiment 1. Figures B-8 through B-24 present identification and data record printouts for experiment 2 through 20, respectively (exclusive of 14 and 16).

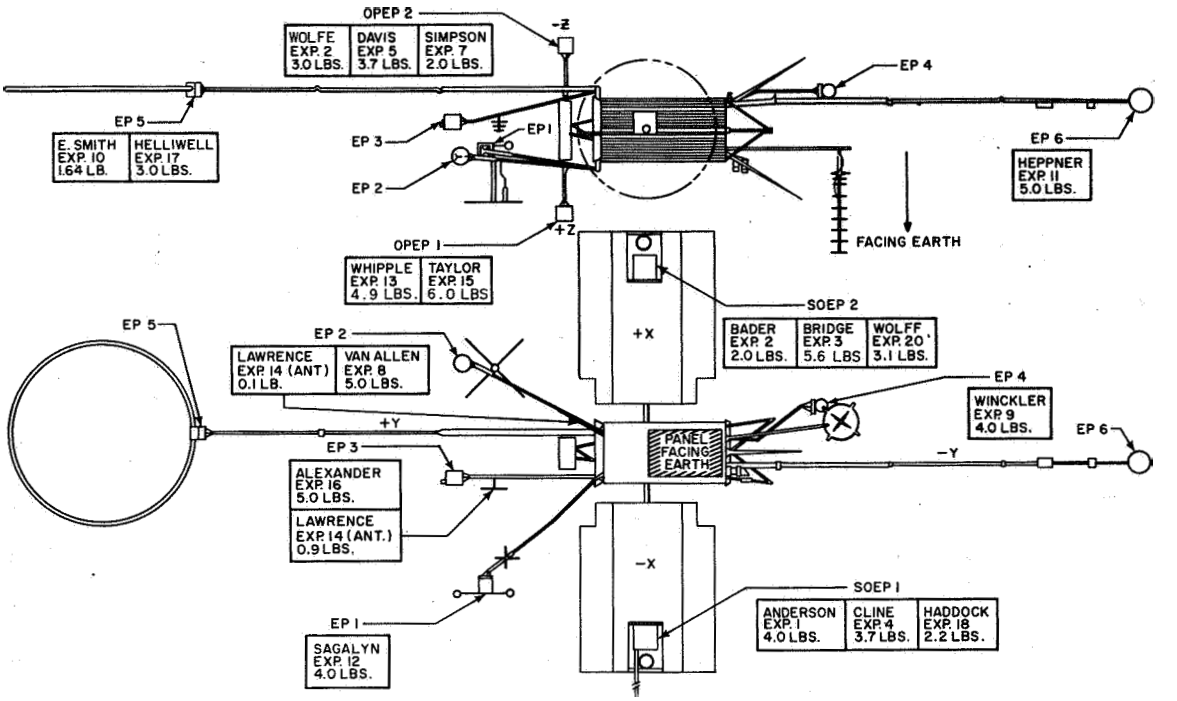


Figure B-1. identification of Experiment Mounting Locations in the OGO Appendages

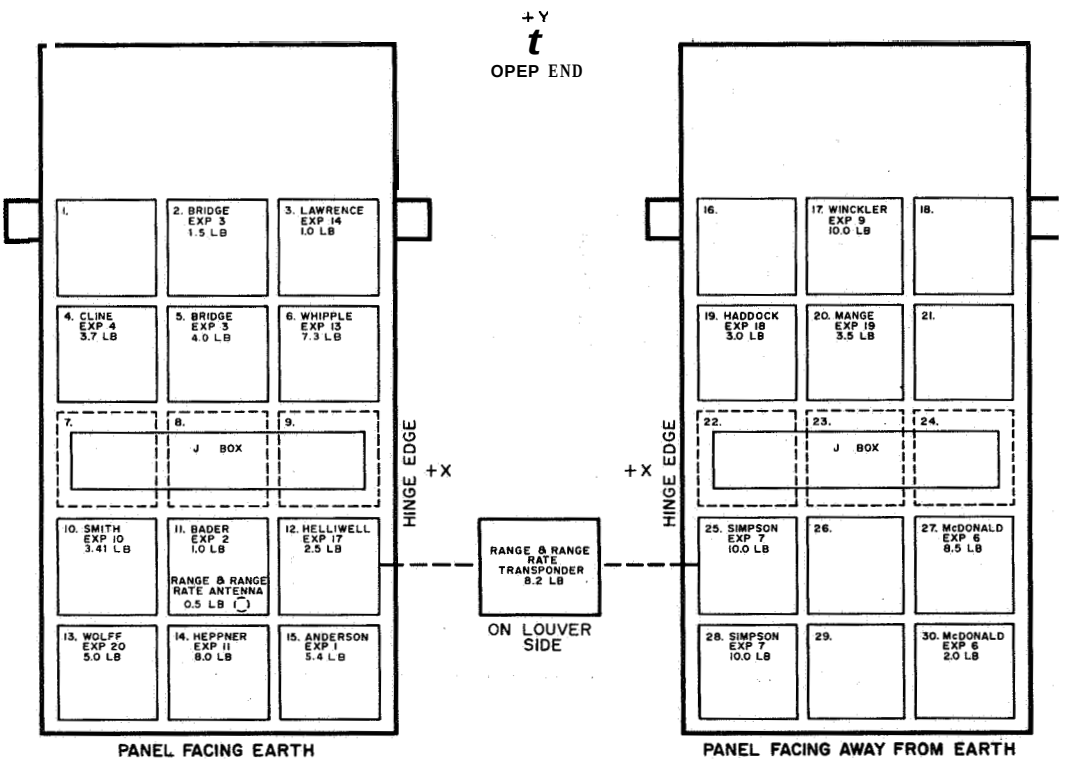


Figure B-2. Identification of Experiment Mounting Locations in the OGO Mainbody

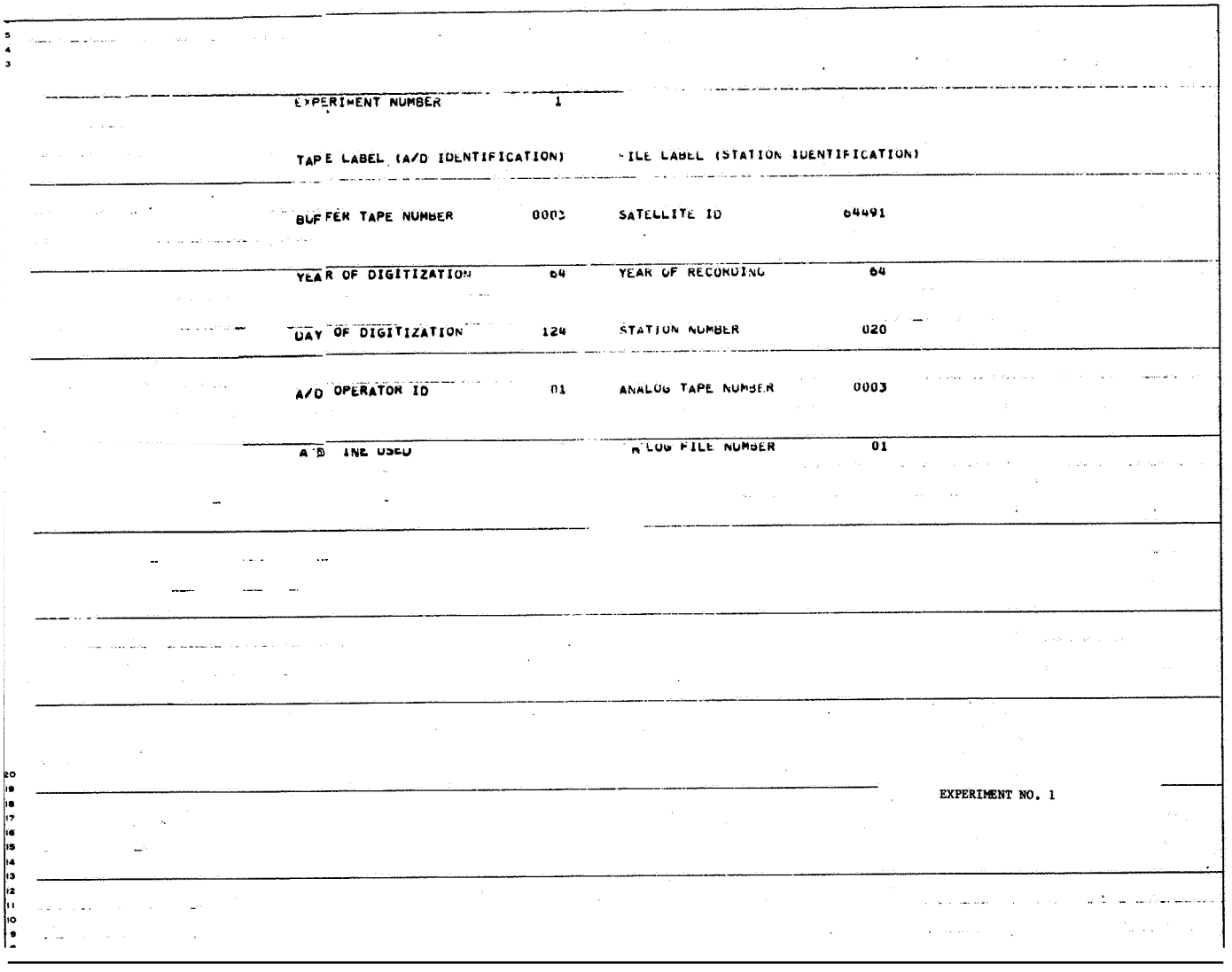
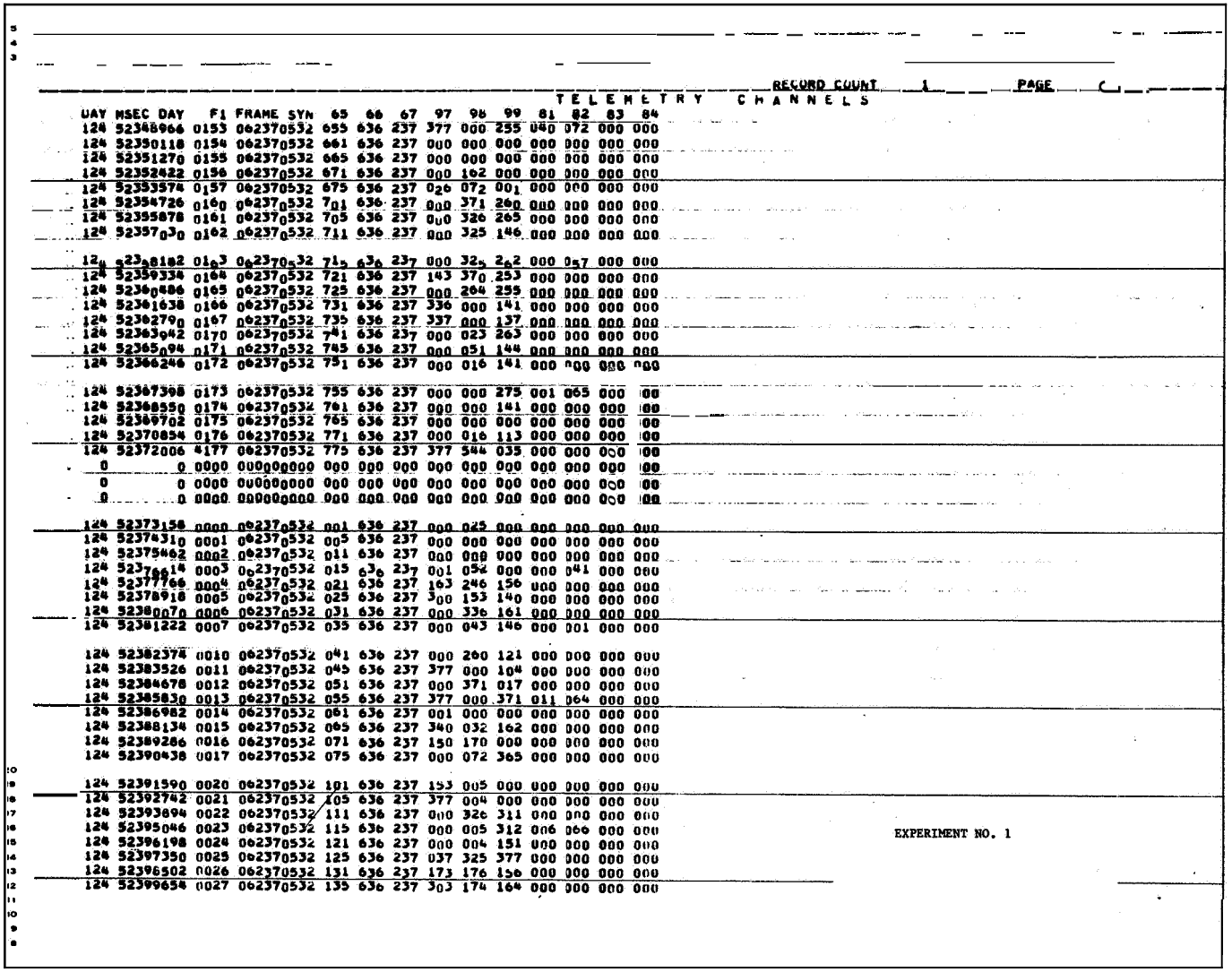


Figure B-3. Identification and Data Record Printout, Experiment 1

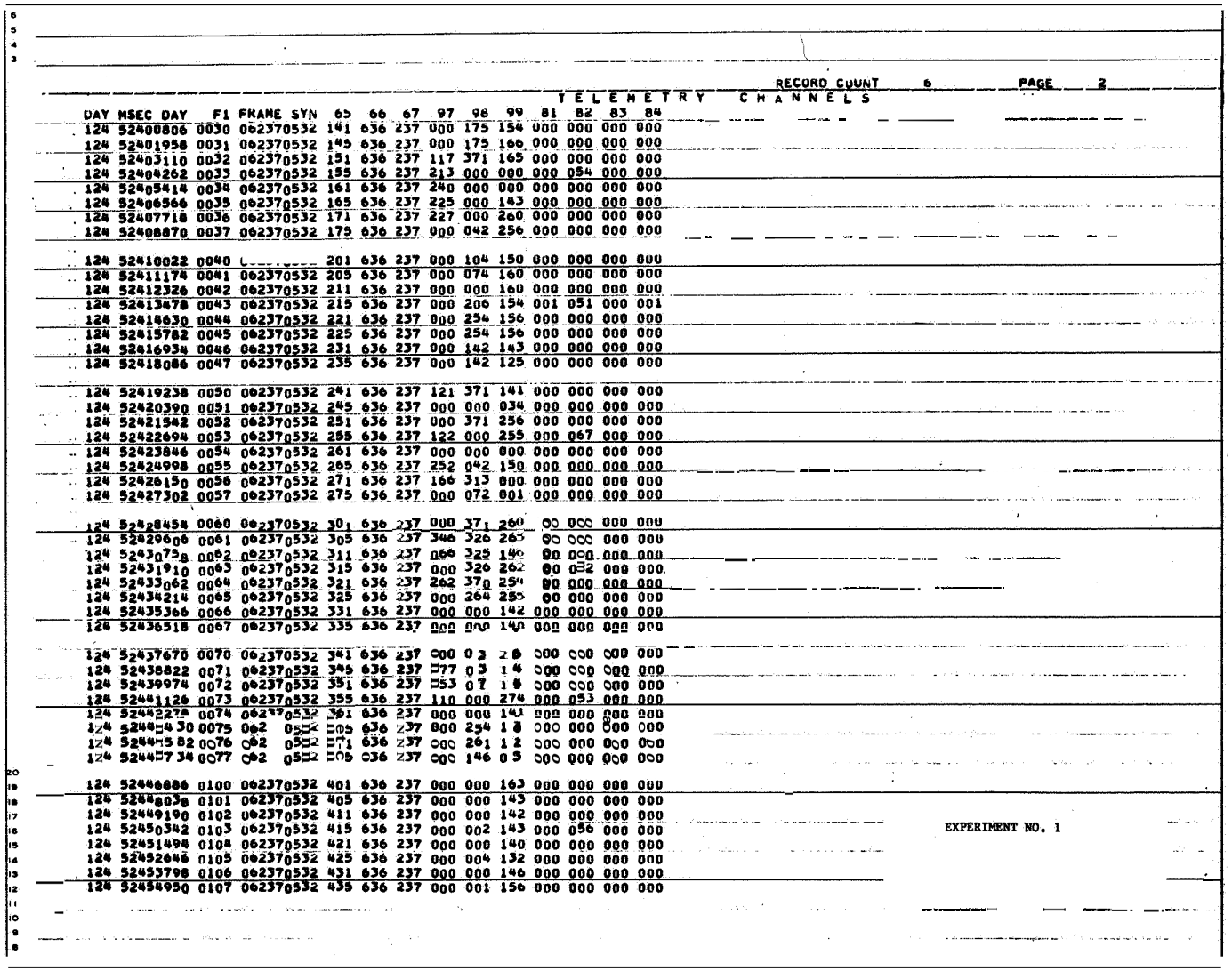


RECORD COUNT 1 PAGE 1

						TELEMETRY CHANNELS							
DAY	MSEC DAY	F1	FRAME SYN	65	66	67	97	98	99	81	82	83	84
124	52348966	0153	06237 0532	655	636	237	377	000	255	040	072	000	000
124	52350118	0154	06237 0532	661	636	237	000	000	000	000	000	000	000
124	52351270	0155	06237 0532	665	636	237	000	000	000	000	000	000	000
124	52352422	0156	06237 0532	671	636	237	000	162	000	000	000	000	000
124	52353574	0157	06237 0532	675	636	237	026	072	001	000	000	000	000
124	52354726	0160	06237 0532	701	636	237	000	371	200	000	000	000	000
124	52355878	0161	06237 0532	705	636	237	000	326	265	000	000	000	000
124	52357030	0162	06237 0532	711	636	237	000	325	146	000	000	000	000
124	52358182	0163	06237 0532	715	636	237	000	325	202	000	057	000	000
124	52359334	0164	06237 0532	721	636	237	143	370	253	000	000	000	000
124	52360486	0165	06237 0532	725	636	237	000	264	255	000	000	000	000
124	52361638	0166	06237 0532	731	636	237	336	000	141	000	000	000	000
124	52362790	0167	06237 0532	735	636	237	337	000	137	000	000	000	000
124	52363942	0170	06237 0532	741	636	237	000	023	263	000	000	000	000
124	52365094	0171	06237 0532	745	636	237	000	051	144	000	000	000	000
124	52366246	0172	06237 0532	751	636	237	000	016	141	000	000	000	000
124	52367398	0173	06237 0532	755	636	237	000	000	275	001	065	000	00
124	52368550	0174	06237 0532	761	636	237	000	000	141	000	000	000	00
124	52369702	0175	06237 0532	765	636	237	000	000	000	000	000	000	00
124	52370854	0176	06237 0532	771	636	237	000	016	113	000	000	000	00
124	52372006	4177	06237 0532	775	636	237	377	544	035	000	000	000	00
0	0	0000	0000000000	000	000	000	000	000	000	000	000	000	00
0	0	0000	0000000000	000	000	000	000	000	000	000	000	000	00
0	0	0000	0000000000	000	000	000	000	000	000	000	000	000	00
124	52373158	0000	06237 0532	001	636	237	000	025	000	000	000	000	000
124	52374310	0001	06237 0532	005	636	237	000	000	000	000	000	000	000
124	52375462	0002	06237 0532	011	636	237	000	000	000	000	000	000	000
124	52376614	0003	06237 0532	015	636	237	001	052	000	000	041	000	000
124	52377766	0004	06237 0532	021	636	237	163	246	156	000	000	000	000
124	52378918	0005	06237 0532	025	636	237	300	153	140	000	000	000	000
124	52380070	0006	06237 0532	031	636	237	000	336	161	000	000	000	000
124	52381222	0007	06237 0532	035	636	237	000	043	146	000	001	000	000
124	52382374	0010	06237 0532	041	636	237	000	200	121	000	000	000	000
124	52383526	0011	06237 0532	045	636	237	377	000	104	000	000	000	000
124	52384678	0012	06237 0532	051	636	237	000	371	017	000	000	000	000
124	52385830	0013	06237 0532	055	636	237	377	000	371	011	064	000	000
124	52386982	0014	06237 0532	061	636	237	001	000	000	000	000	000	000
124	52388134	0015	06237 0532	065	636	237	340	032	162	000	000	000	000
124	52389286	0016	06237 0532	071	636	237	150	170	000	000	000	000	000
124	52390438	0017	06237 0532	075	636	237	000	072	365	000	000	000	000
124	52391590	0020	06237 0532	101	636	237	153	005	000	000	000	000	000
124	52392742	0021	06237 0532	105	636	237	377	004	000	000	000	000	000
124	52393894	0022	06237 0532	111	636	237	000	326	311	000	000	000	000
124	52395046	0023	06237 0532	115	636	237	000	005	312	006	066	000	000
124	52396198	0024	06237 0532	121	636	237	000	004	151	000	000	000	000
124	52397350	0025	06237 0532	125	636	237	037	325	377	000	000	000	000
124	52396502	0026	06237 0532	131	636	237	173	176	156	000	000	000	000
124	52399654	0027	06237 0532	135	636	237	303	174	164	000	000	000	000

