NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Technical Memorandum 33-426

Volume VI

Tracking and Data System Support for the Pioneer Project

Pioneer VII. Extended Mission: February 24, 1967 - July 1, 1968

N. A. Renzetti

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Prepared Under Contract No. NAS 7-100
National Aeronautics and Space Administration

Preface

This report is the sixth in a series documenting Tracking and Data System support by the Jet Propulsion Laboratory of the *Pioneer* missions. *Pioneer* project management, spacecraft systems development, and mission analysis and operations management are at the Ames Research Center. This report documents extended mission support of *Pioneer VII*. Volume II of this series covered the *Pioneer VII* nominal mission. Succeeding reports will cover this mission until there is no further return of meaningful engineering and scientific data.

Acknowledgment

The author acknowledges the assistance of W. R. Barton, R. Santiestevan, R. E. Purdue, A. J. Siegmeth, and J. W. Thatcher in compiling this report. The author also acknowledges the support of the operations staff of the Jet Propulsion Laboratory's Deep Space Network. In addition, material was abstracted from Ames Research Center and Goddard Space Flight Center reports.

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Abstract

The Tracking and Data System supported the deep space phase of the *Pioneer VII* mission, which is in an outward trajectory from the earth in a heliocentric orbit. During the period of this report, six scientific instruments aboard the spacecraft continued to register information relative to interplanetary particles and fields, and radio metric data generated by the network continues to improve our knowledge of the celestial mechanics of the solar system. In addition to detail network support activities, network performance and special support activities are covered.

Tracking and Data System Support for the *Pioneer* Project

Pioneer VII. Extended Mission: February 24, 1967–July 1, 1968

I. *Pioneer* Project and *Pioneer VII* Mission

A. Objectives

Pioneer VII was the second in a second generation of unmanned spacecraft launched by the *Pioneer* Project, under cognizance of the National Aeronautics and Space Administration, to collect data on interplanetary phenomena. At the printing date of this document, *Pioneer VII* was in its fifth year of spatial scientific service.

The *Pioneer* Project was designed to provide a means to study the magnetic field, spatial plasma, cosmic rays, high-energy particles, electron density, electric fields, and cosmic dust within a region of 0.75 to 1.20 astronomical units (AU) from the sun. Data was analyzed to obtain knowledge of solar disturbances and the relationship between solar and galactic fields. The Project was initiated in 1958 as part of U.S. participation in the International Geophysical Year. Near-real-time data reduction and analysis were a part of a *Pioneer* space weather report teletyped regularly to U.S. Space Disturbance Forecast Centers.

Pioneer V, in closing out the first *Pioneer* generation, remained active in space more than three mo, and was not lost to earth contact until it was 27.5 million km from earth. That was a new record.

Pioneer VII was launched by a thrust-augmented improved *Delta* rocket (DSV-35) on August 17, 1966, from Cape Kennedy, Florida. Launch was to an outward trajectory in heliocentric orbit, with perihelion near 1.010 AU and aphelion near 1.125 AU to obtain a syzygy at less than 850 earth radii to investigate the earth's geomagnetospheric tail. The syzygy was successfully performed during the period September 25 to October 1, 1966. *Pioneer VII* also conducted a lunar occultation experiment on January 20, 1967. A Faraday rotation solar occultation experiment was to be performed during the fall of 1971.

Completing the near-earth phase on launch day, the *Pioneer VII* spacecraft was successfully supported by the DSN's 26-m-diam (85-ft-diam) antenna stations until February 9, 1968. The spacecraft was then officially acquired by the Deep Space Network's only 64-m-diam (210-ft-diam) antenna station for what was designated an "extended flight" phase. (DSN plans called for construction of two additional 64-m antenna stations: one in Australia, and one in Spain.)

Before launch of the first spacecraft (*Pioneer VI*) in the second generation of *Pioneer* (December 16, 1965), the life expectancy for spacecraft was estimated to be six to eight months. However, with the extended capability of the completed 64-m-diam antenna at Mars station (DSS 14), Goldstone, Calif., the estimate was changed to five years or more. Improvements also increased the capabilities of the 26-m-diam antenna stations. (*Pioneer VII* support by the DSN was to be terminated if the telemetry bit error rate reached an unacceptable level.)

Table 1 lists the Deep Space Network stations and locations during the period reported. For all missions, a spacecraft's first pass begins with one of the Australian-based stations (DSS 41, Woomera, and DSS 42, Tidbinbilla). DSS 51, Johannesburg, South Africa, is the "zero pass" station. A pass is the period during which a spacecraft is above the horizon of a deep space station.

B. Tracking and Data Acquisition Support

The Tracking and Data System (TDS) began support of *Pioneer VII* during the near-earth phase (launch until deep space station two-way lock with the spacecraft) by tracking the spacecraft. It thereby acquired launch vehicle and spacecraft telemetry data (generating metric data through C-band radar tracking of the transponder on the spacecraft) and also transmitted commands to the spacecraft.

The TDS was made up of the Air Force Eastern Test Range (AFETR), Manned Space Flight Network (MSFN), NASA Communications System (NASCOM), and the Deep Space Network (DSN). This report is concerned with the activities of the DSN, which was under management and technical direction of the Jet Propulsion Laboratory, California Institute of Technology. Ames Research Center (ARC) was the manager of the *Pioneer* Project.

1. DSN configurations. The DSN had the capability for two-way communication with spacecraft traveling as near as 16,090 km from earth and as far as interplanetary distances. Facilities of the DSN were the Deep Space Instrumentation Facility (DSIF) for data acquisition and transmission, the Ground Communications Facility (GCF) for data transfer, and the Space Flight Operations Facility (SFOF) for data processing. The DSN systems included tracking, telemetry, command, simulation, monitoring, and operations control. Figure 1 diagrams the DSN and *Pioneer* Project systems. Figure 2 is a DSN facility system matrix.

