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SUMMARY

The Atmospheric Structure Satellite (Goddard Space Flight Center project S-6), successfully launched on April 2, 1963, was designated Explorer XVII. This spacecraft operated on command, consumed high power, and had the highest PCM telemetry data rate of any scientific satellite at the date of launch. A major problem related to the development, test, and orbital monitoring of this spacecraft was the quick and accurate evaluation of the telemetry data. The problem was solved by incorporating an automatic data processing system as an integral part of the spacecraft telemetry test stand. Two such systems were utilized in the integration, test, and prelaunch phases and for orbital monitoring throughout the scheduled 100-day satellite lifetime.

CONTENTS

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INTRODUCTION

Constant efforts are being made to improve the design and reliability of contemporary spacecraft electronic systems. The success of these efforts depends upon the ability of the designers to evaluate the performance of their equipment on the ground and in orbit. The employment of the most advanced performance evaluation techniques is necessary in the development of spacecraft systems of optimum design and reliability.

A wide selection of performance evaluation techniques is available, only one of which permits identical evaluations to be made on the ground and in orbit. This technique is the performance evaluation of spacecraft systems via telemetry.

Although in many cases it is desirable to measure a large number of quantities hard-wired from the spacecraft under test, the benefit to be derived by the evaluation of performance via RF telemetered data is believed to be much greater. Performance monitoring via RF telemetered data on the ground forces the designer to evaluate spacecraft operation in a manner similar to that used after the spacecraft is launched. By this method the spacecraft system is tested in its entirety; this includes payload and ground support equipment. The number of quantities measured via hard wires should be minimized since this information may not be available once the spacecraft is launched. An effort should be made to avoid dependence on any of these measurements, if used, for significant performance evaluation. Included within the concept of spacecraft performance evaluation via telemetered data are the assumptions that the important experimental and housekeeping data are chosen for transmission, and that a telemetry system capable of transmitting these data is employed.

If spacecraft system performance is to be evaluated solely through telemetered data, the importance of an adequate test stand becomes magnified. Early spacecraft projects used

combinations of hard-wired and telemetered data checkout systems and required relatively low data rate test stands for the decommutation and display of spacecraft data for evaluation. Their test stands employed slow speed display devices such as lights, meters, analog recordings, and low speed printers.

The advent of the Explorer XVII project (S-6*) imposed new and stringent requirements upon the spacecraft test stand because of the decision that all spacecraft checkouts be made via RF. A sophisticated system for the processing and display of the high data rate telemetered data had to be developed. The telemetry system produced 41 main and 42 subcommutator (subcom) channels of information, exclusive of voltage reference, synchronization, and subcom counter channels. Its bit rate was 8640 bits per second of split-phase PCM, with a basic 48-word, 9 bits per word format.

Early in the project, the most meaningful data were selected to be telemetered from the spacecraft. This done, the project then established the requirements for a telemetry test stand, acknowledging recommendations that a computer be incorporated into the test stand. When the test stand was in operation for over 1 year a high speed computer complex was incorporated into the test stand system. This permitted a vastly more comprehensive spacecraft performance evaluation program; it required minimal manpower to conduct the evaluations; and it improved the efficiency and speed with which the evaluations were made. The digital nature of the telemetered data lent itself to the easy decommutation, formatting, and computer processing required in the test stand and computer system. An on-line computer processed, in real time, the telemetered digital data for presentation in meaningful form on a high speed line printer. Analog recordings were also made, but primarily for waveform checks on data. The accurate measurements needed for proper evaluation of the spacecraft system were obtained from computer-processed printouts. The test stand processed data accurately and in easy-to-read form, in real time. The real-time feature of the test stand and computer system was one of its most important and useful assets. Real-time data processing had two significant values: It greatly reduced the amount of time required for testing; it permitted the test conductors to remain closely attuned to spacecraft operation.

The test stand system evolved from a simple one, which employed digital lights and analog recordings for display, into that described herein, a highly versatile test stand and computer system. The decommutation and computer interface equipment was designed and fabricated at Goddard Space Flight Center. The computer, its peripheral typewriter, tape units, and medium speed printer were leased from the Control Data Corporation.

Two test stand and computer systems were used for the checkout of the prototype and flight unit spacecraft during all phases of development. The first system, located in the Technical Control Center (TCC) at Goddard Space Flight Center, was used for the checkout of the spacecraft during integration, environmental testing, and real-time monitoring in orbit (Figures 1 and 2). A second test stand and computer system was assembled and used for a short period of time, exclusively, in the prelaunch checkout of the spacecraft at the Atlantic Missile Range. This system was dismantled shortly after launch.

*Prior to launch the Explorer XVII project was known as the S-6 project, a Goddard Space Flight Center designation only.

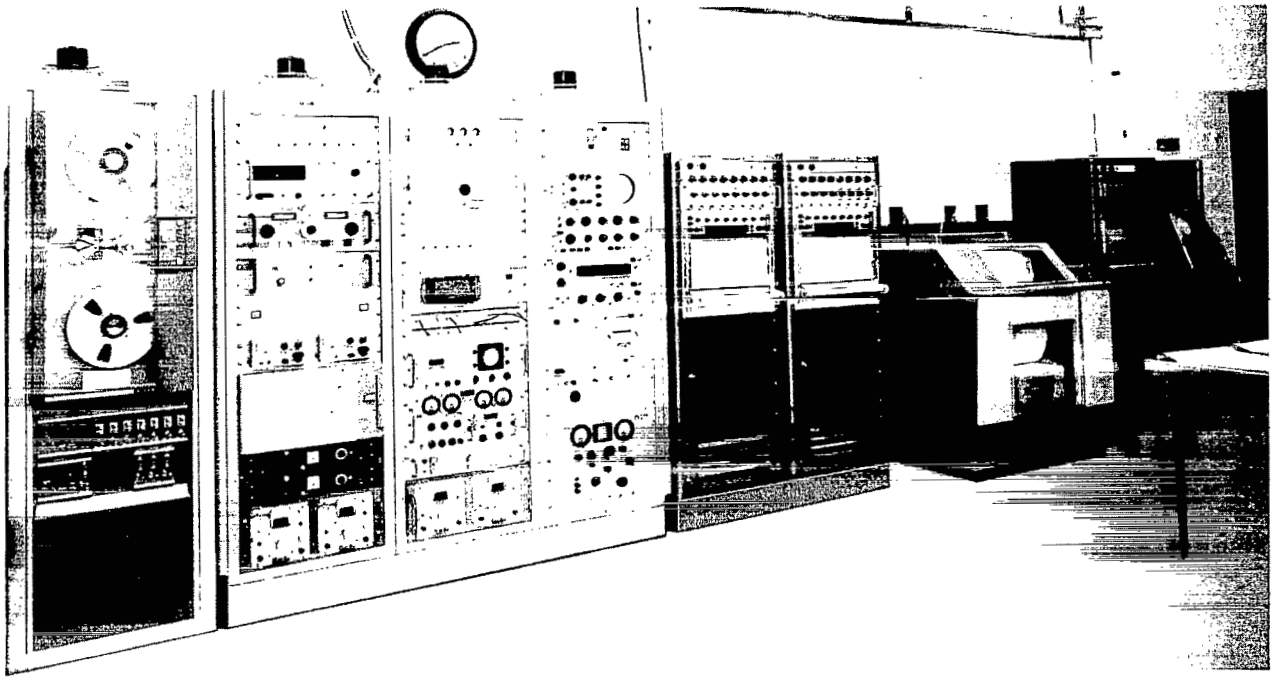


Figure 1—Technical Control Center test stand.

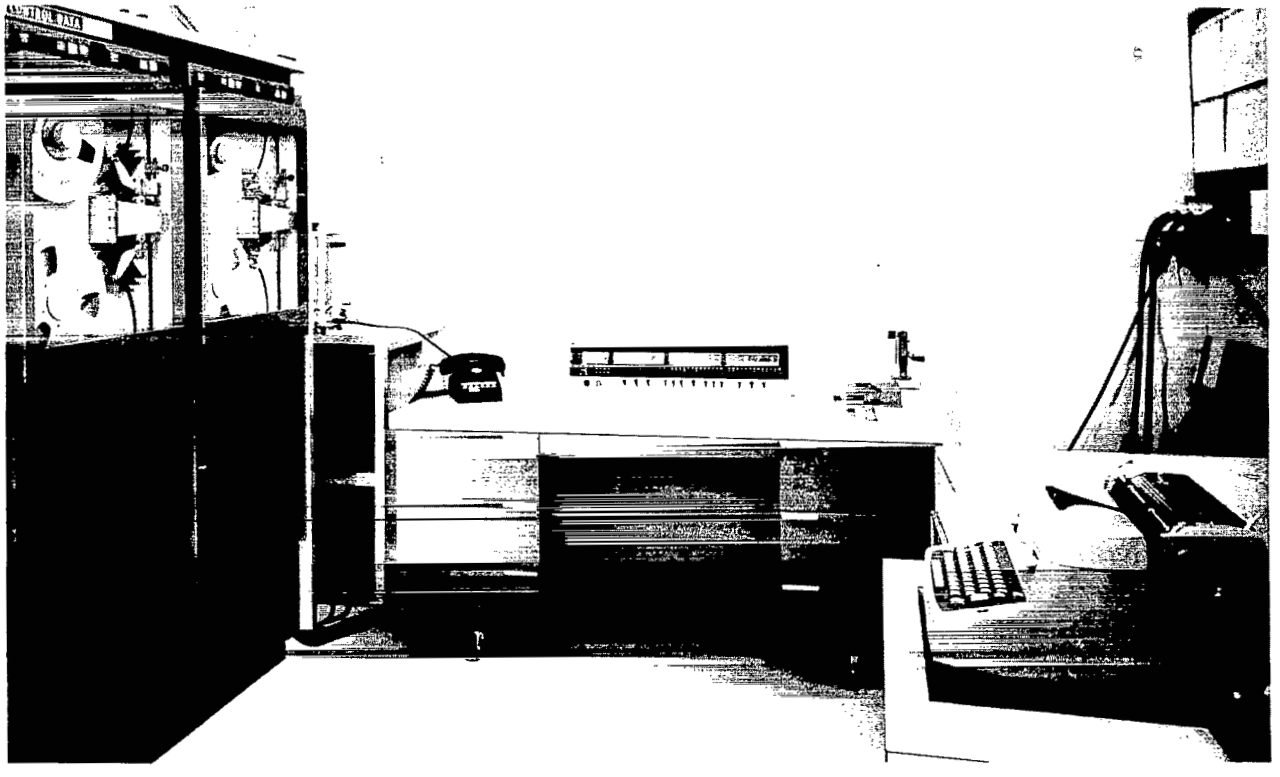


Figure 2—Technical Control Center computer complex.

It is the purpose of this report to describe in detail the development of the test stand and computer system and to discuss the spacecraft computer programs. Appendixes A through E cover telemetry assignments, computer interface electronic operation, computer program flow charts, computer printout formats, and computer program.

TELEMETRY FORMAT

This section is included in order to facilitate understanding of discussions to follow regarding the test stand and computer operations. As has been previously mentioned, the PCM telemetry operated at a bit rate of 8640 bits per sec in a serial data train of 9-bit data words (Figure 3).

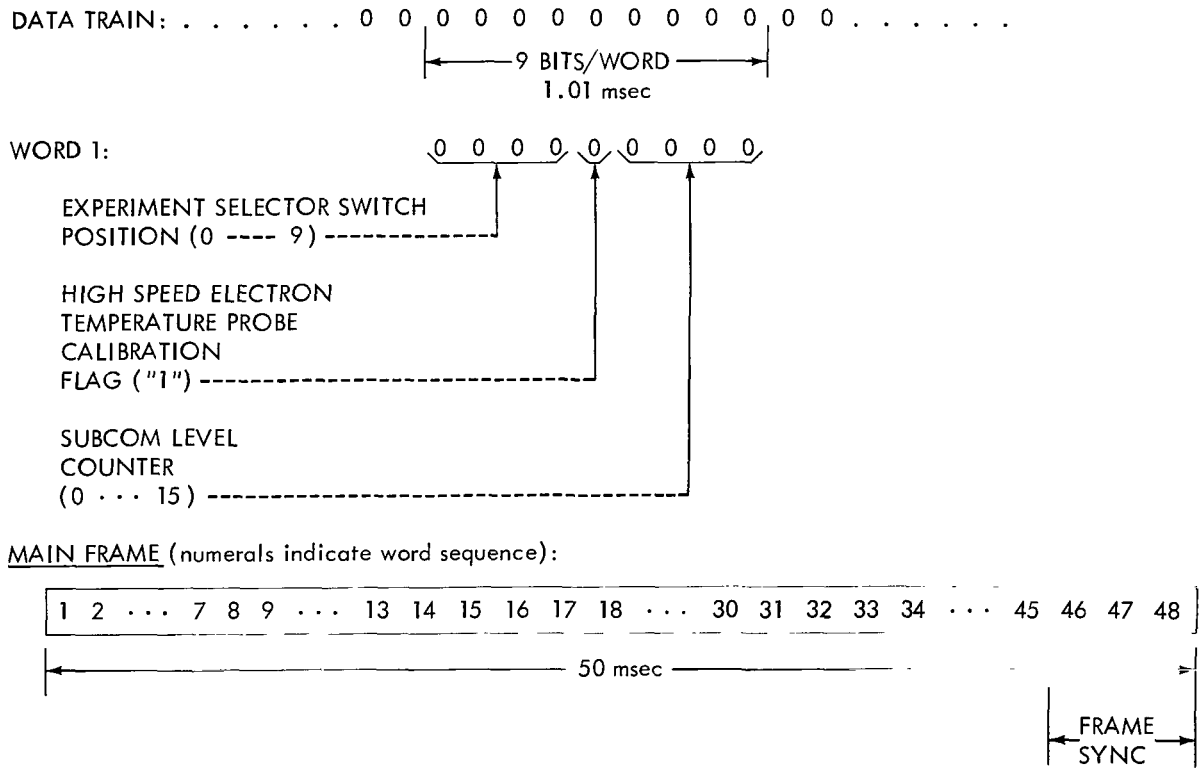


Figure 3—Telemetry words and main frame.

Telemetry Main Frame

Telemetry main frame (Figure 3) was made up of 48 nine-bit words (channels). Word 1, as depicted in Figure 3, carried in digital form the subcom counter information, the experiment selector switch position indication, and an experiment calibration flag. Words 8 and 32 were optical aspect digital information, and words 46, 47, and 48 comprised a fixed 27-bit frame synchronization code. All other words contained analog information encoded into binary digital form, words 14 and 15 assigned to the main channel 0 and 5 volt references, respectively (see Appendix A).

Telemetry Subcom Frame

Words 17, 31, and 33 of the main frame were subcommutated channels. For example, if the main frame depicted in Figure 3 was frame 1 (level 1 indicated in a portion of word 1), words 17, 31, and 33 would carry sample sources 17-1, 31-1, and 33-1, respectively. For the next frame in sequence, word 1 would indicate level 2 and word 17 would sample source 17-2, word 31 would sample source 31-2, and word 33 would sample source 33-2. The level indications and subcommutation would change synchronously with each succeeding frame until 16 frames had been transmitted; the sixteenth frame would contain level 16 in word 1 and words 17, 31, and 33 sampling sources 17-16, 31-16, and 33-16, respectively. In the next sequential frame, word 1 would again indicate level 1 and the subcom words would repeat their sample sequence, beginning with sources 17-1, 31-1, and 33-1. This is shown graphically in Table 1, which represents the telemetry matrix.

The subcom frame was defined as 16 sequential main frames beginning with frame 1. The subcom frame period was determined from the repetition rate of the individual subcom sources (one sample every 16 main frames). This period equalled 0.8 sec and resulted in a subcom rate of 1.25 samples/sec.

Table 1

Explorer XVII Telemetry Matrix

Level	Main Channel Number
1	1 . . . . 17-1 . . . . . . 31-1 . . 33-1 48
2	1 . . . . 17-2 . . . . . . 31-2 . . 33-2 48
3	1 . . . . 17-3 . . . . . . 31-3 . . 33-3 48
4	. . . . 17-4 . . . . . 31-4 . . 33-4 . . . .
5	. . . . 17-5 . . . 31-5 . . 33-5 . . . .
6	. . . . 17-6 . 31-6 . 33-6 . . . .
7	. . . . . . 17-7 31-7 33-7 . . . .
8	. . . . 17-8 31-8 33-8 . . . .
9	. . 17-9 31-9 33-9 . . . . .
10	. 17-10 31-10 33-10 . . .
11	. . 17-11 31-11 33-11 . . . . .
12	. . . . 17-12 31-12 33-12 . . . .
13	. . . . . . 17-13 . 31-13 . 33-13 . . . .
14	. . . . 17-14 . . 31-14 . . 33-14 . . . .
15	. . . . 17-15 . . . . 31-15 . . 33-15 . . . .
16	1 . . . . 17-16 . . . . . . 31-16 . . 33-16 48

Telemetry Supercommutation

Information definition for some sources was improved by increasing the sampling rate of specific sources through supercommutation; that is, the assignment of more than one main channel (word) to a single source. For example, words 10, 26, and 42 were assigned to Redhead No. 1 ac output, a single source. The resultant sample rate for that source, at 3 samples/frame, was 60 samples/sec. Appendix A lists all the channel-to-source assignments for Explorer XVII and indicates their respective sample rates.

TEST STAND AND COMPUTER SYSTEM DEVELOPMENT

Early System

The first complete Explorer XVII PCM test stand is shown in Figure 4. Its main components were:

1. A three-tone command transmitter designed and constructed at Goddard Space Flight Center.
2. A Defense Electronics TMR-6 receiver and TDU-3 panadapter.
3. An Electrac 207 tracking filter.
4. A Mincom C-100 magnetic tape unit.
5. A PCM test stand decommutator (decom) designed and constructed at GSFC.
6. An audio recording and playback system for use with magnetic tape, designed and constructed at GSFC.
7. Two 8-channel pen recorders.

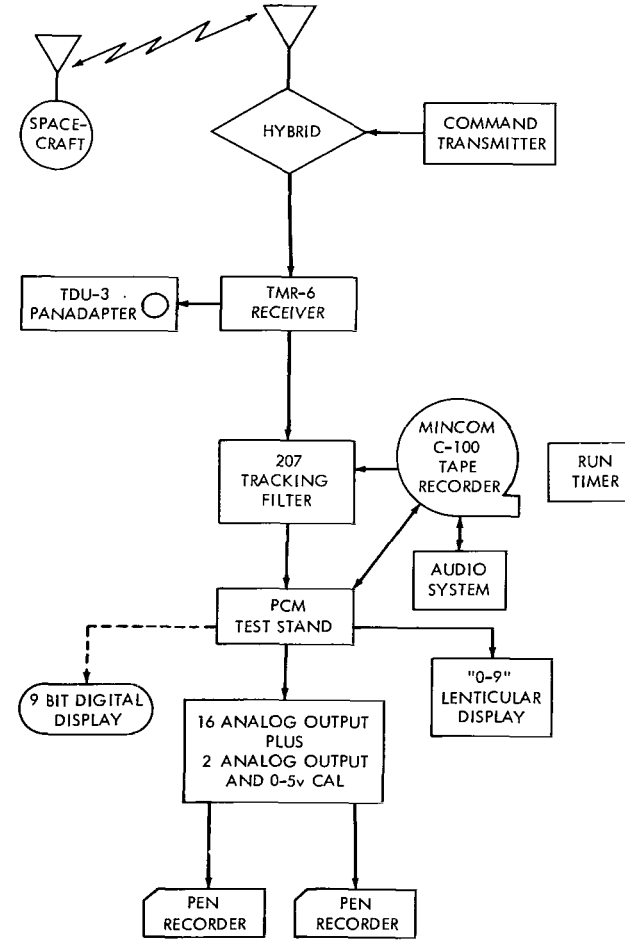


Figure 4—Block diagram of early test stand system.

Test Stand Decom

The decom was originally designed as a prototype of models to be used at NASA's Woomera, Australia, tracking station and the central data processing facilities; it was

delivered to the Explorer XVII integration group in June 1961. This decom was a basic telemetry decommutation system capable of accepting serial split-phase PCM data from a telemetry receiver. As a system it processed the incoming signal, recovering data and producing analog and digital outputs of selected data channels. A patchboard (Figure 5) was provided for these selections. In addition, the binary data relating to the position of the spacecraft experiment selector switch was gated to a 10 numeral lenticular display (Figure 5).

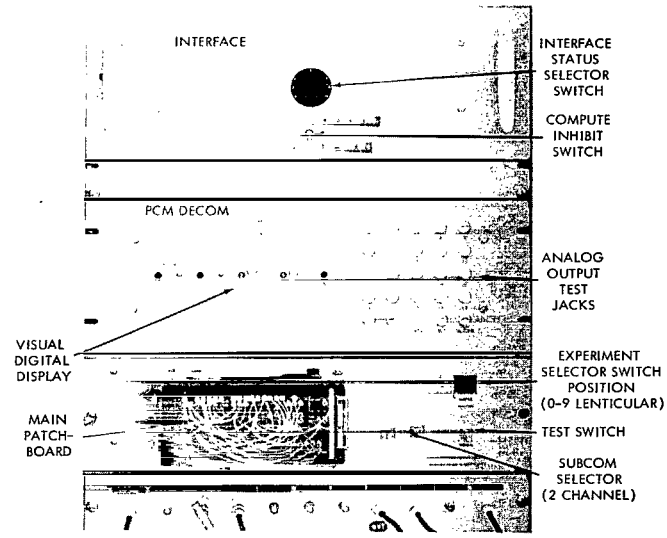


Figure 5—Test stand decom and Mod II interface.

As the project progressed, additional refinements were incorporated into the PCM decom by the integration group, so that the unit was better adapted to the integration and testing of the spacecraft. Noteworthy among these refinements were: Automatic frame synchronization of the decom, an automatic strobe frequency generator (ASFG), a 0 and 5 volt calibration for analog outputs, two additional digital-to-analog converters, a visual digital display, digital parallel output, and signal conditioning equipment.

Automatic Frame Synchronization System

The synchronization system, designed and installed at Goddard Space Flight Center, substantially enhanced the operation of the PCM decom. Prior to the installation of this system, the services of one man were required to maintain the proper phase relation between the incoming and the timing data. The phase selection was made by repeated random manual switching between timing pulses, which occurred in either of two data phases or two inverted data phases (the manual switch is labeled "test switch" in Figure 5). This switching continued until a valid sync pattern was recognized and signal lock-on was achieved by the decom.