EXPERIMENT NO. 1

Figure B-4. Identification and Data Record Printout, Experiment 1



RECORD COUNT 6 PAGE 2

TELEMETRY CHANNELS

DAY	MSEC DAY	F1	FRAME SYN	65	66	67	97	98	99	81	82	83	84
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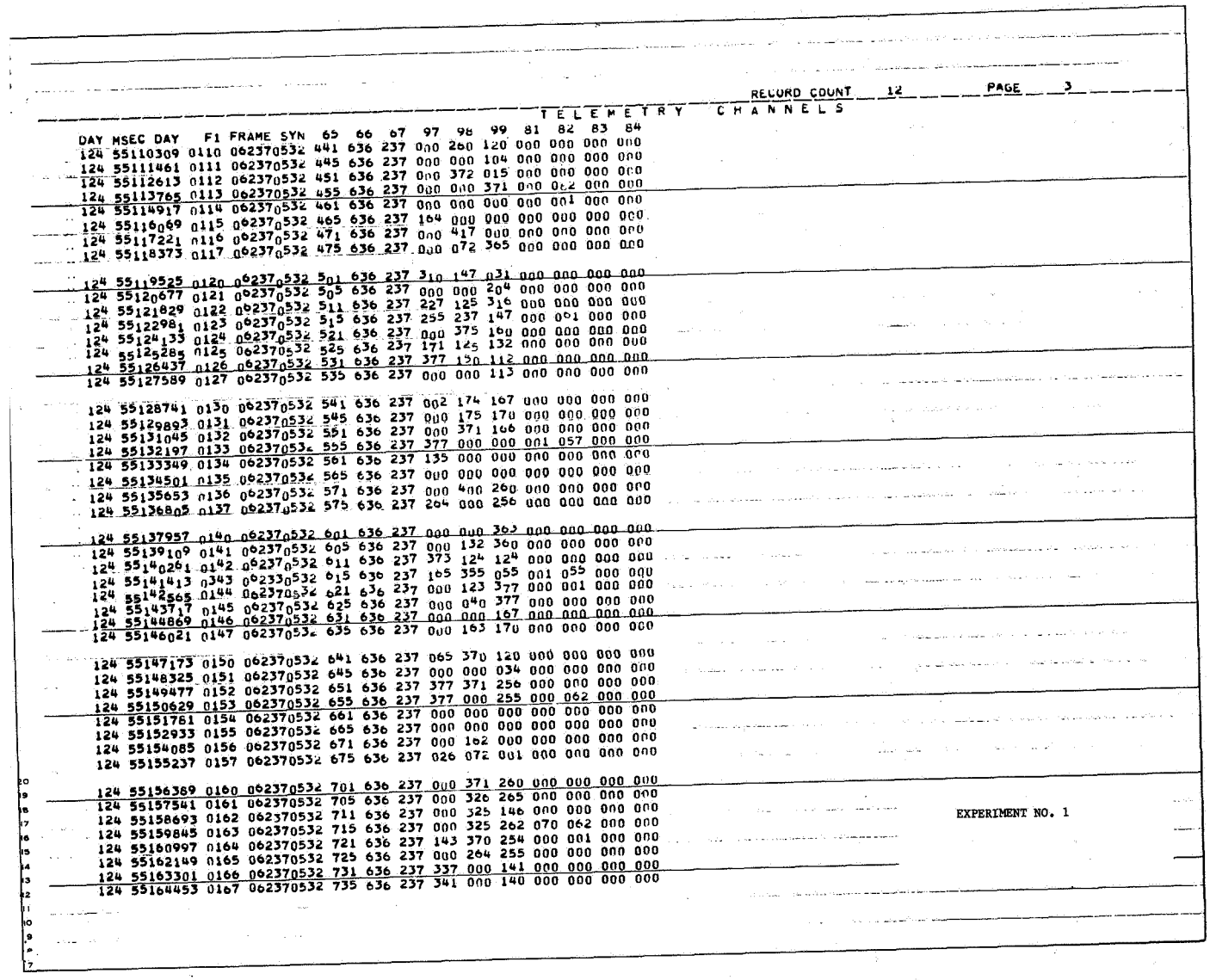
124	52401958	0031	062370532	145	636	237	000	175	166	000	000	000	000
124	52403110	0032	062370532	151	636	237	117	371	165	000	000	000	000
124	52404262	0033	062370532	155	636	237	213	000	000	000	054	000	000
124	52405414	0034	062370532	161	636	237	240	000	000	000	000	000	000
124	52406566	0035	062370532	165	636	237	225	000	143	000	000	000	000
124	52407718	0036	062370532	171	636	237	227	000	260	000	000	000	000
124	52408870	0037	062370532	175	636	237	000	042	256	000	000	000	000
124	52410022	0040	[illegible]	201	636	237	000	104	150	000	000	000	000
124	52411174	0041	062370532	205	636	237	000	074	160	000	000	000	000
124	52412326	0042	062370532	211	636	237	000	000	160	000	000	000	000
124	52413478	0043	062370532	215	636	237	000	206	154	001	051	000	001
124	52414630	0044	062370532	221	636	237	000	254	156	000	000	000	000
124	52415782	0045	062370532	225	636	237	000	254	156	000	000	000	000
124	52416934	0046	062370532	231	636	237	000	142	143	000	000	000	000
124	52418086	0047	062370532	235	636	237	000	142	125	000	000	000	000
124	52419238	0050	062370532	241	636	237	121	371	141	000	000	000	000
124	52420390	0051	062370532	245	636	237	000	000	034	000	000	000	000
124	52421542	0052	062370532	251	636	237	000	371	256	000	000	000	000
124	52422694	0053	062370532	255	636	237	122	000	255	000	067	000	000
124	52423846	0054	062370532	261	636	237	000	000	000	000	000	000	000
124	52424998	0055	062370532	265	636	237	252	042	150	000	000	000	000
124	52426150	0056	062370532	271	636	237	166	313	000	000	000	000	000
124	52427302	0057	062370532	275	636	237	000	072	001	000	000	000	000
124	52428454	0060	062370532	301	636	237	000	371	260	00	000	000	000
124	52429606	0061	062370532	305	636	237	346	326	265	00	000	000	000
124	52430758	0062	062370532	311	636	237	066	325	140	00	000	000	000
124	52431910	0063	062370532	315	636	237	000	326	262	00	002	000	000
124	52433062	0064	062370532	321	636	237	262	370	254	00	000	000	000
124	52434214	0065	062370532	325	636	237	000	264	255	00	000	000	000
124	52435366	0066	062370532	331	636	237	000	000	142	000	000	000	000
124	52436518	0067	062370532	335	636	237	000	000	140	000	000	000	000
124	52437670	0070	062370532	341	636	237	000	03	20	000	000	000	000
124	52438822	0071	062370532	345	636	237	377	03	14	000	000	000	000
124	52439974	0072	062370532	351	636	237	353	07	18	000	000	000	000
124	52441126	0073	062370532	355	636	237	110	000	274	000	053	000	000
124	52442278	0074	062370532	361	636	237	000	000	140	000	000	000	000
124	52443430	0075	062	05	05	636	237	000	254	18	000	000	000
124	52444582	0076	062	05	05	636	237	000	261	12	000	000	000
124	52445734	0077	062	05	05	636	237	000	146	03	000	000	000
124	52446886	0100	062370532	401	636	237	000	000	163	000	000	000	000
124	52448038	0101	062370532	405	636	237	000	000	143	000	000	000	000
124	52449190	0102	062370532	411	636	237	000	000	142	000	000	000	000
124	52450342	0103	062370532	415	636	237	000	002	143	000	056	000	000
124	52451494	0104	062370532	421	636	237	000	000	140	000	000	000	000
124	52452646	0105	062370532	425	636	237	000	004	132	000	000	000	000
124	52453798	0106	062370532	431	636	237	000	000	146	000	000	000	000
124	52454950	0107	062370532	435	636	237	000	001	156	000	000	000	000

EXPERIMENT NO. 1

Figure B-5. Identification and Data Record Printout, Experiment 1



RECORD COUNT 12 PAGE 3

					TELEMETRY CHANNELS									
DAY	MSEC DAY	F1	FRAME SYN	65	66	67	97	98	99	81	82	83	84
124	55110309	0110	062370532	441	636	237	000	260	120	000	000	000	000
124	55111461	0111	062370532	445	636	237	000	000	104	000	000	000	000
124	55112613	0112	062370532	451	636	237	000	372	015	000	000	000	000
124	55113765	0113	062370532	455	636	237	000	000	371	000	062	000	000
124	55114917	0114	062370532	461	636	237	000	000	000	000	001	000	000
124	55116069	0115	062370532	465	636	237	164	000	000	000	000	000	000
124	55117221	0116	062370532	471	636	237	000	417	000	000	000	000	000
124	55118373	0117	062370532	475	636	237	000	072	365	000	000	000	000
124	55119525	0120	062370532	501	636	237	310	147	031	000	000	000	000
124	55120677	0121	062370532	505	636	237	000	000	204	000	000	000	000
124	55121829	0122	062370532	511	636	237	227	125	316	000	000	000	000
124	55122981	0123	062370532	515	636	237	255	237	147	000	001	000	000
124	55124133	0124	062370532	521	636	237	000	375	160	000	000	000	000
124	55125285	0125	062370532	525	636	237	171	125	132	000	000	000	000
124	55126437	0126	062370532	531	636	237	377	150	112	000	000	000	000
124	55127589	0127	062370532	535	636	237	000	000	113	000	000	000	000
124	55128741	0130	062370532	541	636	237	002	174	167	000	000	000	000
124	55129893	0131	062370532	545	636	237	000	175	170	000	000	000	000
124	55131045	0132	062370532	551	636	237	000	371	166	000	000	000	000
124	55132197	0133	062370532	555	636	237	377	000	000	001	057	000	000
124	55133349	0134	062370532	561	636	237	135	000	000	000	000	000	000
124	55134501	0135	062370532	565	636	237	000	000	000	000	000	000	000
124	55135653	0136	062370532	571	636	237	000	400	260	000	000	000	000
124	55136805	0137	062370532	575	636	237	264	000	256	000	000	000	000
124	55137957	0140	062370532	601	636	237	000	000	363	000	000	000	000
124	55139109	0141	062370532	605	636	237	000	132	360	000	000	000	000
124	55140261	0142	062370532	611	636	237	373	124	124	000	000	000	000
124	55141413	0143	062330532	615	636	237	165	355	055	001	055	000	000
124	55142565	0144	062370532	621	636	237	000	123	377	000	001	000	000
124	55143717	0145	062370532	625	636	237	000	040	377	000	000	000	000
124	55144869	0146	062370532	631	636	237	000	000	167	000	000	000	000
124	55146021	0147	062370532	635	636	237	000	163	170	000	000	000	000
124	55147173	0150	062370532	641	636	237	065	370	120	000	000	000	000
124	55148325	0151	062370532	645	636	237	000	000	034	000	000	000	000
124	55149477	0152	062370532	651	636	237	377	371	256	000	000	000	000
124	55150629	0153	062370532	655	636	237	377	000	255	000	062	000	000
124	55151781	0154	062370532	661	636	237	000	000	000	000	000	000	000
124	55152933	0155	062370532	665	636	237	000	000	000	000	000	000	000
124	55154085	0156	062370532	671	636	237	000	162	000	000	000	000	000
124	55155237	0157	062370532	675	636	237	026	072	001	000	000	000	000
124	55156389	0160	062370532	701	636	237	000	371	260	000	000	000	000
124	55157541	0161	062370532	705	636	237	000	326	265	000	000	000	000
124	55158693	0162	062370532	711	636	237	000	325	146	000	000	000	000
124	55159845	0163	062370532	715	636	237	000	325	262	070	062	000	000
124	55160997	0164	062370532	721	636	237	143	370	254	000	001	000	000
124	55162149	0165	062370532	725	636	237	000	264	255	000	000	000	000
124	55163301	0166	062370532	731	636	237	337	000	141	000	000	000	000
124	55164453	0167	062370532	735	636	237	341	000	140	000	000	000	000

EXPERIMENT NO. 1

Figure B-6. Identification and Data Record Printout, Experiment 1

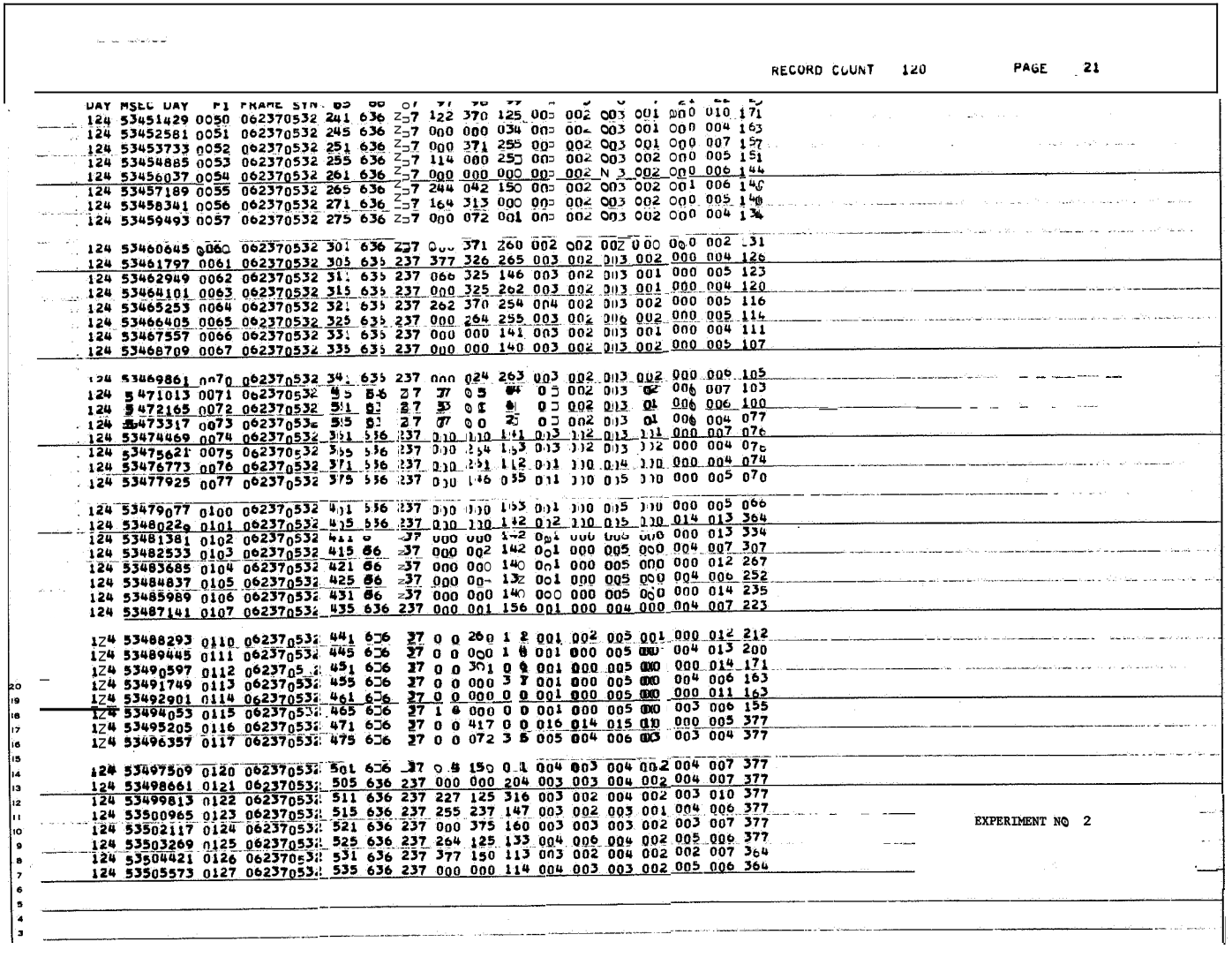
RECORD COUNT 306 PAGE 52

TELEMETRY CHANNELS

DAY	MSEC DAY	F1	FRAME SYN	65	66	67	97	98	99	81	82	83	84
124	55165605	0170	062370532	741	636	237	000	023	263	000	000	000	000
124	55166757	0171	062370532	745	636	237	000	053	144	000	000	000	000
124	55167909	0172	062370532	751	636	237	000	016	141	000	000	000	000
124	55169061	0173	062370532	755	636	237	000	000	274	170	056	000	000
124	55170213	0174	062370532	761	636	237	000	000	140	000	000	000	000
124	55171365	0175	062370532	765	636	237	000	000	000	000	000	000	000
124	55172517	0176	062370532	771	636	237	000	016	112	000	000	000	000
124	55173669	4177	062370532	775	636	237	377	544	035	000	000	000	000
124	55174821	0000	062370532	001	636	237	000	025	000	000	000	000	000
124	55175973	0001	062370532	005	636	237	000	000	000	000	000	000	000
124	55177125	0002	062370532	011	636	237	000	000	000	000	000	000	000
124	55178277	0003	062370532	015	636	237	001	052	000	000	063	000	000
124	55179429	0004	062370532	021	636	237	402	247	156	000	000	000	000
124	55180581	0005	062370532	025	636	237	700	151	132	000	000	000	000
124	55181733	0006	062370532	031	636	237	000	336	160	000	000	000	000
124	55182885	0007	062370532	035	636	237	000	043	145	000	000	000	000
124	55184037	0010	062370532	041	636	237	000	260	120	000	000	000	000
124	55185189	0011	062370532	045	636	237	377	000	104	000	000	000	000
124	55186341	0012	062370532	051	636	237	000	371	015	000	000	000	000
124	55187493	0013	062370532	055	636	237	377	000	371	000	060	001	000
124	55188645	0014	062370532	061	636	237	002	000	000	000	000	000	000
124	55189797	0015	062370532	065	636	237	333	031	160	000	000	000	000
124	55190949	0016	062370532	071	636	237	146	170	000	000	000	000	000
124	55192101	0017	062370532	075	636	237	000	072	365	000	000	000	000
124	55193254	0020	062370532	101	636	237	243	005	000	000	000	000	000
124	55194402	2221	000160002	000	000	764	003	020	000	000	000	000	000
124	55195548	3622	740000000	000	000	000	000	000	000	000	000	003	600
124	55196692	3423	000000007	000	000	000	070	000	000	000	000	030	000
124	55197838	3024	000000177	004	000	000	740	000	000	000	000	000	000
124	55198986	3225	000000000	000	000	000	000	000	000	000	764	000	000
124	55200132	3226	012104000	000	000	000	000	000	000	000	000	000	000
************		2020	020020020	020	020	020	020	020	020	020	020	020	020
************		2020	020020020	020	020	020	020	020	020	020	020	020	020
************		2020	020020020	020	020	020	020	020	020	020	020	020	020
************		2020	020020020	020	020	020	020	020	020	020	020	020	020
************		2020	020020020	020	020	020	020	020	020	020	020	020	020
************		2020	020020020	020	020	020	020	020	020	020	020	020	020
************		2020	020020020	020	020	020	020	020	020	020	020	020	020
************		2020	020020020	020	020	020	020	020	020	020	020	020	020
************		2020	020020020	020	020	020	020	020	020	020	020	020	020