Table 1. DSN station designations and locations

Location	Station number	Geodetic latitude	Geodetic longitude	Height above mean sea level, m	Geocentric latitude	Geocentric longitude	Geocentric radius, km
Goldstone, Calif. (Pioneer)	11	35.38950°N	243.15175°E	1037.5	35.20805°N	243.15080°E	6372.0341
Goldstone, Calif. (Echo)	12	35.29986°N	243.19539°E	989.5	35.11861°N	243.19445°E	6372.0176
Goldstone, Calif. (Venus)	13	35.24772°N	243.20599°E	1213.5	35.06662°N	243.20507°E	6372.2599
Goldstone, Calif. (Mars)	14	35.42528°N	243.12222°E	1160	35.24376°N	243.12127°E	6372.1341
Woomera, Australia	41	31.38314°S	136.88614°E	144.8	31.21236°S	136.88614°E	6372.5317
Tidbinbilla,[a] Australia	42	35.40111°S	148.98027°E	654	35.21962°S	148.98027°E	6371.6686
Johannesburg, South Africa	51	25.88921°S	27.68570°E	1398.1	25.73876°S	27.68558°E	6375.5415
Madrid, Spain (Robledo)	61	40.429°N	355.751°E	800	40.238°N	355.751°E	6370.0868
Cerebros, Spain	62	—	—	—	—	—	—
Cape Kennedy, Fla.	71	28.48713°N	279.42315°E	4.0	28.32648°N	279.42315°E	6373.2913
Ascension Island[b]	72	7.95474°S	345.67242°E	526.7	7.89991°S	345.67362°E	6378.2386

[a]Formerly listed as Canberra.

[b]No longer operated by DSN.

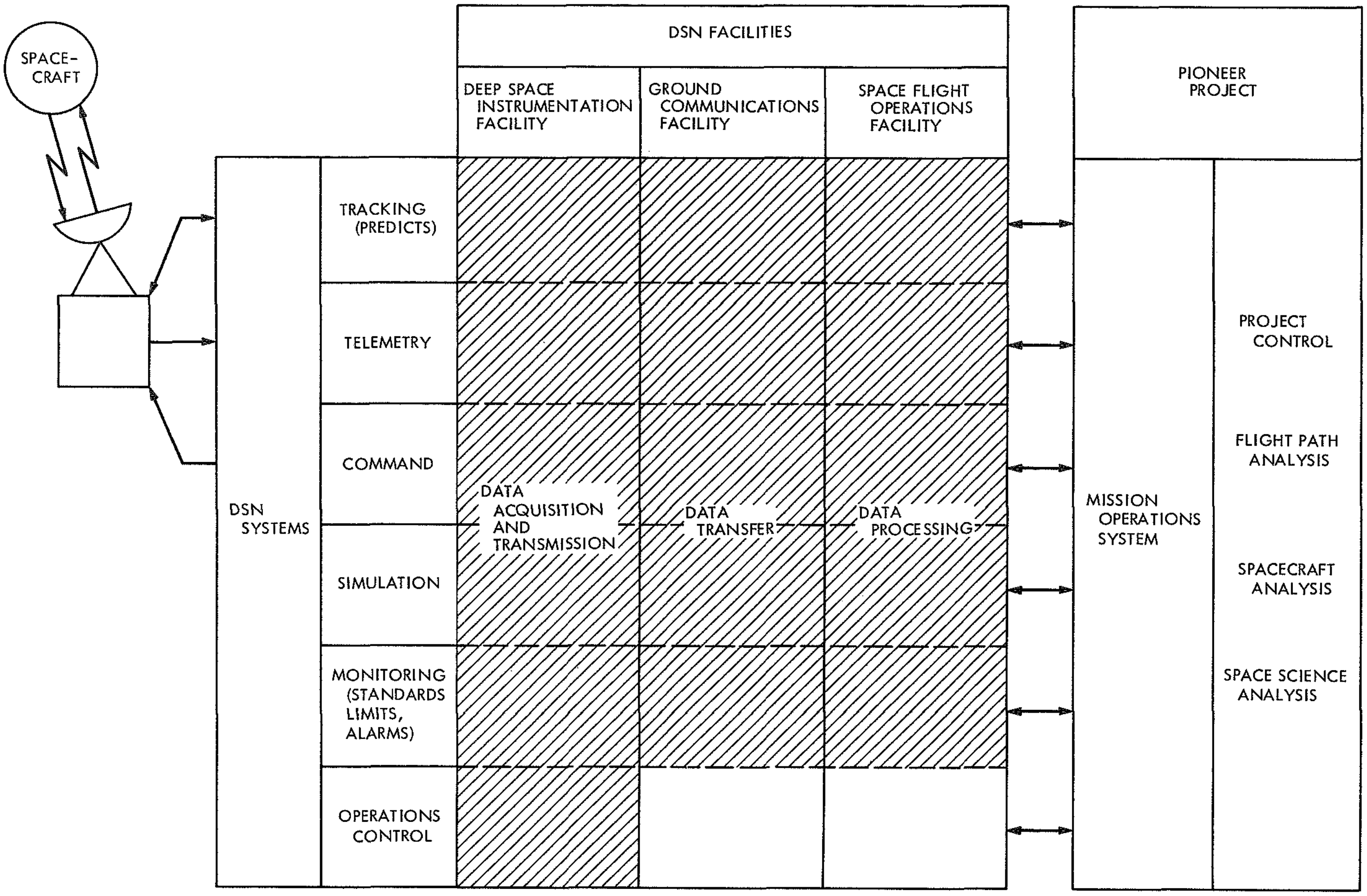

Fig. 1. DSN and *Pioneer* Project systems diagram

Objectives of the DSN were:

(1) Acquire spacecraft engineering and science data via telemetry.

(2) Provide for positive control of spacecraft.

(3) Provide for accurate spacecraft navigation by generating radio metric data.

(4) Provide support for a number of complex missions concurrently.

(5) Provide master data records of validated data in near-real-time.