This problem was subsequently eliminated by the addition of an automatic frame synchronization circuit which consisted of two selectable, coded, 27-bit frame sync recognizers; two threshold detectors; one flip-flop; and associated gating circuits. One frame sync recognizer always was set to recognize the frame synchronization format and the other recognizer was set to recognize the inverse of that established code. The recognizers were manually set to their respective codes by the actuation of 27 switches that connected the main shift register flip-flops to the sync recognizers, one side of each flip-flop to "sync" and the other side to "not sync." These recognizer codes were "sync": 000110010011111000101011010; and "not sync"; 111001101100000111010100101. The summing node of each recognizer was connected to its associated threshold detector. The outputs from both of the latter were used to reset word counters and other devices. The output

of the "not sync" detector was also used to toggle a flip-flop that gated the proper timing pulses to return the decom to a synchronized condition. This autosync system required only 2 frames (100 msec) to regain frame sync after a dropout, whereas the same operation performed manually might have consumed a time on the order of seconds. Adoption of the automatic frame synchronization system sharply reduced the amount of data lost due to sync dropouts.

Automatic Strobe Frequency Generator (ASFG)

This circuit, designed and developed by the integration group, further reduced the number of sync dropouts and resultant data loss by generating a strobe frequency which automatically tracked the incoming PCM signal. The ASFG consisted of a controlled astable multivibrator and associated circuitry. It developed timing pulses at twice the bit frequency and maintained constant phase relation between that frequency and the frequency of the incoming data over a 100 cps bandwidth. Prior to adoption of the ASFG in the test stand system, a harmonic wave analyzer was used, with some difficulty, to extract the second harmonic of the bit frequency and develop a strobe frequency twice as great, and to provide tracking of second harmonic frequency variations over a 3.5 cps bandwidth. The ASFG increased this bandwidth and greatly reduced data deterioration resulting from bit-rate fluctuations introduced by variations in tape speed and system parameters.

Automatic Calibrator

The analog outputs of the PCM decom were all initially based on 0 and 5 volt references established in the spacecraft and transmitted in the telemetry data train; all analog outputs were scaled against these references. As the latter were "floating" and subject to variations (particularly from one spacecraft telemetry encoder to another), the accuracy of the analog pen recordings was questionable and visual data reduction of them was difficult.

The automatic calibrator (autocal) was devised by the integration group to simultaneously scale and calibrate all analog outputs by providing 0 and 5 volt reference outputs for use in setting up each pen recorder channel, with full scale representing 5 volts. Major components of the autocal device were astable multivibrators, relay drivers, and test switching circuits. Multivibrators were used to switch, via relays, all decom analog output lines between normal data outputs and the reference voltage outputs—which in turn were switched by a multivibrator-relay combination between the 0 and 5 volt references. Manual switches provided selection of several calibration modes. For setting up the recorder channels, the first calibration mode, a steady square wave of 0 and 5 volt reference pulses (Figure 6) was delivered to all recorder channels, the data for these references in general being derived from magnetic tape recording of the spacecraft telemetry. For the most accurate analysis of the pen recordings, reruns

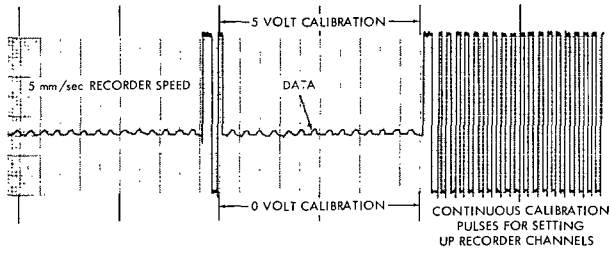


Figure 6—Strip chart illustrating 0 and 5 volt calibration pulses.

were made with the recorders scaled from the references of the particular run desired. The second calibration mode was an occasional interruption of normal data flow with a small group (1 to 2) of scaling pulses. The repetition rate of these calibration bursts was preset at 1 calibration burst every 30 sec to provide minimum interference with data flow and convenient referencing for the analyst. The scaling pulses could be inserted at two rates, one of which is shown in the left (data) portion of Figure 6.

Visual Digital Display

While the optical aspect and telemetry systems were being integrated and tested, the need arose for digital display of selected channels of the incoming data. The visual digital display, consisting of a 9-bit storage register, nine light indicator circuits, and the gating required to maintain compatibility with the PCM decom, was appended to the test stand (Figure 5). Channel selection for the display was made at the PCM decom main patchboard (Figure 5) and permitted display of one word or of several words superimposed on one another.

Other Changes

Also during integration, it became apparent that the original analog storage circuits were not able to store data for one complete subcom cycle (0.8 sec) without decay. This situation was rectified by adding two separate digital-to-analog converters, along with an auxiliary patch panel for channel selection. (This patch panel was mounted in the PCM decom bucket, behind the output test jacks in Figure 5).

An RF link was used between the spacecraft and the test stand during all environmental tests. Adverse signal conditions, such as those expected in orbit (attenuation and noise), were simulated from the outset of this phase of the project. It became apparent that the tracking filter provided a marginally acceptable output under poor signal conditions. Therefore, in April 1962, a Dynatronics 5202 bit synchronizer and signal conditioner was added to the system (Figure 7). This new unit greatly improved data recovery in adverse signal conditions.

Initial Computer Installation

As integration progressed in the spring of 1962, it became increasingly apparent that the methods employed for voltage determination of the housekeeping telemetry channels were inadequate. The hand reduction of this information was a lengthy process, requiring more than an hour per commanded run to reduce readouts averaged from a visual digital display. Shortly after installation (May 1962), a CDC 160 computer was programmed to replace the notation-and-slide-rule conversion to volts. One averaged readout per run from each subcom channel was entered in Flexowriter code by punch tape and input to the computer. The conversions were output on punch tape and then typed out in column format by the Flexowriter (Table 2), "cutting" approximately 1 hour from the manual process.

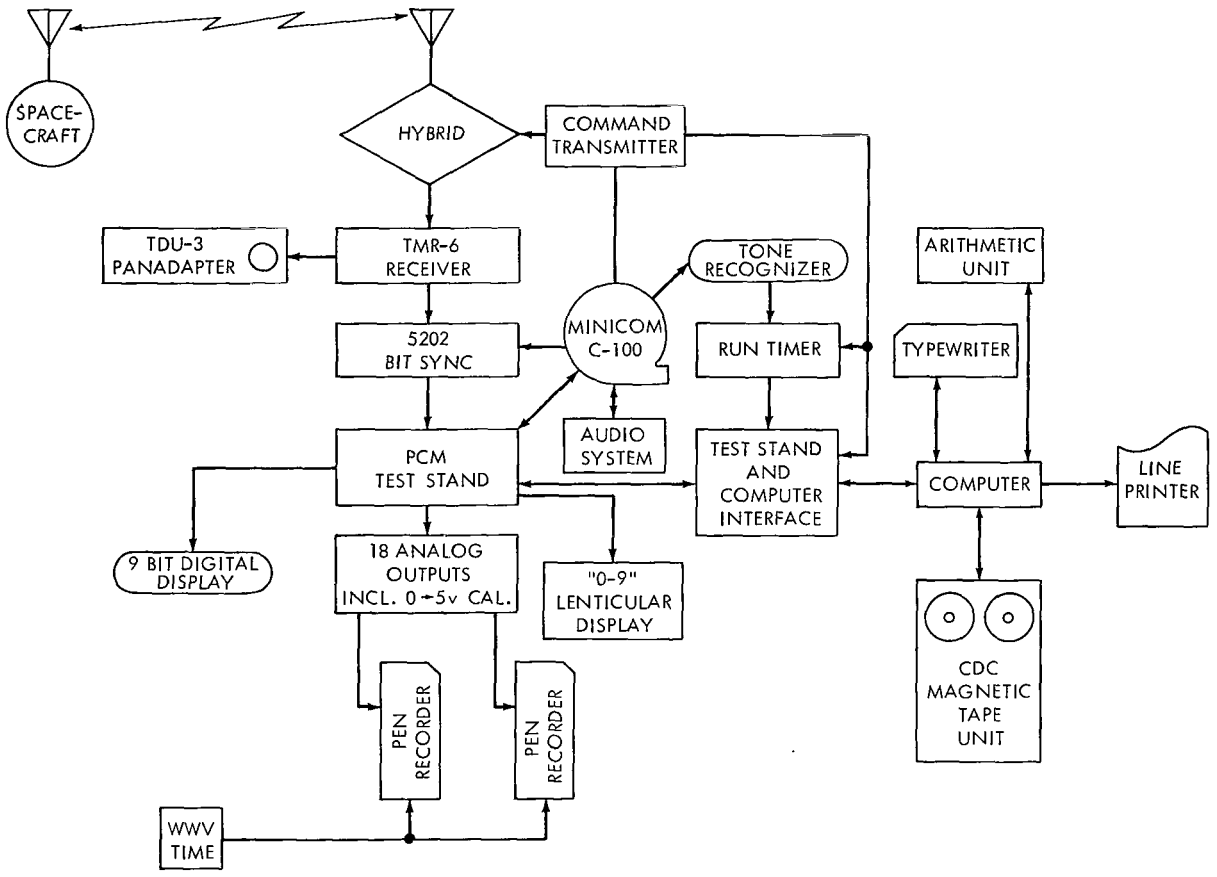


Figure 7—Advanced test stand and computer system.

Off-line reduction of spacecraft data for integration purposes reached a peak with these developments, and all further efforts were directed toward real-time data reduction, utilizing a computer on-line with the test stand system.

First Test Stand and Computer System (MOD I)

In conjunction with the PCM test stand, a real-time digital data conversion system was developed to improve digital data handling and analysis during spacecraft testing. This system required a *test stand and computer interface,* which was developed in two stages. The Mod I interface had limited capability and acted as an interim system until the Mod II interface could be brought to an operational state of development. Several limiting factors of the Mod I interface were:

1. It "slaved" the computer, preventing the use of any other peripheral equipment for input operations.

2. It required a limited computer program and a fixed computer output format.

3. It employed a gating arrangement that allowed only housekeeping data (subcom channels and spacecraft status) to be extracted from the test stand. The telemetry format chart (Table 1) shows that the spacecraft status word (word 1) was required by the computer to correctly establish the subcom channel levels (subchannels).

Table 2

Subcom Data in Volts (June 29, 1962).*

Subcom Level	Subcom Data (volts)		
	Channel 17	Channel 31	Channel 33
01	3.97	3.98	0.00
02	4.15	4.32	5.00
03	4.43	2.72	3.56
04	1.61	2.91	3.34
05	1.38	3.64	1.47
06	2.27	3.41	1.54
07	2.30	0.71	3.11
08	2.33	0.69	2.75
09	4.07	1.02	0.00
10	1.85	0.00	0.00
11	4.57	0.00	0.00
12	3.75	0.55	0.00
13	2.26	2.23	0.00
14	2.26	2.91	0.00
15	0.00	5.00	2.52
16	5.00	0.00	1.39

*Note that each subcommutated channel has its own 0 and 5 volt references (levels 1 and 2 or 15 and 16).

The first limitation requires further explanation. In a standard system, several pieces of equipment may be connected in parallel to a CDC 160 input-output channel, along which the computer transmits a "select code." Only the appropriate (desired) unit recognizes this code and performs the input or output functions to follow; all other units (in most cases) are inhibited from interfering with the selected communication link. These "selected-inhibited" functions are contained in what is broadly termed a "select package," and such a unit was not incorporated in the Mod I interface. Outputs from the computer were not affected because the interface used only the input portion of the computer input-output channel. The net result of the limitation was to require the physical disconnection of the interface-computer cable for the use of the input capabilities of the CDC 161 typewriter and 164 magnetic tape unit.

Development of this test stand and computer system required the solution of problems in the areas of logic level differences, timing, and synchronization. The digital logic incorporated in the test stand operated at different levels than that of the CDC 160 (or 160A) computers (see Appendix B, Figure B2). Therefore, appropriate logic interfacing circuits were designed to integrate the two systems. Line activity between the test stand and computer was high, with 960 data requests and 960 data responses—plus numerous status requests and responses—occurring every second. This requirement for a high data transfer rate placed utmost importance on interleaving the two independent system timing cycles. One of the important factors considered in the integration of these systems was line settling time for data and timing pulses from one device to the other. Data transfer coordination was obtained by properly delaying and gating the intersystem signals. The computer input word was of sufficient length (12 bits) to allow spacecraft data to be gated on the low-order 9 bits and flagging information on the high order 3 bits.

The Mod I interface permitted the 160 computer to be used on-line with the test stand. After the installation of a CDC 166-2 line printer (120 characters/line, 150 lines/min), the computer

was programmed to compute and print out housekeeping voltages in real time. The first successful real-time printout of Explorer XVII spacecraft data was made on July 26, 1962. Because of the time-share requirement for input-output operations and the limitation in printer drum speed, real-time processing was limited to every third subcom frame. Nonetheless, the amount of processed information presented decimally in volts was increased in excess of 100 times over prior methods and, most desirable of all, it was available during spacecraft operation.

Advanced Test Stand and Computer System (MOD II)

The development of a new (Mod II) test stand and computer interface (Figure 5 and Appendix A) and the replacement of the CDC 160 computer with the more sophisticated CDC 160A made possible further refinements and a data sampling rate increase for the automatic processing system. The Mod II interface retained all of the desirable features of the Mod I while overcoming the latter's limitations. Because the Mod II incorporated a "select package" and thus acted as normal peripheral equipment to the computer, it permitted other input devices to be used normally with the computer. The 160A provided extended memory (8192 memory locations) and an input-output buffer channel which, when paralleled with the normal input-output channel, made this advanced system (Figure 7) capable of inputting data from the test stand concurrent with voltage printout. The primary new feature of the improved interface was that all of the telemetry data were made available for real-time processing. Other new features of the Mod II interface and of the computer programs will now be discussed.

Interface Status Transponder

This was the digital decoder-encoder system described in Appendix B. It permitted the computer to interrogate the transponder requesting the status of the interface at the moment. The latter would reply (via a program selection system) with a 12 bit code that could be used at the discretion of the computer to select a particular program, subprogram, or operation assigned to that code by the programmer. Computer recognition of one bit of the status word resulted in effectual remote start-stop control of computer data processing. Typical status request and response words are shown in Figure 8, along with a subprogram listing for status responses in Table 3.

Interface Selection System

This system allowed the computer to select the test stand and use it as normal peripheral equipment. Described above as a "select package," it was in essence a decoder-encoder device that, upon receipt and recognition of a proper code word and appropriate signals from the computer, transmitted to that unit a 12 bit word in digital parallel form and in computer format, 9 bits comprising spacecraft data from the test stand and 3 bits expressing a preset flagging code for particular words (see Figure 8).

Program Running-Timer System

This was a clock system (Appendix B) that was started automatically at spacecraft turn-on time (or at run-start time as defined by a tone recorded on the tape) and counted running time in

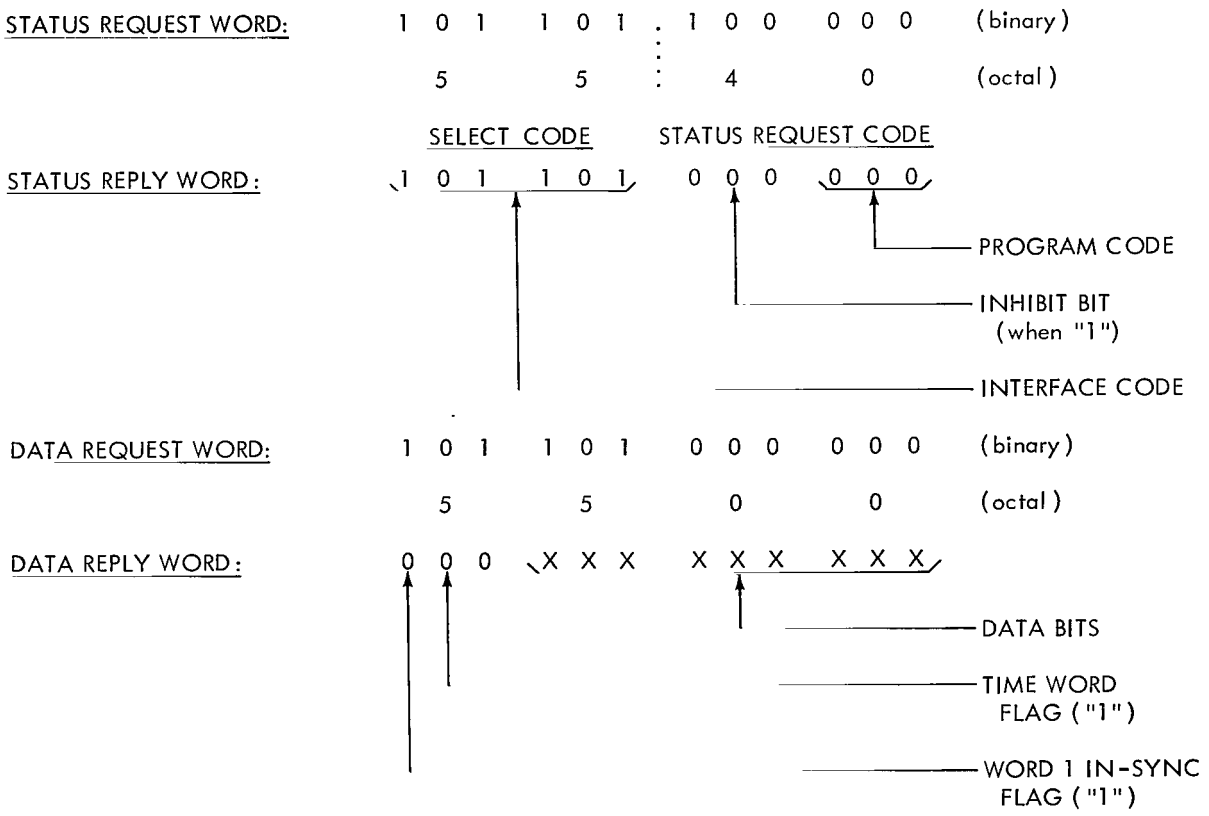


Figure 8—Interface and computer word formats.

seconds throughout the spacecraft program cycle. The system consisted of a binary counter clock driven by 1 sec pulses from a modified Hewlett-Packard 523CR run timer, a storage register, and associated gating circuits. By an appropriate gating arrangement, one of the frame synchronization words (word 46) in the data format was replaced by a 9 bit time word taken from the running-time storage register. These data were handled as a part of the normal telemetered data and were transferred to the computer in the low-order 9 bits of the input word. In addition, one of the three high-order bits was preset to a "1" or a "0" to indicate to the computer that data in word 46 was a running-time word or the first frame sync word, respectively (Figure 8). This selection was controlled by a selector switch behind the interface panel and ordinarily was set to transfer time information. In the latter condition, the controlled bit provided a useful 1 bit flag for additional frame synchronization at the computer and thus released the computer program from the necessity of maintaining a rigid word count during lengthy computations.

Thus, the Mod II interface provided all-channel capability, a "test stand in sync" flag, program running-time, and position status of an interface selector switch (Figure 5).

Computer Program Refinements

At this time various new functions were introduced into the computer program. Spacecraft thermistor data were computed in °C, several main channels were periodically processed, and

Table 3

Interface Status Response Selections
(the program details are in the "Computer Programs" section).

Interface Selector Switch Position	Transmitted Program Code	Program Selected
1	0 0 1	Automatic program (Table 4)
2	0 1 0	Subcom program (continuous)
3	0 1 1	Bayard-Alpert program (continuous)
4	1 0 0	Program hold
5	1 0 1	Redhead program (continuous)
6	1 1 0	Electron temperature probe (ETP) program (calibrations)
7	1 1 1	Optical aspect program (continuous)

computer subprograms became remotely selectable at the test stand. Refinements continued on the programs, particularly when the line printer speed was increased to 300 lines/min by installation of a print drum with two fields of numerics and one split field of alphabetics. With this new capability, it was possible to provide:

1. Continuous printout of optical aspect information in raw digital form.
2. Sampling of alternate subcom frames, an increase of 50 percent in data printed out.
3. A preselected format (Table 4) to establish a quick-look cross-section of payload operation, control of the format depending on computer reduction of the spacecraft's experiment selector switch (ESS) data.

In addition, similar programs were written for a CDC 1612, 1000 line/min line printer, which was used for some time in the Technical Control Center (TCC). Printout formats were established through integration of equipment capability, programming practicability, and information priority as expressed by the recipients of the data. Computer program flow charts and computer format facsimiles and descriptions are presented in Appendixes B, C, and D.

System Used at the Atlantic Missile Range (AMR)

In January of 1962 a universal PCM ground station was delivered to the integration group. The PCM test stand and the ground station were used in parallel during the final phases of spacecraft testing. The ground station was interfaced to the CDC 160A computer with the same type of interfacing system as that used on the PCM test stand but with minor changes. The ground station and computer system was shipped to Cape Canaveral (now Cape Kennedy) and used in prelaunch checkout of the spacecraft. This system is shown in Figure 9.

Flight Monitor System

With the exception of the RF data link, no significant changes in the test stand parameters were made for monitoring the spacecraft in orbit. As illustrated in Figure 10, spacecraft

Table 4

Automatic Program Format.*

ESS Positions 4, 5, 6, 7, 8	ESS Position 9	ESS Positions 1, 2, 3
T=24	T=24	T=24
Dateline	Dateline	Dateline
Subcoms	Subcoms	Subcoms
55	55	55
ETP II calibrations ETP I calibrations	ETP II calibrations ETP I calibrations	Subcoms
115	115	85
Bayard-Alpert and Redhead calibrations	Subcoms	Bayard-Alpert and Redhead calibrations
145	145	145
Optical aspect	Optical aspect	Optical aspect
175	175	175
Subcoms	Subcoms	Subcoms
205	205	205
Bayard-Alpert and Redhead levels	Bayard-Alpert and Redhead levels	Bayard-Alpert and Redhead levels
210	210	210
Subcoms	Subcoms	Subcoms
T=240	T=240	T=240

*Selection of these vertical sequence formats was determined from computer reduction of the spacecraft e periment selector switch (ESS) position information in telemetry word 1. Each block represents a printer page (see Appendix D), T = running time in seconds.

telemetry was acquired at the Blossom Point, Maryland, tracking facility and relayed through a Bell System microwave-and-landline link directly to the test stand bit synchronizer. Figure 11 shows the prototype as it was flown to simulate orbital passes over Blossom Point and to check out the described system.