EXPERIMENT NO. 1

[illegible] B-7 Identification and Data Record Printout, [illegible] 1

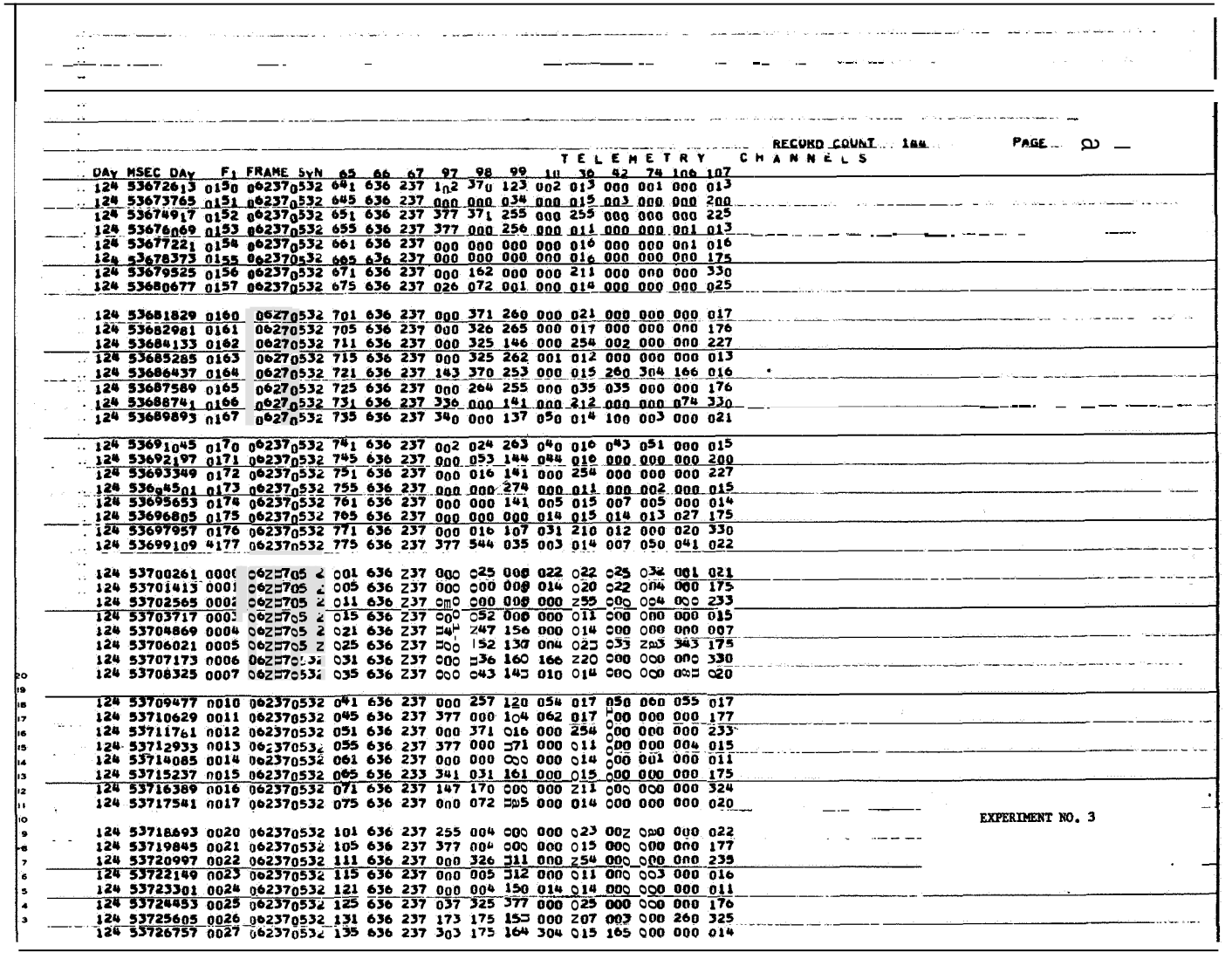


RECORD COUNT 120 PAGE 21

	DAY	MSEC DAY	F1	FRAME SYN													
	124	53451429	0050	062370532	241	636	Z37	122	370	125	003	002	003	001	000	010	171
	124	53452581	0051	062370532	245	636	Z37	000	000	034	003	002	003	001	000	004	163
	124	53453733	0052	062370532	251	636	Z37	000	371	255	003	002	003	001	000	007	157
	124	53454885	0053	062370532	255	636	Z37	114	000	255	003	002	003	002	000	005	151
	124	53456037	0054	062370532	261	636	Z37	000	000	000	003	002	N 3	002	000	006	144
	124	53457189	0055	062370532	265	636	Z37	244	042	150	003	002	003	002	001	006	140
	124	53458341	0056	062370532	271	636	Z37	164	313	000	003	002	003	002	000	005	140
	124	53459493	0057	062370532	275	636	Z37	000	072	001	003	002	003	002	000	004	134
	124	53460645	0060	062370532	301	636	Z37	000	371	260	002	002	002	000	000	002	131
	124	53461797	0061	062370532	305	636	237	377	326	265	003	002	003	002	000	004	126
	124	53462949	0062	062370532	311	636	237	066	325	146	003	002	003	001	000	005	123
	124	53464101	0063	062370532	315	636	237	000	325	262	003	002	003	001	000	004	120
	124	53465253	0064	062370532	321	636	237	262	370	254	004	002	003	002	000	005	116
	124	53466405	0065	062370532	325	636	237	000	264	255	003	002	003	002	000	005	114
	124	53467557	0066	062370532	331	636	237	000	000	141	003	002	003	001	000	004	111
	124	53468709	0067	062370532	335	636	237	000	000	140	003	002	003	002	000	005	107
	124	53469861	0070	062370532	341	636	237	000	024	263	003	002	003	002	000	006	105
	124	53471013	0071	062370532	345	636	237	377	005	004	003	002	003	002	000	007	103
	124	53472165	0072	062370532	351	636	237	377	005	001	003	002	003	001	000	006	100
	124	53473317	0073	062370532	355	636	237	377	000	255	003	002	003	001	000	004	077
	124	53474469	0074	062370532	361	636	237	000	000	141	003	002	003	001	000	007	076
	124	53475621	0075	062370532	365	636	237	000	254	143	003	002	003	002	000	004	076
	124	53476773	0076	062370532	371	636	237	000	251	142	001	000	004	000	000	004	074
	124	53477925	0077	062370532	375	636	237	000	146	035	001	000	005	000	000	005	070
	124	53479077	0100	062370532	401	636	237	000	000	143	001	000	005	000	000	005	066
	124	53480229	0101	062370532	405	636	237	000	000	142	002	000	005	000	004	013	364
	124	53481381	0102	062370532	411	6	237	000	000	142	001	000	005	000	000	013	334
	124	53482533	0103	062370532	415	66	237	000	002	142	001	000	005	000	004	007	307
	124	53483685	0104	062370532	421	66	237	000	000	140	001	000	005	000	000	012	267
	124	53484837	0105	062370532	425	66	237	000	000	132	001	000	005	000	004	006	252
	124	53485989	0106	062370532	431	66	237	000	000	140	000	000	005	000	000	014	235
	124	53487141	0107	062370532	435	636	237	000	001	156	001	000	004	000	004	007	223
	124	53488293	0110	062370532	441	636	37	0	0	260	1	2	001	002	005	001	000	012	212
	124	53489445	0111	062370532	445	636	37	0	0	000	1	0	001	000	005	000	004	013	200
	124	53490597	0112	062370532	451	636	37	0	0	301	0	0	001	000	005	000	000	014	171
20	124	53491749	0113	062370532	455	636	37	0	0	000	3	7	001	000	005	000	004	006	163
19	124	53492901	0114	062370532	461	636	37	0	0	000	0	0	001	000	005	000	000	011	163
18	124	53494053	0115	062370532	465	636	37	1	0	000	0	0	001	000	005	000	003	006	155
17	124	53495205	0116	062370532	471	636	37	0	0	417	0	0	016	014	015	010	000	005	377
16	124	53496357	0117	062370532	475	636	37	0	0	072	3	6	005	004	006	003	003	004	377
15																	
14	124	53497509	0120	062370532	501	636	37	0	0	150	0	1	004	003	004	002	004	007	377
13	124	53498661	0121	062370532	505	636	237	000	000	204	003	003	004	002	004	007	377
12	124	53499813	0122	062370532	511	636	237	227	125	316	003	002	004	002	003	010	377
11	124	53500965	0123	062370532	515	636	237	255	237	147	003	002	003	001	004	006	377
10	124	53502117	0124	062370532	521	636	237	000	375	160	003	003	003	002	003	007	377
9	124	53503269	0125	062370532	525	636	237	264	125	133	004	006	004	002	005	006	377
8	124	53504421	0126	062370532	531	636	237	377	150	113	003	002	004	002	002	007	364
7	124	53505573	0127	062370532	535	636	237	000	000	114	004	003	003	002	005	006	364
6																	
5																	
4																	
3																	

EXPERIMENT NO 2

Figure B-8. Identification and Data Record Printout, Experiment 2

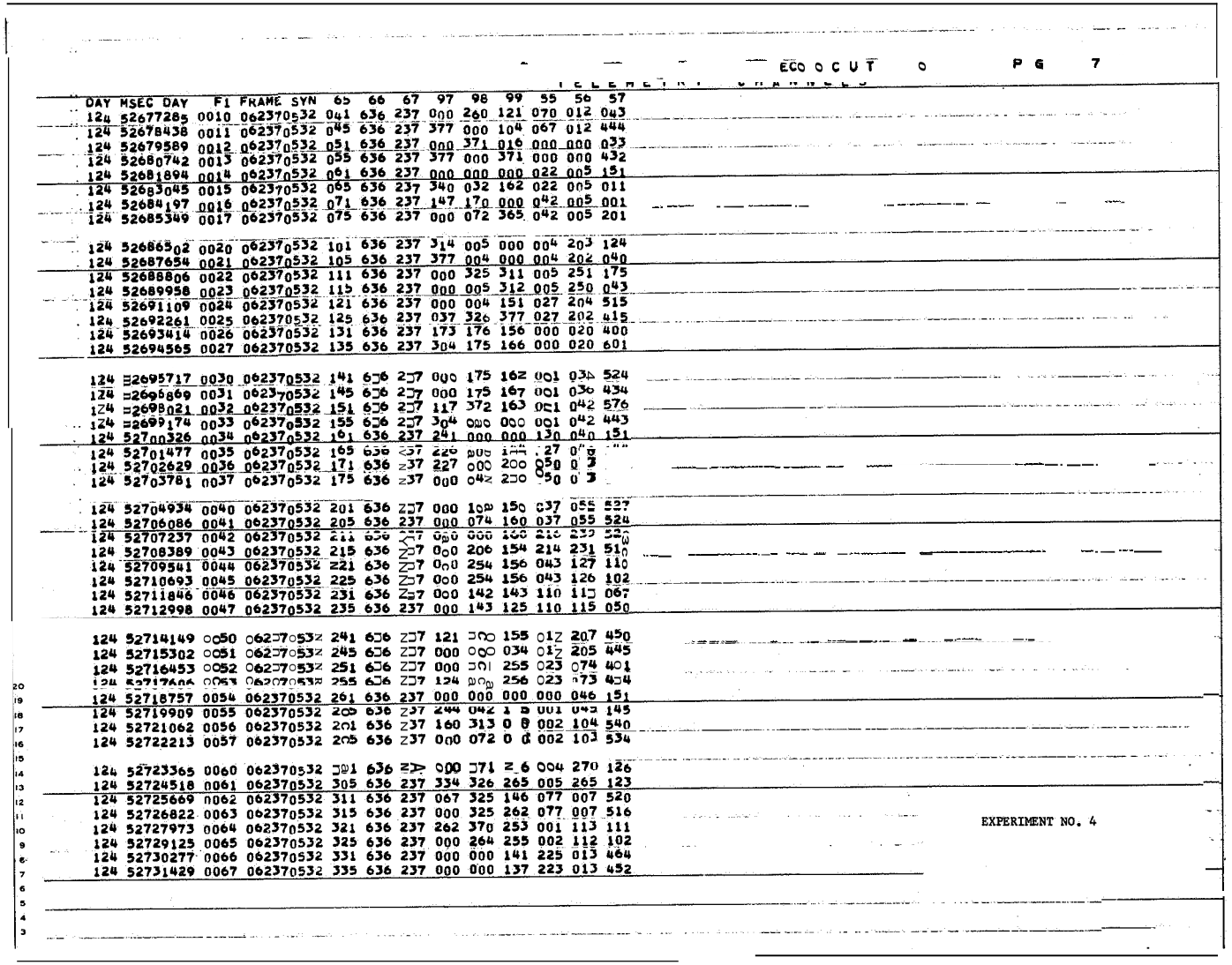


RECORD COUNT 184 PAGE 2

												TELEMETRY CHANNELS					
DAY	MSEC DAY	F1	FRAME SYN	65	66	67	97	98	99	10	36	42	74	106	107
124	53672613	0150	06237 0532	041	636	237	102	370	123	002	013	000	001	000	013
124	53673765	0151	06237 0532	045	636	237	000	000	034	000	015	003	000	000	200
124	53674917	0152	06237 0532	051	636	237	377	371	255	000	255	000	000	000	225
124	53676069	0153	06237 0532	055	636	237	377	000	256	000	011	000	000	001	013
124	53677221	0154	06237 0532	061	636	237	000	000	000	000	010	000	000	001	016
124	53678373	0155	06237 0532	065	636	237	000	000	000	000	016	000	000	000	175
124	53679525	0156	06237 0532	071	636	237	000	162	000	000	211	000	000	000	330
124	53680677	0157	06237 0532	075	636	237	026	072	001	000	014	000	000	000	025
124	53681829	0160	06237 0532	101	636	237	000	371	260	000	021	000	000	000	017
124	53682981	0161	06237 0532	105	636	237	000	326	265	000	017	000	000	000	176
124	53684133	0162	06237 0532	111	636	237	000	325	146	000	254	002	000	000	227
124	53685285	0163	06237 0532	115	636	237	000	325	262	001	012	000	000	000	013
124	53686437	0164	06237 0532	121	636	237	143	370	253	000	015	260	304	166	016
124	53687589	0165	06237 0532	125	636	237	000	264	255	000	035	035	000	000	176
124	53688741	0166	06237 0532	131	636	237	336	000	141	000	212	000	000	074	330
124	53689893	0167	06237 0532	135	636	237	340	000	137	050	014	100	003	000	021
124	53691045	0170	06237 0532	141	636	237	002	024	263	040	016	043	051	000	015
124	53692197	0171	06237 0532	145	636	237	000	053	144	044	010	000	000	000	200
124	53693349	0172	06237 0532	151	636	237	000	016	141	000	254	000	000	000	227
124	53694501	0173	06237 0532	155	636	237	000	000	274	000	011	000	002	000	015
124	53695653	0174	06237 0532	161	636	237	000	000	141	005	015	007	005	000	014
124	53696805	0175	06237 0532	165	636	237	000	000	000	014	015	014	013	027	175
124	53697957	0176	06237 0532	171	636	237	000	016	107	031	210	012	000	020	330
124	53699109	0177	06237 0532	175	636	237	377	544	035	003	014	007	050	041	022
124	53700261	0000	06237 0532	201	636	237	000	025	000	022	022	025	032	001	021
124	53701413	0001	06237 0532	205	636	237	000	000	000	014	020	022	004	000	175
124	53702565	0002	06237 0532	211	636	237	000	000	000	000	255	000	004	000	233
124	53703717	0003	06237 0532	215	636	237	000	052	000	000	011	000	000	000	015
124	53704869	0004	06237 0532	221	636	237	144	247	156	000	014	000	000	000	007
124	53706021	0005	06237 0532	225	636	237	000	152	130	004	022	033	203	343	175
124	53707173	0006	06237 0532	231	636	237	000	036	160	166	220	000	000	000	330
124	53708325	0007	06237 0532	235	636	237	000	043	142	010	014	000	000	000	020
124	53709477	0010	06237 0532	241	636	237	000	257	120	054	017	050	060	055	017
124	53710629	0011	06237 0532	245	636	237	377	000	104	062	017	000	000	000	177
124	53711781	0012	06237 0532	251	636	237	000	371	016	000	254	000	000	000	233
124	53712933	0013	06237 0532	255	636	237	377	000	271	000	011	000	000	004	015
124	53714085	0014	06237 0532	261	636	237	000	000	000	000	014	000	001	000	011
124	53715237	0015	06237 0532	265	636	233	341	031	161	000	015	000	000	000	175
124	53716389	0016	06237 0532	271	636	237	147	170	000	000	211	000	000	000	324
124	53717541	0017	06237 0532	275	636	237	000	072	205	000	014	000	000	000	020
124	53718693	0020	06237 0532	301	636	237	255	004	000	000	023	002	000	000	022
124	53719845	0021	06237 0532	305	636	237	377	004	000	000	015	000	000	000	177
124	53720997	0022	06237 0532	311	636	237	000	326	311	000	254	000	000	000	239
124	53722149	0023	06237 0532	315	636	237	000	005	312	000	011	000	003	000	016
124	53723301	0024	06237 0532	321	636	237	000	004	150	014	014	000	000	000	011
124	53724453	0025	06237 0532	325	636	237	037	325	377	000	025	000	000	000	176
124	53725605	0026	06237 0532	331	636	237	173	175	155	000	207	003	000	260	325
124	53726757	0027	06237 0532	335	636	237	303	175	164	304	015	165	000	000	014

EXPERIMENT NO. 3

Figure B-9. Identification and Data Record Printout, Experiment 3

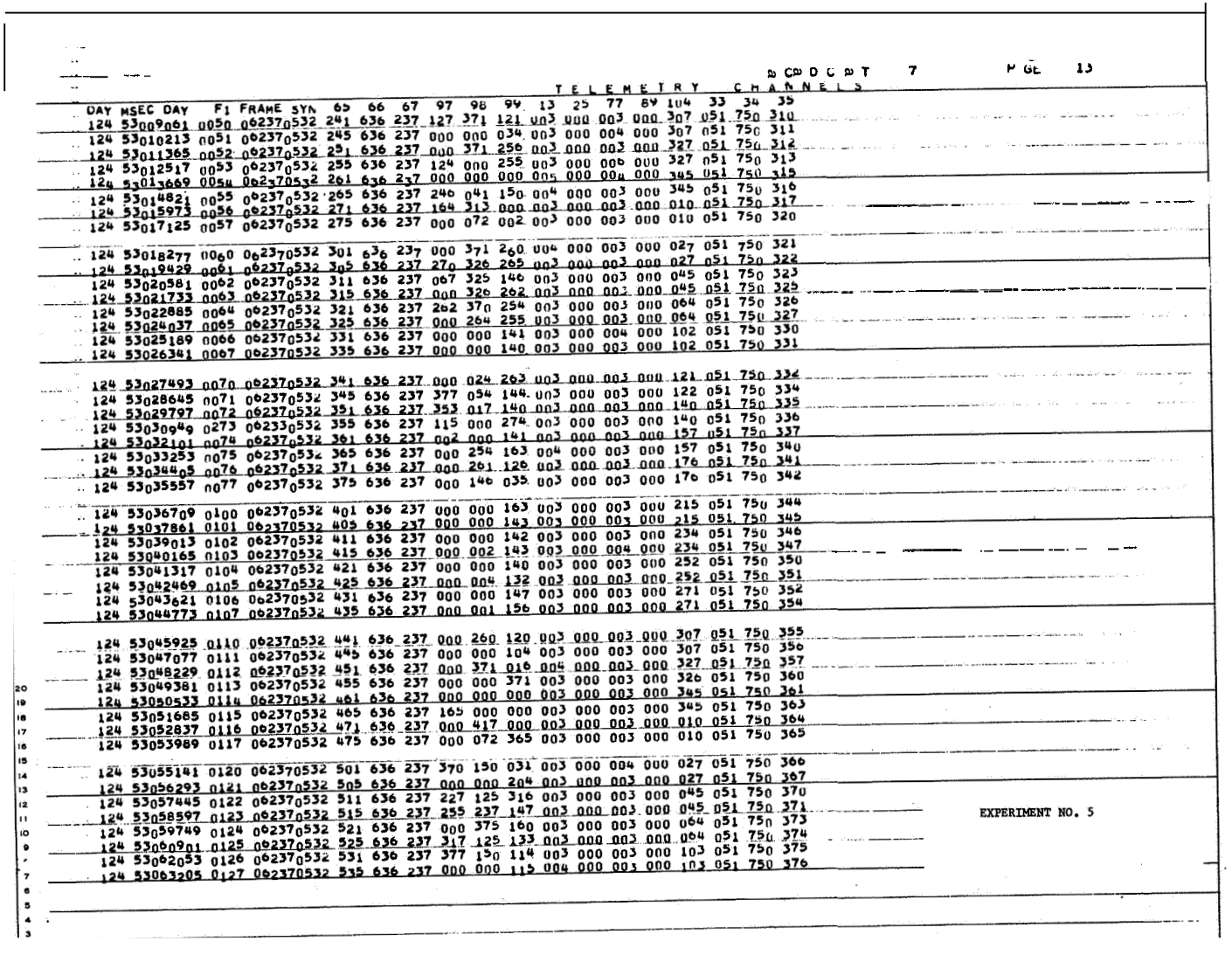


ECO O C U T O P G 7

DAY	MSEC DAY	F1	FRAME SYN	65	66	67	97	98	99	55	56	57
124	52677285	0010	062370532	041	636	237	000	260	121	070	012	043
124	52678438	0011	062370532	045	636	237	377	000	104	067	012	444
124	52679589	0012	062370532	051	636	237	000	371	016	000	000	033
124	52680742	0013	062370532	055	636	237	377	000	371	000	000	432
124	52681894	0014	062370532	061	636	237	000	000	000	022	005	151
124	52683045	0015	062370532	065	636	237	340	032	162	022	005	011
124	52684197	0016	062370532	071	636	237	147	170	000	042	005	001
124	52685349	0017	062370532	075	636	237	000	072	365	042	005	201
124	52686502	0020	062370532	101	636	237	314	005	000	004	203	124
124	52687654	0021	062370532	105	636	237	377	004	000	004	202	040
124	52688806	0022	062370532	111	636	237	000	325	311	005	251	175
124	52689958	0023	062370532	115	636	237	000	005	312	005	250	043
124	52691109	0024	062370532	121	636	237	000	004	151	027	204	515
124	52692261	0025	062370532	125	636	237	037	326	377	027	202	415
124	52693414	0026	062370532	131	636	237	173	176	156	000	020	400
124	52694565	0027	062370532	135	636	237	304	175	166	000	020	601
124	52695717	0030	062370532	141	636	237	000	175	162	001	035	524
124	52696869	0031	062370532	145	636	237	000	175	167	001	036	434
124	52698021	0032	062370532	151	636	237	117	372	163	001	042	576
124	52699174	0033	062370532	155	636	237	304	000	000	001	042	443
124	52700326	0034	062370532	161	636	237	241	000	000	130	040	151
124	52701477	0035	062370532	165	636	237	226	000	200	027	000	000
124	52702629	0036	062370532	171	636	237	227	000	200	050	003	003
124	52703781	0037	062370532	175	636	237	000	042	200	050	003	003
124	52704934	0040	062370532	201	636	237	000	100	150	037	055	527
124	52706086	0041	062370532	205	636	237	000	074	160	037	055	524
124	52707237	0042	062370532	211	636	237	000	000	160	210	233	520
124	52708389	0043	062370532	215	636	237	000	206	154	214	231	510
124	52709541	0044	062370532	221	636	237	000	254	156	043	127	110
124	52710693	0045	062370532	225	636	237	000	254	156	043	126	102
124	52711846	0046	062370532	231	636	237	000	142	143	110	113	067
124	52712998	0047	062370532	235	636	237	000	143	125	110	115	050
124	52714149	0050	062370532	241	636	237	121	000	155	012	207	450
124	52715302	0051	062370532	245	636	237	000	000	034	012	205	445
124	52716453	0052	062370532	251	636	237	000	001	255	023	074	401
124	52717606	0053	062370532	255	636	237	124	000	256	023	073	404
124	52718757	0054	062370532	261	636	237	000	000	000	000	046	151
124	52719909	0055	062370532	265	636	237	244	042	1	001	043	145
124	52721062	0056	062370532	271	636	237	160	313	0	002	104	540
124	52722213	0057	062370532	275	636	237	000	072	0	002	103	534
124	52723365	0060	062370532	301	636	237	000	371	2	004	270	126
124	52724518	0061	062370532	305	636	237	334	326	265	005	265	123
124	52725669	0062	062370532	311	636	237	067	325	146	077	007	520
124	52726822	0063	062370532	315	636	237	000	325	262	077	007	516
124	52727973	0064	062370532	321	636	237	262	370	253	001	113	111
124	52729125	0065	062370532	325	636	237	000	264	255	002	112	102
124	52730277	0066	062370532	331	636	237	000	000	141	225	013	464
124	52731429	0067	062370532	335	636	237	000	000	137	223	013	452