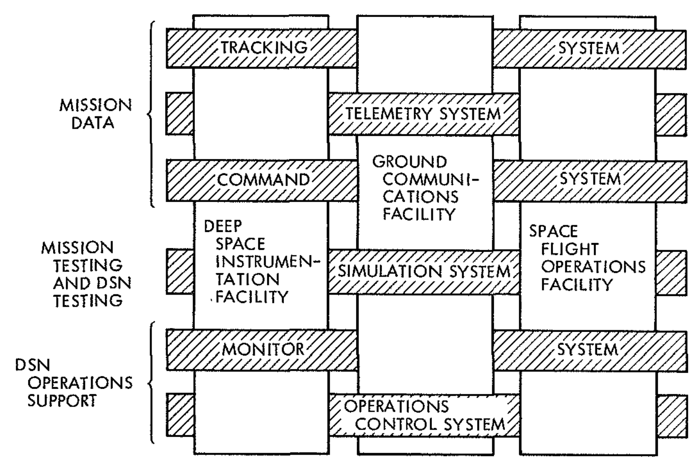

Fig. 2. DSN facility–system matrix

The network was capable of providing 24-h coverage for spacecraft. This requirement was important for flexibility in planning missions and providing maximum data return and also for immediate detection of spacecraft failure and initiation of recovery procedures. If mission density required two such 24-h-coverage networks, then the alternate network provided coverage for a station outage. Station locations were approximately 120 deg apart in longitude and within a band of 35-deg latitude on each side of the equator. This provided continuous coverage of spacecraft in the ecliptic plane in most cases.

The amount of data processing or data compression activity at deep space stations depended greatly on the bandwidth, signal-to-noise quality, and reliability of the ground interstation communications network. The characteristics of ground communications facilities dictated that data processing and compression be available at deep space stations. Ideally, in the interests of simplifying the deep space station design and reducing station costs, it was desirable to transmit the baseband data directly from the receiver to a central facility, where the data would be detected and/or formatted for local use. This required a reliable, continuously available, wideband (<2 MHz) duplex channel between the control center and each station. The situation required that a certain amount of data processing and compression for tracking data formatting, telemetry bit and word detection, and command formatting be used at the stations. The ground communication system could make use of a common carrier to convey this material to the stations, but it was more economical, when standard communication circuits were required for several networks, to have a centralized agency; NASCOM (National Aeronautics and Space Administration Communication Network) provided this service. Such centralized service provided high-speed data lines (2400 bits/s), voice, limited wideband lines, and teletypewriter circuits via ground or communications satellite facilities.

The control center or Space Flight Operations Facility provided a central processing system and areas designed for several spacecraft mission control operations. The control center also provided the control function for operation of the space communication stations, ground communication facilities, and the control center itself.

2. *Pioneer* design concepts. The *Pioneer* data system was developed to provide (1) a highly efficient telemetry channel compatible with the DSN, (2) a capability for the DSN to generate two-way coherent doppler measurements while spacecraft were tracked, and (3) an earth-to-spacecraft command capability to control spacecraft subsystems and science payload.

a. Spacecraft radio frequency subsystem. The radio frequency subsystem included three antennas (one high-gain and two omnidirectional), a transmitter driver, two redundant traveling-wave-tube (TWT) power amplifiers, two redundant receivers, coaxial switches, filters, and diplexers. Switch position was controlled by ground command. The beam of each of the antennas was axially symmetrical with the spacecraft spin axis, which was perpendicular to the ecliptic plane. The beamwidth of the omnidirectional, or low-gain, antenna was 110 deg, and the beamwidth of the high-gain antenna was 5 deg.

The power output of the spacecraft transmitter exciter was 44 W and could be switched by ground command to the low-gain antenna, or used as a driver for the two TWT power amplifiers. Each amplifier had a power output of approximately 7.7 W and could be turned on or off, or switched to either the low- or high-gain antenna by ground command.

The auxiliary oscillator was modulated by a 2048-Hz squarewave subcarrier as part of a pulse code modulate/phase shift keyed/phase modulation (PCM/PSK/PM) telemetry system.

The spacecraft had two partially redundant (redundancy limited by the antenna configurations) phase-lock receivers. Each operated on a different frequency and was powered at all times; the desired receiver was thus selected by the frequency of the ground transmitter.

b. Spacecraft command subsystem. The command subsystem consisted of two redundant decoders and a command distribution unit (CDU). The input signal to both decoders was the demodulated signal from either of the spacecraft receivers. The desired decoder was selected by command address.

The command message was a 23-bit word arranged in the following order:

5 bits, preamble

3 bits, decoder address

7 bits, command complement

7 bits, command

1 bit, post-squelch

The command and command complement were compared within the decoder on a bit-by-bit basis, and the command-execute signal from the decoder was inhibited when errors occurred. The ones and zeros within the message were represented by two audio tones. The command carrier was phase-modulated by these tones at the rate of 1 bit/s.

c. Spacecraft telemetry subsystem. The generation of timing and status signals, analog-to-digital conversion, data retrieval and processing for telemetry, and data storage on the spacecraft were accomplished by the digital telemetry unit (DTU), the signal conditioner, and the data storage unit (DSU).

The output of the DTU was a 2048-Hz squarewave which was biphase-modulated with the time-multiplexed PCM bit train using a non-return-to-zero-mark format. This squarewave phase-modulated the transmitted carrier in all modes of operation.

The DSU had a capacity of 15,232 bits. Readout from the memory unit was destructive and, once initiated, could not be temporarily interrupted by ground command without destroying the remaining data in the unit. Furthermore, the unit had to be cleared of any data stored there, either by ground command or by readout of stored data, before a new storage cycle was begun.

By ground command, one of four operating modes and one of five bit rates could be selected for operation of the DTU. The operating modes were (1) real-time, (2) telemetry store, (3) duty cycle store, and (4) memory readout. The bit rates were 512, 256, 64, 16, and 8 bits/s.

In the duty-cycle storage mode, the DSN did not receive telemetry from the spacecraft, and the data was stored on the spacecraft. It was the least desirable type of data retrieval method because the spacecraft memory unit had limited capacity and a portion of the subsequent tracking period of a station had to be reserved for playback. At the lowest bit rate, the time for playback could amount to 32 min. The storage mode was used during periods when the DSN was unable to furnish tracking and data acquisition support. Less than 0.1% of the total data was received in that mode.

Data quality for *Pioneer VII* was determined by the error rate printout on the engineering data. In addition, ARC kept plots of error rate printout values. An error rate printout of 0.116 corresponds to one error in 1000 bits of information and was used as a criterion for good data. (If the parity error rate was not less than this value, the bit rate was dropped to the next lower value.) Primary interest was in data for the time interval beginning 3 h prior to the time of maximum spacecraft elevation and extending until 3 h after. Some passes terminated before the spacecraft reached maximum elevation, and parity error rates were calculated from such data as was available.