The input-output operations of the computer complex during final checkouts were carried forward, with minor changes, into the flight monitoring phase. Once given a program start, the computer was controlled entirely by peripheral gear until shutdown. Operations for a typical run took the following sequence:

1. The pass number and command time were entered in the 160A computer via typewriter prior to a pass.

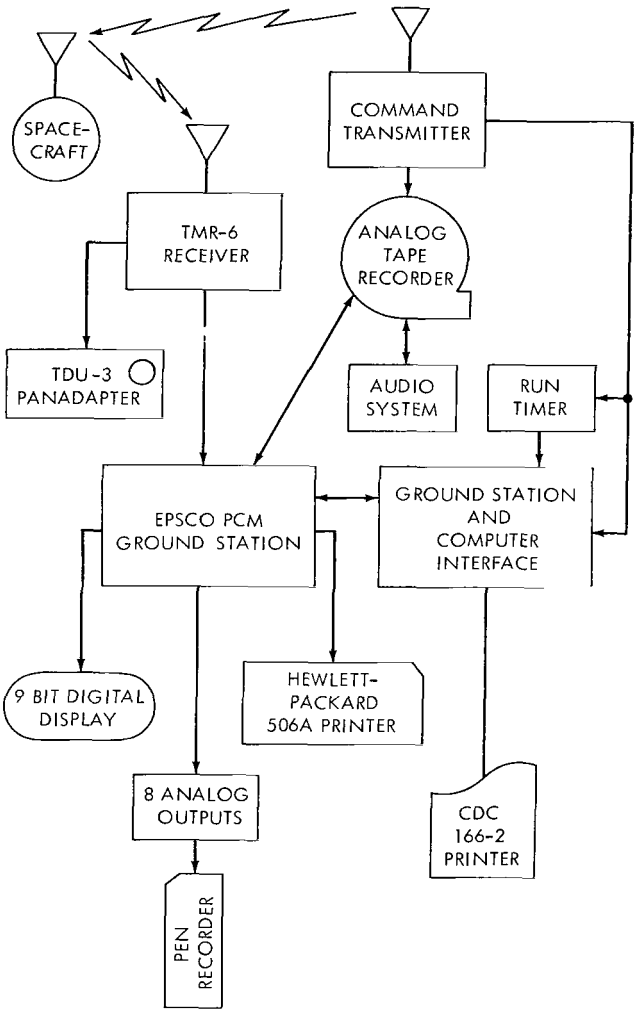


Figure 9—Computer system used at the Atlantic Missile Range.

2. Computer-interface operations commenced upon release of a "compute inhibit" switch located at the test stand and, as mentioned, controlled 1 status bit of the interface status word.

3. Initiation of data processing was subject to delays predetermined by runtime, the sync flag, or both.

4. Command counter data (at the subcom rate) were decommutated and converted to a decimal number, which was entered in the run identification line; the latter was then printed out.

5. Subprogram control was exercised at the interface; selections could be changed during the run as circumstances dictated.

6. Computer-interface operations were concluded, and the computer complex was set up for a new pass or rerun of the last pass by closure of the "compute inhibit" switch.

In addition to the data computation and readout functions described, the system was also utilized for the production of IBM-compatible data tapes and for the periodic computation and printout of Explorer XVII battery power drain summaries.

COMPUTER PROGRAMS

For the most part, all Explorer XVII test stand computer programs were written in machine language. They began as relatively simple programs for the conversion of spacecraft data to volts and were subsequently expanded and modified during operations through launch. Though far more cumbersome in preparation than those of the assembly type, the machine language programs were comparatively easy to trouble-shoot and modify. The increased use of subroutines and the establishment of known memory locations for data storage allowed a considerable degree of

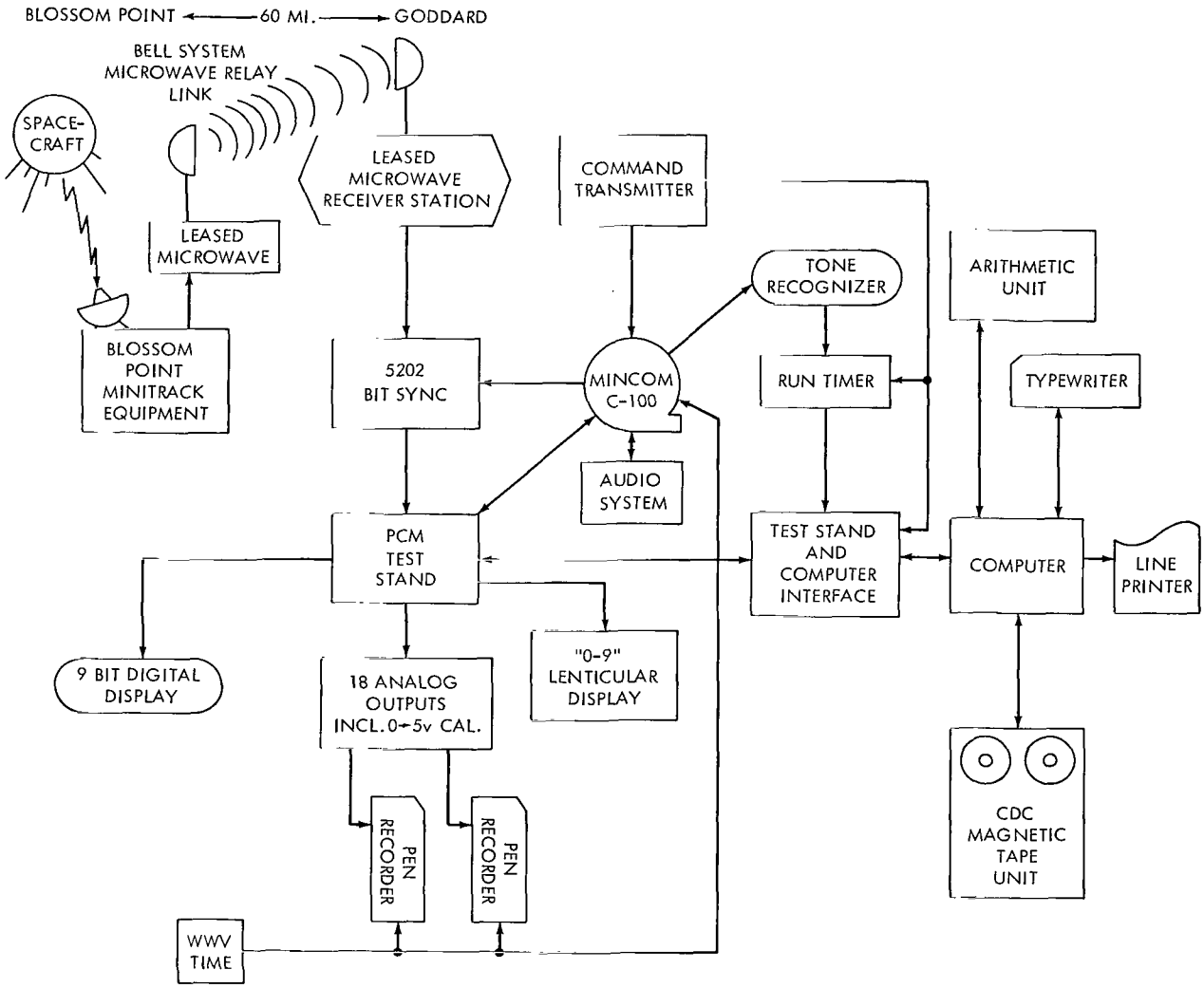


Figure 10—TCC test stand and computer system for real-time monitoring of Explorer XVII in orbit.

capability and flexibility in assessing difficulties encountered with programs, the test stand interface, and the telemetry data train itself. In addition, a small library of short maintenance routines was established to implement the standard programs in this area. Another advantage derived from the machine language programming approach, as implemented, was the fine determination of machine time for various loops and subroutines operating in periods where computation time intervals were critical. In this regard, the time required for several conversion operations was substantially reduced through unique logic techniques.

The computer complex was utilized for reduction of real-time or recorded telemetry data originating in the spacecraft. The basic computer operation was to *input* all telemetered data, retaining only those desired for the particular subprogram. Initially, computer frame sync was

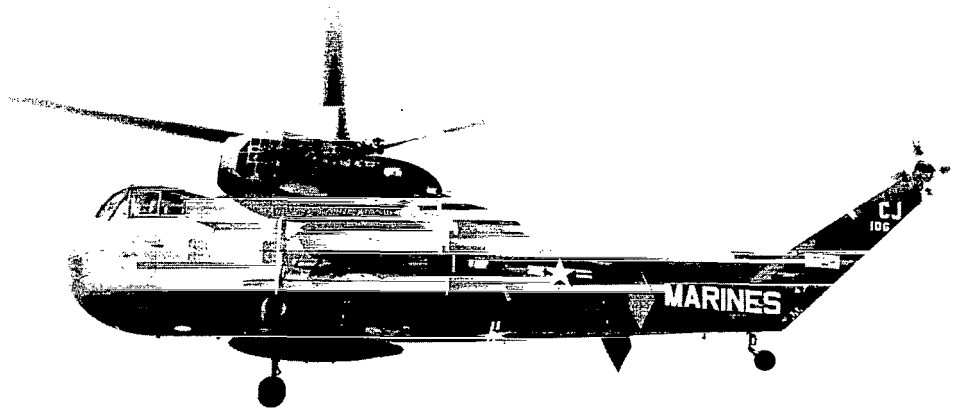


Figure 11—Prototype suspended from a helicopter in flight past the Blossom Point tracking and data acquisition facility.

established through recognition of the frame sync flag on word 1 as sent from the test stand; reduction of the word 1 subcom level counter plus word counters in the computer program maintained orientation of that program in the telemetry matrix. However, problems arose when the conversion times occasionally exceeded the 1 msec word interval. Consequently, conversion operations frequently were delayed for a frame until the desired data and references for that frame were *input.* Once this was done, decision, conversion, and output operations commenced with computer frame sync being re-established through recognition of the time word flag on word 46. In the few cases where data word position in the frame allowed too small an interval prior to word 46, other methods were used to permit successful reduction of at least a large portion of an uninterrupted data chain. For most cases, requested data were rejected when the following conditions existed: Word 1 sync flag was absent; the subcom level counter was not in sequence; or the 0 and 5 volt reference range was illogical or beyond predetermined limits (defined as "illegal"). The rejection of any word was flagged by "**" in that word's normal printout location. Among other decisions, the program refused to convert temperature data to °C when that data indicated

thermistor output outside the range of values for which voltage calibrations had been made. In such cases, the computed voltage data were printed out. Printout formats are shown in Appendix D and a typical computer program is listed in Appendix E.

Subcom Program

The subcom program was the most complex of all data subprograms because of the dispersal of the reference voltages throughout the subcom frame. To establish a compute-start basis, a block of subcom data with legal references was stored in computer memory. The next block in sequence then utilized these references for computation, replacing them with the new references if the latter were legal. Similarly, if a data word was rejected as previously described, its last known value was retained in the printout format. Because of timing errors and telemetry sync dropouts, the retention of "last-known" values occasionally extended for several seconds and masked the event occurrence time on some channels. This difficulty was overcome through the use of the "**" indicator and more precise program timing; the last-known legal references were retained.

Following conversion to volts of all data and decommutation of the running-time data, conversion of the appropriate voltages to °C was accomplished and printout operations begun. Since the latter occupied a major part of the 0.8 sec subcom cycle, and to avoid timing difficulties, data were *input* on alternate subcom frames (for the more recent programs). A careful study of the programs and system capabilities indicates that, in the future, all subcom data of a similar nature can be computed, converted, and printed out in real time.

A typical subcom routine flow chart is depicted in Appendix C, Figure C1, and a flow chart for the digits-to-volts conversion subroutine is shown in Appendix C, Figure C2. The subcom printout format is shown in Appendix D, Table D1. To permit use of the 300 line/min print feature (i.e., minimum use of the split alpha field), temperatures were designated by no unit abbreviation and "-1" was indicated by "*." The programs written for the 1612 1000 line/min printer used "C" for temperature unit indication and "$\underline{<}$" for "-1" indication.

Bayard-Alpert and Redhead Pressure Gage Programs

Bayard-Alpert (BA) and Redhead (RH) experiments utilized main telemetry channels with sample rates of 3 samples/frame (60 samples/sec) for each channel, 4 for the BA's and 2 for the RH's. For checkout purposes, it was felt that reduction of a long continuous stream of data from either experiment was not necessary and that a reasonable real-time approach would be to print out blocks of 3 or 4 successive frames of BA and RH data in volts. Time selection of these blocks could be exercised at the test stand interface, repeated there for spaced-block presentation, or internally selected by the program through the use of flags, such as the pressure gage calibration flags on sublevel 10 of channel 31.

The programs for these experiments were similar. In both cases, an experiment and source identification line was printed following initial selection of the particular subprogram. (This line was not reprinted if the same subprogram remained selected.) Then, after computer recognition of frame sync, the main channels comprising the reference voltages and the pertinent experiment outputs were selected from the data input stream. Data were computed and stored. The next two frames were similarly processed, with the aforementioned treatment of "no sync" or illegal reference conditions. Printout of the 3-frame block was then initiated, followed by an interface status check to determine whether the subprogram was to be repeated or another route was to be followed. Printout formats for the BA's and RH's are shown in Appendix D, Table D3.

Electron Temperature Probe Program

The subprogram for the electron temperature probes (ETP) was itself separated into two subprograms, one for the fast-sweeping ETP 1 and one for the slow-sweeping ETP II. Data rates for these experiments were 180 samples/sec and 40 samples/sec, respectively. Because calibration flags for either type may have appeared in the data stream after calibration initiation, and because these calibration cycles were determined to be most significant for proper checkout, a definite, continuously up-dated block of data had to be retained in memory so that the final printout format would encompass the entire calibration period. For ETP II this format also included three or four sweeps of live data following calibration and was repeated once in order to cover both high and low sensitivity calibrations. The format for ETP I did not guarantee inclusion of live data following calibration. To overcome this difficulty, the ETP I format was repeated 3 times after the first calibration cycle printed, with the following resultant sequence of printout blocks: calibration (high or low sensitivity), live data, calibration (the sensitivity not covered by the first block), and live data for the latter sensitivity.

ETP II Subprogram

After printout of a dateline, the ETP program was first routed to the ETP II subprogram. The ETP II main channels and pertinent references were selected from the data stream and stored in such a manner that the most recent successive 80 data points and their references were retained in memory, with no consideration at that time for their legality. Upon recognition of the ETP II calibration flag, 240 more successive data points with references were stored in memory, sequentially following the original 80 points. Processing and printout *format* began on these 320 stored successive data points in the same manner as previously described. Printout was accomplished (Appendix D, Table D2), and the same routine was repeated through the next calibration. Control of the program was then routed to the ETP I subprogram.

ETP I Subprogram

This program was similar, with two significant exceptions, to that for ETP II. The first dissimilarity was that only one frame (9 data points) was kept current in memory until the ETP I

calibration flag (1 bit on word 1) was recognized and only 7 successive frames were stored following that recognition. Another difference was that the ETP I process-printout cycle was repeated 4 times as described. These 4 blocks appear in Appendix D, Table D2, following the 2 blocks of ETP II data.

Optical Aspect Subprogram

For optical aspect (OA) a considerably different type of processing was utilized than that for the experiments. This spacecraft subsystem output digital data on two main channels (40 samples/sec), and proper analysis of these data required the presentation of all successive frames, including those in which sync was lost, for a minimum of 30 sec and a maximum limited by spacecraft operating time. Upon installation of the CDC 1612 1000 line/min printer, an acceptable OA program became a possibility. Prior to that time, limited printout capability had inhibited all-data presentation of the OA information. For the 1612, two lines of 5 frames (individually processed into "1"s and "0"s) were transmitted in printer code to that device, and printout of those two lines was initiated, with an immediate program return to the data-search routine to acquire the next sequential frame. Sync loss was represented by all "0"s (an illegal OA code) for the pertinent frames.

After an analysis of the CDC 166-2 line printer with 300 line/min capability, it was determined that it could be utilized for an all-data OA program. Instead of a block of 10 successive frames *input* for storage and printout, an 8 frame block, in two printer lines, was incorporated. Thus, the data time for each line (200 msec for 4 frames) equalled the line-print time at 300 lines/min, or 1 line every 200 msec, and resulted in effectual synchronization between the optical aspect output and printout.

The OA printout format is shown in Appendix D, Figure D4. With 12.4 sec of data represented on each printer sheet, an all-data printout of optical aspect would consume twenty sheets for a typical run. Despite this length, the format presented no obstacles for accurate and convenient analysis.

Automatic Program

This subprogram was of considerable value during final integration and checkout of Explorer XVII, particularly during closely spaced sequential operations. It permitted a quick-look cross-section of payload operation, enabling testing to continue without the delays imposed by long post-run analyses. Basically a routing scheme, the automatic program was also required to operate on the data stream for the determination of time, events, and position of the ESS. These determinations were then utilized in establishing sequences for entrances to and exits from the other selectable programs. In essence, the automatic program used the experiment, subcom, and OA programs as subroutines. Format sequences appear in Table 4.

CONCLUDING REMARKS

Test stand and computer systems have been used to provide data for the Explorer XVII spacecraft performance evaluation by processing telemetered data in real time. This equipment was used to monitor Explorer XVII during the integration, environmental testing, and prelaunch checkout phases of spacecraft development. Later, it played a vital role in daily real-time monitoring in orbit.

Future plans call for the expansion of the spacecraft test stand and computer system to provide control signals for artificial experiment excitation of the spacecraft under test while the telemetered responses from the spacecraft are being automatically evaluated. This capability will "close the loop" on spacecraft testing. Such tests in the past have been carried out by the operation of experiment excitation equipment by technicians at the spacecraft and the remote evaluation of processed telemetered responses by other operators. Testing in this fashion resulted in difficulties both in the synchronization of efforts between the exciter and the monitor operators, and in test reproducibility. Computer control of experiment excitation and monitoring will establish means by which experiments will be efficiently tested in a reproducible manner, will better simulate orbital conditions, and will eliminate human variability in test operations.

Finally, advanced test stand and computer systems are being programmed to satisfy such requirements as: Special quick-look data processing of the experimental data requested by experimenters before and after launch; power studies for power supply design and lifetime predictions early in spacecraft projects; generation and up-dating of spacecraft cabling and wiring tables; automatic and remote testing of spacecraft systems; generation of command schedules; and back-up digitizing of telemetry data for special data processing and information display.

(Manuscript received November 13, 1963)

Appendix A

Telemetry Assignment for Explorer XVII

MAIN COMMUTATOR

Measurement	Channel Assignment	Sample Second
Subcommutator Position (digital)	Last 4 bits	
Programmer Position (digital)	First 4 bits	20
Electron Temperature Probe High Frequency Calibration Flag	Middle bit	
Electron Temperature 1 Output	2,7,12,18, 23,28,34,39,44	180
Electron Temperature 2 Output	16,40	40
Bayard-Alpert Gage 1:		
dc	3,19,35,	60
ac	4,20,36	60
Bayard-Alpert Gage 2:		
dc	5,21,37,	60
ac	6,22,38	60
Aspect (digital)	8,32	40
Mass Spectrometer 1		
Log Amplifier Output	9,25,41	60
Electrometer Biased Output	24	20
Redhead Gage 1	10,26,42	60
Redhead Gage 2	11,27,43	60
Mass Spectrometer 2		
Log Amplifier Output	13,29,45	60
Electrometer Biased Output	30	20
Zero Volt Reference	14	20
Five Volt Reference	15	20
Subcommutator 1 Output	17	20
Subcommutator 2 Output	31	20
Subcommutator 3 Output	33	20
Frame Synchronization	46,47,48	60

SUBCOMMUTATOR DECK 1 (appears on channel 17 of main commutator)

Measurement	Channel Assignment	Word 1 Last 4 Bits	Subcom Counter Count
Mass Spectrometer 1:			
Ionization Current and Voltage	1	1111	15
High Voltage Monitor	2	0000	0
Repeller Monitor	3	0001	1
Amplifier B plus Monitor	4	0010	2
Mass Marker	5	0011	3
Log Amplifier Temperature-Calibration Flag	6	0100	4
Electrometer Temperature	7	0101	5
Mass Spectrometer 2:			
Ionization Current and Voltage	8	0110	6
High Voltage Monitor	9	0111	7
Repeller Monitor	10	1000	8
Amplifier B plus Monitor	11	1001	9
Mass Marker	12	1010	10
Log Amplifier Temperature-Calibration Flag	13	1011	11
Electrometer Temperature	14	1100	12
Zero Volt Reference	15	1110	13
Full Sacle (5 volt) Reference	16	1110	14

SUBCOMMUTATOR DECK 2 (appears on channel 31 of main commutator)

Measurement	Channel Assignment	Subcom Counter Count
Bayard-Alpert Emission Current 1	1	15
Bayard-Alpert Emission Current 2	2	0
Bayard-Alpert Gage Temperatures 1	3	1
Bayard-Alpert Gage Temperatures 2	4	2
Bayard-Alpert Electrometer Temperatures 1	5	3
Bayard-Alpert Electrometer Temperatures 2	6	4
Bayard-Alpert Voltages, Bias 1	7	5
Bayard-Alpert Voltages, Bias 2	8	6
Sphere Pressure	9	7
Pressure Gage-Calibration Flags	10	8
Experiment Squib Monitor	11	9
Turn-on Counter	12	10

Telemetry Voltage (+20.15 v)	13	11
9.3 Volt Battery Monitor	14	12
Full Scale (5 v) Reference	15	13
Zero Volt Reference	16	14

SUBCOMMUTATOR DECK 3 (appears on channel 33 of main commutator)

Measurement	Channel Assignment	Subcom Counter Count
Zero Volt Reference	1	15
Full Scale (5 v) Reference	2	0
Bayard-Alpert Card Temperatures 1	3	1.
Bayard-Alpert Card Temperatures 2	4	2
Bayard-Alpert Ion Trap-Filament Monitor 1	5	3
Bayard-Alpert Ion Trap-Filament Monitor 2	6	4
6.2 Volt Battery Monitor	7	5
-27.9 Volt Battery Monitor	8	6
Thermistor 1 (low mass spectrometer boss)	9	7
Thermistor 2 (skin, lower 45 degrees)	10	8
Thermistor 3 (ambient, top of Redhead stack)	11	9
Thermistor 4 (skin, equator)	12	10
+13.95 Monitor	13	11
Thermistor 5 (skin, upper 45 degrees)	14	12
Thermistor 6 (upper mass spectrometer boss)	15	13
Electron Temperature Probe High Temperature Calibration Flag	16	14