EXPERIMENT NO. 4

Figure B-10. Identification and Data Record Printout, Experiment 4



RECORD 7 PAGE 13

					TELEMETRY CHANNELS													
DAY	MSEC DAY	FI	FRAME SYN	65	66	67	97	98	99	13	25	77	89	104	33	34	35
124	53009061	0050	06237 0532	241	636	237	127	371	121	003	000	003	000	307	051	750	310
124	53010213	0051	06237 0532	245	636	237	000	000	034	003	000	004	000	307	051	750	311
124	53011365	0052	06237 0532	251	636	237	000	371	256	003	000	003	000	327	051	750	312
124	53012517	0053	06237 0532	255	636	237	124	000	255	003	000	006	000	327	051	750	313
124	53013669	0054	06237 0532	261	636	237	000	000	000	005	000	004	000	345	051	750	315
124	53014821	0055	06237 0532	265	636	237	246	041	150	004	000	003	000	345	051	750	316
124	53015973	0056	06237 0532	271	636	237	164	313	000	003	000	003	000	010	051	750	317
124	53017125	0057	06237 0532	275	636	237	000	072	002	003	000	003	000	010	051	750	320
124	53018277	0060	06237 0532	301	636	237	000	371	260	004	000	003	000	027	051	750	321
124	53019429	0061	06237 0532	305	636	237	270	326	265	003	000	003	000	027	051	750	322
124	53020581	0062	06237 0532	311	636	237	067	325	146	003	000	003	000	045	051	750	323
124	53021733	0063	06237 0532	315	636	237	000	326	262	003	000	003	000	045	051	750	325
124	53022885	0064	06237 0532	321	636	237	262	370	254	003	000	003	000	064	051	750	326
124	53024037	0065	06237 0532	325	636	237	000	264	255	003	000	003	000	064	051	750	327
124	53025189	0066	06237 0532	331	636	237	000	000	141	003	000	004	000	102	051	750	330
124	53026341	0067	06237 0532	335	636	237	000	000	140	003	000	003	000	102	051	750	331
124	53027493	0070	06237 0532	341	636	237	000	024	263	003	000	003	000	121	051	750	332
124	53028645	0071	06237 0532	345	636	237	377	054	144	003	000	003	000	122	051	750	334
124	53029797	0072	06237 0532	351	636	237	353	017	140	003	000	003	000	140	051	750	335
124	53030949	0073	06233 0532	355	636	237	115	000	274	003	000	003	000	140	051	750	336
124	53032101	0074	06237 0532	361	636	237	002	000	141	003	000	003	000	157	051	750	337
124	53033253	0075	06237 0532	365	636	237	000	254	163	004	000	003	000	157	051	750	340
124	53034405	0076	06237 0532	371	636	237	000	261	126	003	000	003	000	176	051	750	341
124	53035557	0077	06237 0532	375	636	237	000	146	035	003	000	003	000	176	051	750	342
124	53036709	0100	06237 0532	401	636	237	000	000	163	003	000	003	000	215	051	750	344
124	53037861	0101	06237 0532	405	636	237	000	000	143	003	000	003	000	215	051	750	345
124	53039013	0102	06237 0532	411	636	237	000	000	142	003	000	003	000	234	051	750	346
124	53040165	0103	06237 0532	415	636	237	000	002	143	003	000	004	000	234	051	750	347
124	53041317	0104	06237 0532	421	636	237	000	000	140	003	000	003	000	252	051	750	350
124	53042469	0105	06237 0532	425	636	237	000	004	132	003	000	003	000	252	051	750	351
124	53043621	0106	06237 0532	431	636	237	000	000	147	003	000	003	000	271	051	750	352
124	53044773	0107	06237 0532	435	636	237	000	001	156	003	000	003	000	271	051	750	354
124	53045925	0110	06237 0532	441	636	237	000	260	120	003	000	003	000	307	051	750	355
124	53047077	0111	06237 0532	445	636	237	000	000	104	003	000	003	000	307	051	750	356
124	53048229	0112	06237 0532	451	636	237	000	371	016	004	000	003	000	327	051	750	357
124	53049381	0113	06237 0532	455	636	237	000	000	371	003	000	003	000	326	051	750	360
124	53050533	0114	06237 0532	461	636	237	000	000	000	003	000	003	000	345	051	750	361
124	53051685	0115	06237 0532	465	636	237	165	000	000	003	000	003	000	345	051	750	363
124	53052837	0116	06237 0532	471	636	237	000	417	000	003	000	003	000	010	051	750	364
124	53053989	0117	06237 0532	475	636	237	000	072	365	003	000	003	000	010	051	750	365
124	53055141	0120	06237 0532	501	636	237	370	150	031	003	000	004	000	027	051	750	366
124	53056293	0121	06237 0532	505	636	237	000	000	204	003	000	003	000	027	051	750	367
124	53057445	0122	06237 0532	511	636	237	227	125	316	003	000	003	000	045	051	750	370
124	53058597	0123	06237 0532	515	636	237	255	237	147	003	000	003	000	045	051	750	371
124	53059749	0124	06237 0532	521	636	237	000	375	160	003	000	003	000	064	051	750	373
124	53060901	0125	06237 0532	525	636	237	317	125	133	003	000	003	000	064	051	750	374
124	53062053	0126	06237 0532	531	636	237	377	150	114	003	000	003	000	103	051	750	375
124	53063205	0127	06237 0532	535	636	237	000	000	115	004	000	003	000	103	051	750	376

EXPERIMENT NO. 5

Figure B-11. Identification and Data Record Printout, Experiment 5

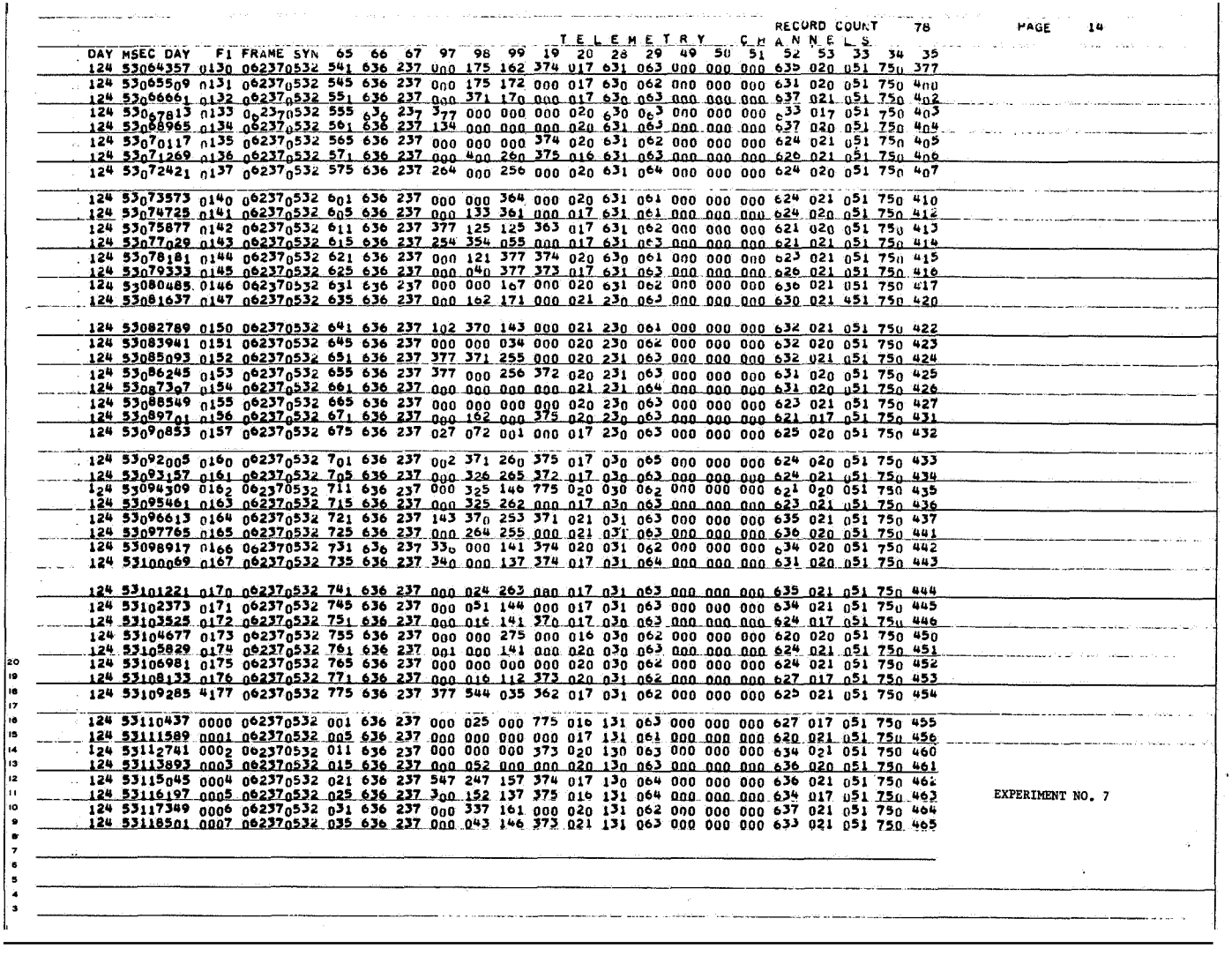
RECORD COUNT 108 PAGE 19

TELEMETRY CHANNELS

DAY	MSEC DAY	F1	FRAME SYN	65	66	67	97	98	99	58	59	60	33	34	35
							000	260	121	000	000	260	051	751	024
124	53340837	0110	062370532	441	636	237	000	000	104	000	000	000	051	751	025
124	53341989	0111	062370532	445	636	237	000	371	016	000	000	000	051	751	026
124	53343141	0112	062370532	451	636	237	000	000	371	000	000	000	051	751	027
124	53344293	0113	062370532	455	636	237	000	000	000	000	000	000	051	751	030
124	53345445	0114	062370532	461	636	237	165	000	000	000	000	000	051	751	031
124	53346597	0115	062370532	465	636	237	000	417	000	000	000	340	051	751	033
124	53347749	0116	062370532	471	636	237	000	072	365	000	000	642	051	751	034
124	53348901	0117	062370532	475	636	237									
							162	150	031	000	000	260	051	751	035
124	53350053	0120	062370532	501	636	237	000	000	204	000	000	000	051	751	036
124	53351205	0121	062370532	505	636	237	227	125	316	003	002	002	051	751	037
124	53352357	0122	062370532	511	636	237	255	237	147	002	002	002	051	751	040
124	53353509	0123	062370532	515	636	237	000	375	161	000	000	001	051	751	042
124	53354661	0124	062370532	521	636	237	265	124	133	000	000	000	051	751	043
124	53355813	0125	062370532	525	636	237	377	150	113	002	002	340	051	751	044
124	53356965	0126	062370532	531	636	237	000	000	114	000	000	642	051	751	045
124	53358117	0127	062370532	535	636	237									
							000	175	171	000	000	260	051	751	046
124	53359269	0130	062370532	541	636	237	000	175	166	000	000	000	051	751	047
124	53360421	0131	062370532	545	636	237	000	371	165	000	000	000	051	751	050
124	53361573	0132	062370532	551	636	237	377	000	000	000	000	001	051	751	052
124	53362725	0133	062370532	555	636	237	134	000	000	000	000	000	051	751	053
124	53363877	0134	062370532	561	636	237	000	000	000	000	000	000	051	751	054
124	53365029	0135	062370532	565	636	237	000	400	260	000	000	340	051	751	055
124	53366181	0136	062370532	571	636	237	264	000	256	000	000	642	051	751	056
124	53367333	0137	062370532	575	636	237									
							000	000	364	002	003	261	051	751	057
124	53368485	0140	062370532	601	636	237	000	133	361	000	000	000	451	751	060
124	53369637	0141	062370532	605	636	237	377	125	125	000	000	000	051	751	062
124	53370789	0142	062370532	611	636	237	235	355	055	000	000	000	051	751	063
124	53371941	0143	062370532	615	636	237	000	122	377	000	000	000	051	751	064
124	53373093	0144	062370532	621	636	237	000	040	377	000	000	000	051	751	065
124	53374245	0145	062370532	625	636	237	000	000	167	000	000	340	051	751	066
124	53375397	0146	062370532	631	636	237	000	163	171	000	000	642	051	751	067
124	53376549	0147	062370532	635	636	237									
							106	371	137	000	000	260	051	751	071
124	53377701	0150	062370532	641	636	237	000	000	034	000	000	000	051	751	072
124	53378853	0151	062370532	645	636	237	377	371	256	000	000	000	051	751	073
124	53380005	0152	062370532	651	636	237	377	000	255	000	000	000	051	751	074
124	53381157	0153	062370532	655	636	237	000	000	000	000	000	000	051	751	075
124	53382309	0154	062370532	661	636	237	000	000	000	000	000	000	051	751	076
124	53383461	0155	062370532	665	636	237	000	162	000	000	000	340	051	751	077
124	53384613	0156	062370532	671	636	237	030	072	001	000	000	642	051	751	101
124	53385765	0157	062370532	675	636	237									
							000	371	260	000	000	261	051	751	102
124	53386917	0160	062370532	701	636	237	000	326	265	000	000	000	051	751	103
124	53388069	0161	062370532	705	636	237	000	325	146	000	000	000	051	751	104
124	53389221	0162	062370532	711	636	237	000	326	262	000	000	001	051	751	105
124	53390373	0163	062370532	715	636	237	143	370	254	000	000	002	051	751	106
124	53391525	0164	062370532	721	636	237	000	264	255	000	000	000	051	751	110
124	53392677	0165	062370532	725	636	237	336	000	142	000	000	340	051	751	111
124	53393829	0166	062370532	731	636	237	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	051	751	112

EXPERIMENT NO. 6

Figure B-12. Identification and Data Record Printout, Experiment 6



RECORD COUNT 78 PAGE 14

TELEMETRY CHANNELS

DAY	MSEC DAY	F1	FRAME SYN	65	66	67	97	98	99	19	20	28	29	49	50	51	52	53	33	34	35	
124	53064357	0130	06237 0532	541	636	237	000	175	162	374	017	631	063	000	000	000	635	020	051	750	377	
124	53065509	0131	06237 0532	545	636	237	000	175	172	000	017	630	062	000	000	000	631	020	051	750	400	
124	53066661	0132	06237 0532	551	636	237	000	371	170	000	017	630	063	000	000	000	637	021	051	750	402	
124	53067813	0133	06237 0532	555	636	237	377	000	000	000	020	630	063	000	000	000	633	017	051	750	403	
124	53068965	0134	06237 0532	561	636	237	134	000	000	000	020	631	063	000	000	000	637	020	051	750	404	
124	53070117	0135	06237 0532	565	636	237	000	000	000	374	020	631	062	000	000	000	624	021	051	750	405	
124	53071269	0136	06237 0532	571	636	237	000	400	260	375	016	631	063	000	000	000	626	021	051	750	406	
124	53072421	0137	06237 0532	575	636	237	264	000	256	000	020	631	064	000	000	000	624	020	051	750	407	
124	53073573	0140	06237 0532	601	636	237	000	000	364	000	020	631	061	000	000	000	624	021	051	750	410	
124	53074725	0141	06237 0532	605	636	237	000	133	361	000	017	631	061	000	000	000	624	020	051	750	411	
124	53075877	0142	06237 0532	611	636	237	377	125	125	363	017	631	062	000	000	000	621	020	051	750	413	
124	53077029	0143	06237 0532	615	636	237	254	354	055	000	017	631	063	000	000	000	621	021	051	750	414	
124	53078181	0144	06237 0532	621	636	237	000	121	377	374	020	630	061	000	000	000	623	021	051	750	415	
124	53079333	0145	06237 0532	625	636	237	000	040	377	373	017	631	063	000	000	000	626	021	051	750	416	
124	53080485	0146	06237 0532	631	636	237	000	000	167	000	020	631	062	000	000	000	636	021	051	750	417	
124	53081637	0147	06237 0532	635	636	237	000	162	171	000	021	230	063	000	000	000	630	021	451	750	420	
124	53082789	0150	06237 0532	641	636	237	102	370	143	000	021	230	061	000	000	000	632	021	051	750	422	
124	53083941	0151	06237 0532	645	636	237	000	000	034	000	020	230	062	000	000	000	632	020	051	750	423	
124	53085093	0152	06237 0532	651	636	237	377	371	255	000	020	231	063	000	000	000	632	021	051	750	424	
124	53086245	0153	06237 0532	655	636	237	377	000	256	372	020	231	063	000	000	000	631	020	051	750	425	
124	53087397	0154	06237 0532	661	636	237	000	000	000	000	021	231	064	000	000	000	631	020	051	750	426	
124	53088549	0155	06237 0532	665	636	237	000	000	000	000	020	230	063	000	000	000	623	021	051	750	427	
124	53089701	0156	06237 0532	671	636	237	000	162	000	375	020	230	063	000	000	000	621	017	051	750	431	
124	53090853	0157	06237 0532	675	636	237	027	072	001	000	017	230	063	000	000	000	625	020	051	750	432	
124	53092005	0160	06237 0532	701	636	237	002	371	260	375	017	030	065	000	000	000	624	020	051	750	433	
124	53093157	0161	06237 0532	705	636	237	000	326	265	372	017	030	063	000	000	000	624	021	051	750	434	
124	53094309	0162	06237 0532	711	636	237	000	325	146	775	020	030	062	000	000	000	624	020	051	750	435	
124	53095461	0163	06237 0532	715	636	237	000	325	262	000	017	030	063	000	000	000	623	021	051	750	436	
124	53096613	0164	06237 0532	721	636	237	143	370	253	371	021	031	063	000	000	000	635	021	051	750	437	
124	53097765	0165	06237 0532	725	636	237	000	264	255	000	021	031	063	000	000	000	636	020	051	750	441	
124	53098917	0166	06237 0532	731	636	237	330	000	141	374	020	031	062	000	000	000	634	020	051	750	442	
124	53100069	0167	06237 0532	735	636	237	340	000	137	374	017	031	064	000	000	000	631	020	051	750	443	
124	53101221	0170	06237 0532	741	636	237	000	024	263	000	017	031	063	000	000	000	635	021	051	750	444	
124	53102373	0171	06237 0532	745	636	237	000	051	144	000	017	031	063	000	000	000	634	021	051	750	445	
124	53103525	0172	06237 0532	751	636	237	000	016	141	370	017	030	063	000	000	000	624	017	051	750	446	
124	53104677	0173	06237 0532	755	636	237	000	000	275	000	016	030	062	000	000	000	620	020	051	750	450	
124	53105829	0174	06237 0532	761	636	237	001	000	141	000	020	030	063	000	000	000	624	021	051	750	451	
124	53106981	0175	06237 0532	765	636	237	000	000	000	000	020	030	062	000	000	000	624	021	051	750	452	
124	53108133	0176	06237 0532	771	636	237	000	016	112	373	020	031	062	000	000	000	627	017	051	750	453	
124	53109285	4177	06237 0532	775	636	237	377	544	035	362	017	031	062	000	000	000	625	021	051	750	454	
124	53110437	0000	06237 0532	001	636	237	000	025	000	775	016	131	063	000	000	000	627	017	051	750	455	
124	53111589	0001	06237 0532	005	636	237	000	000	000	000	017	131	061	000	000	000	620	021	051	750	456	
124	53112741	0002	06237 0532	011	636	237	000	000	000	373	020	130	063	000	000	000	634	021	051	750	460	
124	53113893	0003	06237 0532	015	636	237	000	052	000	000	020	130	063	000	000	000	636	020	051	750	461	
124	53115045	0004	06237 0532	021	636	237	547	247	157	374	017	130	064	000	000	000	636	021	051	750	462	
124	53116197	0005	06237 0532	025	636	237	300	152	137	375	016	131	064	000	000	000	634	017	051	750	463	EXPERIMENT NO. 7
124	53117349	0006	06237 0532	031	636	237	000	337	161	000	020	131	062	000	000	000	637	021	051	750	464	
124	53118501	0007	06237 0532	035	636	237	000	043	146	373	021	131	063	000	000	000	633	021	051	750	465	