Varying amounts of data were lost or degraded in locking the receiver in a two-way mode on each pass; the amount varied because of the round-trip-light-time (RTLT), which increased as the spacecraft's distance from earth increased. Spacecraft acquisition time also contributed a small portion of lost or bad (degraded) metric data. Receiver-lock was essential for good data recovery.

In the real-time mode, the information was transmitted directly in the format and bit rate selected. In the telemetry-store mode, data was stored and transmitted simultaneously in the selected format and bit rate. In the duty-cycle-store mode, data was stored intermittently in groups of 224 bits each at a rate of 512 bits/s. The period between groups stored could be selected by ground command to provide partial data coverage for periods up to 19 h. The memory-readout mode provided the capability for retrieving the data stored. When readout was complete, the DTU reverted automatically to the real-time mode in the format and at the bit rate in use prior to the readout.

The spacecraft data word was composed of 7 bits. The first 6 bits transmitted were generally information; the seventh bit indicated parity. Odd parity was employed by sampling the first, third, and fifth bits.

d. Mission-dependent ground equipment. This equipment consisted of a demodulator/synchronizer, a command encoder, and a computer buffer. A DSN computer was used at the deep space station to:

(1) Provide selected telemetry data for teletype transmission to the SFOF.

(2) Monitor the engineering data for out-of-limit occurrences.

(3) Provide computer typewriter printout of selected data.

(4) Display selected spacecraft parameters as required.

(5) Transmit command messages on instructions from the SFOF.

(6) Check command messages for validity before transmission.

(7) Verify that commands are being transmitted correctly.

(8) Maintain a command accountability list.

The complete data stream was recorded on magnetic tape for subsequent data processing and analysis.

*3. **Extended flight phase support requirements.*** Almost from launch, *Pioneer VII* mission requirements for TDS support increased. Changes resulted, in the main, from the spacecraft's increased life expectation and the added possibilities from an extension of capability by the Deep Space Network.

4. Network support implementation. Research and development stemming from analyses of the DSN's regular support of *Pioneer* missions resulted in significant enhancement of network capabilities. The threshold of the 26-m-diam antenna stations was to be extended from 0.4 AU (1965) to approximately 1.5 AU (1970). Telecommunications hardware implemented after 1965 by JPL increased the telemetry signal-to-noise ratio (SNR) by 8.5 dB.

a. 26-m-diam antenna stations. The deep space stations equipped with 26-m-diam parabolic antennas furnished most of the support. The 64-m antenna (DSS 14, Goldstone, Calif.) was used mainly for spacecraft beyond the threshold capabilities of the 26-m antenna stations.

b. Advanced antenna system. DSS 14 was originally made available to the *Pioneer* missions on a best-effort basis. However, the Support Instrumentation Requirements Document (SIRD) and the NASA Support Plan (NSP) for *Pioneers VI, VII,* and *C* (*VIII*) were completed in 1967. The guidelines called for DSS 14 to furnish a minimum of 180 h per mo for tracking and data acquisition support for *Pioneer* spacecraft. Minimum support to *Pioneer VII* was to be increased whenever possible. At that time, *Pioneer VI* was regularly being tracked by the DSS 14 64-m antenna. However, because of the improved capabilities of the 26-m antenna stations, previously noted, there was no necessity to transfer all *Pioneer VII* support responsibility to DSS 14 until February 9, 1968 (Pass 542), some 18 mo after launch.

5. Advanced antenna system facility description. The 64-m advanced antenna system (AAS) (Fig. 3), increased the DSN range two and a half times. Under limited communications conditions, the system reached to the edge of the solar system. This improved capability provided six and a half times more transmitting power and receiving sensitivity for the DSN than was available with 26-m antennas. The 64-m antenna had a gain of approximately 60 dB in transmitting and 62 dB in receiving. The 26-m antennas originally had a gain of 51 dB transmitting and 53 dB receiving. The beamwidth was 0.1 deg at DSS 14 and 0.35 deg for 26-m antennas.

The added capability permitted either extension of communication distances in space or acquisition of more data from spacecraft at shorter ranges. Because DSS 14 located much of the complex equipment on the ground, less complex and more reliable communication equipment could be carried by spacecraft.

The operating and signal-processing techniques used for the 64-m antenna were basically the same as those used for the smaller antennas. The huge reflector was tuned to collect spacecraft signals coming from such distances that their energy was measured in billionths of a billionth of a watt. These signals were amplified and fed into receivers and the data forwarded to the SFOF in Pasadena. Tracking of the spacecraft began as it appeared above the horizon.

Frequency, time, and angle data of the predicted trajectory was supplied by teletype from the SFOF and other DSN stations. Signal acquisition and lockon were normally achieved in 4 to 10 min. The antenna was then switched to the automatic mode and tracked until the spacecraft disappeared below the horizon.

The 64-m antenna operated in either of two pointing modes, depending on the nature of the mission being covered. It was pointed so as to track the spacecraft signal automatically, as did the 26-m antennas, or the pointing information was sent to the larger antenna's master equatorial reference system, which then designated the path for the antenna.

Like other DSN antennas operated at frequencies of 2100 MHz transmitting and 2300 MHz receiving, the DSS 14 antenna incorporated a Cassegrain cone feed, mounted at the center of the reflector. (During March 1968, an ultracone was installed. This improved the downlink signal strength by some 5 dBmW for one-way tracking.) The Cassegrain design was similar to that of an optical telescope. Signals reflected from the main dish hit a subreflector mounted on a truss-type support extending outward from the center of the dish. The subreflector focused the signal into the feed horn in the Cassegrain cone, where it was amplified by a maser.

The Cassegrain cone maser was capable of accomplishing maximum amplification of the signal while, at the same time, generating a minimum of background noise. Because heat was a major source of noise, the maser was immersed in liquid helium to maintain its temperature at 4.2°K. The spacecraft signal was usually maser-amplified on the order of 40,000 times before it was fed into the receiver, where it was further amplified.