Appendix B

Computer-Interface Operation

Computer-interface operation can best be described by discussing the complete cycle of operation (Figure B1). The computer initiates an external function command that sends a function select pulse and the associated 12 bit select code to the computer interface. Upon receiving the function code and after a short period of line settling time, the decode interrogate pulse turns on the decoder. If the proper code is detected, an input interrogate pulse is generated which turns on the input transponder and completes the cycle of the select transponder by developing

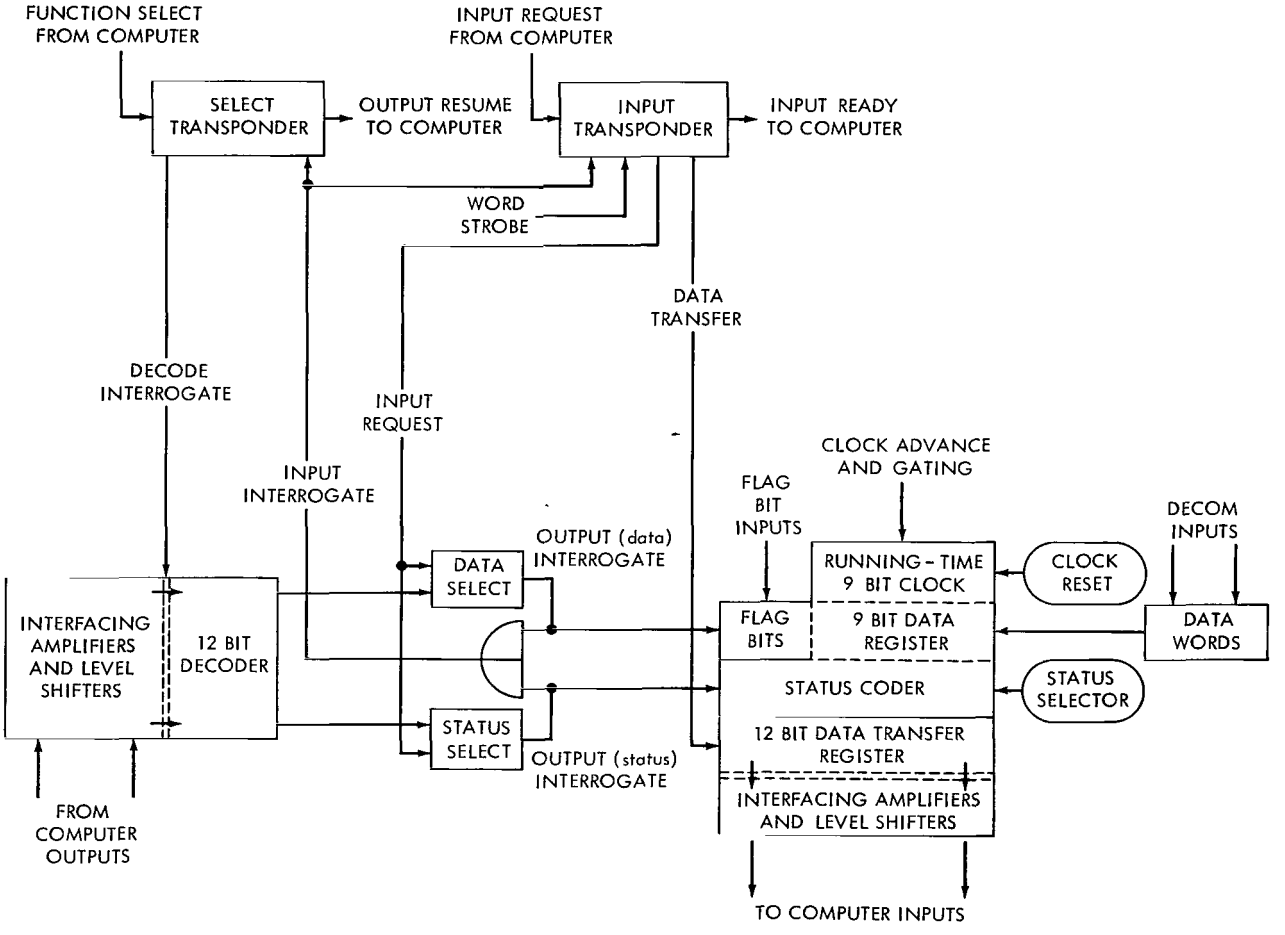


Figure B1—Computer-interface operation.

an output resume pulse. The output resume pulse is sent back to the computer, and upon completion of the computer's output cycle the select transponder's cycle is terminated. Figure B2 shows the timing involved in operations for this and the following paragraph.

Unless the interface is deselected, it is now ready to send either data or status information to the computer, depending on which selector is interrogated by the code sent from the computer. The combination of the input request pulse and the input interrogate pulse (received during the select cycle) turns on the input transponder. Then either the output (status) interrogate pulse or the output (data) interrogate pulse is initiated at input request time. The next operation is the insertion of a 2 μsec word strobe* pulse and the 9 bit data word from the PCM decom station. If data are chosen by the computer, then the output (data) interrogate pulse turns on the 12 bit data register consisting of 3 flag bits† and the 9 bit data word. At word strobe time a data transfer pulse is developed that transfers the data to the computer via the interfacing amplifiers (line drivers).

The same cycle is followed to return status data. Here the computer requests status and the status coder is interrogated by the output (status) interrogate pulse. The status code preselected by the operator is then transferred to the computer upon receipt of the data transfer pulse. The timing for the status operation is shown in Figure B3.

The running-time clock, which consists of a 9 bit binary counter, a 9 bit storage register, and associated gating, provides spacecraft running-time. The binary counter is advanced by a 1 sec pulse obtained from a secondary time standard. A gating arrangement that utilized gating pulses from the PCM decom allows the 9 bit time code to be inserted as a normal data word during one of the sync word times in the format. The time word is then transferred to the computer as a normal data word. The clock is reset at each "on" command sent by the command transmitter or detected automatically during magnetic tape playbacks; then it begins a running-time count of the spacecraft program.

Figure B4 is a schematic drawing of the Mod II interface and gives more information on the gating arrangements for the operations discussed.

Word strobe pulse is a pulse generated at the telemetry rate by the PCM decom. This pulse occurs during the ninth data bit and insures that the entire data word is transferred from the PCM decom to the computer at the correct time.

†*3 flag bits* may be used during data transmissions to indicate any of several functions. In the case covered by this report, 1 bit indicated decom frame sync, 1 bit was used to indicate that the time word was present in the data, and the last bit was not assigned.

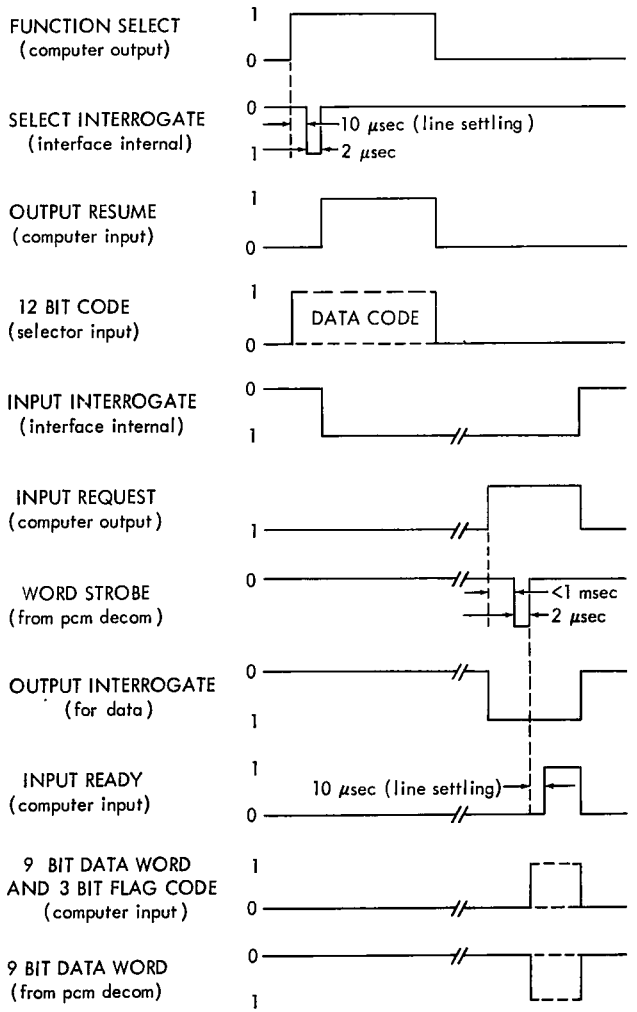


Figure B2—Normal data transfer timing chart.

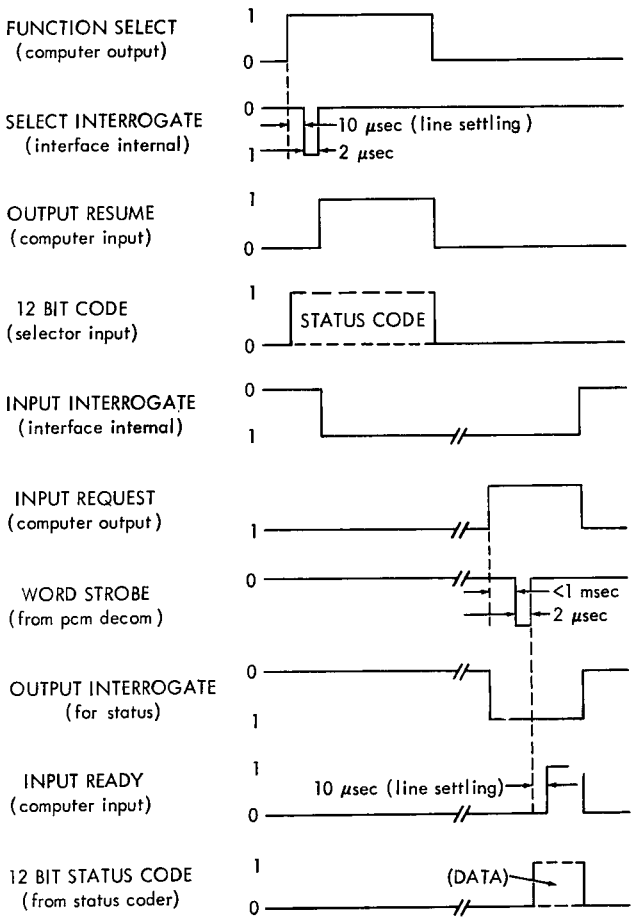
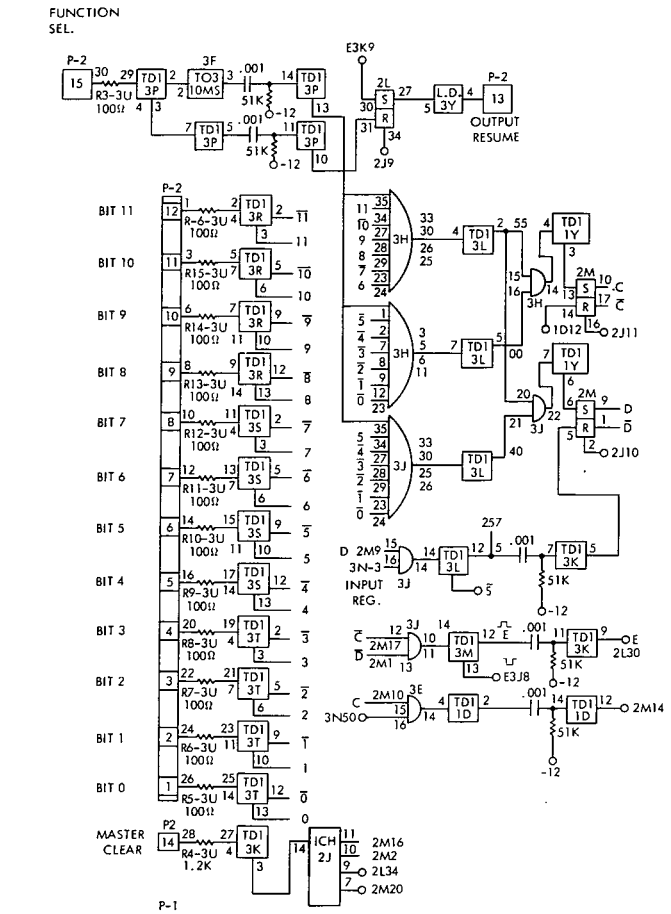
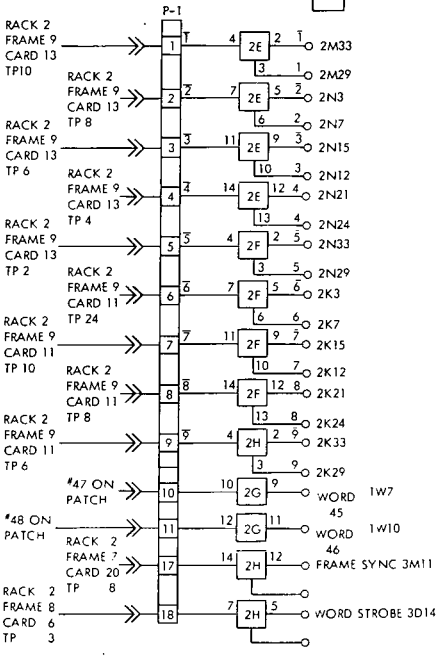


Figure B3—Status data transfer timing chart.


FUNCTION SEL.
E3K9
P-2
OUTPUT RESUME
BIT 11
BIT 10
BIT 9
BIT 8
BIT 7
BIT 6
BIT 5
BIT 4
BIT 3
BIT 2
BIT 1
BIT 0
MASTER CLEAR
INPUT REG.
2J9
2J11
2J10
2M14
2L30
E3J8
3N50
2M16
2M2
2L34
2M20


RACK 2 FRAME 9 CARD 13 TP10
RACK 2 FRAME 9 CARD 13 TP 8
RACK 2 FRAME 9 CARD 13 TP 6
RACK 2 FRAME 9 CARD 13 TP 4
RACK 2 FRAME 9 CARD 13 TP 2
RACK 2 FRAME 9 CARD 11 TP 24
RACK 2 FRAME 9 CARD 11 TP 10
RACK 2 FRAME 9 CARD 11 TP 8
RACK 2 FRAME 9 CARD 11 TP 6
#47 ON PATCH
#48 ON PATCH
RACK 2 FRAME 7 CARD 20 TP 8
RACK 2 FRAME 8 CARD 6 TP 3
WORD 45
WORD 46
FRAME SYNC 3M11
WORD STROBE 3D14

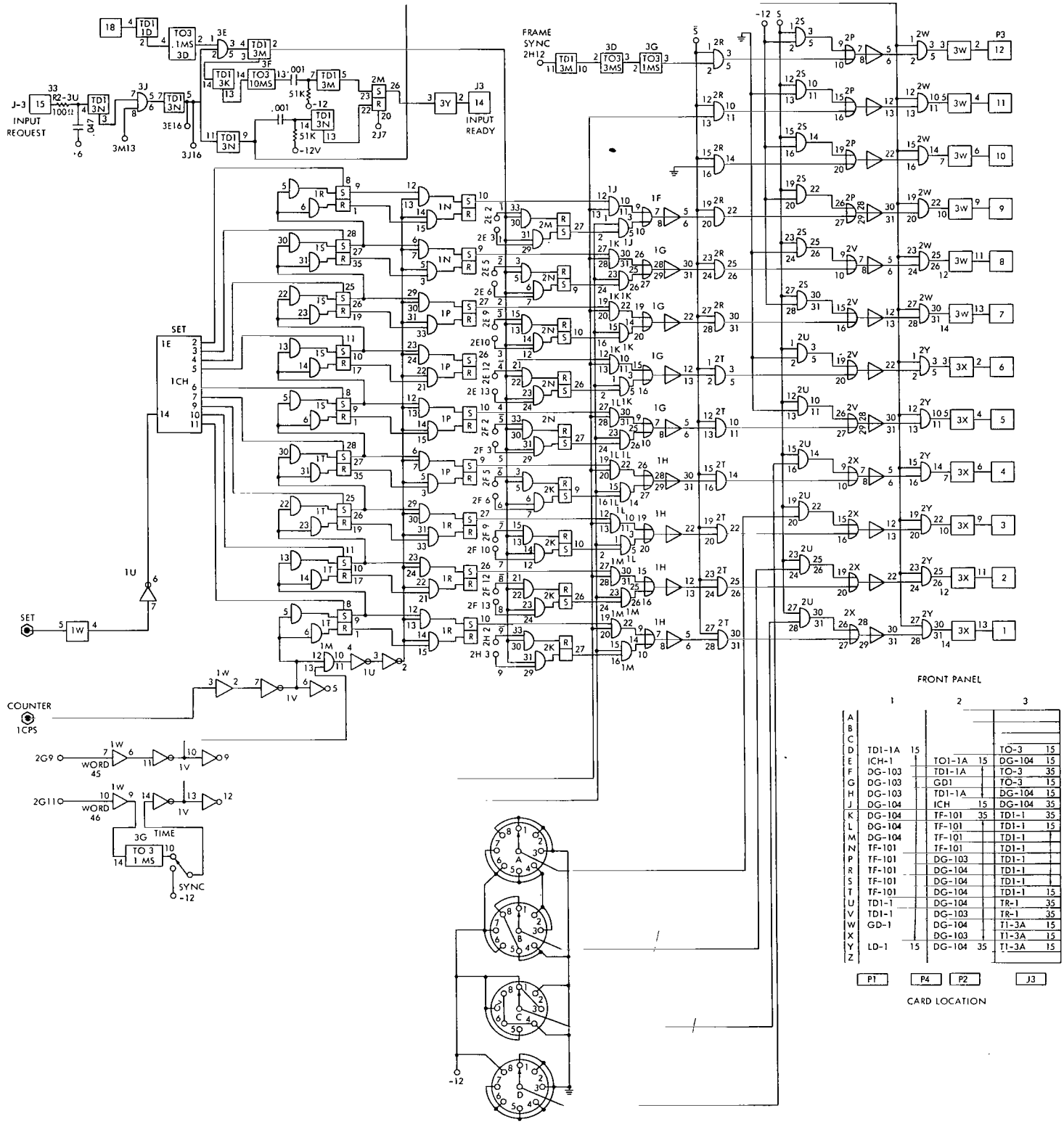


Figure B4—Schematic of Mod II computer interface.

Appendix C

Computer Program Flow Charts

Figure C1 is a generalized flow chart of a typical program for computer reduction of the Explorer XVII subcommutated data channels, with the initial main program flow included to show the subprogram selecting method. No attempt was made to conform to a particular symbolic system, and several loops and subroutines have been indicated in block form only.

A typical subroutine for computing the analog data from a normalized binary form into volts is shown in Figure C2. This subroutine was utilized by several of the subprograms. For future applications, this subroutine will be replaced by one that uses similar logic and additional arithmetic equipment to reduce machine time for the pertinent operations.

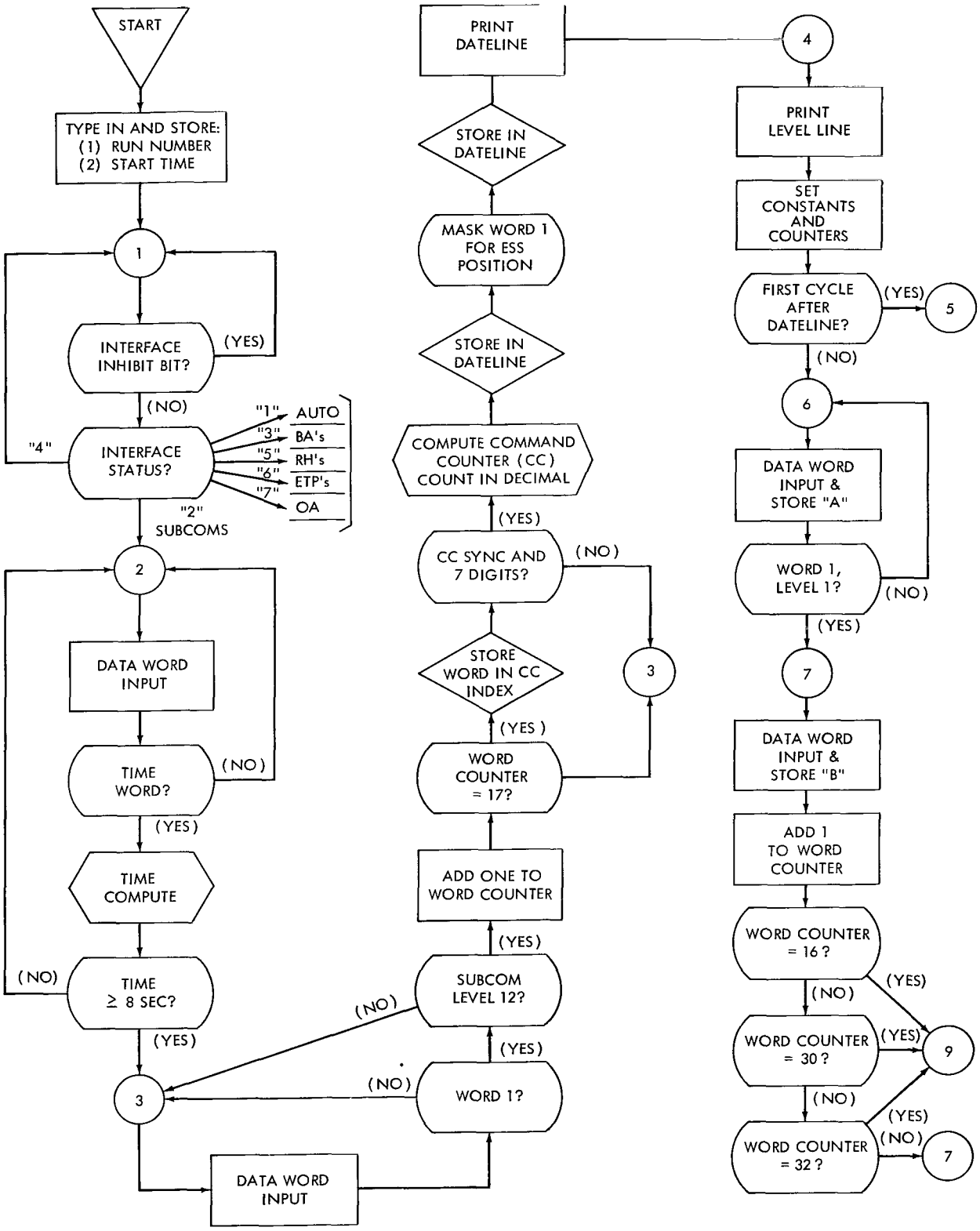


Figure C1—Subcom program flow chart.