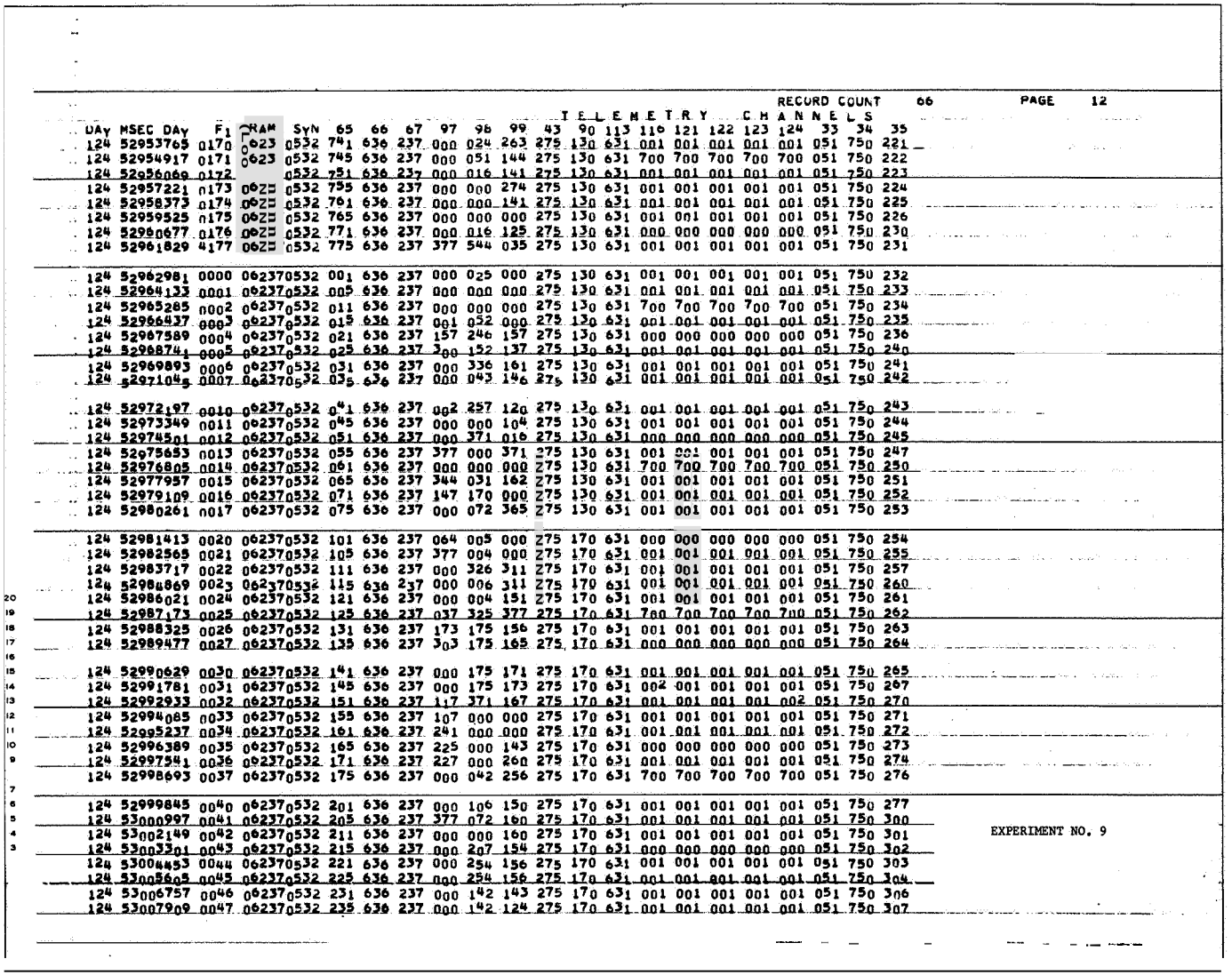
Figure B-13. Identification and Data Record Printout, Experiment 7

RECORD COUNT 78 PAGE 14

DAY	MSEC DAY	F1	FRAME SYN	65	66	67	97	98	99	114	115	33	34	35
124	53064357	0130	062370532	541	636	237	000	175	162	000	000	051	750	377
124	53065509	0131	062370532	545	636	237	000	175	172	000	000	051	750	400
124	53066661	0132	062370532	551	636	237	000	371	170	000	000	051	750	402
124	53067813	0133	062370532	555	636	237	377	000	000	000	000	051	750	403
124	53068965	0134	062370532	561	636	237	134	000	000	000	000	051	750	404
124	53070117	0135	062370532	565	636	237	000	000	000	000	000	051	750	405
124	53071269	0136	062370532	571	636	237	000	400	260	000	000	051	750	406
124	53072421	0137	062370532	575	636	237	264	000	256	000	000	051	750	407
124	53073573	0140	062370532	601	636	237	000	000	364	000	000	051	750	410
124	53074725	0141	062370532	605	636	237	000	133	361	000	000	051	750	412
124	53075877	0142	062370532	611	636	237	377	125	125	000	000	051	750	413
124	53077029	0143	062370532	615	636	237	254	354	055	[illegible]	000	051	750	[illegible]
124	53078181	0144	062370532	621	636	237	000	121	377	000	000	051	750	415
124	53079333	0145	062370532	625	636	237	000	040	377	000	000	051	750	416
124	53080485	0146	062370532	631	636	237	000	000	167	000	000	051	750	417
124	53081637	0147	062370532	635	636	237	000	162	171	000	000	451	750	420
124	53082789	0150	062370532	641	636	237	102	370	143	000	000	051	750	422
124	53083941	0151	062370532	645	636	237	000	000	034	000	000	051	750	423
124	53085093	0152	062370532	651	636	237	377	371	255	000	000	051	750	424
124	53086245	0153	062370532	655	636	237	377	000	256	000	000	051	750	425
124	53087397	0154	062370532	661	636	237	000	000	000	000	000	051	750	426
124	53088549	0155	062370532	665	636	237	000	000	000	000	000	051	750	427
124	53089701	0156	062370532	671	636	237	000	162	000	000	000	051	750	431
124	53090853	0157	062370532	675	636	237	027	072	001	000	000	051	750	432
124	53092005	0160	062370532	701	636	237	002	371	260	000	000	051	750	433
124	53093157	0161	062370532	705	636	237	000	326	265	000	000	051	750	434
124	53094309	0162	062370532	711	636	237	000	325	146	000	000	051	750	435
124	53095461	0163	062370532	715	636	237	000	325	262	000	000	051	750	436
124	53096613	0164	062370532	721	636	237	143	370	253	000	000	051	750	437
124	53097765	0165	062370532	725	636	237	000	264	255	000	000	051	750	441
124	53098917	0166	062370532	731	636	237	336	000	141	000	000	051	750	442
124	53100069	0167	062370532	735	636	237	340	000	137	000	000	051	750	443
124	53101221	0170	062370532	741	636	237	000	024	263	000	000	051	750	444
124	53102373	0171	062370532	745	636	237	000	051	144	000	000	051	750	445
124	53103525	0172	062370532	751	636	237	000	016	141	000	000	051	750	446
124	53104677	0173	062370532	755	636	237	000	000	275	000	000	051	750	450
124	53105829	0174	062370532	761	636	237	001	000	141	000	000	051	750	451
124	53106981	0175	062370532	765	636	237	000	000	000	000	000	051	750	452
124	53108133	0176	062370532	771	636	237	000	016	112	000	000	051	750	453
124	53109285	4177	062370532	775	636	237	377	544	035	000	000	051	750	454
124	53110437	0000	062370532	001	636	237	000	025	000	000	000	051	750	455
124	53111569	0001	062370532	005	636	237	000	000	000	000	000	051	750	456
124	53112741	0002	062370532	011	636	237	000	000	000	000	000	051	750	460
124	53113893	0003	062370532	015	636	237	000	052	000	000	000	051	750	461
124	53115045	0004	062370532	021	636	237	547	247	157	000	000	051	750	462
124	53116197	0005	062370532	025	636	237	300	152	137	000	000	051	750	463
124	53117349	0006	062370532	031	636	237	000	337	161	000	000	051	750	464
124	53118501	0007	062370532	035	636	237	000	043	146	000	000	051	750	465

EXPERIMENT NO. 8

Figure B-14. Identification and Data Record Printout, Experiment 8



RECORD COUNT 66 PAGE 12

	DAY	MSEC	DAY	F1	FRAM	SYN	65	66	67	97	98	99	43	90	113	110	121	122	123	124	33	34	35
	124	52953765	0170	0623	0532	741	636	237	000	024	263	275	130	631	001	001	001	001	001	051	750	221	
	124	52954917	0171	0623	0532	745	636	237	000	051	144	275	130	631	700	700	700	700	700	051	750	222	
	124	52956069	0172		0532	751	636	237	000	016	141	275	130	631	001	001	001	001	001	051	750	223	
	124	52957221	0173	062Ξ	0532	755	636	237	000	000	274	275	130	631	001	001	001	001	001	051	750	224	
	124	52958373	0174	062Ξ	0532	761	636	237	000	000	141	275	130	631	001	001	001	001	001	051	750	225	
	124	52959525	0175	062Ξ	0532	765	636	237	000	000	000	275	130	631	001	001	001	001	001	051	750	226	
	124	52960677	0176	062Ξ	0532	771	636	237	000	016	125	275	130	631	000	000	000	000	000	051	750	230	
	124	52961829	4177	062Ξ	0532	775	636	237	377	544	035	275	130	631	001	001	001	001	001	051	750	231	
	124	52962981	0000	062370532		001	636	237	000	025	000	275	130	631	001	001	001	001	001	051	750	232	
	124	52964133	0001	062370532		005	636	237	000	000	000	275	130	631	001	001	001	001	001	051	750	233	
	124	52965285	0002	062370532		011	636	237	000	000	000	275	130	631	700	700	700	700	700	051	750	234	
	124	52966437	0003	062370532		015	636	237	001	052	000	275	130	631	001	001	001	001	001	051	750	235	
	124	52967589	0004	062370532		021	636	237	157	246	157	275	130	631	000	000	000	000	000	051	750	236	
	124	52968741	0005	062370532		025	636	237	300	152	137	275	130	631	001	001	001	001	001	051	750	240	
	124	52969893	0006	062370532		031	636	237	000	336	161	275	130	631	001	001	001	001	001	051	750	241	
	124	52971045	0007	062370532		035	636	237	000	043	146	275	130	631	001	001	001	001	001	051	750	242	
	124	52972197	0010	062370532		041	636	237	002	257	120	275	130	631	001	001	001	001	001	051	750	243	
	124	52973349	0011	062370532		045	636	237	000	000	104	275	130	631	001	001	001	001	001	051	750	244	
	124	52974501	0012	062370532		051	636	237	000	371	016	275	130	631	000	000	000	000	000	051	750	245	
	124	52975653	0013	062370532		055	636	237	377	000	371	275	130	631	001	001	001	001	001	051	750	247	
	124	52976805	0014	062370532		061	636	237	000	000	000	275	130	631	700	700	700	700	700	051	750	250	
	124	52977957	0015	062370532		065	636	237	344	031	162	275	130	631	001	001	001	001	001	051	750	251	
	124	52979109	0016	062370532		071	636	237	147	170	000	275	130	631	001	001	001	001	001	051	750	252	
	124	52980261	0017	062370532		075	636	237	000	072	365	275	130	631	001	001	001	001	001	051	750	253	
	124	52981413	0020	062370532		101	636	237	064	005	000	275	170	631	000	000	000	000	000	051	750	254	
	124	52982565	0021	062370532		105	636	237	377	004	000	275	170	631	001	001	001	001	001	051	750	255	
	124	52983717	0022	062370532		111	636	237	000	326	311	275	170	631	001	001	001	001	001	051	750	257	
	124	52984869	0023	062370532		115	636	237	000	006	311	275	170	631	001	001	001	001	001	051	750	260	
20	124	52986021	0024	062370532		121	636	237	000	004	151	275	170	631	001	001	001	001	001	051	750	261	
19	124	52987173	0025	062370532		125	636	237	037	325	377	275	170	631	700	700	700	700	700	051	750	262	
18	124	52988325	0026	062370532		131	636	237	173	175	156	275	170	631	001	001	001	001	001	051	750	263	
17	124	52989477	0027	062370532		135	636	237	303	175	165	275	170	631	000	000	000	000	000	051	750	264	
16																							
15	124	52990629	0030	062370532		141	636	237	000	175	171	275	170	631	001	001	001	001	001	051	750	265	
14	124	52991781	0031	062370532		145	636	237	000	175	173	275	170	631	002	001	001	001	001	051	750	267	
13	124	52992933	0032	062370532		151	636	237	117	371	167	275	170	631	001	001	001	001	002	051	750	270	
12	124	52994085	0033	062370532		155	636	237	107	000	000	275	170	631	001	001	001	001	001	051	750	271	
11	124	52995237	0034	062370532		161	636	237	241	000	000	275	170	631	001	001	001	001	001	051	750	272	
10	124	52996389	0035	062370532		165	636	237	225	000	143	275	170	631	000	000	000	000	000	051	750	273	
9	124	52997541	0036	062370532		171	636	237	227	000	260	275	170	631	001	001	001	001	001	051	750	274	
	124	52998693	0037	062370532		175	636	237	000	042	256	275	170	631	700	700	700	700	700	051	750	276	
7																							
6	124	52999845	0040	062370532		201	636	237	000	106	150	275	170	631	001	001	001	001	001	051	750	277	
5	124	53000997	0041	062370532		205	636	237	377	072	160	275	170	631	001	001	001	001	001	051	750	300	
4	124	53002149	0042	062370532		211	636	237	000	000	160	275	170	631	001	001	001	001	001	051	750	301	EXPERIMENT NO. 9
3	124	53003301	0043	062370532		215	636	237	000	207	154	275	170	631	000	000	000	000	000	051	750	302	
	124	53004453	0044	062370532		221	636	237	000	254	156	275	170	631	001	001	001	001	001	051	750	303	
	124	53005605	0045	062370532		225	636	237	000	254	156	275	170	631	001	001	001	001	001	051	750	304	
	124	53006757	0046	062370532		231	636	237	000	142	143	275	170	631	001	001	001	001	001	051	750	306	
	124	53007909	0047	062370532		235	636	237	000	142	124	275	170	631	001	001	001	001	001	051	750	307	

Figure B-15. Identification and Data Record Printout, Experiment 9

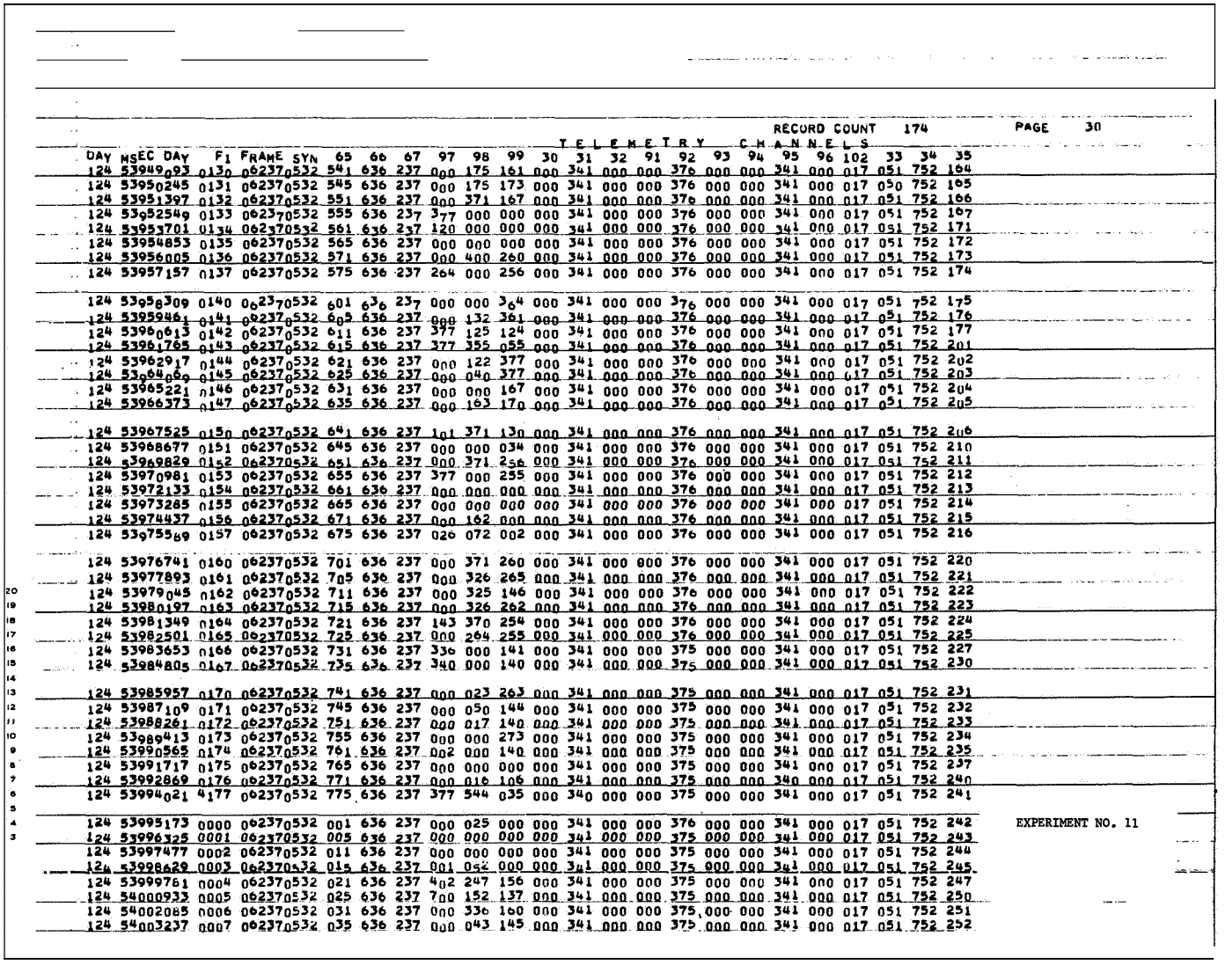
EXPERIMENT NO. 10

RECORD COUNT 102 PAGE 18

TELEMETRY CHANNELS

DAY	MSEC DAY	F1	FRAME SYN	65	66	67	97	98	99	14	15	16	37	38	39	61	62	63	80	86	87	88	117	118	119	33	34	35
124	53285541	0030	062370532	141	636	237	001	175	167	200	201	177	217	174	172	214	172	163	377	167	176	162	216	170	143	051	750	734
124	53286693	0031	062370532	145	636	237	000	175	173	153	206	076	125	215	123	151	211	136	377	174	201	161	146	212	203	051	750	736
124	53287845	0032	062370532	151	636	237	117	371	171	157	202	153	146	216	126	150	217	141	377	240	176	143	205	202	167	051	750	737
124	53288997	0033	062370532	155	636	237	364	000	000	172	211	165	225	167	306	270	134	377	000	236	147	346	212	164	261	051	750	740
124	53290149	0034	062370532	161	636	237	241	000	000	205	173	212	221	170	176	252	160	202	000	223	170	171	220	172	164	051	750	741
124	53291301	0035	062370532	165	636	237	226	000	142	172	203	171	155	205	177	154	205	200	377	157	205	206	176	174	211	051	750	742
124	53292453	0036	062370532	171	636	237	227	000	260	216	167	217	213	172	215	207	176	204	377	210	201	203	176	201	201	051	750	743
124	53293605	0037	062370532	175	636	237	000	042	256	151	206	200	174	200	205	214	174	170	377	202	205	142	215	174	160	051	750	744
124	53294757	0040	062370532	201	636	237	000	106	150	205	172	167	161	202	172	167	174	224	377	200	176	206	170	201	202	051	750	746
124	53295909	0041	062370532	205	636	237	000	072	160	201	177	171	217	171	177	220	171	173	377	175	170	212	221	172	167	051	750	747
124	53297061	0042	062370532	211	636	237	000	000	157	207	176	173	165	206	170	150	210	204	377	203	176	224	155	175	260	051	750	750
124	53298213	0043	062370532	215	636	237	000	206	154	173	202	226	170	204	211	206	201	221	377	170	211	204	142	217	215	051	750	751
124	53299365	0044	062370532	221	636	237	000	254	156	165	220	201	236	202	171	231	204	157	377	213	205	166	221	204	157	051	750	752
124	53300517	0045	062370532	225	636	237	000	254	156	205	207	177	157	213	202	155	214	206	377	155	220	176	170	210	206	051	750	753
124	53301669	0046	062370532	231	636	237	000	142	142	166	212	201	153	217	165	145	222	146	377	166	217	152	166	216	167	051	750	755
124	53302821	0047	062370532	235	636	237	000	143	123	202	211	172	216	204	156	211	211	144	377	201	214	161	174	215	167	051	750	756
124	53303973	0050	062370532	241	636	237	127	370	134	177	204	210	204	203	204	176	201	200	377	201	177	201	210	173	217	051	750	757
124	53305125	0051	062370532	245	636	237	000	000	034	211	173	220	174	200	223	172	203	213	377	176	203	211	177	207	212	051	750	760
124	53306277	0052	062370532	251	636	237	000	371	255	176	206	206	167	212	205	170	211	212	377	167	207	213	157	211	212	051	750	761
124	53307429	0053	062370532	255	636	237	130	000	255	165	207	211	200	205	210	207	201	204	377	212	174	202	176	200	177	051	750	762
124	53308581	0054	062370532	261	636	237	000	000	000	204	177	174	207	176	173	207	202	174	377	210	203	175	221	175	212	051	750	763
124	53309733	0055	062370532	265	636	237	244	041	150	223	176	224	213	177	215	205	202	205	377	177	202	214	206	176	206	051	750	765
124	53310885	0056	062370532	271	636	237	166	313	000	206	201	177	177	202	165	174	177	215	377	201	177	206	170	201	171	051	750	766
124	53312037	0057	062370532	275	636	237	000	072	001	166	175	206	174	201	172	163	200	177	377	161	210	146	160	202	174	051	750	767
124	53313189	0060	062370532	301	636	237	0 0	371	2 6	162	177	167	166	176	201	175	175	201	377	201	176	200	172	202	201	051	750	770
124	53314341	0061	062370532	305	636	237	3 6	326	2 5	203	201	205	207	203	202	210	200	204	377	202	200	204	206	177	205	051	750	771
124	53315493	0062	062370532	311	636	237	0 6	325	1 4	202	[illegible]	205	201	202	204	201	176	207	377	171	171	173	202	175	174	051	750	772
124	53316645	0063	062370532	315	636	237	0 0	325	2 8	202	177	177	172	203	177	161	204	177	377	161	203	203	163	200	200	051	750	774
124	53317797	0064	062370532	321	636	237	2 0	370	2 5	163	203	202	165	206	200	173	206	205	377	176	207	211	176	207	207	051	750	775
124	53318949	0065	062370532	325	636	237	0 0	26[illegible]	2 5	174	212	176	166	212	167	163	211	164	377	160	210	177	156	207	175	051	750	776
124	53320101	0066	062370532	331	636	237	0 0	000	1 [illegible]	165	206	200	167	205	176	166	204	177	377	170	203	200	170	203	200	051	750	777
124	53321253	0067	062370532	335	636	237	0 0	000	1 3	174	205	161	174	204	155	177	201	162	377	167	202	165	175	175	171	051	751	000
124	53322405	0070	062370532	341	636	237	000	02[illegible]	263	170	177	166	163	203	166	174	202	176	377	176	202	177	176	204	174	051	751	001
124	53323557	0071	062370532	345	636	237	37[illegible]	051	144	210	201	175	215	177	176	217	176	173	377	204	176	164	237	170	157	051	751	002
124	53324709	0072	062370532	351	636	237	35[illegible]	016	141	200	176	171	136	211	204	157	204	214	377	163	207	163	127	212	166	051	751	004
124	53325861	0073	062370532	355	636	237	251	000	274	137	211	162	166	206	122	173	200	154	377	175	200	105	146	205	111	051	751	005
124	53327013	0074	062370532	361	636	237	000	000	141	251	171	062	170	176	055	142	177	134	377	164	176	172	162	166	110	051	751	006
124	53328165	0075	062370532	[illegible]	636	237	000	254	163	230	172	160	215	171	140	215	165	151	000	220	170	204	211	171	206	051	751	007
124	53329317	0076	062370532	371	636	237	000	261	156	205	171	23[illegible]	221	164	220	212	167	215	000	215	171	215	221	170	207	051	751	010
124	53330469	0077	062370532	375	636	237	000	146	035	217	167	207	176	174	203	156	177	213	377	152	201	211	141	176	226	051	751	011
124	53331621	0100	062370532	401	636	237	000	000	163	131	202	207	120	210	213	075	224	160	000	134	206	163	160	177	166	051	751	012
124	53332773	0101	062370532	405	636	237	000	000	142	165	177	163	164	204	155	202	201	155	000	210	174	170	233	170	206	051	751	014
124	53333925	0102	062370532	411	636	237	000	000	142	224	170	213	215	175	212	213	172	207	377	221	165	203	216	173	202	051	751	015
124	53335077	0103	062370532	415	636	237	000	002	142	216	171	203	205	173	206	173	176	205	377	171	173	212	177	173	211	051	751	016
124	53336229	0104	062370532	421	636	237	000	000	140	173	176	210	176	177	207	177	203	206	377	205	201	175	175	205	176	051	751	017
124	53337381	0105	062370532	425	636	237	000	004	132	205	207	205	252	167	221	235	173	221	377	321	146	254	340	143	236	051	751	020
124	53338533	0106	062370532	431	636	237	000	000	146	227	173	244	126	220	172	116	225	160	377	131	222	170	202	205	173	051	751	021
124	53339685	0107	062370532	435	636	237	000	001	156	204	203	176	137	214	204	137	214	210	377	154	213	173	155	212	177	051	751	023