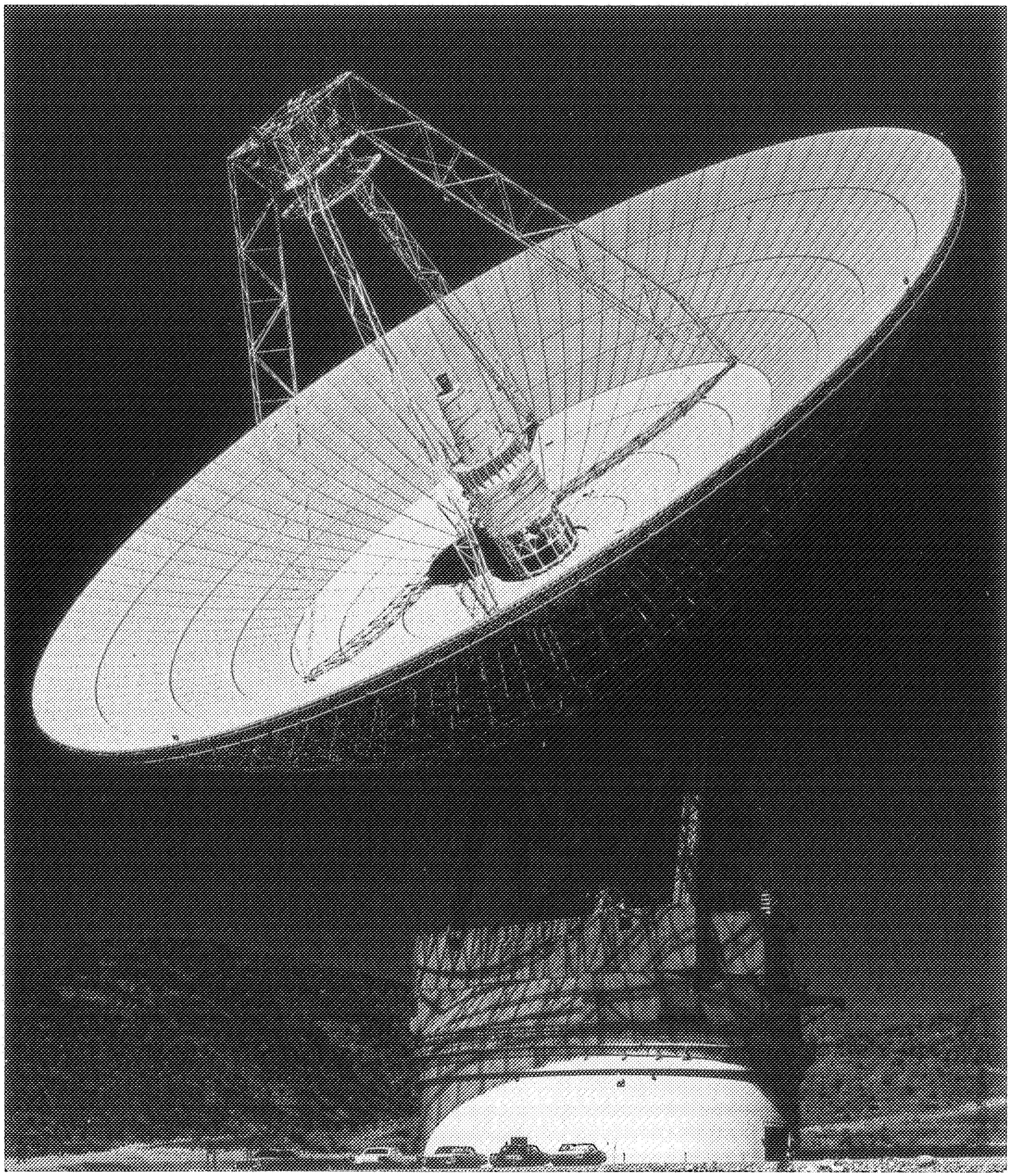

Fig. 3. View of 64-m-diam antenna

The receiver used four separate channels: two reference (or sum) channels for doppler information, spacecraft telemetry, and TV signals; and two channels carrying angle-tracking data for automatic antenna pointing. The data from all four channels, depending on the information conveyed, was transmitted to the SFOF.

Dimensions and weights of the 64-m-diam antenna are given in Table 2. A profile of the antenna is presented in Fig. 4.

Table 2. Goldstone 64-m-diam antenna dimensions and weights

Antenna dimensions	
Diameter, m	64
Focal length, m	27.109
Focal length/diameter ratio	0.4235
Surface area, m^2	3483
Depth of paraboloid, m	9.45
Pedestal wall thickness, m	1.1
Outside diameter of pedestal, m	25.3
Overall height of instrument tower,[a] m	42.4
Total concrete, m^3	1912
[a]Height of concrete section, 20.8m, including 10.1m below grade.	
Antenna weights, kg	
Overall	7.26×10^6
On elevation bearings	1.14×10^4
On azimuth bearings (including bearings)	2.27×10^6
On soil	7.26×10^6
Total rotating	2.27×10^6
Total tipping	1.135×10^6
Component	
Hyperboloid	1.9×10^3
Feed cone and equipment	28.1×10^3
Quadripod	17.7×10^3
Primary reflector surface	26.3×10^3
Reflector assembly (including reflector, wheels, and elevation counterweight)	1.1×10^6
Alidade and buildings	0.99×10^6
Azimuth bearings	1.8×10^5
Pedestal and foundation	4.54×10^6
Instrument tower (including wind shield)	
Steel	43.6×10^3
Concrete	0.52×10^6

II. Scientific Events and Measurements

A. Special Coverage

Special coverage was given *Pioneer* spacecraft during occultations and syzygys; analyses of solar events were made, as were investigations of magnetosheath and bow shock.

During a solar event of high scientific value, continuous tracking coverage for 30 to 50 h following the event was required for *Pioneer* spacecraft. Dependent upon the location and characteristics of a specific event, coverage was shared by the *Pioneers* as determined by the *Pioneer* Project at the time of the event. For magnetosheath and bow shock, onboard plasma and magnetometer instruments needed to be operating and the resultant scientific data received by launch plus 3 to 3.5 h or 8 to 10 earth-radii altitude.

A geomagnetospheric tail analysis and a lunar occultation investigation by the *Pioneer VII* mission were successfully supported by the network. The geomagnetospheric tail analysis, which was successfully completed October 1, 1966, required 24-h continuous tracking coverage from syzygy minus 5 days to syzygy plus 15 days. The lunar occultation investigation, which was successfully completed January 20, 1967, required continuous coverage for lunar occultation entrance and exit times plus 10 h before and after.