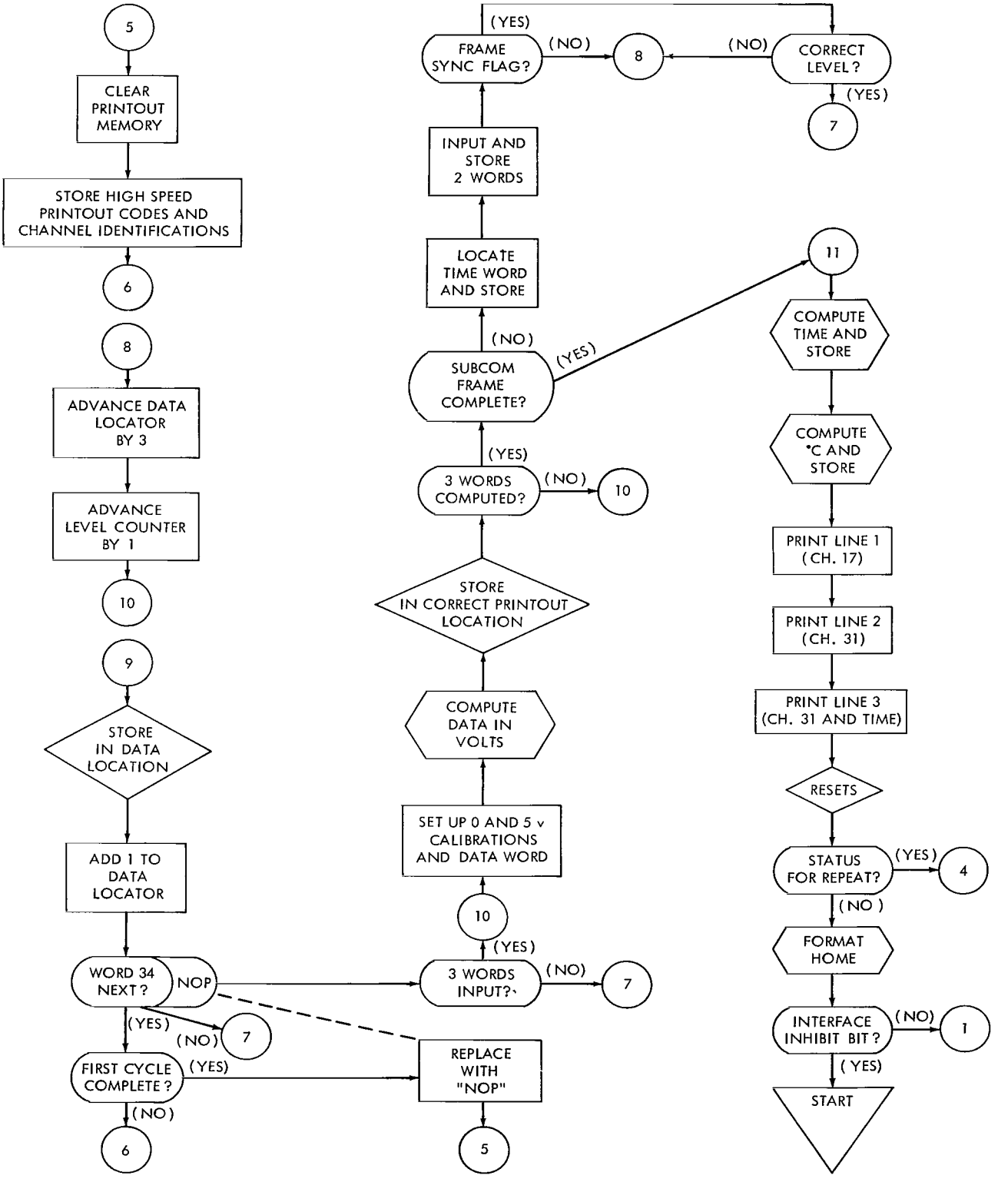


Figure C1(continued)—Subcom program flow chart.

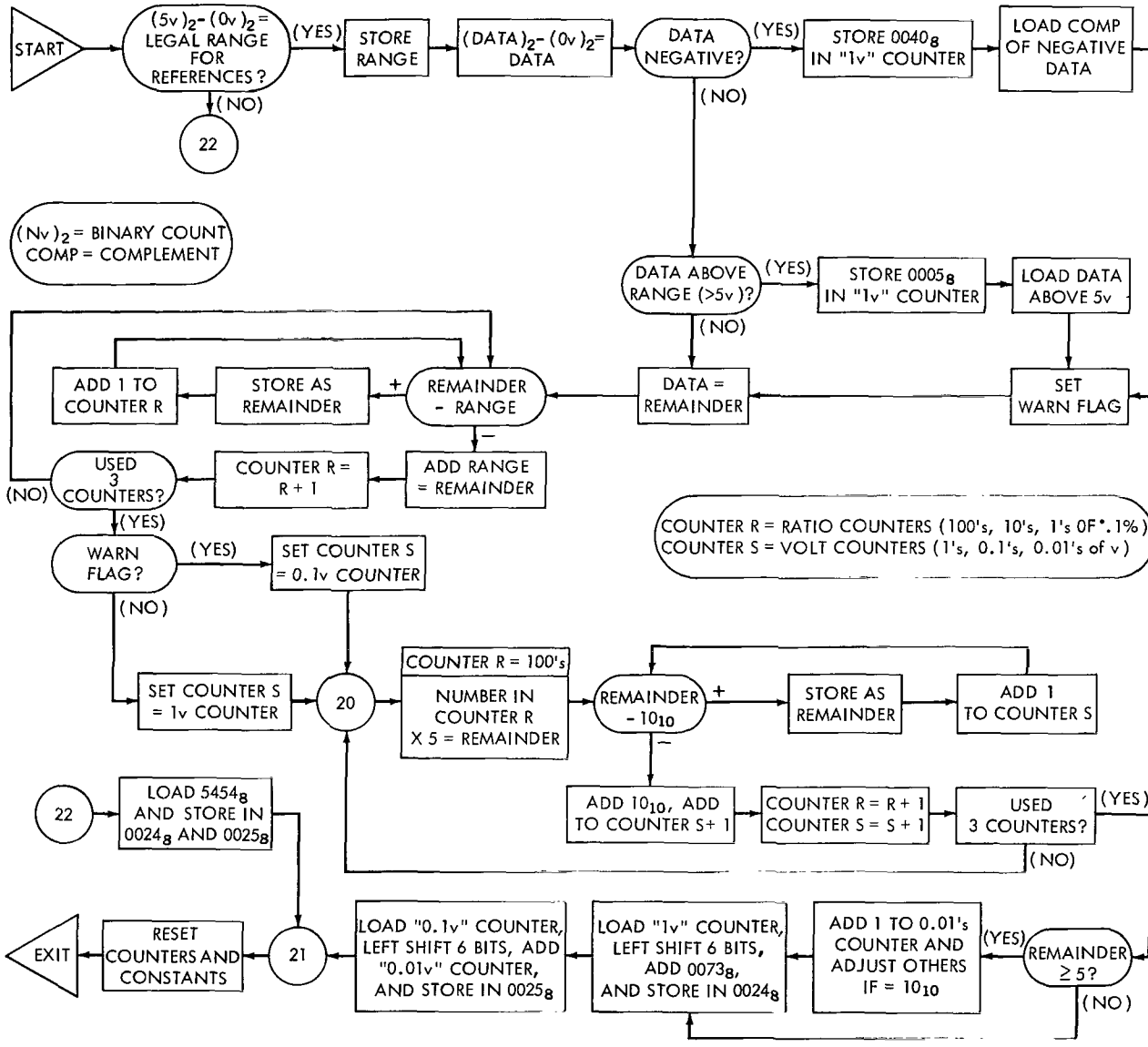


Figure C2—Voltage subroutine flow chart.

Appendix D

Computer Program Printout Formats

The formats as shown in this section are those derived for a CDC 166-2 line printer with a 300 line/min capability. Similar formats were used for a CDC 1612 line printer which printed 1000 lines/min. A dateline (Table D1), which contained the date, time, and pass (or run) number, and command counter and location information, is included for the subcom format only, although this line ordinarily was inserted in any format when selected at initiation of the particular run and program.

Subcom Format

Table D1 illustrates the subcommutator (subcom) format. Following the dateline was a level line that identified the particular levels of subcommutation. The subcom main channels (17, 31, and 33) were identified in the left margin. In real time the telemetered information was not received in the sequence of lines as indicated, but took the sequence: channel 17, level 1 (17-1); channel 31, level 1 (31-1); channel 33, level 1 (33-1); channel 17, level 2 (17-2); $\cdots$; channel 33, level 16 (33-16). At this point, program running-time was computed and formatted at the right margin of the channel 33 printout. Note the 0 and 5 volt references at the beginning or end of the voltage printout for each channel. Unacceptable data, in most cases, were represented by "****" in the appropriate printout location. Temperatures in °C were represented by two-numeral numbers without decimal points, as shown for channel 33, level 3. The staggered format was utilized to facilitate the tracing of a data point from one subcom frame to another.

Electron Temperature Probe (ETP) Data Format

The first block of data in Table D2 is information from ETP II and covers calibration and several live data cycles from that experiment. Data were received, as presented in this format, sequentially from left to right, line by line. A "-1 volt" was indicated by an "*" preceding the decimal point, and unacceptable data by "****".

The second block is again ETP II information and covers calibration and some raw data for the sensitivity (low or high) following that sampled for the first block.

The 4 smaller blocks are ETP I information and take the following sequence: calibration, sensitivity Y; live data, sensitivity Y; calibration, sensitivity Z; and live data, sensitivity Z. Y and Z represent high and low sensitivities but not necessarily in that order. The data sequence

for ETP I, which utilized nine main channels, was from left to right, line by line, and, to facilitate plotting of printed values, was formatted in frames, with 2 frames/line.

Bayard-Alpert and Redhead Pressure Gage Data Formats

The format shown in Table D3 was that used during the pressure gage calibration period. For each main sample source, 9 successive samples were printed out, 3 samples (1 main frame)/line, 3 frames/block. The sampled sources were identified by name, and the same special indications were used as those for the subcom and ETP formats. The illustrated calibration sequence first presented high calibration for the BA's and RH's, then mid-calibration, and concluded with low calibration. Program running-time for the last sampled frame for each experiment group was printed out in the right margin.

Optical Aspect Format

The optical aspect system utilized 2 coded words (8 and 32) that relayed information on selected events and counters. This was formatted for printout as shown in Table D4, beginning with word 8 at the extreme left, followed by word 32 to its right, word 8 again, and so on for 4 frames, which completed 1 printout line. The following frame was presented in the next printout line; and, except for periods of prolonged loss of frame synchronization, all optical aspect data were printed out sequentially. "No sync" was indicated by "000000000," an illegal code for the aspect system.

Table D1

Subcommutator Printout Format.

APR 8 63 CTR= 078 ORBIT OVER 8-PT PASS 0079 PN 5 0920DST

CH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	TIME
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	
31	0.01	0.00	0.00	0.00	05	0.00	0.00	0.00	0.00	0.00	0.00	2.30	2.41	0.40	5.00	0.00	
33	0.00	5.00	0.00	0.00	0.01	0.01	0.32	0.01	27	16	26	16	2.42	19	16	0.01	024
17	0.00	0.00	0.00	0.00	0.50	42	0.00	1.35	2.28	0.00	4.34	0.45	0.00	24	0.00	5.00	
31	0.01	0.00	90	0.00	32	32	0.00	0.81	0.78	0.00	0.00	2.04	2.41	2.87	5.00	0.00	
33	0.00	5.00	0.00	0.00	0.15	0.86	0.32	2.62	27	16	25	16	2.42	21	16	0.01	026
17	4.09	3.36	3.10	0.00	0.48	42	27	1.35	4.05	3.75	4.38	0.45	38	24	0.00	5.00	
31	4.41	4.16	32	0.00	35	32	0.69	0.81	0.77	0.00	0.00	2.04	2.42	2.87	5.00	0.00	
33	0.00	5.00	30	0.00	1.36	0.86	3.13	2.62	27	16	26	16	2.36	21	16	0.00	027
17	4.12	3.41	3.15	0.00	0.50	34	27	3.92	4.05	3.72	4.36	0.46	38	24	0.00	5.00	
31	4.45	4.20	34	0.00	35	34	0.69	0.67	0.77	0.00	0.00	3.58	2.42	2.90	5.00	0.00	
33	0.00	5.00	32	0.00	1.37	1.47	3.13	2.60	27	16	26	16	2.36	19	16	0.01	029
17	4.13	3.41	3.15	0.00	0.51	34	27	3.92	4.05	3.74	4.39	0.49	38	24	0.00	5.00	
31	4.45	4.20	36	0.00	35	34	0.70	0.67	0.78	0.00	0.00	2.03	2.42	2.89	5.00	0.00	
33	0.00	5.00	34	0.00	1.38	1.47	3.13	2.60	27	16	26	16	2.36	19	16	0.01	031
17	4.10	3.40	3.13	0.00	0.48	34	27	3.92	4.05	3.72	4.34	0.49	38	24	0.00	5.00	
31	4.45	4.20	38	0.00	35	34	0.70	0.67	0.78	0.00	0.00	2.03	2.41	2.89	5.00	0.00	
33	0.00	5.00	36	0.00	1.38	1.47	3.12	2.58	27	16	26	16	2.37	19	16	0.00	032
17	4.12	3.39	3.13	4.47	0.48	34	27	3.92	4.05	3.72	4.34	0.49	38	24	0.00	5.00	
31	4.41	4.17	38	48	35	34	0.70	0.67	0.78	0.00	0.00	2.03	2.41	2.89	5.00	0.00	
33	0.00	5.00	36	29	1.38	1.47	3.12	2.58	27	16	26	16	2.37	19	16	0.00	034
17	4.12	3.39	3.13	4.45	0.48	34	27	3.91	4.05	3.72	4.39	0.49	38	24	0.00	5.00	
31	4.42	4.19	38	48	35	36	0.70	0.67	0.78	0.00	0.00	2.03	2.41	2.89	5.00	0.00	
33	0.00	5.00	36	29	1.38	1.50	3.11	2.58	27	16	26	16	2.38	19	16	0.01	035
17	4.14	3.42	3.15	4.48	0.48	34	27	3.91	4.05	3.72	4.39	0.49	38	24	0.00	5.00	
31	4.45	4.18	38	48	35	36	0.70	0.67	0.78	0.00	0.00	2.03	2.41	2.89	5.00	0.00	
33	0.00	5.00	36	29	1.38	1.50	3.11	2.58	27	16	26	16	2.38	19	16	0.01	037
17	4.13	3.39	3.15	4.46	0.48	34	27	3.91	4.05	3.73	4.36	0.47	38	24	0.00	5.00	
31	4.42	4.18	38	48	35	36	0.70	0.67	0.78	0.01	0.00	2.09	2.41	2.87	5.00	0.00	
33	0.00	5.00	36	29	1.38	1.51	3.11	2.60	27	16	25	16	2.38	19	16	0.01	039
17	4.12	3.39	3.12	4.45	0.50	34	27	3.90	4.02	3.73	4.34	0.47	38	24	0.00	5.00	
31	4.43	4.18	40	48	35	36	0.70	0.67	0.78	0.01	0.00	2.09	2.41	2.87	5.00	0.00	
33	0.00	5.00	38	29	1.40	1.50	3.11	2.60	27	16	26	16	2.38	19	16	0.00	040
17	4.13	3.43	3.16	4.45	0.51	31	27	3.94	4.02	3.74	4.39	0.47	36	24	0.00	5.00	
31	4.41	4.17	40	48	35	36	0.70	0.67	0.78	0.00	0.00	2.09	2.42	2.87	5.00	0.00	
33	0.00	5.00	38	29	1.41	1.51	3.12	2.60	27	16	26	16	2.38	19	16	0.01	042
17	4.10	3.41	3.11	4.45	0.51	34	27	3.91	4.01	3.74	4.36	0.46	38	24	0.00	5.00	
31	4.41	4.18	40	48	35	36	0.70	0.67	0.77	0.00	0.00	2.10	2.42	2.87	5.00	0.00	
33	0.00	5.00	38	31	1.41	1.51	3.12	2.60	27	16	26	16	2.39	19	16	0.01	043
17	4.10	3.41	3.11	4.44	0.51	34	27	3.92	4.01	3.72	4.34	0.46	38	24	0.00	5.00	
31	4.43	4.15	40	48	35	36	0.70	0.67	0.77	0.00	0.00	2.10	2.42	2.87	5.00	0.00	
33	0.00	5.00	38	31	1.41	1.51	3.12	2.58	27	16	26	16	2.37	19	16	0.00	045
17	4.12	3.41	3.14	4.44	0.51	34	27	3.92	4.01	3.72	4.34	0.46	38	24	0.00	5.00	
31	4.41	4.17	40	48	35	36	0.70	0.67	0.77	0.00	0.00	2.10	2.42	2.87	5.00	0.00	
33	0.00	5.00	38	31	1.41	1.51	3.12	2.58	27	16	26	16	2.37	19	16	0.00	047
17	2.73	3.41	3.14	4.44	0.51	34	27	3.92	4.01	3.72	4.34	0.46	38	24	0.00	5.00	
31	4.43	4.17	40	48	35	36	0.70	0.67	0.77	0.00	0.00	2.10	2.42	2.87	5.00	0.00	
33	0.00	5.00	38	31	1.41	1.51	3.12	2.58	27	16	26	16	2.37	19	16	0.00	048
17	2.44	3.41	3.14	4.44	0.92	34	27	2.15	4.04	3.72	4.36	0.96	38	24	0.00	5.00	
31	4.43	4.17	40	48	35	36	0.70	0.67	0.77	0.00	0.00	2.10	2.42	2.86	5.00	0.00	
33	0.00	5.00	38	31	1.41	1.51	3.13	2.60	27	16	26	16	2.37	19	16	1.55	050
17	2.41	3.40	3.13	4.44	0.95	34	27	2.14	4.04	3.71	4.35	0.93	38	24	0.00	5.00	
31	4.41	4.15	40	48	35	36	0.70	0.67	0.77	0.01	0.00	2.10	2.42	2.86	5.00	0.00	
33	0.00	5.00	38	31	1.41	1.51	3.13	2.59	27	16	26	16	2.37	21	16	0.00	051
17	2.43	3.41	3.14	4.44	0.95	31	27	2.15	4.02	3.73	4.38	0.93	36	24	0.00	5.00	
31	4.40	4.15	40	48	35	36	0.70	0.67	0.77	0.00	0.00	2.10	2.41	2.86	5.00	0.00	
33	0.00	5.00	38	31	1.41	1.51	3.12	2.59	27	16	26	16	2.37	21	16	0.00	053

Table D2

Electron Temperature Probe Printout Format.