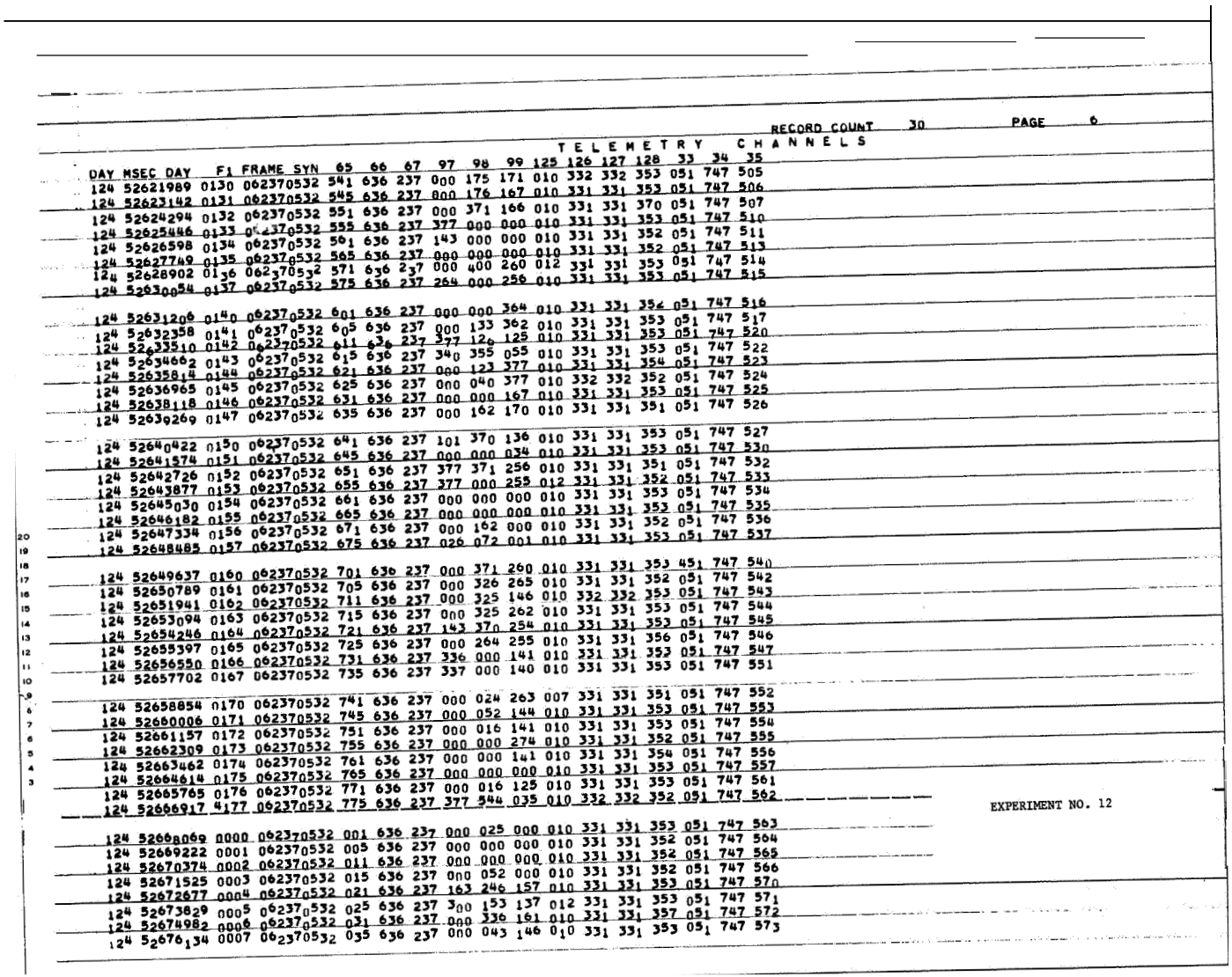
Figure B 4 Identification and Data Re ord Printout Eperirnnt 10



RECORD COUNT 174 PAGE 30

DAY	MSEC	DAY	F1	FRAME SYN	TELEMETRY CHANNELS 65	66	67	97	98	99	30	31	32	91	92	93	94	95	96	102	33	34	35	
124	53949093	0130	06237532	541	636	237	000	175	161	000	341	000	000	376	000	000	341	000	017	051	752	164		
124	53950245	0131	06237532	545	636	237	000	175	173	000	341	000	000	376	000	000	341	000	017	050	752	165		
124	53951397	0132	06237532	551	636	237	000	371	167	000	341	000	000	376	000	000	341	000	017	051	752	166		
124	53952549	0133	06237532	555	636	237	377	000	000	000	341	000	000	376	000	000	341	000	017	051	752	167		
124	53953701	0134	06237532	561	636	237	120	000	000	000	341	000	000	376	000	000	341	000	017	051	752	171		
124	53954853	0135	06237532	565	636	237	000	000	000	000	341	000	000	376	000	000	341	000	017	051	752	172		
124	53956005	0136	06237532	571	636	237	000	400	260	000	341	000	000	376	000	000	341	000	017	051	752	173		
124	53957157	0137	06237532	575	636	237	264	000	256	000	341	000	000	376	000	000	341	000	017	051	752	174		
124	53958309	0140	06237532	601	636	237	000	000	364	000	341	000	000	376	000	000	341	000	017	051	752	175		
124	53959461	0141	06237532	605	636	237	000	132	361	000	341	000	000	376	000	000	341	000	017	051	752	176		
124	53960613	0142	06237532	611	636	237	377	125	124	000	341	000	000	376	000	000	341	000	017	051	752	177		
124	53961765	0143	06237532	615	636	237	377	355	055	000	341	000	000	376	000	000	341	000	017	051	752	201		
124	53962917	0144	06237532	621	636	237	000	122	377	000	341	000	000	376	000	000	341	000	017	051	752	202		
124	53964069	0145	06237532	625	636	237	000	040	377	000	341	000	000	376	000	000	341	000	017	051	752	203		
124	53965221	0146	06237532	631	636	237	000	000	167	000	341	000	000	376	000	000	341	000	017	051	752	204		
124	53966373	0147	06237532	635	636	237	000	163	170	000	341	000	000	376	000	000	341	000	017	051	752	205		
124	53967525	0150	06237532	641	636	237	101	371	130	000	341	000	000	376	000	000	341	000	017	051	752	206		
124	53968677	0151	06237532	645	636	237	000	000	034	000	341	000	000	376	000	000	341	000	017	051	752	210		
124	53969829	0152	06237532	651	636	237	000	371	256	000	341	000	000	376	000	000	341	000	017	051	752	211		
124	53970981	0153	06237532	655	636	237	377	000	255	000	341	000	000	376	000	000	341	000	017	051	752	212		
124	53972133	0154	06237532	661	636	237	000	000	000	000	341	000	000	376	000	000	341	000	017	051	752	213		
124	53973285	0155	06237532	665	636	237	000	000	000	000	341	000	000	376	000	000	341	000	017	051	752	214		
124	53974437	0156	06237532	671	636	237	000	162	000	000	341	000	000	376	000	000	341	000	017	051	752	215		
124	53975589	0157	06237532	675	636	237	026	072	002	000	341	000	000	376	000	000	341	000	017	051	752	216		
124	53976741	0160	06237532	701	636	237	000	371	260	000	341	000	000	376	000	000	341	000	017	051	752	220		
124	53977893	0161	06237532	705	636	237	000	326	265	000	341	000	000	376	000	000	341	000	017	051	752	221		
124	53979045	0162	06237532	711	636	237	000	325	146	000	341	000	000	376	000	000	341	000	017	051	752	222		
124	53980197	0163	06237532	715	636	237	000	326	262	000	341	000	000	376	000	000	341	000	017	051	752	223		
124	53981349	0164	06237532	721	636	237	143	370	254	000	341	000	000	376	000	000	341	000	017	051	752	224		
124	53982501	0165	06237532	725	636	237	000	264	255	000	341	000	000	376	000	000	341	000	017	051	752	225		
124	53983653	0166	06237532	731	636	237	336	000	141	000	341	000	000	375	000	000	341	000	017	051	752	227		
124	53984805	0167	06237532	735	636	237	340	000	140	000	341	000	000	375	000	000	341	000	017	051	752	230		
124	53985957	0170	06237532	741	636	237	000	023	263	000	341	000	000	375	000	000	341	000	017	051	752	231		
124	53987109	0171	06237532	745	636	237	000	050	144	000	341	000	000	375	000	000	341	000	017	051	752	232		
124	53988261	0172	06237532	751	636	237	000	017	140	000	341	000	000	375	000	000	341	000	017	051	752	233		
124	53989413	0173	06237532	755	636	237	000	000	273	000	341	000	000	375	000	000	341	000	017	051	752	234		
124	53990565	0174	06237532	761	636	237	002	000	140	000	341	000	000	375	000	000	341	000	017	051	752	235		
124	53991717	0175	06237532	765	636	237	000	000	000	000	341	000	000	375	000	000	341	000	017	051	752	237		
124	53992869	0176	06237532	771	636	237	000	016	106	000	341	000	000	375	000	000	340	000	017	051	752	240		
124	53994021	4177	06237532	775	636	237	377	544	035	000	340	000	000	375	000	000	341	000	017	051	752	241		
124	53995173	0000	06237532	001	636	237	000	025	000	000	341	000	000	376	000	000	341	000	017	051	752	242	EXPERIMENT NO. 11	
124	53996325	0001	06237532	005	636	237	000	000	000	000	341	000	000	375	000	000	341	000	017	051	752	243		
124	53997477	0002	06237532	011	636	237	000	000	000	000	341	000	000	375	000	000	341	000	017	051	752	244		
124	53998629	0003	06237532	015	636	237	001	052	000	000	341	000	000	375	000	000	341	000	017	051	752	245		
124	53999781	0004	06237532	021	636	237	402	247	156	000	341	000	000	375	000	000	341	000	017	051	752	247		
124	54000933	0005	06237532	025	636	237	700	152	137	000	341	000	000	375	000	000	341	000	017	051	752	250		
124	54002085	0006	06237532	031	636	237	000	336	160	000	341	000	000	375	000	000	341	000	017	051	752	251		
124	54003237	0007	06237532	035	636	237	000	043	145	000	341	000	000	375	000	000	341	000	017	051	752	252		

Figure B-17. Identification and Data Record Printout, Experiment 11

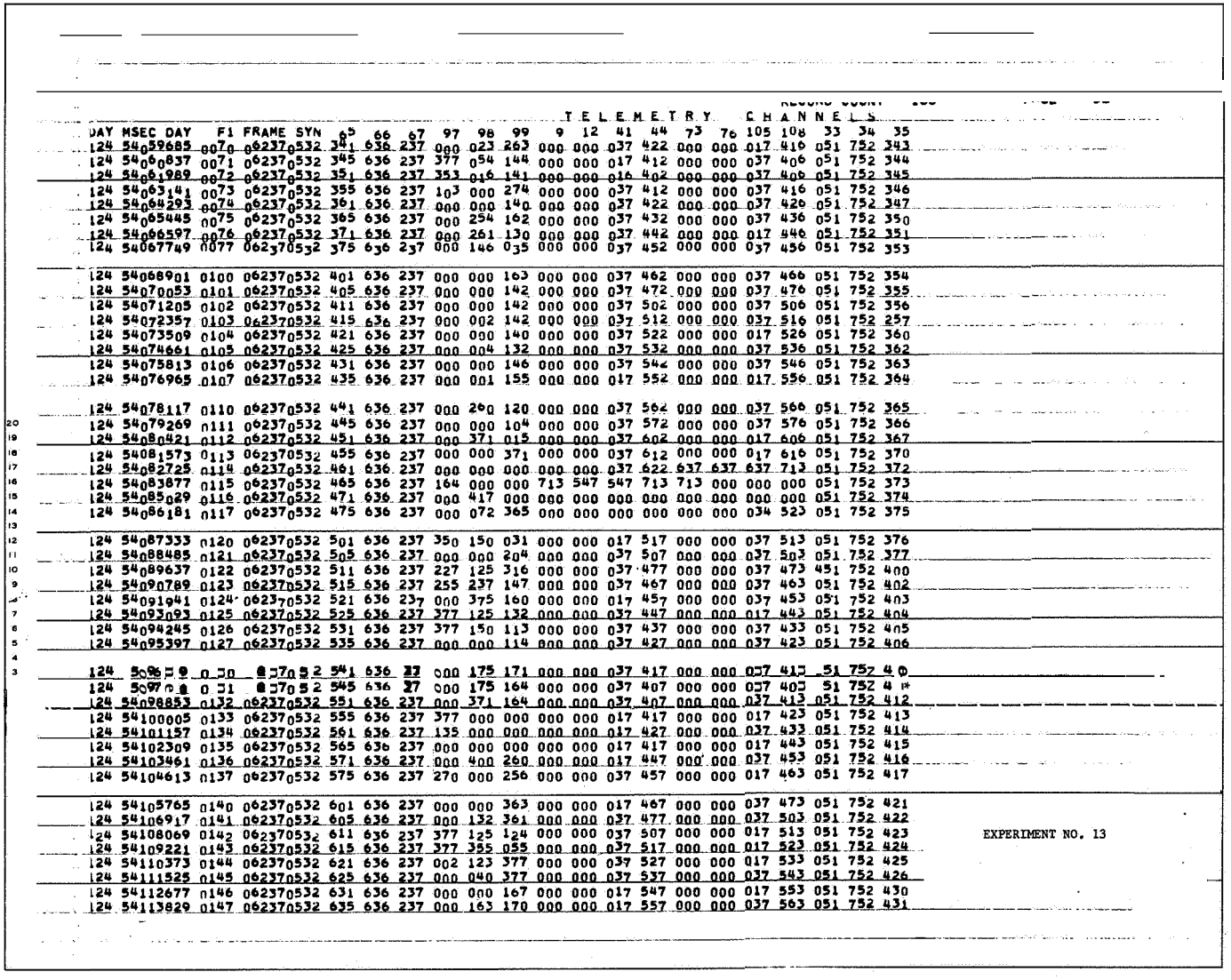


RECORD COUNT 30 PAGE 6

DAY	MSEC DAY	F1	FRAME SYN	TELEMETRY CHANNELS 65	66	67	97	98	99	125	126	127	128	33	34	35
124	52621989	0130	062370532	541	636	237	000	175	171	010	332	332	353	051	747	505
124	52623142	0131	062370532	545	636	237	000	176	167	010	331	331	353	051	747	506
124	52624294	0132	062370532	551	636	237	000	371	166	010	331	331	370	051	747	507
124	52625446	0133	062370532	555	636	237	377	000	000	010	331	331	353	051	747	510
124	52626598	0134	062370532	561	636	237	143	000	000	010	331	331	352	051	747	511
124	52627749	0135	062370532	565	636	237	000	000	000	010	331	331	352	051	747	513
124	52628902	0136	062370532	571	636	237	000	400	260	012	331	331	353	051	747	514
124	52630054	0137	062370532	575	636	237	264	000	256	010	331	331	353	051	747	515
124	52631206	0140	062370532	601	636	237	000	000	364	010	331	331	354	051	747	516
124	52632358	0141	062370532	605	636	237	000	133	362	010	331	331	353	051	747	517
124	52633510	0142	062370532	611	636	237	377	126	125	010	331	331	353	051	747	520
124	52634662	0143	062370532	615	636	237	340	355	055	010	331	331	353	051	747	522
124	52635814	0144	062370532	621	636	237	000	123	377	010	331	331	354	051	747	523
124	52636965	0145	062370532	625	636	237	000	040	377	010	332	332	352	051	747	524
124	52638118	0146	062370532	631	636	237	000	000	167	010	331	331	353	051	747	525
124	52639269	0147	062370532	635	636	237	000	162	170	010	331	331	351	051	747	526
124	52640422	0150	062370532	641	636	237	101	370	136	010	331	331	353	051	747	527
124	52641574	0151	062370532	645	636	237	000	000	034	010	331	331	353	051	747	530
124	52642726	0152	062370532	651	636	237	377	371	256	010	331	331	351	051	747	532
124	52643877	0153	062370532	655	636	237	377	000	255	012	331	331	352	051	747	533
124	52645030	0154	062370532	661	636	237	000	000	000	010	331	331	353	051	747	534
124	52646182	0155	062370532	665	636	237	000	000	000	010	331	331	353	051	747	535
124	52647334	0156	062370532	671	636	237	000	162	000	010	331	331	352	051	747	536
124	52648485	0157	062370532	675	636	237	026	072	001	010	331	331	353	051	747	537
124	52649637	0160	062370532	701	636	237	000	371	260	010	331	331	353	451	747	540
124	52650789	0161	062370532	705	636	237	000	326	265	010	331	331	352	051	747	542
124	52651941	0162	062370532	711	636	237	000	325	146	010	332	332	353	051	747	543
124	52653094	0163	062370532	715	636	237	000	325	262	010	331	331	353	051	747	544
124	52654246	0164	062370532	721	636	237	143	370	254	010	331	331	353	051	747	545
124	52655397	0165	062370532	725	636	237	000	264	255	010	331	331	356	051	747	546
124	52656550	0166	062370532	731	636	237	336	000	141	010	331	331	353	051	747	547
124	52657702	0167	062370532	735	636	237	337	000	140	010	331	331	353	051	747	551
124	52658854	0170	062370532	741	636	237	000	024	263	007	331	331	351	051	747	552
124	52660006	0171	062370532	745	636	237	000	052	144	010	331	331	353	051	747	553
124	52661157	0172	062370532	751	636	237	000	016	141	010	331	331	353	051	747	554
124	52662309	0173	062370532	755	636	237	000	000	274	010	331	331	352	051	747	555
124	52663462	0174	062370532	761	636	237	000	000	141	010	331	331	354	051	747	556
124	52664614	0175	062370532	765	636	237	000	000	000	010	331	331	353	051	747	557
124	52665765	0176	062370532	771	636	237	000	016	125	010	331	331	353	051	747	561
124	52666917	0177	062370532	775	636	237	377	544	035	010	332	332	352	051	747	562
124	52668069	0000	062370532	001	636	237	000	025	000	010	331	331	353	051	747	563
124	52669222	0001	062370532	005	636	237	000	000	000	010	331	331	352	051	747	564
124	52670374	0002	062370532	011	636	237	000	000	000	010	331	331	352	051	747	565
124	52671525	0003	062370532	015	636	237	000	052	000	010	331	331	352	051	747	566
124	52672677	0004	062370532	021	636	237	163	246	157	010	331	331	353	051	747	570
124	52673829	0005	062370532	025	636	237	300	153	137	012	331	331	353	051	747	571
124	52674982	0006	062370532	031	636	237	000	336	161	010	331	331	357	051	747	572
124	52676134	0007	062370532	035	636	237	000	043	146	010	331	331	353	051	747	573