Pioneer VII carried six scientific instruments, which totalled 15.46 kg or 25% of the total spacecraft weight. Nine W of power were required for the instruments when one plasma detector was operating in low power mode and 18 W when in the high power mode (approximately 18 and 35% of the total spacecraft power).

The instruments covered approximately 0.181 m^2 of the spacecraft platform. Approximately 72% of the telemetry data was allocated directly to the scientific instruments when telemetering in the scientific data mode. This mode was used throughout the mission except for rare occasions. Approximately 33% of the command capability was allocated directly to the scientific instruments for controlling the operating conditions.

Power to the scientific instruments was supplied directly from the spacecraft primary bus. Each instrument, therefore, had its own converter. Power to all instruments was turned off by a single ground command. Each instrument could be turned on individually by ground command.

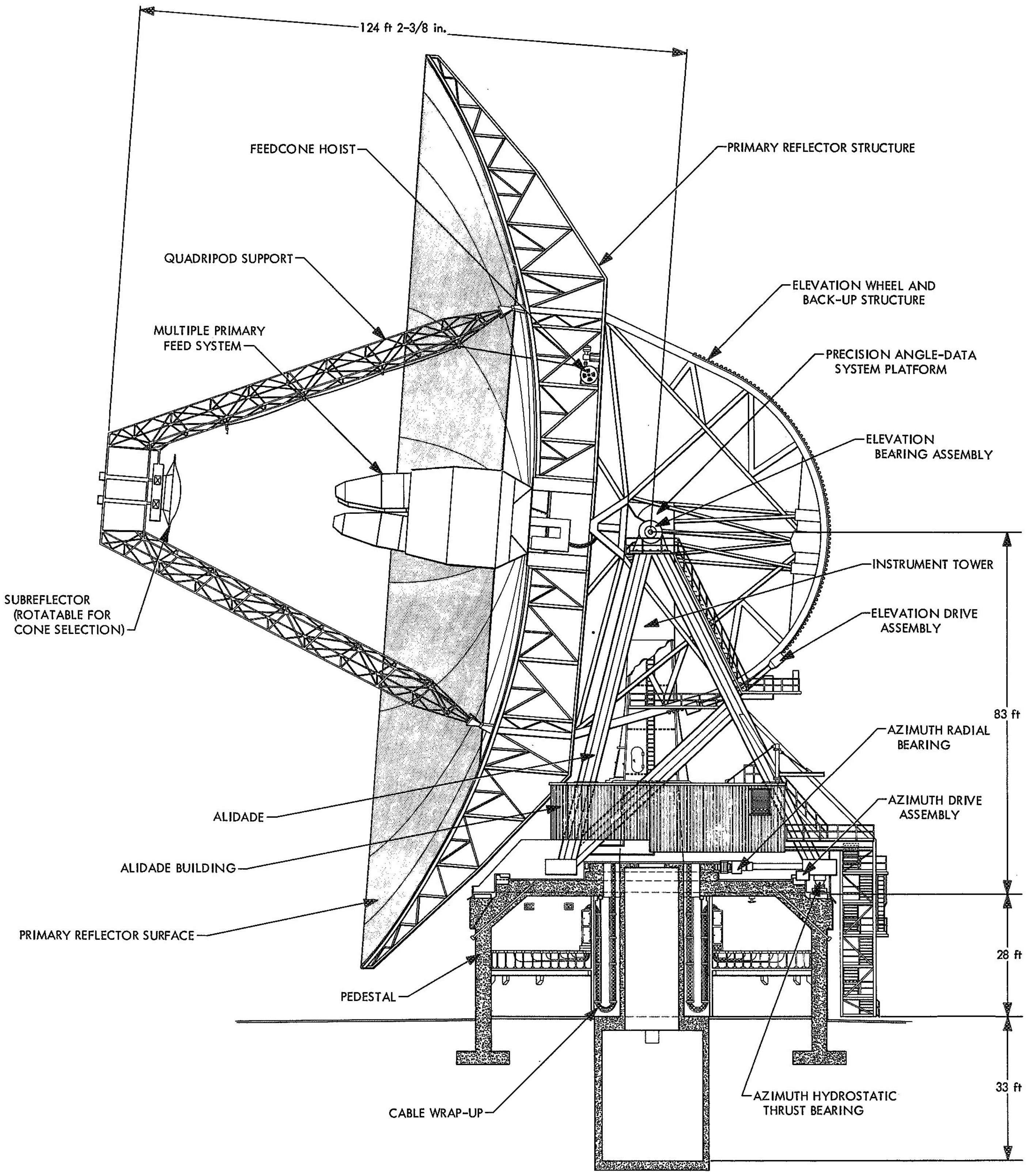

Fig. 4. Profile of 64-m-diam antenna

One scientific experiment, the celestial mechanics investigation, required no special instruments on the spacecraft. However, funding for this investigation was not available until fiscal 1968.

B. Experiments

The experiments, managers, and principal investigators are listed in Table 3.

1. Celestial mechanics investigation (Jet Propulsion Laboratory). The three primary objectives of the *Pioneer* celestial mechanics experiment (PCME) were:

(1) Obtain primary determinations of the masses of the earth and moon and the astronomical unit.

(2) Use the tracking data from the whole series of *Pioneer* probes in a program designed to improve the ephemeris of the earth.

(3) Investigate the possibility of a test of general relativistic mechanics with the *Pioneer* orbits.

The experiment made use of the on-board receiver and transmitter equipment in conjunction with DSS equipment to obtain two-way doppler measurements. *Pioneer* data was appropriate for this experiment because of the absence of midcourse orbit corrections and near-planetary encounters. In addition, solar-radiation pressure effects were slight for the *Pioneer* configuration.

Table 3. *Pioneer VII* experiments

Experiment/scientific instrument	Management	Principal investigator
Single axis magnetometer	NASA/GSFC	N. Ness
Plasma cup detector	MIT	H. Bridge
Quadrispherical plasma analyzer	NASA/ARC	John H. Wolfe
Radio propagation detector	Stanford University	V. R. Eshleman
Cosmic ray anisotropy detector	Southwest Center for Advanced Studies	Kenneth McCracken
Cosmic ray telescope	University of Chicago	J. Simpson
Celestial mechanics investigation[a]	JPL	John D. Anderson
Faraday rotation investigation (S-band)[b]	JPL	Gerald S. Levy

[a]Requires no onboard instrumentation; uses two-way doppler tracking as data source.