1.07	1.12	1.16	1.24	1.30	1.35	1.37	1.38	1.39	1.47	1.53	1.63	1.69	1.75	1.77	1.81	1.87	2.68	2.26	2.41
0.73	5.36	5.22	5.10	5.01	4.88	4.78	4.69	4.54	4.50	4.35	4.22	4.13	4.03	3.89	3.79	3.67	3.59	3.46	3.36
3.24	3.13	****	****	2.79	2.72	2.54	2.46	2.35	2.25	2.11	2.00	1.93	1.79	1.68	1.59	1.45	1.35	1.27	1.16
1.02	0.97	0.83	0.75	0.67	0.58	0.51	0.54	0.53	0.54	0.53	0.56	0.53	0.51	0.44	0.40	0.31	0.25	0.20	0.20
0.20	0.20	0.27	0.32	0.39	0.48	0.58	0.70	0.81	0.89	0.98	1.10	1.18	1.30	1.40	1.49	1.62	1.75	1.84	1.96
2.05	2.18	2.27	2.40	3.35	5.37	5.21	5.15	5.02	4.92	4.78	4.73	4.56	4.48	4.34	4.25	4.12	4.03	3.89	3.79
3.69	3.59	3.48	3.39	3.22	3.18	3.03	2.91	2.79	2.70	2.55	2.49	2.34	2.25	2.12	2.02	1.89	1.81	1.68	1.59
1.48	1.36	1.25	1.17	1.06	0.98	0.86	0.77	0.65	0.62	0.54	0.54	0.50	0.54	0.54	0.53	0.50	0.49	0.45	0.39
0.30	0.26	0.21	0.20	0.17	0.22	0.25	0.34	0.41	0.50	0.57	0.68	0.78	0.89	0.97	1.10	*.00	*.00	*.03	*.03
*.03	*.03	*.03	*.03	*.03	*.03	*.02	*.02	*.03	0.68	0.63	0.62	0.63	0.65	0.59	0.60	0.60	0.59	0.56	0.64
0.63	0.64	0.59	0.60	0.59	0.58	0.58	0.58	0.60	0.56	0.56	0.60	0.62	0.64	0.58	0.58	0.60	0.64	0.60	0.60
0.58	0.60	0.55	0.56	0.58	0.60	0.58	0.55	0.55	0.58	0.54	0.53	0.49	0.47	0.46	0.51	0.51	0.54	0.55	0.58
0.59	0.59	0.54	0.57	0.55	0.55	0.46	0.30	0.26	0.71	1.18	1.67	2.17	2.84	3.41	4.08	4.45	4.73	5.35	*.05
*.02	*.02	5.40	5.16	5.00	*.03	*.02	*.02	*.02	*.02	*.02	*.02	*.02	0.68	0.63	0.63	0.61	0.63	0.62	0.63
0.65	0.66	0.64	0.61	0.59	0.60	0.58	0.59	0.61	0.62	0.59	0.61	0.60	0.64	0.60	0.62	0.62	0.63	0.60	0.61
0.59	0.63	0.61	0.61	0.57	0.59	0.61	0.63	0.58	0.60	0.56	0.56	0.54	0.57	0.56	0.56	0.51	0.55	0.55	0.58

0.60	0.59	0.59	0.59	0.58	0.59	0.79	0.83	0.82	0.43	0.05	0.21	0.10	0.05	0.05	0.15	0.22	0.32	0.45	0.58
0.68	0.79	0.86	0.89	0.88	0.88	0.88	0.89	0.89	0.93	0.98	1.10	1.21	1.35	1.46	1.59	1.73	1.87	2.00	2.12
2.25	2.42	****	****	2.82	2.97	3.09	3.25	3.36	3.53	3.64	3.78	3.92	4.07	4.18	4.34	4.45	4.60	4.72	4.87
0.91	4.67	4.51	4.40	4.24	4.12	3.97	3.82	3.69	3.56	3.42	3.30	3.15	3.02	2.87	2.75	2.60	2.48	2.32	2.21
2.06	1.94	1.79	1.68	1.53	1.40	1.26	1.13	1.00	0.88	0.74	0.63	0.49	0.39	0.26	0.17	0.07	0.05	0.08	0.20
0.29	0.41	0.51	0.64	0.74	0.85	0.88	0.91	0.87	0.90	0.88	0.89	0.89	0.96	1.03	1.13	1.26	1.41	1.53	1.68
1.79	1.94	2.06	2.21	2.32	2.49	2.60	2.75	2.88	3.03	3.15	3.31	3.43	3.56	3.70	3.86	3.97	4.11	4.25	4.41
4.51	4.68	4.78	4.93	4.69	4.52	4.45	4.34	4.17	4.06	3.91	3.78	3.63	3.49	3.35	3.24	3.08	2.96	2.81	2.69
2.54	2.41	2.26	2.15	2.00	1.88	1.39	0.97	0.97	0.98	0.99	1.00	0.97	0.97	0.97	0.98	0.97	0.98	0.99	1.00
0.97	0.98	0.97	0.98	0.98	1.00	0.98	1.01	1.00	1.01	0.99	1.01	0.97	0.98	0.97	1.00	0.98	1.01	0.96	0.98
1.00	1.03	1.10	1.20	1.24	1.31	1.35	1.45	1.51	1.59	1.62	1.67	1.65	1.78	1.78	1.76	1.69	1.65	1.68	1.73
1.81	1.87	1.96	2.02	2.01	2.06	2.19	2.33	0.96	0.98	0.96	0.97	0.97	0.98	0.96	0.98	0.97	0.98	0.97	0.97
0.97	0.98	0.97	0.98	0.97	0.98	0.96	0.97	0.96	0.97	0.97	0.98	0.96	0.97	0.97	1.00	0.97	0.98	0.97	0.98
0.97	0.98	0.97	1.00	0.97	0.98	0.97	1.00	0.98	1.00	0.98	1.00	0.97	1.00	0.97	0.98	0.97	0.98	0.97	0.98
0.97	1.00	0.98	1.02	1.02	1.10	1.15	1.24	1.31	1.41	1.45	1.52	1.53	1.55	1.68	1.70	1.63	1.57	1.54	1.59
1.66	1.71	1.86	1.92	1.89	1.98	2.05	2.08	2.15	2.24	2.07	2.07	0.97	0.98	0.97	0.98	0.97	0.98	0.97	1.00

1.10	1.12	1.16	*.05	*.05	*.05	*.05	1.48	0.83	0.97	1.43	1.92	2.56	3.10	3.64	4.26	4.72	5.10		
*.05	*.05	*.03	*.03	*.03	*.03	*.03	*.03	2.91	0.84	0.89	1.37	1.98	2.51	3.05	3.67	4.20	4.65		
5.12	5.41	*.03	*.03	*.03	*.03	*.03	*.03	*.03	2.38	0.81	0.87	1.39	1.89	2.41	3.07	3.60	4.11		
4.68	5.07	3.40	1.18	1.25	1.31	1.36	1.41	1.46	1.58	1.70	0.92	0.92	0.91	0.93	0.93	0.93	0.97		

1.13	1.16	1.25	1.36	1.46	0.92	0.91	0.91	0.93	0.93	0.93	0.92	0.96	0.97	1.00	1.05	1.11	1.17		
1.29	1.36	1.46	1.56	1.70	1.82	0.92	0.93	0.93	0.94	0.94	0.93	0.98	1.01	1.05	1.08	1.15	1.20		
1.27	1.32	1.37	1.48	1.51	1.54	1.60	0.94	0.93	0.95	0.93	0.97	0.98	0.99	0.98	1.02	1.07	1.12		
1.17	1.17	1.22	1.26	1.27	1.30	1.32	1.37	0.88	0.93	0.91	0.92	0.93	0.93	0.93	0.96	0.97	0.98		

0.94	0.94	*.03	3.41	3.62	3.86	4.11	4.32	4.51	4.73	2.46	1.00	1.01	1.22	1.44	1.70	1.93	2.15		
2.43	2.65	2.89	3.16	3.37	3.60	3.87	4.08	4.29	4.53	4.72	4.03	0.97	1.02	1.20	1.45	1.67	1.88		
2.17	2.40	2.60	2.91	3.11	3.35	3.62	3.83	4.02	4.30	4.50	4.69	3.59	1.00	1.00	1.17	1.41	1.63		
1.91	2.13	1.12	1.15	1.17	1.21	1.24	1.26	1.27	1.30	1.29	1.30	1.29	1.31	0.98	1.00	1.01	1.00		

1.19	1.19	1.26	1.27	1.27	1.31	1.32	1.32	1.36	1.00	0.98	1.00	0.98	1.01	1.01	1.04	1.06	1.07		
1.13	1.14	1.16	1.17	1.18	1.19	1.22	1.25	0.12	1.32	0.96	1.02	1.00	1.03	1.03	1.03	1.04	1.04		
1.08	1.10	1.14	1.18	1.20	1.23	1.24	1.27	1.30	1.31	1.34	0.97	1.00	1.00	1.00	0.98	0.97	1.00		
1.01	1.01	1.05	1.05	1.08	1.11	1.16	1.21	1.22	1.30	1.32	1.37	0.91	1.00	1.00	0.98	1.00	0.98		

Table D3

Bayard-Alpert and Redhead Printout Format During Calibration.

BA I DC			BA I AC			BA II DC			BA II AC			TIME
4.62	4.63	4.63	2.44	2.45	2.45	4.24	4.24	4.24	2.50	2.50	2.50	124
4.63	4.64	4.64	2.45	2.44	2.44	4.24	4.25	4.24	2.50	2.50	2.50	
4.63	4.63	4.64	2.45	2.45	2.45	4.24	4.24	4.24	2.51	2.50	2.51	

RH I AC			RH II AC			TIME
4.73	4.73	4.70	4.83	4.83	4.81	
4.73	4.73	4.70	4.83	4.83	4.81	
4.70	4.73	4.72	4.81	4.83	4.83	126

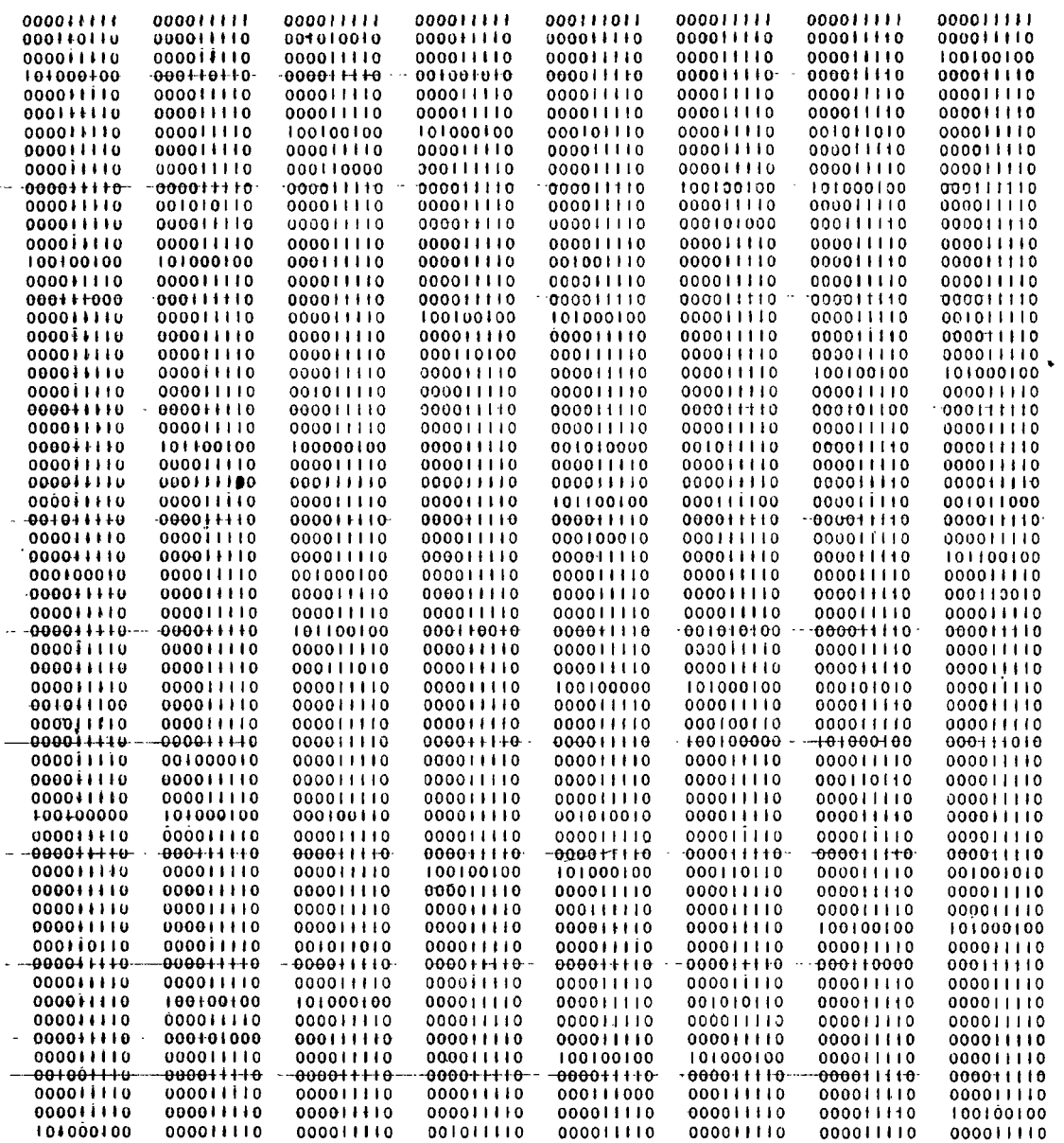
RH I AC			RH II AC			TIME
3.47	3.48	3.48	3.48	3.46	3.46	
3.47	3.48	3.47	3.48	3.46	3.46	
3.47	3.47	3.48	3.48	3.46	3.46	129

BA I DC			BA I AC			BA II DC			BA II AC			TIME
2.42	2.42	2.42	1.42	1.42	1.42	2.18	2.18	2.18	1.77	1.76	1.77	135
2.42	2.41	2.42	1.40	1.40	1.40	2.19	2.19	2.18	1.77	1.76	1.76	
2.41	2.42	2.42	1.40	1.40	1.40	2.18	2.18	2.19	1.77	1.77	1.77	

RH I AC			RH II AC			TIME
2.01	2.01	2.01	1.96	1.96	1.96	
2.01	2.01	2.01	1.96	1.96	1.96	
2.01	2.01	2.01	1.95	1.96	1.96	137

Table D4

Optical Aspect Printout Format.



Appendix E

Typical Test Stand and CDC 160A Computer Program

Special storage areas in bank "1":

0101-0200	Program dateline
0201-0300	Subcom level line
0301-0400	BA channel identification line
0401-0500	RH channel identification line
0600-0641	Printer codes for numerics and sign
1001-2000	Printout load locations
2000-2060	Raw data storage
3001-5400	Printout load locations
5401-6200	Reference storage
6600-6677	Thermistor conversion constants

bank "0"

0000	7123	0060	0000	0140	4010	0220	4010	0300	4010	0360	6753
0001	0000	0061	0000	0141	0001	0221	0001	0301	2015	0361	0503
0002	0000	0062	0000	0142	0001	0222	0001	0302	0703	0362	5355
0003	0000	0063	0000	0143	0001	0223	0001	0303	4015	0363	0601
0004	0000	0064	0000	0144	7500	0224	0401	0304	0001	0364	4355
0005	0000	0065	0000	0145	0740	0225	4241	0305	2205	0365	7101
0006	0000	0066	0000	0146	7600	0226	4017	0306	4067	0366	2600
0007	0000	0067	2055	0147	6503	0227	0400	0307	2206	0367	5623
0010	0000	0070	7774	0150	7500	0230	4005	0310	4070	0370	3432
0011	0000	0071	0000	0151	0720	0231	2023	0311	6207	0371	6026
0012	0000	0072	4210	0152	7101	0232	4015	0312	2055	0372	7500
0013	0000	0073	0013	0153	6631	0233	7500	0313	2053	0373	5500
0014	0000	0074	7703	0154	0020	0234	5500	0314	2005	0374	7600
0015	2000	0075	0001	0155	7666	0235	7600	0315	2052	0375	4050
0016	0000	0076	0076	0156	0021	0236	1060	0316	2056	0376	0110
0017	0000	0077	7715	0157	7104	0237	3461	0317	2002	0377	0207
0020	0000	0100	0061	0160	3000	0240	0717	0320	7100	0400	0702
0021	0120	0101	7100	0161	0200	0241	6506	0321	6175	0401	6707
0022	7020	0102	6373	0162	0600	0242	7500	0322	2024	0402	7101
0023	3500	0103	0712	0163	0152	0243	5500	0323	0001	0403	7000
0024	0535	0104	6703	0164	1200	0244	7600	0324	0001	0404	7500
0025	1301	0105	7101	0165	2757	0245	1031	0325	4100	0405	5500
0026	0000	0106	4450	0166	4056	0246	4115	0326	1004	0406	7600
0027	0000	0107	7500	0167	3500	0247	5405	0327	0001	0407	4024
0030	0000	0110	5500	0170	7500	0250	0720	0330	0001	0410	1060
0031	0000	0111	7600	0171	0740	0251	6707	0331	0001	0411	3461
0032	0000	0112	0102	0172	7600	0252	6013	0332	2025	0412	0677
0033	0000	0113	4024	0173	6503	0253	0716	0333	0001	0413	6524
0034	0000	0114	0201	0174	7101	0254	6712	0334	0001	0414	4005
0035	0000	0115	0701	0175	5002	0255	6010	0335	4100	0415	7101
0036	0000	0116	6507	0176	7101	0256	0702	0336	1005	0416	0242
0037	0000	0117	2024	0177	0170	0257	6715	0337	0001	0417	0060
0040	0000	0120	0111	0200	0020	0260	6005	0340	0001	0420	2200
0041	0000	0121	0217	0201	2200	0261	0720	0341	0001	0421	1004
0042	0000	0122	4163	0202	0152	0262	6720	0342	0001	0422	4100
0043	0000	0123	2200	0203	4100	0263	4005	0343	2200	0423	0326
0044	0000	0124	0101	0204	0575	0264	6422	0344	0101	0424	0601
0045	0000	0125	0105	0205	0021	0265	5415	0345	5317	0425	4100
0046	0000	0126	0123	0206	7101	0266	6207	0346	0601	0426	0336
0047	4424	0127	2200	0207	2620	0267	3452	0347	4311	0427	0001
0050	0000	0130	0177	0210	2200	0270	6726	0350	0001	0430	0001
0051	0000	0131	0106	0211	0277	0271	2200	0351	0001	0431	0001
0052	0000	0132	0127	0212	0106	0272	6207	0352	0001	0432	0001
0053	0000	0133	7500	0213	0210	0273	4305	0353	0001	0433	0001
0054	0000	0134	0740	0214	7100	0274	6746	0354	5415	0434	0001
0055	0000	0135	7600	0215	0175	0275	5410	0355	5750	0435	0061
0056	0000	0136	6503	0216	0001	0276	0703	0356	5747	0436	2200
0057	0000	0137	7100	0217	7100	0277	6735	0357	3445	0437	0677

bank "0"

0440	4326	0520	2200	0600	0020	0660	0061	0740	0002	1020	0001
0441	7100	0521	1001	0601	2200	0661	7500	0741	0003	1021	0001
0442	6626	0522	4332	0602	0152	0662	5500	0742	0004	1022	0001
0443	7100	0523	2200	0603	4100	0663	7600	0743	0005	1023	0001
0444	6343	0524	1077	0604	1147	0664	1036	0744	0022	1024	0001
0445	2024	0525	4331	0605	0021	0665	0102	0745	0023	1025	0001
0446	4100	0526	6202	0606	0001	0666	0701	0746	0024	1026	0001
0447	1267	0527	0000	0607	0001	0667	6506	0747	0025	1027	5725
0450	2025	0530	2200	0610	2200	0670	7500	0750	0042	1030	0277
0451	4100	0531	2000	0611	0301	0671	5500	0751	0043	1031	0744
0452	1270	0532	4015	0612	0105	0672	7600	0752	0044	1032	6042
0453	7101	0533	5604	0613	0610	0673	4024	0753	0045	1033	0412
0454	0467	0534	0723	0614	2200	0674	5406	0754	0001	1034	5324
0455	0000	0535	6015	0615	0377	0675	0715	0755	4005	1035	0601
0456	0000	0536	6102	0616	0106	0676	6103	0756	4006	1036	4323
0457	0000	0537	0000	0617	0614	0677	2024	0757	2200	1037	0001
0460	0000	0540	7500	0620	7100	0700	4121	0760	3625	1040	0001
0461	0000	0541	5540	0621	4010	0701	2006	0761	4346	1041	0001
0462	0000	0542	7600	0622	7100	0702	0716	0762	0544	1042	0001
0463	0000	0543	0277	0623	2664	0703	6107	0763	5344	1043	5405
0464	0000	0544	4024	0624	0001	0704	2024	0764	7500	1044	0704
0465	0000	0545	0701	0625	7100	0705	4116	0765	5500	1045	6544
0466	0000	0546	6021	0626	0175	0706	2021	0766	7600	1046	4005
0467	2200	0547	2024	0627	0001	0707	4070	0767	4050	1047	2600
0470	1001	0550	0702	0630	0001	0710	2016	0770	0110	1050	0045
0471	0105	0551	6016	0631	7101	0711	4067	0771	0207	1051	5341
0472	0467	0552	0400	0632	0647	0712	2006	0772	0702	1052	0601
0473	2200	0553	4314	0633	1001	0713	3625	0773	6507	1053	4340
0474	1077	0554	0001	0634	5701	0714	6524	0774	4006	1054	0001
0475	0106	0555	0001	0635	3600	0715	2024	0775	7100	1055	0001
0476	0473	0556	0001	0636	2000	0716	4100	0776	6343	1056	0001
0477	7100	0557	0001	0637	6506	0717	2000	0777	7100	1057	0001
0500	0175	0560	7500	0640	6007	0720	5701	1000	1175	1060	0277
0501	7100	0561	0740	0641	0000	0721	0277	1001	2200	1061	0713
0502	4010	0562	7600	0642	0000	0722	0744	1002	2000	1062	6561
0503	0001	0563	6503	0643	0000	0723	6032	1003	4015	1063	2200
0504	0001	0564	7500	0644	0000	0724	5711	1004	7100	1064	0067
0505	0001	0565	0727	0645	0000	0725	0277	1005	6175	1065	5355
0506	2312	0566	7103	0646	0000	0726	0741	1006	2024	1066	0601
0507	0602	0567	7101	0647	0060	0727	6537	1007	4100	1067	4354
0510	4320	0570	0227	0650	2200	0730	4006	1010	1001	1070	0001
0511	3200	0571	3431	0651	1001	0731	0514	1011	2025	1071	0001
0512	0076	0572	7103	0652	4100	0732	5317	1012	4100	1072	0001
0513	4317	0573	0000	0653	1111	0733	6552	1013	1002	1073	0001
0514	5613	0574	0000	0654	2200	0734	7101	1014	7101	1074	6573
0515	0703	0575	0152	0655	1077	0735	0764	1015	1027	1075	0544
0516	6527	0576	7101	0656	4100	0736	0001	1016	0001	1076	5374
0517	4210	0577	0205	0657	1115	0737	0001	1017	0001	1077	2200

bank "0"

1100	1001	1160	2024	1240	7500	1320	7104	1400	7500	1460	5617
1101	4371	1161	4100	1241	5500	1321	0701	1401	5500	1461	0702
1102	0601	1162	1067	1242	7600	1322	6003	1402	7600	1462	6552
1103	4370	1163	0001	1243	0110	1323	7101	1403	4050	1463	4214
1104	0001	1164	0001	1244	0207	1324	1247	1404	0110	1464	5406
1105	0001	1165	0001	1245	0704	1325	4006	1405	0207	1465	0703
1106	0001	1166	0001	1246	6506	1326	5734	1406	0702	1466	6106
1107	0001	1167	0001	1247	7500	1327	5727	1407	6507	1467	4006
1110	2200	1170	0001	1250	5500	1330	2024	1410	7100	1470	7100
1111	1001	1171	2025	1251	7600	1331	4221	1411	6175	1471	6343
1112	0105	1172	4100	1252	4024	1332	2213	1412	2024	1472	7100
1113	1110	1173	1070	1253	5406	1333	4115	1413	4100	1473	1175
1114	2200	1174	7101	1254	0711	1334	5415	1414	1001	1474	7101
1115	1077	1175	0000	1255	6104	1335	5703	1415	2025	1475	3200
1116	0106	1176	7101	1256	2024	1336	3600	1416	4100	1476	0000
1117	1114	1177	1160	1257	4266	1337	2221	1417	1002	1477	0000
1120	7100	1200	0060	1260	7144	1340	6506	1420	7101	1500	0400
1121	4010	1201	2200	1261	0701	1341	2200	1421	1433	1501	4006
1122	0001	1202	0152	1262	6104	1342	2213	1422	0001	1502	0060
1123	0001	1203	4100	1263	2024	1343	4311	1423	0001	1503	4100
1124	0001	1204	3321	1264	4264	1344	6110	1424	0001	1504	1650
1125	7100	1205	0061	1265	7137	1345	0000	1425	0001	1505	0061
1126	0175	1206	2200	1266	0703	1346	0000	1426	0001	1506	2200
1127	2200	1207	0401	1267	6105	1347	0000	1427	0001	1507	2000
1130	0100	1210	0105	1270	2024	1350	0000	1430	0001	1510	4015
1131	5320	1211	1206	1271	4100	1351	0000	1431	0001	1511	2016
1132	2200	1212	2200	1272	6300	1352	0000	1432	0001	1512	4067
1133	0100	1213	0477	1273	7131	1353	0000	1433	5415	1513	2021
1134	5317	1214	0106	1274	0701	1354	5701	1434	0403	1514	4070
1135	3600	1215	1212	1275	6105	1355	0703	1435	5321	1515	7500
1136	1377	1216	7100	1276	2024	1356	6003	1436	0601	1516	5500
1137	6527	1217	0175	1277	4100	1357	7101	1437	4320	1517	7600
1140	7101	1220	7100	1300	6000	1360	1240	1440	0001	1520	4047
1141	3340	1221	4010	1301	7123	1361	4306	1441	0001	1521	0110
1142	0701	1222	0060	1302	0713	1362	0503	1442	0001	1522	0207
1143	6007	1223	2200	1303	6104	1363	5371	1443	0001	1523	0704
1144	7500	1224	6300	1304	2024	1364	0503	1444	5632	1524	6507
1145	0602	1225	4245	1305	4241	1365	5365	1445	0703	1525	2047
1146	7101	1226	2200	1306	7116	1366	2200	1446	6536	1526	0217
1147	0000	1227	6000	1307	0701	1367	2000	1447	4227	1527	0705
1150	7101	1230	4250	1310	6104	1370	4015	1450	0402	1530	6513
1151	0610	1231	0061	1311	2024	1371	2100	1451	5335	1531	6012
1152	7101	1232	0400	1312	4237	1372	6000	1452	0601	1532	7500
1153	0647	1233	4006	1313	7111	1373	4167	1453	4334	1533	5500
1154	0000	1234	7100	1314	0717	1374	2100	1454	0001	1534	7600
1155	0000	1235	2664	1315	6104	1375	6300	1455	0001	1535	4047
1156	0000	1236	2023	1316	2024	1376	4170	1456	0001	1536	0110
1157	0000	1237	4015	1317	4230	1377	0001	1457	0001	1537	0207

bank "0"