EXPERIMENT NO. 12

Figure B 18 Identification and Data Record Printout, Experiment 12



TELEMETRY CHANNELS

DAY	MSEC DAY	F1	FRAME SYN	65	66	67	97	98	99	9	12	41	44	73	76	105	108	33	34	35	
124	54059685	0070	06237 0532	341	636	237	000	023	263	000	000	037	422	000	000	017	416	051	752	343	
124	54060837	0071	06237 0532	345	636	237	377	054	144	000	000	017	412	000	000	037	406	051	752	344	
124	54061989	0072	06237 0532	351	636	237	353	016	141	000	000	016	402	000	000	037	400	051	752	345	
124	54063141	0073	06237 0532	355	636	237	103	000	274	000	000	037	412	000	000	037	416	051	752	346	
124	54064293	0074	06237 0532	361	636	237	000	000	140	000	000	037	422	000	000	037	420	051	752	347	
124	54065445	0075	06237 0532	365	636	237	000	254	162	000	000	037	432	000	000	037	436	051	752	350	
124	54066597	0076	06237 0532	371	636	237	000	261	130	000	000	037	442	000	000	017	446	051	752	351	
124	54067749	0077	06237 0532	375	636	237	000	146	035	000	000	037	452	000	000	037	456	051	752	353	
124	54068901	0100	06237 0532	401	636	237	000	000	163	000	000	037	462	000	000	037	466	051	752	354	
124	54070053	0101	06237 0532	405	636	237	000	000	142	000	000	037	472	000	000	037	476	051	752	355	
124	54071205	0102	06237 0532	411	636	237	000	000	142	000	000	037	502	000	000	037	506	051	752	356	
124	54072357	0103	06237 0532	415	636	237	000	002	142	000	000	037	512	000	000	037	516	051	752	357	
124	54073509	0104	06237 0532	421	636	237	000	000	140	000	000	037	522	000	000	017	526	051	752	360	
124	54074661	0105	06237 0532	425	636	237	000	004	132	000	000	037	532	000	000	037	536	051	752	362	
124	54075813	0106	06237 0532	431	636	237	000	000	146	000	000	037	542	000	000	037	546	051	752	363	
124	54076965	0107	06237 0532	435	636	237	000	001	155	000	000	017	552	000	000	017	556	051	752	364	
124	54078117	0110	06237 0532	441	636	237	000	200	120	000	000	037	562	000	000	037	566	051	752	365	
124	54079269	0111	06237 0532	445	636	237	000	000	104	000	000	037	572	000	000	037	576	051	752	366	
124	54080421	0112	06237 0532	451	636	237	000	371	015	000	000	037	602	000	000	017	606	051	752	367	
124	54081573	0113	06237 0532	455	636	237	000	000	371	000	000	037	612	000	000	017	616	051	752	370	
124	54082725	0114	06237 0532	461	636	237	000	000	000	000	000	037	622	637	637	637	713	051	752	372	
124	54083877	0115	06237 0532	465	636	237	164	000	000	713	547	547	713	713	000	000	000	051	752	373	
124	54085029	0116	06237 0532	471	636	237	000	417	000	000	000	000	000	000	000	000	000	051	752	374	
124	54086181	0117	06237 0532	475	636	237	000	072	365	000	000	000	000	000	000	000	034	523	051	752	375
124	54087333	0120	06237 0532	501	636	237	350	150	031	000	000	017	517	000	000	037	513	051	752	376	
124	54088485	0121	06237 0532	505	636	237	000	000	204	000	000	037	507	000	000	037	503	051	752	377	
124	54089637	0122	06237 0532	511	636	237	227	125	316	000	000	037	477	000	000	037	473	451	752	400	
124	54090789	0123	06237 0532	515	636	237	255	237	147	000	000	037	467	000	000	037	463	051	752	402	
124	54091941	0124	06237 0532	521	636	237	000	375	160	000	000	017	457	000	000	037	453	051	752	403	
124	54093093	0125	06237 0532	525	636	237	377	125	132	000	000	037	447	000	000	017	443	051	752	404	
124	54094245	0126	06237 0532	531	636	237	377	150	113	000	000	037	437	000	000	037	433	051	752	405	
124	54095397	0127	06237 0532	535	636	237	000	000	114	000	000	037	427	000	000	037	423	051	752	406	
124	54096549	0130	06237 0532	541	636	237	000	175	171	000	000	037	417	000	000	037	413	051	752	407	
124	54097701	0131	06237 0532	545	636	237	000	175	164	000	000	037	407	000	000	037	403	051	752	410	
124	54098853	0132	06237 0532	551	636	237	000	371	164	000	000	037	407	000	000	037	413	051	752	412	
124	54100005	0133	06237 0532	555	636	237	377	000	000	000	000	017	417	000	000	017	423	051	752	413	
124	54101157	0134	06237 0532	561	636	237	135	000	000	000	000	017	427	000	000	037	433	051	752	414	
124	54102309	0135	06237 0532	565	636	237	000	000	000	000	000	017	417	000	000	017	443	051	752	415	
124	54103461	0136	06237 0532	571	636	237	000	400	260	000	000	017	447	000	000	037	453	051	752	416	
124	54104613	0137	06237 0532	575	636	237	270	000	256	000	000	037	457	000	000	017	463	051	752	417	
124	54105765	0140	06237 0532	601	636	237	000	000	363	000	000	017	467	000	000	037	473	051	752	421	
124	54106917	0141	06237 0532	605	636	237	000	132	361	000	000	037	477	000	000	037	503	051	752	422	
124	54108069	0142	06237 0532	611	636	237	377	125	124	000	000	037	507	000	000	017	513	051	752	423	
124	54109221	0143	06237 0532	615	636	237	377	355	055	000	000	037	517	000	000	017	523	051	752	424	
124	54110373	0144	06237 0532	621	636	237	002	123	377	000	000	037	527	000	000	017	533	051	752	425	
124	54111525	0145	06237 0532	625	636	237	000	040	377	000	000	037	537	000	000	037	543	051	752	426	
124	54112677	0146	06237 0532	631	636	237	000	000	167	000	000	017	547	000	000	017	553	051	752	430	
124	54113829	0147	06237 0532	635	636	237	000	163	170	000	000	017	557	000	000	037	563	051	752	431	

EXPERIMENT NO. 13

Figure B-19. Identification and Data Record Printout, Experiment 13

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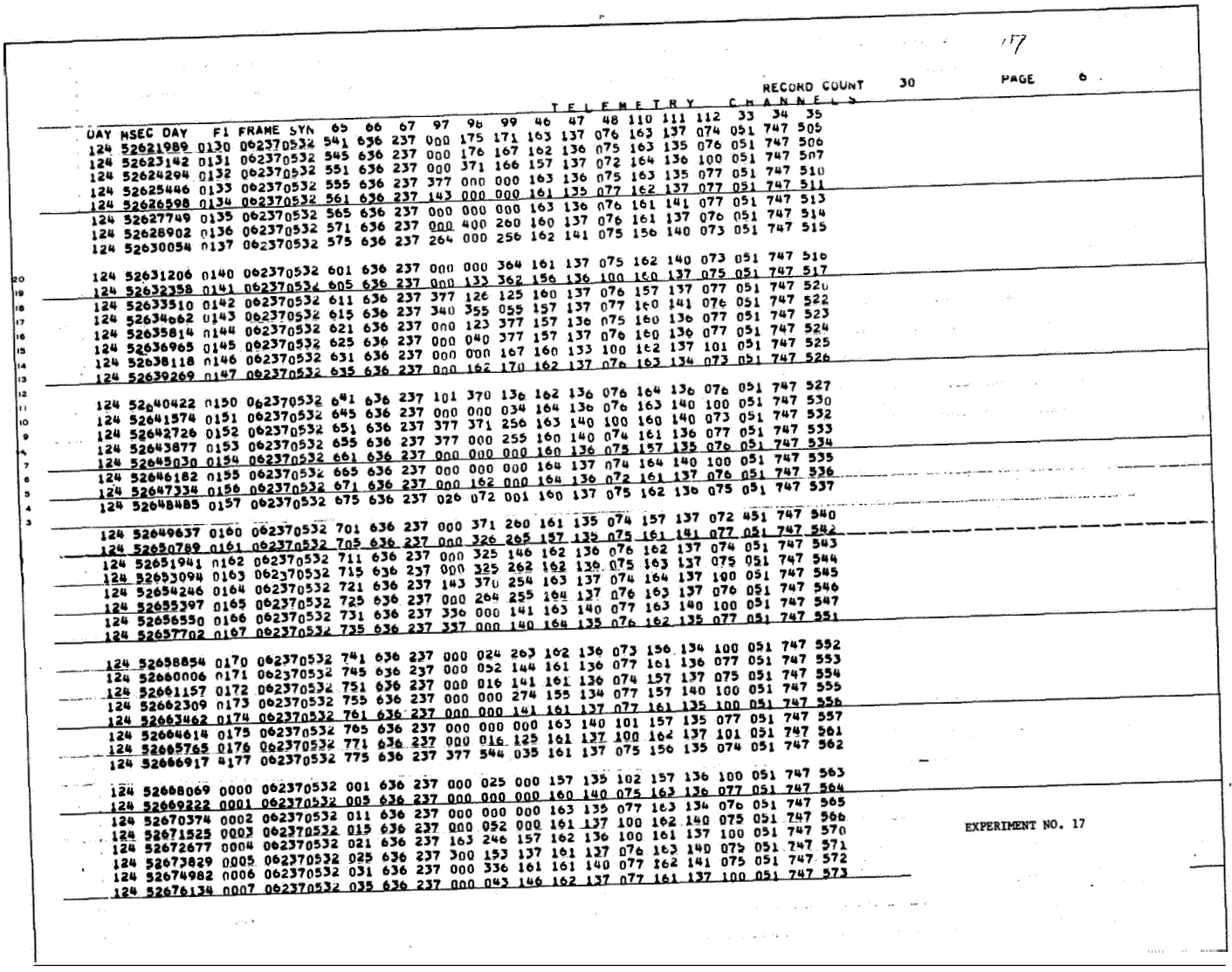
RECORD COUNT 120 PAGE 21

TELEMETRY CHANNELS

DAY	MSEC DAY	F1	FRAME SYN	65	66	67	97	98	99	24	27	40	54	68	69	70	71	72	100	101	109	33	34	35
124	53451429	0050	062370532	241	636	237	122	370	125	000	011	000	001	055	000	010	002	006	153	000	140	051	751	202
124	53452581	0051	062370532	245	636	237	000	000	034	000	010	000	001	044	000	010	000	001	153	000	032	051	751	203
124	53453733	0052	062370532	251	636	237	000	371	255	000	011	000	000	016	000	010	000	000	153	000	036	051	751	205
124	53454885	0053	062370532	255	636	237	114	000	253	000	011	001	000	022	000	010	000	000	154	000	026	051	751	206
124	53456037	0054	062370532	261	636	237	000	000	000	000	012	002	000	032	000	011	001	002	154	000	060	051	751	207
124	53457189	0055	062370532	265	636	237	244	042	150	000	011	000	001	043	000	011	000	000	154	000	017	051	751	210
124	53458341	0056	062370532	271	636	237	164	313	000	000	012	000	000	033	000	012	000	001	154	000	056	051	751	211
124	53459493	0057	062370532	275	636	237	000	072	001	000	011	000	000	023	000	010	000	002	155	000	066	051	751	212
124	53460645	0060	062370532	301	636	237	000	371	260	001	011	000	000	040	000	011	000	000	154	000	040	051	751	214
124	53461797	0061	062370532	305	636	237	377	326	265	002	010	000	000	023	000	010	000	000	154	000	043	051	751	215
124	53462949	0062	062370532	311	636	237	066	325	146	000	010	000	001	013	000	010	000	001	154	000	065	051	751	216
124	53464101	0063	062370532	315	636	237	000	325	262	000	010	000	002	033	001	011	000	001	154	000	045	051	751	217
124	53465253	0064	062370532	321	636	237	262	370	254	000	011	000	000	032	002	010	001	001	154	000	055	051	751	220
124	53466405	0065	062370532	325	636	237	000	264	255	000	010	000	000	035	000	011	002	003	155	000	131	051	751	221
124	53467557	0066	062370532	331	636	237	000	000	141	000	011	000	000	016	000	010	000	002	155	000	056	051	751	222
124	53468709	0067	062370532	335	636	237	000	000	140	000	010	000	000	013	000	010	000	001	155	000	050	051	751	224
124	53469861	0070	062370532	341	636	237	000	024	263	000	011	001	000	020	000	011	000	000	155	000	022	051	751	225
124	53471013	0071	062370532	345	636	237	377	053	144	000	012	002	000	011	000	010	000	000	155	000	013	051	751	226
124	53472165	0072	062370532	351	636	237	353	016	141	000	011	000	000	016	000	011	000	001	155	000	004	051	751	227
124	53473317	0073	062370532	355	636	237	077	000	275	000	011	000	000	031	000	012	000	001	155	000	002	051	751	230
124	53474469	0074	062370532	361	636	237	000	000	141	000	011	000	000	026	000	010	000	002	156	000	026	051	751	231
124	53475621	0075	062370532	365	636	237	000	254	163	001	011	000	001	055	000	010	000	000	155	000	043	051	751	232
124	53476773	0076	062370532	371	636	237	000	261	112	002	011	000	000	033	000	011	000	001	156	000	046	051	751	234
124	53477925	0077	062370532	375	636	237	000	146	035	000	010	000	001	020	000	010	000	000	155	000	031	051	751	235
124	53479077	0100	062370532	401	636	237	000	000	163	000	011	000	002	050	000	010	000	001	156	000	114	051	751	236
124	53480229	0101	062370532	405	636	237	000	000	142	000	010	000	000	037	002	010	000	002	156	000	142	051	751	237
124	53481381	0102	062370532	411	636	237	000	000	142	000	011	000	000	030	000	011	002	001	156	000	054	051	751	240
124	53482533	0103	062370532	415	636	237	000	002	142	000	011	000	000	034	000	010	000	000	156	000	042	051	751	241
124	53483685	0104	062370532	421	636	237	000	000	140	000	011	000	000	031	000	011	000	001	156	000	037	051	751	243
124	53484837	0105	062370532	425	636	237	000	004	132	000	011	001	000	026	000	011	000	000	156	000	012	051	751	244
124	53485989	0106	062370532	431	636	237	000	000	147	000	012	002	000	017	000	010	000	002	156	000	060	051	751	245
124	53487141	0107	062370532	435	636	237	000	001	156	000	011	000	001	072	000	011	000	002	156	000	075	051	751	246
124	53488293	0110	062370532	441	636	237	000	260	121	000	011	000	000	022	000	012	000	001	157	000	073	051	751	247
124	53489445	0111	062370532	445	636	237	000	000	104	000	010	000	001	020	000	010	000	002	157	000	052	051	751	250
124	53490597	0112	062370532	451	636	237	000	371	016	001	011	000	000	030	000	011	000	002	157	000	061	051	751	251
124	53491749	0113	062370532	455	636	237	000	000	371	002	011	000	000	032	000	010	000	000	157	000	031	051	751	253
124	53492901	0114	062370532	461	636	237	000	000	000	000	010	000	001	067	000	011	000	000	160	000	034	051	751	254
124	53494053	0115	062370532	465	636	237	164	000	000	000	011	000	002	024	000	011	000	000	157	000	024	051	751	255
124	53495205	0116	062370532	471	636	237	000	417	000	000	011	000	000	012	002	010	000	000	157	000	015	051	751	256
124	53496357	0117	062370532	475	636	237	000	072	365	000	011	000	000	011	000	010	002	000	157	000	020	051	751	257
124	53497509	0120	062370532	501	636	237	043	150	031	000	010	000	000	005	000	010	000	004	160	000	070	051	751	260
124	53498661	0121	062370532	505	636	237	000	000	204	000	011	000	000	024	000	011	000	001	160	000	030	051	751	262
124	53499813	0122	062370532	511	636	237	227	125	316	000	011	000	000	017	000	010	000	001	160	000	037	051	751	263
124	53500965	0123	062370532	515	636	237	255	237	147	000	012	002	001	065	000	010	000	002	160	000	064	051	751	264
124	53502117	0124	062370532	521	636	237	000	375	160	000	011	000	000	027	000	011	000	002	160	000	133	051	751	265
124	53503269	0125	062370532	525	636	237	264	125	133	000	011	000	000	022	000	012	000	001	160	000	057	051	751	266
124	53504421	0126	062370532	531	636	237	377	150	113	000	011	000	000	026	000	010	000	002	161	000	065	051	751	267
124	53505573	0127	062370532	535	636	237	000	000	114	001	011	000	000	016	000	011	000	000	160	000	025	051	751	270

EXPERIMENT NO. 15

Figure B 20. Identification and Data Record Printout Experiment 15



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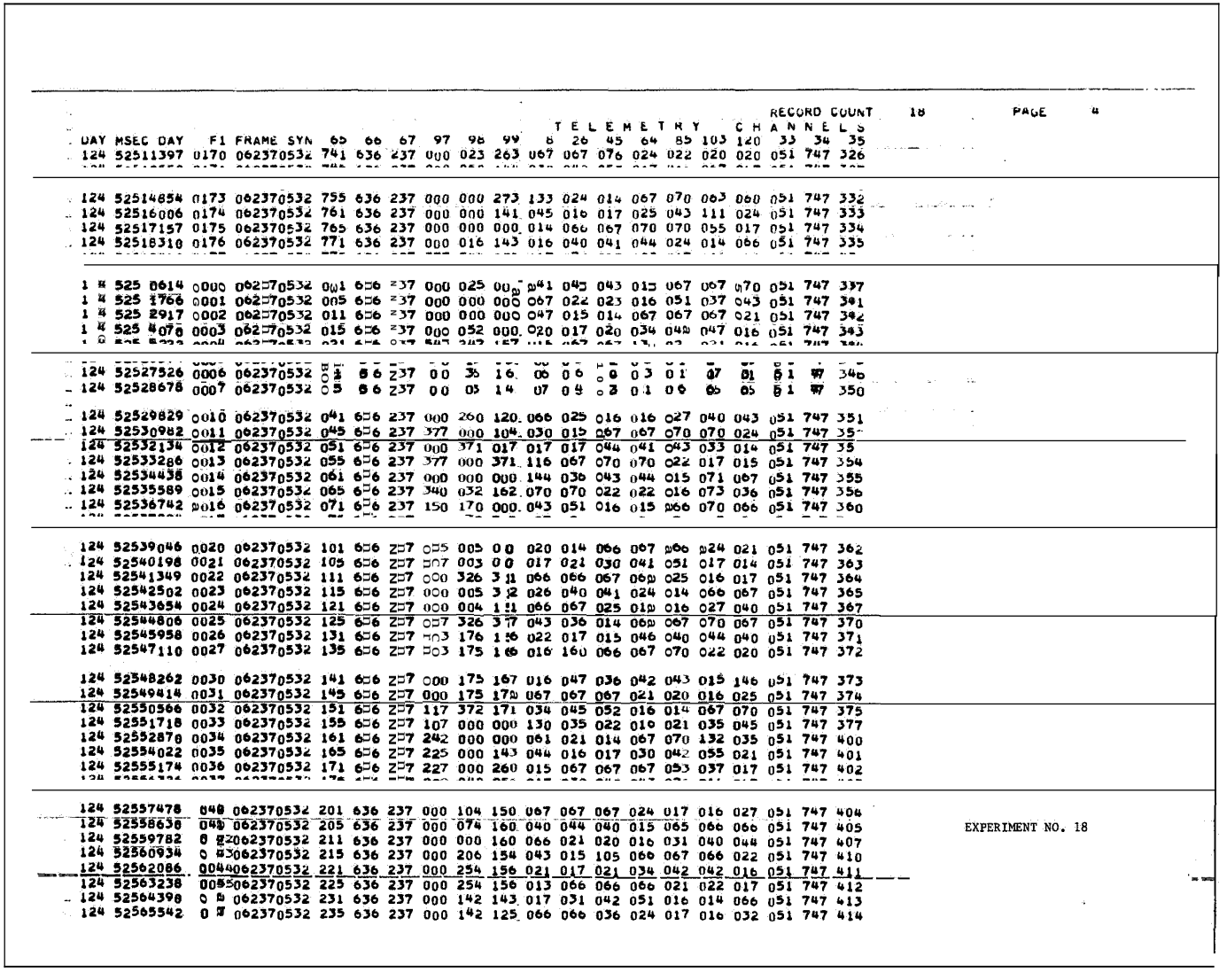
RECORD COUNT 30 PAGE 6