[b]Performed only for solar occultations.

2. Cosmic ray telescope (University of Chicago). This instrument measured the intensity and energy spectra of protons and alpha particles, electron energy over a limited range, and particle anisotropy. It had three solid-state lithium-drift detectors, a plastic scintillator cylinder designed to exclude particles not confined to the telescope angle of 60 deg, a photomultiplier tube, and associated electronics.

Proton and alpha particle energy spectra measurement was divided into these four energy windows: (1) 0.6–13 million MeV per nucleon, (2) 13–70 MeV per nucleon, (3) 70–190 MeV per nucleon, and (4) greater than 190 MeV per nucleon. Detection of electron energy spectra was limited to the energy windows of 0.16–1 and 1–20 MeV per nucleon.

3. Cosmic ray anisotropy detector (Southwest Center for Advanced Studies). Measured were the anisotropy of low-energy primary and solar cosmic radiation and its variation with energy, time, and nuclear species. The instrument comprised a scintillator crystal, an anticoincidence scintillator, two photomultiplier tubes, and associated electronics. The acceptance cone for the detector was 107 deg. Energy window discrimination was achieved by means of a four-channel onboard pulse-height analyzer.

4. Plasma cup detector (Massachusetts Institute of Technology). This detector used a Faraday cup with an energy-determining grid, a split collector, and associated electronics. The viewing angle was ± 20 deg in the plane perpendicular to the spacecraft spin axis and ± 60 deg in the plane parallel to the spin axis. Measured were the energy spectrum, flux, and angular distribution of both positive ions and electrons of the interplanetary plasma.

The energy per unit charge of the positive ions was determined in 14 intervals extending from 0.1 to 9.5 kV, the energy of the electrons in four energy bands extending from 0.1 to 1.6 keV, and the flux sensitivity range from 2×10^5 to 2×10^9 particles/cm^2/s.

5. Quadrispherical plasma analyses (Ames Research Center). This instrument, like the plasma cup detector, measured the energy spectrum, flux, and angular distribution of both positive ions and electrons of the interplanetary plasma. The instantaneous viewing angle was approximately 15 deg in the plane perpendicular to the spacecraft spin axis or equatorial plane and ± 80 deg in the plane parallel to the spin axis. The latter was divided into eight channels symmetrical about the equatorial plane and with widths, starting at the equatorial plane, of 15, 15, 20, and 30 deg.

The energy per unit charge of the positive ions was determined in 16 logarithmically spaced bands extending from 0.2 to 10 kV, the energy of the electrons in 8 logarithmically spaced bands extending from 0.002 to 0.5 kV, and the flux sensitivity from 10^5 to 10^9 particles/cm^2/s.

Besides a quadrispherical electrostatic analyzer, eight separate and contiguous current collectors provided eight sectors and associated electronics. The current or flux measurement was expressed as a 7-bit word and, together with other information identifying energy levels, positive or negative particles, collector, and equatorial interval, was stored in a core memory. The instrument recorded data concurrently with telemetering data.

6. Magnetometer (Goddard Space Flight Center). The magnetometer, with a range of $\pm 64\gamma$, sequentially measured the magnitude of the three orthogonal components of the interplanetary magnetic field. Capable of four different data recording sequences, the instrument had a single flux gate sensor and associated electronics. A mechanical flip mechanism, which rotated the sensor through 180 deg, permitted detection and elimination of permanent magnetization of the core. The flip mechanism contained 22 small squibs grouped in pairs for redundancy. Each pair of squibs was activated by ground command.

7. Radio propagation (Stanford University). This experiment involved the transmission of two modulated coherent carriers of approximately 49.8 and 423.3 MHz from the ground and the reception of these signals by receivers aboard the spacecraft. The receivers were designed to measure the relative phase of the modulation envelopes of the two carrier frequencies which, since the higher frequency was relatively unaffected by the presence of ionization, provided a value for the integrated electron density. In addition, the rate of change of phase of one carrier with respect to the other was measured, thus accurately determining the time variation of the integrated electron density. Signal strength was also measured.

Instrumentation comprised two ground-based transmitters operating into a 46-m-diam parabolic antenna located on the Stanford University campus, a dual channel, phase-locked-loop receiver aboard the spacecraft, the spacecraft telemetry, and the DSN. All elements of the system operated simultaneously to provide closed loop operation.

III. Support Summary: February 24, 1967–July 1, 1968 (Passes 192–681)

The *Pioneer VII* spacecraft was being tracked 69.77 million km from earth and 168.07 million km from the sun by the DSN when this first report on the extended flight phase began. At the close of the report period, the spacecraft was being supported 185.95 million km from earth and 159.79 million km from the sun. Aphelion of 1.125 AU—subjecting the spacecraft to its coldest temperatures and highest onboard crystal frequencies—was reached during early February 1967 and again in March 1968. Perihelion at 1.010 AU was passed through during August 1967.

The *Pioneer* spacecraft was used in observing several solar disturbances during the period of this report. The first solar flare coverage was on pass 197; there were 27 h of flare coverage for passes 278 and 279 (the second a special pass); and 12 h of coverage were given on pass 286.

A. Support Performance

Tracking and data acquisition support was given successfully by the DSN throughout the reporting period. The performance was notable because 26-m antenna stations provided support 10 mo after their designed telemetry threshold was reached. This enhancement of capability made possible not only more TDA support for *Pioneer VI* at DSS 14 but also additional hours of *Pioneer VII* support when the DSN was supporting other lunar and planetary missions. At the close of the period, DSS 14 was giving satisfactory support at 8, 16, and 64 bits/s. (As reported previously, an ultracone had been installed at DSS 14 during March 1968.)

B. Supporting Stations

Stations that supported *Pioneer VII* spacecraft during the reporting period were DSS 11, 12, 13, 42, and 51, all 26-m-diam antenna facilities, and DSS 14, the 64-m antenna facility. DSS 11 at Goldstone, California, tracked only pass 408 (September 28, 1967); the pass was a special commanding pass for the cosmic ray telescope experiment managed by the University of Chicago. The bulk of the support was by DSS 51, Johannesburg, South Africa, and by DSS 14 at Goldstone.