1540	0704	1620	6300	1700	1001	1760	0720	2040	0061	2120	4337
1541	6002	1621	2200	1701	4213	1761	6562	2041	7500	2121	2200
1542	6136	1622	0000	1702	0001	1762	6003	2042	5500	2122	3604
1543	7500	1623	4115	1703	0001	1763	0000	2043	7600	2123	4345
1544	5500	1624	5415	1704	0601	1764	0000	2044	4047	2124	2200
1545	7600	1625	5710	1705	4220	1765	4302	2045	0110	2125	5401
1546	4024	1626	5706	1706	0001	1766	5702	2046	0207	2126	4314
1547	5406	1627	0001	1707	0001	1767	0702	2047	0704	2127	7100
1550	0715	1630	0001	1710	2126	1770	6003	2050	6507	2130	2460
1551	6104	1631	0001	1711	0001	1771	7101	2051	7500	2131	7500
1552	2024	1632	0001	1712	0001	1772	2026	2052	5500	2132	5500
1553	4170	1633	0001	1713	4100	1773	4307	2053	7600	2133	7600
1554	7123	1634	0001	1714	1001	1774	7101	2054	4024	2134	4047
1555	0701	1635	7100	1715	0001	1775	0000	2055	5604	2135	0110
1556	6104	1636	2460	1716	0001	1776	7101	2056	3604	2136	0207
1557	2024	1637	5604	1717	0001	1777	1500	2057	6114	2137	0704
1560	4167	1640	0712	1720	5426	2000	0400	2060	6030	2140	6577
1561	7116	1641	6103	1721	2126	2001	4006	2061	0000	2141	2047
1562	0701	1642	6004	1722	0001	2002	2170	2062	0001	2142	0220
1563	6104	1643	0000	1723	0001	2003	0060	2063	0006	2143	6014
1564	2024	1644	7101	1724	4100	2004	4100	2064	0013	2144	7101
1565	4223	1645	1532	1725	1002	2005	1610	2065	0021	2145	2051
1566	7111	1646	4303	1726	0001	2006	4100	2066	0026	2146	7500
1567	0721	1647	2200	1727	0001	2007	1622	2067	0033	2147	5500
1570	6104	1650	0000	1730	0001	2010	0061	2070	0041	2150	7600
1571	2024	1651	6112	1731	0001	2011	7101	2071	0046	2151	0110
1572	4261	1652	2200	1732	5426	2012	1607	2072	0053	2152	0207
1573	7104	1653	0000	1733	0403	2013	5612	2073	2312	2153	0704
1574	0707	1654	3600	1734	5320	2014	0724	2074	0715	2154	6003
1575	6007	1655	0160	1735	0601	2015	6003	2075	6105	2155	7101
1576	7101	1656	6203	1736	4311	2016	7101	2076	2024	2156	2242
1577	1543	1657	7101	1737	0001	2017	1710	2077	4100	2157	7500
1600	7101	1660	2566	1740	0001	2020	4205	2100	5520	2160	5500
1601	2000	1661	0401	1741	0001	2021	7100	2101	6114	2161	7600
1602	0001	1662	4312	1742	0001	2022	0175	2102	0701	2162	4024
1603	0001	1663	5605	1743	7101	2023	7101	2103	6112	2163	5604
1604	4006	1664	0720	1744	2013	2024	1745	2104	2024	2164	3604
1605	2024	1665	6004	1745	2200	2025	0000	2105	4100	2165	6114
1606	4214	1666	7101	1746	1001	2026	7100	2106	5530	2166	6030
1607	2200	1667	1532	1747	0105	2027	0175	2107	6106	2167	0000
1610	0000	1670	0000	1750	1745	2030	7500	2110	2024	2170	0001
1611	4115	1671	4301	1751	2200	2031	0721	2111	4100	2171	0006
1612	5415	1672	7100	1752	1077	2032	7101	2112	5401	2172	0013
1613	2167	1673	2664	1753	0106	2033	1500	2113	5701	2173	0021
1614	4100	1674	7101	1754	1751	2034	0000	2114	5736	2174	0026
1615	6000	1675	2500	1755	7100	2035	0000	2115	2334	2175	0033
1616	2170	1676	0001	1756	4010	2036	0000	2116	0753	2176	0041
1617	4100	1677	2200	1757	5604	2037	0000	2117	6546	2177	0046

bank "0"

2200	0053	2260	5752	2340	0001	2420	4100	2500	2200	2560	4026
2201	2312	2261	5745	2341	0001	2421	2307	2501	2500	2561	0400
2202	0715	2262	6530	2342	0403	2422	0610	2502	4026	2562	4324
2203	6105	2263	2200	2343	5316	2423	4100	2503	2200	2563	7101
2204	2024	2264	5412	2344	0601	2424	2312	2504	2000	2564	1677
2205	4100	2265	4345	2345	4315	2425	7103	2505	4015	2565	7600
2206	5521	2266	2200	2346	0001	2426	0000	2506	2100	2566	0060
2207	6114	2267	5521	2347	0001	2427	0000	2507	6000	2567	2324
2210	0701	2270	4362	2350	0001	2430	2463	2510	4167	2570	4100
2211	6112	2271	0610	2351	0001	2431	5610	2511	2100	2571	1615
2212	2024	2272	4356	2352	5735	2432	0707	2512	6300	2572	2321
2213	4100	2273	2200	2353	5653	2433	6104	2513	4170	2573	4100
2214	5531	2274	1001	2354	0711	2434	4205	2514	7100	2574	1620
2215	6106	2275	4230	2355	0541	2435	7101	2515	6175	2575	0061
2216	2024	2276	0601	2356	4250	2436	2263	2516	2024	2576	7101
2217	4100	2277	4231	2357	0402	2437	7101	2517	4126	2577	1505
2220	5412	2300	0001	2360	5333	2440	2236	2520	5426	2600	2451
2221	5701	2301	0001	2361	0601	2441	0000	2521	2025	2601	0060
2222	5736	2302	0001	2362	4332	2442	7500	2522	4126	2602	5100
2223	2334	2303	0001	2363	0001	2443	5500	2523	5426	2603	0326
2224	0753	2304	7100	2364	0001	2444	7600	2524	5415	2604	0601
2225	6546	2305	2664	2365	0001	2445	0110	2525	3724	2605	4100
2226	4337	2306	2100	2366	0001	2446	0207	2526	6011	2606	0336
2227	2200	2307	5520	2367	5760	2447	0702	2527	5607	2607	0061
2230	3604	2310	4170	2370	5756	2450	6506	2530	0702	2610	7101
2231	4345	2311	2100	2371	5636	2451	7500	2531	6515	2611	0367
2232	7100	2312	5530	2372	0702	2452	5500	2532	4204	2612	0001
2233	2460	2313	4167	2373	6565	2453	7600	2533	5724	2613	0001
2234	7101	2314	2100	2374	4233	2454	7500	2534	5722	2614	0001
2235	2431	2315	5401	2375	0406	2455	5500	2535	6527	2615	0001
2236	5730	2316	4115	2376	5351	2456	7600	2536	0000	2616	0001
2237	5723	2317	7100	2377	0601	2457	7101	2537	2200	2617	0001
2240	6572	2320	6175	2400	4350	2460	1637	2540	2000	2620	7100
2241	0000	2321	2024	2401	0001	2461	7101	2541	4015	2621	2664
2242	2322	2322	0001	2402	0001	2462	2442	2542	2200	2622	2200
2243	4204	2323	0001	2403	0001	2463	0061	2543	6000	2623	0107
2244	2100	2324	4100	2404	0001	2464	7101	2544	4335	2624	4100
2245	5520	2325	1001	2405	3600	2465	2702	2545	0060	2625	1001
2246	4100	2326	2025	2406	1402	2466	0000	2546	4100	2626	2200
2247	0000	2327	4100	2407	6003	2467	0117	2547	1615	2627	0301
2250	5606	2330	1002	2410	7101	2470	0000	2550	2200	2630	4100
2251	0711	2331	7101	2411	2306	2471	0000	2551	6300	2631	1101
2252	6005	2332	2342	2412	0060	2472	0000	2552	4100	2632	2200
2253	5704	2333	0001	2413	2200	2473	0000	2553	1620	2633	0303
2254	4334	2334	0001	2414	5401	2474	0000	2554	0061	2634	4100
2255	6511	2335	0001	2415	4100	2475	0000	2555	4343	2635	1201
2256	0000	2336	0001	2416	2315	2476	0000	2556	2200	2636	2200
2257	4301	2337	0001	2417	3250	2477	0000	2557	2500	2637	0201

bank "0"

2640	0105	2720	0602	3000	0400	3060	0736	3140	7102	3220	0175
2641	2640	2721	4313	3001	4217	3061	6506	3141	4355	3221	2200
2642	7101	2722	3200	3002	4230	3062	4203	3142	7101	3222	1001
2643	0210	2723	0076	3003	2163	3063	2024	3143	3760	3223	0105
2644	0001	2724	4312	3004	0704	3064	7102	3144	7100	3224	3221
2645	0001	2725	3600	3005	6204	3065	0000	3145	3175	3225	2200
2646	0001	2726	1477	3006	0401	3066	3071	3146	6203	3226	1077
2647	1000	2727	6524	3007	4211	3067	3107	3147	7100	3227	0106
2650	0061	2730	2200	3010	6105	3070	3123	3150	0575	3230	3225
2651	0400	2731	1001	3011	0705	3071	7100	3151	7101	3231	7100
2652	4100	2732	4324	3012	6103	3072	6175	3152	4056	3232	4010
2653	1000	2733	2200	3013	0401	3073	2024	3153	7100	3233	0060
2654	5701	2734	1077	3014	4216	3074	0111	3154	0575	3234	5500
2655	3600	2735	4323	3015	7100	3075	0277	3155	7100	3235	1372
2656	2000	2736	7100	3016	0575	3076	0702	3156	1147	3236	0601
2657	6506	2737	0175	3017	2200	3077	6540	3157	7100	3237	5500
2660	2311	2740	7500	3020	0000	3100	5714	3160	3321	3240	1375
2661	4306	2741	0721	3021	6106	3101	7101	3161	7100	3241	0061
2662	6105	2742	5614	3022	7100	3102	3740	3162	3175	3242	5624
2663	7101	2743	0704	3023	2775	3103	0001	3163	7100	3243	0703
2664	1674	2744	6544	3024	7101	3104	0001	3164	0575	3244	6003
2665	7101	2745	4211	3025	3031	3105	7101	3165	7101	3245	7101
2666	2650	2746	7100	3026	0001	3106	3037	3166	3500	3246	1371
2667	7101	2747	0175	3027	7100	3107	7100	3167	0000	3247	4217
2670	4740	2750	7500	3030	0575	3110	6175	3170	7100	3250	0060
2671	0000	2751	0721	3031	2200	3111	2024	3171	0175	3251	2200
2672	0000	2752	7101	3032	0000	3112	0111	3172	7500	3252	6000
2673	0000	2753	0000	3033	6004	3113	0277	3173	0727	3253	4100
2674	0000	2754	7101	3034	7101	3114	0701	3174	7101	3254	1372
2675	0000	2755	2700	3035	3147	3115	6556	3175	0000	3255	2200
2676	0000	2756	0000	3036	0001	3116	5732	3176	7101	3256	6300
2677	0000	2757	2200	3037	7500	3117	7101	3177	3170	3257	4100
2700	7101	2760	0152	3040	5500	3120	3750	3200	0060	3260	1375
2701	4014	2761	4214	3041	7600	3121	7101	3201	2200	3261	2200
2702	0001	2762	7100	3042	4047	3122	3037	3202	1001	3262	2000
2703	7100	2763	1775	3043	0110	3123	7100	3203	4100	3263	0061
2704	0175	2764	7100	3044	0207	3124	6175	3204	1414	3264	4015
2705	2200	2765	3475	3045	0704	3125	2024	3205	0601	3265	2200
2706	1001	2766	7100	3046	6507	3126	0111	3206	4100	3266	0000
2707	0105	2767	2753	3047	2047	3127	0277	3207	1417	3267	4006
2710	2705	2770	7100	3050	0217	3130	0712	3210	0001	3270	7500
2711	2200	2771	0175	3051	0710	3131	6572	3211	0001	3271	5540
2712	1077	2772	7500	3052	6513	3132	2025	3212	0001	3272	7600
2713	0106	2773	0727	3053	7500	3133	0111	3213	0001	3273	4024
2714	2711	2774	7101	3054	5500	3134	0277	3214	0001	3274	0210
2715	7100	2775	0000	3055	7600	3135	0710	3215	0001	3275	6002
2716	4010	2776	7101	3056	4115	3136	6677	3216	0061	3276	7130
2717	2305	2777	2762	3057	5606	3137	2200	3217	7100	3277	2024

bank "0"

3300	0207	3360	7101	3440	2200	3520	3024	3600	0012	3660	2024
3301	0701	3361	1146	3441	4241	3521	4201	3601	0000	3661	0207
3302	6106	3362	0702	3442	4100	3522	2272	3602	0007	3662	0706
3303	7100	3363	6103	3443	0225	3523	4001	3603	0010	3663	6513
3304	0175	3364	7101	3444	2200	3524	5701	3604	0004	3664	7101
3305	7500	3365	0647	3445	2650	3525	3600	3605	0000	3665	0100
3306	0721	3366	7100	3446	4100	3526	4005	3606	0003	3666	0000
3307	7112	3367	0175	3447	2666	3527	6515	3607	0011	3667	0000
3310	0704	3370	7500	3450	0061	3530	0504	3610	0005	3670	0000
3311	6103	3371	0727	3451	7113	3531	5306	3611	0000	3671	0000
3312	7101	3372	7101	3452	0060	3532	0001	3612	0002	3672	0000
3313	1223	3373	1146	3453	0401	3533	7500	3613	0000	3673	0000
3314	7100	3374	0000	3454	4100	3534	4220	3614	0006	3674	0000
3315	0175	3375	0000	3455	0225	3535	7600	3615	0000	3675	0000
3316	7500	3376	0000	3456	2200	3536	0751	3616	0001	3676	0000
3317	0727	3377	0000	3457	2663	3537	6504	3617	0000	3677	0000
3320	7101	3400	2013	3460	4100	3540	7500	3620	0000	3700	7500
3321	0000	3401	0277	3461	2666	3541	4220	3621	0000	3701	5500
3322	7101	3402	0712	3462	0061	3542	7600	3622	0000	3702	7600
3323	1206	3403	6102	3463	7101	3543	4024	3623	0000	3703	4226
3324	0000	3404	5412	3464	0572	3544	0422	3624	0000	3704	0110
3325	0000	3405	2012	3465	0000	3545	0111	3625	0000	3705	0207
3326	3500	3406	0277	3466	0000	3546	3024	3626	0012	3706	0702
3327	0000	3407	0712	3467	0000	3547	4201	3627	0000	3707	6507
3330	0000	3410	6314	3470	7100	3550	2254	3630	0007	3710	7500
3331	0000	3411	6004	3471	0175	3551	4005	3631	0000	3711	5500
3332	0000	3412	2012	3472	7500	3552	5701	3632	0004	3712	7600
3333	0000	3413	0712	3473	0721	3553	6107	3633	0000	3713	4206
3334	0000	3414	4012	3474	7101	3554	4011	3634	0003	3714	0110
3335	0000	3415	5411	3475	0000	3555	0010	3635	0000	3715	0207
3336	0000	3416	0277	3476	7101	3556	0000	3636	0005	3716	0702
3337	0000	3417	0712	3477	3470	3557	0000	3637	0000	3717	6507
3340	7500	3420	6304	3500	0061	3560	0000	3640	0002	3720	2200
3341	5540	3421	2011	3501	7500	3561	0011	3641	0000	3721	0000
3342	7600	3422	0712	3502	4240	3562	3706	3642	0006	3722	0702
3343	4024	3423	4011	3503	7600	3563	6523	3643	0000	3723	3606
3344	0210	3424	0400	3504	6503	3564	0504	3644	0001	3724	6714
3345	6003	3425	4004	3505	7500	3565	5314	3645	0000	3725	7101
3346	7101	3426	0473	3506	4220	3566	7111	3646	0000	3726	3724
3347	3500	3427	7101	3507	7600	3567	7500	3647	0000	3727	7101
3350	2024	3430	6152	3510	0704	3570	5540	3650	7500	3730	3700
3351	0207	3431	7500	3511	6504	3571	7600	3651	5500	3731	0000
3352	0701	3432	5540	3512	7500	3572	0210	3652	7600	3732	0000
3353	6107	3433	7600	3513	4220	3573	0710	3653	4024	3733	0000
3354	7100	3434	0277	3514	7600	3574	6405	3654	0110	3734	0000
3355	0175	3435	0702	3515	4024	3575	7101	3655	0207	3735	0000
3356	7500	3436	6014	3516	0422	3576	3650	3656	0702	3736	0000
3357	0721	3437	0060	3517	0111	3577	4700	3657	6506	3737	0000

bank "0"

3740	7100	4020	2200	4100	0061	4160	6105	4240	0502	4320	2200
3741	3726	4021	2047	4101	0400	4161	2024	4241	5306	4321	5601
3742	7100	4022	4100	4102	4100	4162	4211	4242	0602	4322	4214
3743	1147	4023	2141	4103	5675	4163	7101	4243	4305	4323	2200
3744	7100	4024	0061	4104	0412	4164	4151	4244	2024	4324	5677
3745	3321	4025	7111	4105	4100	4165	0730	4245	4100	4325	4215
3746	7101	4026	4211	4106	5676	4166	6515	4246	5601	4326	6107
3747	3037	4027	0060	4107	0400	4167	4005	4247	5701	4327	2200
3750	7100	4030	2200	4110	4100	4170	2024	4250	5611	4330	5701
3751	3726	4031	0400	4111	5775	4171	4207	4251	0705	4331	4205
3752	7100	4032	4100	4112	0412	4172	2200	4252	6517	4332	2200
3753	3321	4033	2141	4113	4100	4173	5220	4253	4206	4333	5777
3754	7101	4034	0061	4114	5776	4174	4207	4254	5706	4334	4206
3755	3037	4035	7101	4115	0001	4175	7101	4255	5605	4335	2200
3756	0000	4036	2040	4116	7500	4176	4202	4256	0702	4336	5701
3757	0000	4037	0000	4117	5540	4177	2200	4257	7101	4337	0105
3760	7100	4040	5615	4120	7600	4200	5220	4260	4427	4340	4337
3761	3726	4041	0703	4121	0210	4201	4202	4261	0000	4341	2200
3762	7100	4042	6104	4122	6504	4202	2200	4262	0000	4342	5777
3763	1147	4043	7500	4123	7500	4203	0522	4263	0000	4343	0106
3764	7100	4044	0720	4124	5500	4204	0102	4264	4302	4344	4343
3765	3321	4045	7107	4125	7600	4205	4302	4265	7101	4345	0001
3766	7101	4046	0701	4126	0110	4206	0201	4266	4040	4346	0001
3767	3144	4047	6104	4127	0207	4207	6102	4267	6007	4347	0001
3770	0000	4050	4205	4130	0704	4210	0412	4270	2007	4350	0001
3771	0000	4051	7101	4131	6506	4211	4207	4271	6003	4351	0001
3772	0000	4052	4277	4132	4005	4212	5701	4272	7101	4352	0001
3773	0000	4053	7101	4133	4007	4213	3600	4273	4123	4353	7500
3774	0000	4054	4270	4134	6015	4214	4220	4274	7101	4354	0710
3775	0000	4055	0000	4135	7500	4215	6513	4275	4410	4355	0120
3776	0000	4056	7500	4136	5500	4216	6013	4276	4313	4356	7300
3777	0000	4057	5540	4137	7600	4217	0000	4277	2200	4357	4356
4000	7500	4060	7600	4140	0110	4220	0000	4300	5701	4360	5605
4001	0710	4061	0060	4141	0207	4221	0000	4301	4333	4361	0702
4002	0120	4062	4100	4142	0704	4222	0000	4302	5611	4362	6126
4003	7300	4063	4370	4143	6006	4223	0000	4303	0702	4363	4202
4004	4000	4064	0061	4144	4007	4224	0000	4304	6111	4364	6002
4005	7500	4065	7101	4145	0400	4225	0000	4305	4206	4365	0000
4006	0720	4066	4100	4146	4225	4226	0000	4306	6021	4366	0001
4007	7101	4067	0000	4147	4231	4227	0000	4307	7101	4367	2200
4010	1757	4070	0000	4150	6022	4230	0000	4310	4116	4370	0000
4011	7101	4071	0000	4151	7500	4231	0511	4311	7101	4371	0207
4012	4000	4072	0000	4152	5500	4232	5321	4312	4410	4372	0701
4013	7300	4073	0000	4153	7600	4233	2314	4313	0000	4373	6103
4014	5623	4074	0000	4154	0110	4234	0111	4314	4301	4374	7101
4015	0702	4075	0000	4155	4024	4235	4024	4315	2200	4375	4760
4016	6010	4076	0000	4156	5405	4236	2316	4316	5601	4376	0706
4017	0060	4077	0000	4157	0707	4237	5024	4317	4351	4377	6103

bank "0"