						TELEMETRY CHANNELS															
DAY	MSEC DAY	F1	FRAME SYN	65	66	67	97	98	99	46	47	48	110	111	112	33	34	35			
124	52621989	0130	062370532	541	636	237	000	175	171	163	137	076	163	137	074	051	747	505			
124	52623142	0131	062370532	545	636	237	000	176	167	162	136	075	163	135	076	051	747	506			
124	52624294	0132	062370532	551	636	237	000	371	166	157	137	072	164	136	100	051	747	507			
124	52625446	0133	062370532	555	636	237	377	000	000	163	136	075	163	135	077	051	747	510			
124	52626598	0134	062370532	561	636	237	143	000	000	161	135	077	162	137	077	051	747	511			
124	52627749	0135	062370532	565	636	237	000	000	000	163	136	076	161	141	077	051	747	513			
124	52628902	0136	062370532	571	636	237	000	400	260	160	137	076	161	137	076	051	747	514			
124	52630054	0137	062370532	575	636	237	264	000	256	162	141	075	156	140	073	051	747	515			
124	52631206	0140	062370532	601	636	237	000	000	364	161	137	075	162	140	073	051	747	516			
124	52632358	0141	062370532	605	636	237	000	133	362	156	136	100	160	137	075	051	747	517			
124	52633510	0142	062370532	611	636	237	377	126	125	160	137	076	157	137	077	051	747	520			
124	52634662	0143	062370532	615	636	237	340	355	055	157	137	077	160	141	076	051	747	522			
124	52635814	0144	062370532	621	636	237	000	123	377	157	136	075	160	136	077	051	747	523			
124	52636965	0145	062370532	625	636	237	000	040	377	157	137	076	160	136	077	051	747	524			
124	52638118	0146	062370532	631	636	237	000	000	167	160	133	100	162	137	101	051	747	525			
124	52639269	0147	062370532	635	636	237	000	162	170	162	137	076	163	134	073	051	747	526			
124	52640422	0150	062370532	641	636	237	101	370	136	162	136	076	164	136	076	051	747	527			
124	52641574	0151	062370532	645	636	237	000	000	034	164	136	076	163	140	100	051	747	530			
124	52642726	0152	062370532	651	636	237	377	371	256	163	140	100	160	140	073	051	747	532			
124	52643877	0153	062370532	655	636	237	377	000	255	160	140	074	161	136	077	051	747	533			
124	52645030	0154	062370532	661	636	237	000	000	000	160	136	075	157	135	076	051	747	534			
124	52646182	0155	062370532	665	636	237	000	000	000	164	137	074	164	140	100	051	747	535			
124	52647334	0156	062370532	671	636	237	000	162	000	164	136	072	161	137	076	051	747	536			
124	52648485	0157	062370532	675	636	237	026	072	001	160	137	075	162	136	075	051	747	537			
124	52649637	0160	062370532	701	636	237	000	371	260	161	135	074	157	137	072	451	747	540			
124	52650789	0161	062370532	705	636	237	000	326	265	157	135	075	161	141	077	051	747	542			
124	52651941	0162	062370532	711	636	237	000	325	146	162	136	076	162	137	074	051	747	543			
124	52653094	0163	062370532	715	636	237	000	325	262	162	136	075	163	137	075	051	747	544			
124	52654246	0164	062370532	721	636	237	143	370	254	163	137	074	164	137	100	051	747	545			
124	52655397	0165	062370532	725	636	237	000	264	255	164	137	076	163	137	076	051	747	546			
124	52656550	0166	062370532	731	636	237	336	000	141	163	140	077	163	140	100	051	747	547			
124	52657702	0167	062370532	735	636	237	337	000	140	164	135	076	162	135	077	051	747	551			
124	52658854	0170	062370532	741	636	237	000	024	263	162	136	073	156	134	100	051	747	552			
124	52660006	0171	062370532	745	636	237	000	052	144	161	136	077	161	136	077	051	747	553			
124	52661157	0172	062370532	751	636	237	000	016	141	161	136	074	157	137	075	051	747	554			
124	52662309	0173	062370532	755	636	237	000	000	274	155	134	077	157	140	100	051	747	555			
124	52663462	0174	062370532	761	636	237	000	000	141	161	137	077	161	135	100	051	747	556			
124	52664614	0175	062370532	765	636	237	000	000	000	163	140	101	157	135	077	051	747	557			
124	52665765	0176	062370532	771	636	237	000	016	125	161	137	100	164	137	101	051	747	561			
124	52666917	4177	062370532	775	636	237	377	544	035	161	137	075	156	135	074	051	747	562			
124	52668069	0000	062370532	001	636	237	000	025	000	157	135	102	157	136	100	051	747	563			
124	52669222	0001	062370532	005	636	237	000	000	000	160	140	075	163	136	077	051	747	564			
124	52670374	0002	062370532	011	636	237	000	000	000	163	135	077	163	134	076	051	747	565			
124	52671525	0003	062370532	015	636	237	000	052	000	161	137	100	162	140	075	051	747	566			
124	52672677	0004	062370532	021	636	237	163	246	157	162	136	100	161	137	100	051	747	570			
124	52673829	0005	062370532	025	636	237	300	153	137	161	137	076	163	140	075	051	747	571			
124	52674982	0006	062370532	031	636	237	000	336	161	161	140	077	162	141	075	051	747	572			
124	52676134	0007	062370532	035	636	237	000	043	146	162	137	077	161	137	100	051	747	573			

EXPERIMENT NO. 17

Figure B-21. Identification and Data Record Printout, Experiment 17

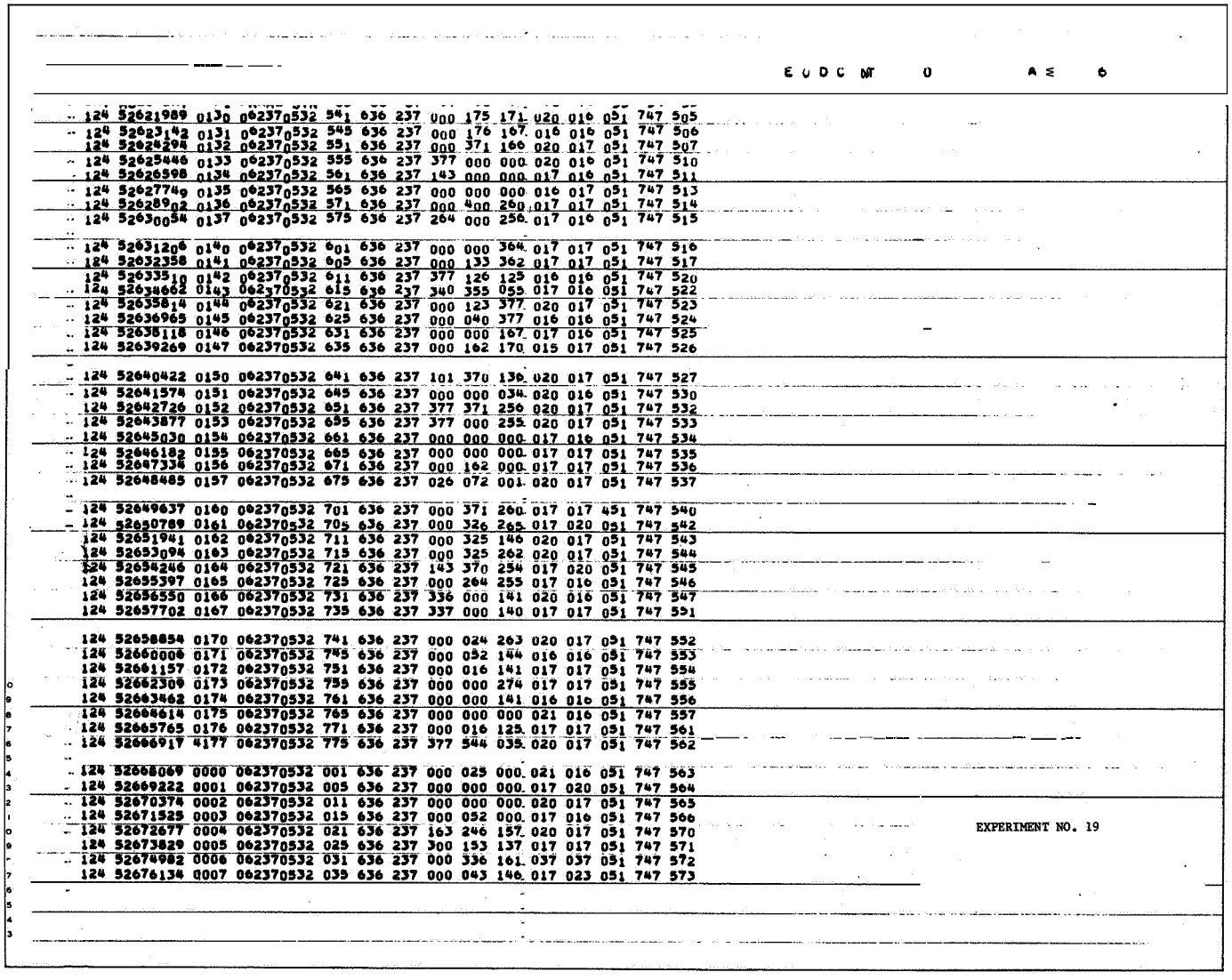


RECORD COUNT 18 PAGE 4

DAY	MSEC DAY	F1	FRAME SYN	65	66	67	97	98	99	TELEMETRY 8	26	45	64	85	103	120	CHANNELS 33	34	35
124	52511397	0170	062370532	741	636	237	000	023	263	067	067	076	024	022	020	020	051	747	326
124	52514854	0173	062370532	755	636	237	000	000	273	133	024	014	067	070	063	060	051	747	332
124	52516006	0174	062370532	761	636	237	000	000	141	045	016	017	025	043	111	024	051	747	333
124	52517157	0175	062370532	765	636	237	000	000	000	014	066	067	070	070	055	017	051	747	334
124	52518310	0176	062370532	771	636	237	000	016	143	016	040	041	044	024	014	066	051	747	335
1	525	0614	0000	062370532	001	636	237	000	025	000	041	043	043	015	067	067	070	051	747	337
1	525	1766	0001	062370532	005	636	237	000	000	000	067	022	023	016	051	037	043	051	747	341
1	525	2917	0002	062370532	011	636	237	000	000	000	047	015	014	067	067	067	021	051	747	342
1	525	4070	0003	062370532	015	636	237	000	052	000	020	017	020	034	040	047	016	051	747	343
124	52527526	0006	062370532	031	636	237	000	036	160	066	066	000	003	001	007	001	001	077	346
124	52528678	0007	062370532	035	636	237	000	003	140	070	045	002	001	004	005	005	001	077	350
124	52529829	0010	062370532	041	636	237	000	260	120	066	025	016	016	027	040	043	051	747	351
124	52530982	0011	062370532	045	636	237	377	000	104	030	015	067	067	070	070	024	051	747	352
124	52532134	0012	062370532	051	636	237	000	371	017	017	017	044	041	043	033	014	051	747	35
124	52533286	0013	062370532	055	636	237	377	000	371	116	067	070	070	022	017	015	051	747	354
124	52534438	0014	062370532	061	636	237	000	000	000	144	036	043	044	015	071	067	051	747	355
124	52535589	0015	062370532	065	636	237	340	032	162	070	070	022	022	016	073	036	051	747	356
124	52536742	0016	062370532	071	636	237	150	170	000	043	051	016	015	066	070	066	051	747	360
124	52539046	0020	062370532	101	636	237	055	005	000	020	014	066	067	066	024	021	051	747	362
124	52540198	0021	062370532	105	636	237	007	003	000	017	021	030	041	051	017	014	051	747	363
124	52541349	0022	062370532	111	636	237	000	326	311	066	066	067	066	025	016	017	051	747	364
124	52542502	0023	062370532	115	636	237	000	005	312	026	040	041	024	014	066	067	051	747	365
124	52543654	0024	062370532	121	636	237	000	004	131	066	067	025	016	027	040	051	051	747	367
124	52544806	0025	062370532	125	636	237	007	326	317	043	036	014	066	067	070	067	051	747	370
124	52545958	0026	062370532	131	636	237	003	176	136	022	017	015	046	040	044	040	051	747	371
124	52547110	0027	062370532	135	636	237	003	175	166	016	160	066	067	070	022	020	051	747	372
124	52548262	0030	062370532	141	636	237	000	175	167	016	047	036	042	043	015	146	051	747	373
124	52549414	0031	062370532	145	636	237	000	175	170	067	067	067	021	020	016	025	051	747	374
124	52550566	0032	062370532	151	636	237	117	372	171	034	045	052	016	014	067	070	051	747	375
124	52551718	0033	062370532	155	636	237	107	000	000	130	035	022	010	021	035	045	051	747	377
124	52552870	0034	062370532	161	636	237	242	000	000	061	021	014	067	070	132	035	051	747	400
124	52554022	0035	062370532	165	636	237	225	000	143	044	016	017	030	042	055	021	051	747	401
124	52555174	0036	062370532	171	636	237	227	000	260	015	067	067	067	053	037	017	051	747	402
124	52557478	0040	062370532	201	636	237	000	104	150	067	067	067	024	017	016	027	051	747	404
124	52558630	0041	062370532	205	636	237	000	074	160	040	044	040	015	065	066	066	051	747	405
124	52559782	0042	062370532	211	636	237	000	000	160	066	021	020	016	031	040	044	051	747	407
124	52560934	0043	062370532	215	636	237	000	206	154	043	015	105	066	067	066	022	051	747	410
124	52562086	0044	062370532	221	636	237	000	254	156	021	017	021	034	042	042	016	051	747	411
124	52563238	0045	062370532	225	636	237	000	254	156	013	066	066	066	021	022	017	051	747	412
124	52564390	0046	062370532	231	636	237	000	142	143	017	031	042	051	016	014	066	051	747	413
124	52565542	0047	062370532	235	636	237	000	142	125	066	066	036	024	017	016	032	051	747	414

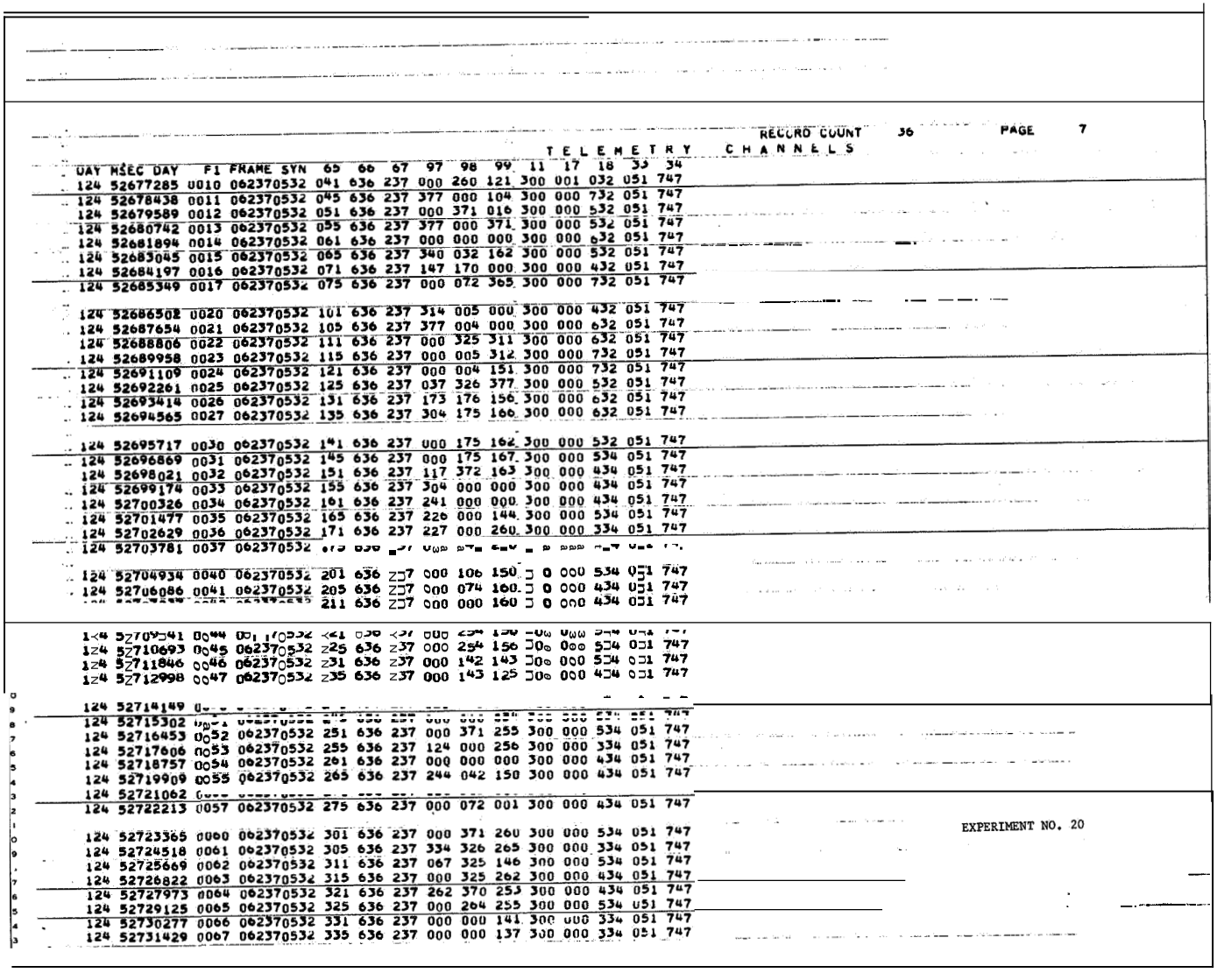
EXPERIMENT NO. 18

Figure B-22. Identification and Data Record Printout, Experiment 18



EXPERIMENT NO. 19

Figure B-23. Identification and Data Record Printout, Experiment 19



RECORD COUNT 36 PAGE 7

					TELEMETRY CHANNELS									
DAY	MSEC DAY	F1	FRAME SYN	65	66	67	97	98	99	11	17	18	33	34
124	52677285	0010	062370532	041	636	237	000	260	121	300	001	032	051	747
124	52678438	0011	062370532	045	636	237	377	000	104	300	000	732	051	747
124	52679589	0012	062370532	051	636	237	000	371	016	300	000	532	051	747
124	52680742	0013	062370532	055	636	237	377	000	371	300	000	532	051	747
124	52681894	0014	062370532	061	636	237	000	000	000	300	000	632	051	747
124	52683045	0015	062370532	065	636	237	340	032	162	300	000	532	051	747
124	52684197	0016	062370532	071	636	237	147	170	000	300	000	432	051	747
124	52685349	0017	062370532	075	636	237	000	072	365	300	000	732	051	747
124	52686502	0020	062370532	101	636	237	314	005	000	300	000	432	051	747
124	52687654	0021	062370532	105	636	237	377	004	000	300	000	632	051	747
124	52688806	0022	062370532	111	636	237	000	325	311	300	000	632	051	747
124	52689958	0023	062370532	115	636	237	000	005	312	300	000	732	051	747
124	52691109	0024	062370532	121	636	237	000	004	151	300	000	732	051	747
124	52692261	0025	062370532	125	636	237	037	326	377	300	000	532	051	747
124	52693414	0026	062370532	131	636	237	173	176	156	300	000	632	051	747
124	52694565	0027	062370532	135	636	237	304	175	166	300	000	632	051	747
124	52695717	0030	062370532	141	636	237	000	175	162	300	000	532	051	747
124	52696869	0031	062370532	145	636	237	000	175	167	300	000	534	051	747
124	52698021	0032	062370532	151	636	237	117	372	163	300	000	434	051	747
124	52699174	0033	062370532	155	636	237	304	000	000	300	000	434	051	747
124	52700326	0034	062370532	161	636	237	241	000	000	300	000	434	051	747
124	52701477	0035	062370532	165	636	237	226	000	144	300	000	534	051	747
124	52702629	0036	062370532	171	636	237	227	000	260	300	000	334	051	747
124	52703781	0037	062370532	[illegible]										
124	52704934	0040	062370532	201	636	237	000	106	150	[illegible]	0	000	534	051	747
124	52706086	0041	062370532	205	636	237	000	074	160	[illegible]	0	000	434	051	747
				211	636	237	000	000	160	[illegible]	0	000	434	051	747
124	52709241	0044	062370532	[illegible]										
124	52710693	0045	062370532	225	636	237	000	254	156	[illegible]	0	000	534	051	747
124	52711846	0046	062370532	231	636	237	000	142	143	[illegible]	0	000	534	051	747
124	52712998	0047	062370532	235	636	237	000	143	125	[illegible]	0	000	434	051	747
124	52714149	0050	062370532	[illegible]										
124	52715302	0051	062370532	[illegible]										
124	52716453	0052	062370532	251	636	237	000	371	255	300	000	534	051	747
124	52717606	0053	062370532	255	636	237	124	000	256	300	000	334	051	747
124	52718757	0054	062370532	261	636	237	000	000	000	300	000	434	051	747
124	52719909	0055	062370532	265	636	237	244	042	150	300	000	434	051	747
124	52721062	0056	062370532	[illegible]										
124	52722213	0057	062370532	275	636	237	000	072	001	300	000	434	051	747
124	52723365	0060	062370532	301	636	237	000	371	260	300	000	534	051	747
124	52724518	0061	062370532	305	636	237	334	326	265	300	000	334	051	747
124	52725669	0062	062370532	311	636	237	067	325	146	300	000	534	051	747
124	52726822	0063	062370532	315	636	237	000	325	262	300	000	434	051	747
124	52727973	0064	062370532	321	636	237	262	370	253	300	000	434	051	747
124	52729125	0065	062370532	325	636	237	000	264	255	300	000	534	051	747
124	52730277	0066	062370532	331	636	237	000	000	141	300	000	334	051	747
124	52731429	0067	062370532	335	636	237	000	000	137	300	000	334	051	747

EXPERIMENT NO. 20

Figure B-24. Identification and Data Record Printout, Experiment 20

APPENDIX C

OGO COMMAND SYSTEM AND SPACECRAFT INSTRUMENTATION LIST

APPENDIX C
OGO COMMAND SYSTEM AND SPACECRAFT INSTRUMENTATION LIST

The material in the June 1964 revision of "S-49 Spacecraft Command, Tracking, and Telemetry Systems, Section I —Command System," is incorporated by reference.

The material in the June 1964 revision of "S-49 Spacecraft Command, Tracking and Telemetry Systems: Appendix I — OGO Spacecraft Instrumentation List," is incorporated by reference.