4400	7101	4460	2047	4540	0000	4620	5610	4700	2001	4760	5612
4401	4116	4461	0217	4541	0000	4621	2024	4701	0111	4761	0750
4402	7100	4462	0712	4542	0000	4622	6605	4702	3002	4762	6003
4403	3175	4463	6513	4543	0000	4623	0612	4703	4100	4763	7101
4404	7101	4464	0400	4544	2200	4624	6102	4704	0126	4764	4116
4405	0142	4465	4005	4545	4206	4625	0412	4705	2003	4765	4205
4406	7101	4466	7500	4546	4330	4626	4240	4706	0111	4766	7100
4407	4100	4467	5500	4547	2323	4627	2200	4707	3004	4767	3175
4410	7101	4470	7600	4550	0702	4630	0000	4710	4100	4770	7101
4411	4672	4471	4024	4551	6004	4631	6102	4711	0127	4771	3153
4412	0001	4472	5405	4552	0501	4632	0412	4712	2005	4772	0000
4413	0110	4473	0736	4553	5304	4633	4230	4713	0111	4773	0000
4414	0207	4474	6506	4554	6505	4634	0400	4714	3006	4774	0000
4415	0702	4475	4005	4555	4025	4635	4305	4715	4100	4775	0000
4416	6506	4476	2024	4556	4005	4636	7101	4716	0134	4776	0000
4417	7500	4477	3600	4557	2310	4637	4662	4717	2007	4777	0000
4420	5500	4500	0260	4560	0604	4640	7101	4720	0111	5000	0000
4421	7600	4501	6204	4561	4201	4641	0107	4721	3010	5001	0000
4422	7500	4502	0400	4562	2332	4642	0060	4722	4100	5002	0000
4423	5500	4503	4024	4563	5025	4643	0400	4723	0135	5003	0000
4424	7600	4504	6011	4564	0102	4644	4100	4724	0400	5004	0000
4425	7101	4505	3600	4565	4025	4645	4524	4725	4001	5005	0000
4426	4135	4506	0270	4566	5405	4646	5701	4726	4002	5006	0000
4427	4220	4507	6204	4567	0707	4647	3600	4727	4003	5007	0000
4430	0060	4510	0401	4570	6003	4650	4544	4730	4004	5010	0000
4431	2200	4511	4024	4571	5707	4651	6506	4731	4005	5011	0000
4432	2314	4512	6103	4572	6510	4652	2200	4732	4006	5012	0000
4433	4100	4513	0402	4573	4005	4653	4524	4733	4007	5013	0000
4434	4233	4514	4024	4574	2200	4654	4307	4734	4010	5014	0000
4435	0602	4515	2024	4575	2323	4655	0061	4735	7101	5015	0000
4436	4100	4516	4206	4576	4327	4656	2025	4736	3567	5016	0000
4437	4236	4517	5701	4577	6143	4657	0114	4737	0000	5017	0000
4440	0061	4520	3600	4600	3455	4660	7101	4740	0412	5020	0000
4441	2206	4521	4226	4601	6306	4661	4600	4741	4100	5021	0000
4442	6103	4522	6022	4602	4024	4662	2200	4742	1076	5022	0000
4443	7101	4523	6553	4603	0401	4663	0000	4743	2200	5023	0000
4444	4264	4524	0000	4604	4100	4664	0111	4744	0100	5024	0000
4445	7101	4525	0000	4605	0111	4665	3200	4745	5303	5025	0000
4446	4177	4526	0000	4606	6106	4666	0000	4746	3600	5026	0000
4447	0000	4527	0000	4607	3055	4667	4100	4747	2076	5027	0000
4450	7500	4530	0000	4610	4024	4670	0112	4750	6510	5030	0000
4451	5500	4531	0000	4611	0412	4671	6531	4751	2200	5031	0000
4452	7600	4532	0000	4612	4100	4672	7500	4752	1076	5032	0000
4453	4047	4533	0000	4613	0111	4673	5500	4753	4311	5033	0000
4454	0110	4534	0000	4614	2024	4674	7600	4754	7101	5034	0000
4455	0207	4535	0000	4615	0712	4675	4050	4755	2663	5035	0000
4456	0704	4536	0000	4616	6305	4676	7101	4756	0000	5036	0000
4457	6507	4537	0000	4617	4024	4677	4413	4757	0000	5037	0000

bank "0"

6000	2167	6060	3433	6140	6606	6220	0000	6300	2037	6360	7500
6001	3570	6061	6306	6141	0612	6221	0000	6301	4011	6361	5500
6002	4033	6062	4024	6142	5015	6222	0000	6302	4012	6362	7600
6003	2115	6063	5401	6143	5701	6223	0000	6303	4013	6363	4050
6004	3570	6064	2024	6144	5707	6224	0000	6304	2050	6364	0110
6005	4024	6065	6013	6145	5404	6225	0000	6305	3455	6365	0207
6006	6031	6066	6515	6146	0703	6226	0000	6306	4024	6366	0702
6007	6206	6067	3033	6147	6725	6227	0000	6307	6305	6367	6507
6010	1422	6070	4024	6150	7101	6230	0000	6310	5411	6370	2050
6011	4024	6071	5706	6151	3400	6231	4000	6311	2024	6371	1031
6012	2041	6072	0207	6152	4024	6232	0000	6312	6014	6372	7101
6013	4011	6073	0704	6153	2111	6233	0000	6313	6606	6373	0103
6014	6226	6074	6003	6154	0111	6234	0000	6314	3055	6374	7101
6015	3433	6075	2024	6155	5024	6235	0000	6315	0712	6375	6360
6016	6305	6076	6626	6156	2112	6236	0000	6316	4024	6376	0000
6017	4024	6077	0503	6157	0111	6237	0000	6317	6305	6377	0000
6020	2034	6100	5315	6160	5113	6240	0000	6320	5412	6400	2200
6021	4011	6101	2035	6161	4025	6241	0000	6321	2024	6401	6600
6022	6220	6102	6012	6162	0400	6242	0000	6322	6004	6402	4210
6023	3033	6103	0411	6163	4001	6243	0000	6323	6606	6403	0620
6024	3440	6104	3401	6164	4002	6244	0000	6324	0612	6404	4211
6025	6306	6105	4001	6165	4003	6245	0000	6325	5013	6405	0620
6026	2167	6106	0411	6166	4035	6246	0000	6326	2111	6406	4056
6027	3115	6107	3402	6167	2013	6247	0000	6327	0001	6407	0620
6030	4024	6110	4002	6170	3437	6250	0000	6330	4024	6410	4057
6031	5435	6111	0412	6171	4113	6251	0000	6331	2112	6411	2100
6032	6205	6112	3403	6172	0412	6252	0000	6332	0111	6412	6620
6033	3040	6113	4003	6173	4137	6253	0000	6333	3113	6413	4053
6034	4024	6114	2043	6174	7101	6254	0000	6334	0001	6414	2100
6035	0001	6115	4207	6175	2516	6255	0000	6335	4025	6415	6640
6036	0001	6116	0503	6176	0001	6256	0000	6336	0400	6416	4054
6037	0406	6117	5216	6177	0001	6257	0000	6337	4011	6417	2154
6040	0111	6120	0503	6200	2167	6260	0000	6340	4012	6420	0277
6041	4011	6121	5221	6201	3570	6261	0000	6341	4013	6421	4024
6042	0406	6122	0400	6202	3600	6262	0000	6342	7101	6422	0001
6043	0111	6123	4024	6203	0550	6263	0000	6343	0445	6423	7101
6044	4012	6124	2004	6204	6305	6264	0000	6344	2050	6424	7054
6045	4013	6125	4024	6205	0400	6265	0000	6345	1031	6425	0612
6046	2024	6126	0103	6206	4004	6266	0000	6346	4050	6426	0705
6047	6045	6127	5024	6207	7101	6267	0000	6347	7101	6427	6303
6050	0112	6130	5704	6210	6000	6270	0000	6350	6300	6430	0401
6051	4024	6131	2024	6211	2200	6271	0000	6351	0000	6431	4213
6052	1036	6132	0712	6212	5454	6272	0000	6352	0000	6432	2154
6053	6004	6133	6306	6213	4024	6273	0000	6353	0000	6433	0712
6054	2024	6134	4024	6214	4025	6274	0000	6354	0000	6434	6002
6055	3433	6135	5414	6215	7101	6275	0000	6355	0000	6435	0612
6056	6104	6136	2024	6216	6174	6276	0000	6356	0000	6436	3206
6057	2024	6137	6004	6217	0000	6277	0000	6357	0000	6437	0712

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6440	6005	6520	2424	6600	6412	6660	6760	6740	3613	7020	0110
6441	0612	6521	3157	6601	5500	6661	0000	6741	7111	7021	0207
6442	5246	6522	4024	6602	6415	6662	0060	6742	0110	7022	0704
6443	6105	6523	6205	6603	0061	6663	0467	6743	7107	7023	6105
6444	0000	6524	0440	6604	2154	6664	0111	6744	4207	7024	2024
6445	5243	6525	4153	6605	0111	6665	4100	6745	0110	7025	0217
6446	0401	6526	2424	6606	4154	6666	6475	6746	3205	7026	7101
6447	4210	6527	4024	6607	0001	6667	4100	6747	7103	7027	0412
6450	0400	6530	2053	6610	0001	6670	6510	6750	0112	7030	0060
6451	4305	6531	0001	6611	0001	6671	5500	6751	7101	7031	2100
6452	7101	6532	4205	6612	0001	6672	6412	6752	6467	7032	0326
6453	6772	6533	4213	6613	0001	6673	5500	6753	0000	7033	0603
6454	6304	6534	4240	6614	0001	6674	6415	6754	0000	7034	4100
6455	7101	6535	0400	6615	0001	6675	0061	6755	0400	7035	0326
6456	6662	6536	4100	6616	5456	6676	7101	6756	6443	7036	0601
6457	0000	6537	1124	6617	5457	6677	6616	6757	0000	7037	4100
6460	0605	6540	4154	6620	3600	6700	6255	6760	4301	7040	0336
6461	3302	6541	2024	6621	6700	6701	6213	6761	0210	7041	0001
6462	5213	6542	3455	6622	6003	6702	6213	6762	0710	7042	0001
6463	0400	6543	4024	6623	7101	6703	6214	6763	6005	7043	0001
6464	4305	6544	6306	6624	6411	6704	6217	6764	2305	7044	0001
6465	0060	6545	5500	6625	7101	6705	6220	6765	0207	7045	0001
6466	2200	6546	1124	6626	0000	6706	6223	6766	7101	7046	0001
6467	6476	6547	2024	6627	7101	6707	6227	6767	0154	7047	0061
6470	4100	6550	6011	6630	6400	6710	6232	6770	7101	7050	0403
6471	6752	6551	6607	6631	7500	6711	6233	6771	3500	7051	5015
6472	0061	6552	3055	6632	5540	6712	6236	6772	2153	7052	7101
6473	2156	6553	0712	6633	7600	6713	7137	6773	0111	7053	0367
6474	7101	6554	4024	6634	4217	6714	7136	6774	0207	7054	2153
6475	6700	6555	6307	6635	7500	6715	0102	6775	0705	7055	3621
6476	0112	6556	5554	6636	5540	6716	7134	6776	7101	7056	6016
6477	4024	6557	2024	6637	7600	6717	4234	6777	6454	7057	2024
6500	0060	6560	6605	6640	4214	6720	0102	7000	7500	7060	6014
6501	2200	6561	0412	6641	3612	6721	3232	7001	5500	7061	2154
6502	6511	6562	4154	6642	6511	6722	7130	7002	7600	7062	0111
6503	4100	6563	6213	6643	2211	6723	0103	7003	4207	7063	0277
6504	6752	6564	0605	6644	4207	6724	7126	7004	7500	7064	4154
6505	0061	6565	6302	6645	5610	6725	4226	7005	5500	7065	2024
6506	2156	6566	5554	6646	0707	6726	0103	7006	7600	7066	0712
6507	7101	6567	2154	6647	6512	6727	3224	7007	4204	7067	6003
6510	6700	6570	6407	6650	4205	6730	7122	7010	7101	7070	7101
6511	5024	6571	0712	6651	6005	6731	0102	7011	7014	7071	6425
6512	0467	6572	6104	6652	0001	6732	4221	7012	0370	7072	7101
6513	0111	6573	5500	6653	0000	6733	0102	7013	0532	7073	6432
6514	4317	6574	1124	6654	0000	6734	3217	7014	7500	7074	7101
6515	4305	6575	6514	6655	0000	6735	7115	7015	5500	7075	6662
6516	0400	6576	0060	6656	2302	6736	4215	7016	7600	7076	1273
6517	4154	6577	5500	6657	7101	6737	0110	7017	4024	7077	0000

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7100	2015	7160	0000
7101	3452	7161	0000
7102	6322	7162	0000
7103	2045	7163	0000
7104	0060	7164	0000
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7106	0357	7166	0000
7107	0601	7167	0000
7110	4100	7170	0000
7111	0362	7171	0000
7112	2200	7172	0000
7113	0677	7173	0000
7114	4100	7174	0000
7115	0440	7175	0000
7116	0061	7176	0000
7117	2200	7177	0000
7120	2000	7200	0000
7121	4015	7201	0000
7122	7101	7202	0000
7123	0262	7203	0000
7124	7101	7204	0000
7125	0410	7205	0000
7126	7500	7206	0000
7127	5500	7207	0000
7130	7600	7210	0000
7131	7500	7211	0000
7132	5500	7212	0000
7133	7600	7213	0000
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7135	1725	7215	0000
7136	7101	7216	0000
7137	1725	7217	0000
7140	0000	7220	0000
7141	0000	7221	0000
7142	0000	7222	0000
7143	0000	7223	0000
7144	0000	7224	0000
7145	0000	7225	0000
7146	0000	7226	0000
7147	0000	7227	0000
7150	0000	7230	0000
7151	0000	7231	0000
7152	0000	7232	0000
7153	0000	7233	0000
7154	0000	7234	0000
7155	0000	7235	0000
7156	0000	7236	0000
7157	0000	7237	0000

bank "1"

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0001	0000	0061	4000	0141	0000
0002	0000	0062	0740	0142	0000
0003	0000	0063	0132	0143	0000
0004	0000	0064	0162	0144	0000
0005	0000	0065	6016	0145	0000
0006	0000	0066	0157	0146	0000
0007	0000	0067	2053	0147	0000
0010	0000	0070	7774	0150	0000
0011	0000	0071	0000	0151	0000
0012	0000	0072	4210	0152	0000
0013	0000	0073	0013	0153	0000
0014	0000	0074	7703	0154	0000
0015	2000	0075	0001	0155	0000
0016	2053	0076	0076	0156	0000
0017	0000	0077	7715	0157	0000
0020	0000	0100	0000	0160	0000
0021	2052	0101	4124	0161	0000
0022	7777	0102	4500	0162	0000
0023	2000	0103	0000	0163	0000
0024	0000	0104	0006	0164	0000
0025	0000	0105	0300	0165	0000
0026	0000	0106	0000	0166	0000
0027	0000	0107	6323	0167	0000
0030	0000	0110	5113	0170	0000
0031	0777	0111	0000	0171	0000
0032	0717	0112	0000	0172	0000
0033	0000	0113	0046	0173	0000
0034	0605	0114	5162	0174	0000
0035	0000	0115	7123	0175	0053
0036	7000	0116	0046	0176	0061
0037	0600	0117	2565	0177	0000
0040	0631	0120	5100	0200	0000
0041	0640	0121	6240	0201	6370
0042	1775	0122	4723	0202	0000
0043	2001	0123	0047	0203	0000
0044	0700	0124	6122	0204	0000
0045	2211	0125	2214	0205	0100
0046	0304	0126	0000	0206	0000
0047	0000	0127	0000	0207	0000
0050	0000	0130	0000	0210	0200
0051	0300	0131	4745	0211	0000
0052	2060	0132	0000	0212	0000
0053	0000	0133	0000	0213	0300
0054	0000	0134	0000	0214	0000
0055	0144	0135	0000	0215	0000
0056	0000	0136	6422	0216	0400
0057	0000	0137	2300	0217	0000

bank "1"

0220	0000	0300	0000	0360	0000	0440	0000	0520	0000	0600	0012
0221	0500	0301	0000	0361	0000	0441	0000	0521	0000	0601	0001
0222	0000	0302	0000	0362	0000	0442	0000	0522	0000	0602	0002
0223	0000	0303	6261	0363	0000	0443	0000	0523	0000	0603	0003
0224	0000	0304	0071	0364	0000	0444	0000	0524	0000	0604	0004
0225	0000	0305	0000	0365	0000	0445	0000	0525	0000	0605	0005
0226	0000	0306	6463	0366	0000	0446	0000	0526	0000	0606	0006
0227	0700	0307	0000	0367	0000	0447	0000	0527	0000	0607	0007
0230	0000	0310	0000	0370	0000	0450	0000	0530	0000	0610	0010
0231	0000	0311	0000	0371	0000	0451	2371	0531	0000	0611	0011
0232	1000	0312	0000	0372	0000	0452	4465	0532	0000	0612	0012
0233	0000	0313	0000	0373	0000	0453	0000	0533	0000	0613	0013
0234	0000	0314	0000	0374	0000	0454	0000	0534	0000	0614	0000
0235	1100	0315	6261	0375	0053	0455	0000	0535	0000	0615	0000
0236	0000	0316	0071	0376	0061	0456	0000	0536	0000	0616	0000
0237	0001	0317	0000	0377	0000	0457	0000	0537	0000	0617	0000
0240	1200	0320	6163	0400	0000	0460	0000	0540	0000	0620	0000
0241	0000	0321	0000	0401	0000	0461	0000	0541	0000	0621	0000
0242	0001	0322	0000	0402	0000	0462	0000	0542	0000	0622	0000
0243	0100	0323	0000	0403	5170	0463	0000	0543	0000	0623	0000
0244	0000	0324	0000	0404	0071	0464	0000	0544	0000	0624	0000
0245	0001	0325	0000	0405	0000	0465	0000	0545	0000	0625	0000
0246	0200	0326	0000	0406	6163	0466	0000	0546	0000	0626	0000
0247	0000	0327	6261	0407	0000	0467	0000	0547	0000	0627	0000
0250	0001	0330	0071	0410	0000	0470	0000	0550	0000	0630	0000
0251	0300	0331	7100	0411	0000	0471	0000	0551	0000	0631	0000
0252	0000	0332	6463	0412	0000	0472	0000	0552	0000	0632	0000
0253	0001	0333	0000	0413	0000	0473	0000	0553	0000	0633	0000
0254	0400	0334	0000	0414	0000	0474	0000	0554	0000	0634	0000
0255	0000	0335	0000	0415	5170	0475	0053	0555	0000	0635	0000
0256	0001	0336	0000	0416	0071	0476	0061	0556	0000	0636	0000
0257	0500	0337	0000	0417	7100	0477	0020	0557	0000	0637	0000
0260	0000	0340	0000	0420	6163	0500	0000	0560	0000	0640	0040
0261	0001	0341	6261	0421	0000	0501	0000	0561	0000	0641	0054
0262	0600	0342	0071	0422	0000	0502	0000	0562	0000	0642	0000
0263	0000	0343	7100	0423	0000	0503	0000	0563	0000	0643	0000
0264	0000	0344	6163	0424	0000	0504	0000	0564	0000	0644	0000
0265	0000	0345	0000	0425	0000	0505	0000	0565	0000	0645	0000
0266	0000	0346	0000	0426	0000	0506	0000	0566	0000	0646	0000
0267	2371	0347	0000	0427	0000	0507	0000	0567	0000	0647	0000
0270	4465	0350	0000	0430	0000	0510	0000	0570	0000	0650	0000
0271	0000	0351	2371	0431	0000	0511	0000	0571	0000	0651	0000
0272	0000	0352	4465	0432	0000	0512	0000	0572	0000	0652	0000
0273	0000	0353	0000	0433	0000	0513	0000	0573	0000	0653	0000
0274	0000	0354	0000	0434	0000	0514	0000	0574	0000	0654	0000
0275	0053	0355	0000	0435	0000	0515	0000	0575	0000	0655	0000
0276	0061	0356	0000	0436	0000	0516	0000	0576	0000	0656	0000
0277	0000	0357	0000	0437	0000	0517	0000	0577	0000	0657	0000

bank "1"

6600	1113	6660	1603
6601	1116	6661	2274
6602	1121	6662	2032
6603	1124	6663	1607
6604	1214	6664	1673
6605	1217	6665	1601
6606	1236	6666	1142
6607	1241	6667	1130
6610	1244	6670	1200
6611	1247	6671	1306
6612	1260	6672	1147
6613	1255	6673	1142
6614	1023	6674	1306
6615	1026	6675	1356
6616	1050	6676	1236
6617	1053	6677	0741
6620	1114	6700	0000
6621	1117	6701	0000
6622	1122	6702	0000
6623	1125	6703	0000
6624	1215	6704	0000
6625	1220	6705	0000
6626	1237	6706	0000
6627	1242	6707	0000
6630	1245	6710	0000
6631	1250	6711	0000
6632	1261	6712	0000
6633	1256	6713	0000
6634	1024	6714	0000
6635	1027	6715	0000
6636	1051	6716	0000
6637	1054	6717	0000
6640	0024	6720	0000
6641	0043	6721	0000
6642	0026	6722	0000
6643	0024	6723	0000
6644	0024	6724	0000
6645	0025	6725	0000
6646	0022	6726	0000
6647	0021	6727	0000
6650	0024	6730	0000
6651	0027	6731	0000
6652	0023	6732	0000
6653	0023	6733	0000
6654	0026	6734	0000
6655	0034	6735	0000
6656	0021	6736	0000
6657	0014	6737	0000

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