Pass 542 (February 9, 1968) was the final pass supported by DSS 51. At that time, the spacecraft went beyond the threshold of the 26-m antenna station network. For the final series of passes supported by DSS 51, tracking was in the one-way mode or two-way noncoherent mode, and the parity error rate was bad.

IV. Engineering and Operations

A. Increased Support Capabilities

Pioneer VII mission support by the 26-m antenna stations was extended approximately 10 mo through engineering improvements during the reporting period of this document. Without the improvements, the data acquisition threshold (0.1% bit error rate) would have been reached on March 21, 1967. Importance of this expanded support by the 26-m antenna stations was heightened because the lone 64-m antenna station (DSS 14) was handicapped with hydrostatic bearing problems.

When the signal received from *Pioneer VII* spacecraft dropped to the telemetry threshold of the 26-m antennas — approximately −163.5 dBmW at 8 bits/s — deep space stations were requested to optimize their systems in an effort to minimize the parity error rate. This signal level of approximately −163.5 dBmW was indicated when the parity error rate reached 0.109 in the engineering printout from the ground-operated equipment telemetry and command processor (GOE/TCP). (Equivalent bit error rate for this parity error rate was one error detected per thousand bits, or 1×10^{-3}.)

The parity error rate of 0.109 was reached earlier at DSS 42 (Tidbinbilla) than at DSS 12 (Goldstone) or DSS 51 (Johannesburg) because of the DSS 42 MSFN configuration. The slight system degradation was a result of the broad bandwidth required, which produced a lower maser gain (from about 40 dB down to 35 dB). The system noise temperature increased due to lower maser gain, and the larger contribution at the follow-on circuitry, from below 40°K up to about 45°K.

Normally at this time operations would have been transferred to the 64-m antenna at DSS 14 for an 8-dB signal enhancement. However, because the hydrostatic bearing problems prevented use of the 64-m antenna, tests were performed at DSS 12 in an effort to establish a means to extend the 26-m antenna range for *Pioneer VII* at a lower telemetry threshold level. (Figure 5 displays predicted signal strength vs time.)

B. DSS 12 Tests

1. Reduction of telemetry bandwidth. When the telemetry bandwidth was reduced from 20 to 4.5 kHz at higher signal strength, no change in the error rate was noted. A degradation rather than improvement occurred when the signal was near threshold level. The data, being a 2048-Hz squarewave, required at least 10 kHz

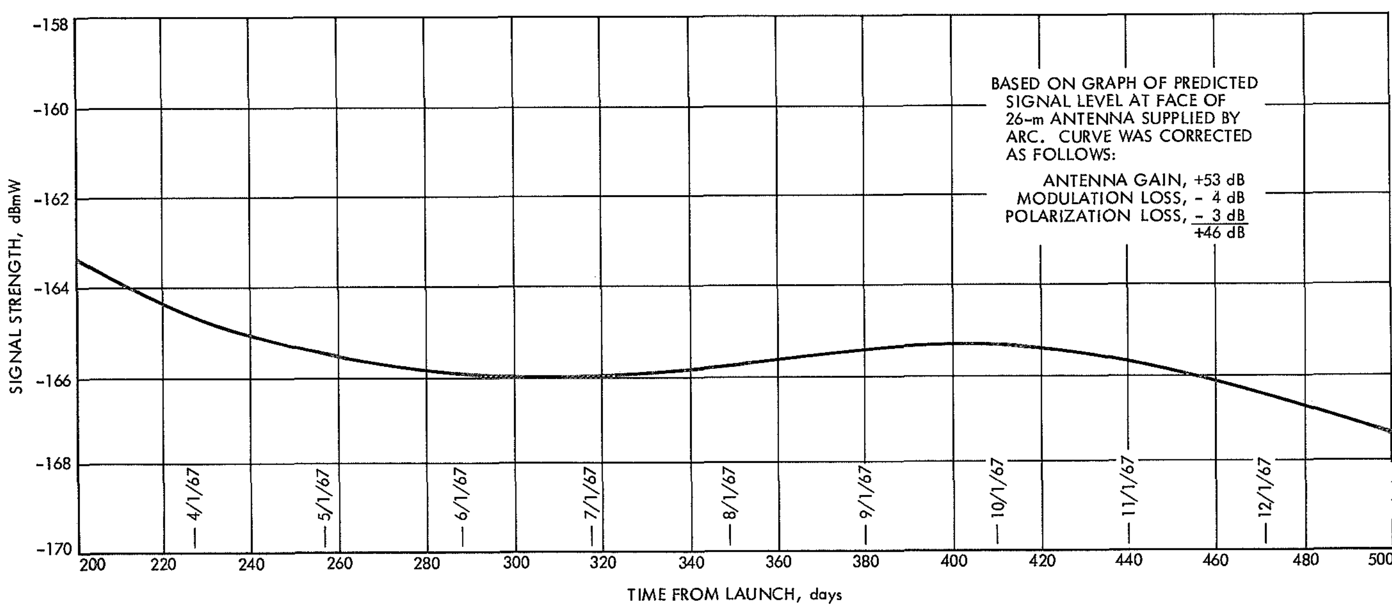

Fig. 5. Predicted signal strength vs time

for optimum squarewave reconstruction at the GOE. No specific analysis of this test was performed, as the results were as expected.

2. Reduction of the 12-Hz tracking loop bandwidth. A significant improvement was noted with a 5-Hz loop bandwidth replacing the 12-Hz tracking loop bandwidth. A 3-Hz loop bandwidth gave slightly better results, indicating some improvement might be achieved with a narrower bandwidth. Figure 6 shows a comparison between the theoretical error rate and the average parity error rate divided by 2. Most of this pass was run in the two-way coherent mode (point A). One parity error rate reading was obtained during the latter portion of the pass in the one-way mode, resulting in a significantly improved parity error rate (point B). Degradation, while the system was operating coherently, was attributed to additional noise contributed by the uplink signal-to-noise plus the slight degradation caused by leakage in the diplexer. This test demonstrated the improvement while the transmitter was off.

3. Installation of waveguide bypass. By electrically removing the diplexer and two waveguide switches from the microwave feed assembly, system noise temperature was reduced approximately 11.5°K. Figure 7 shows the results of this test (Fig. 8), which was divided into the following three parts.

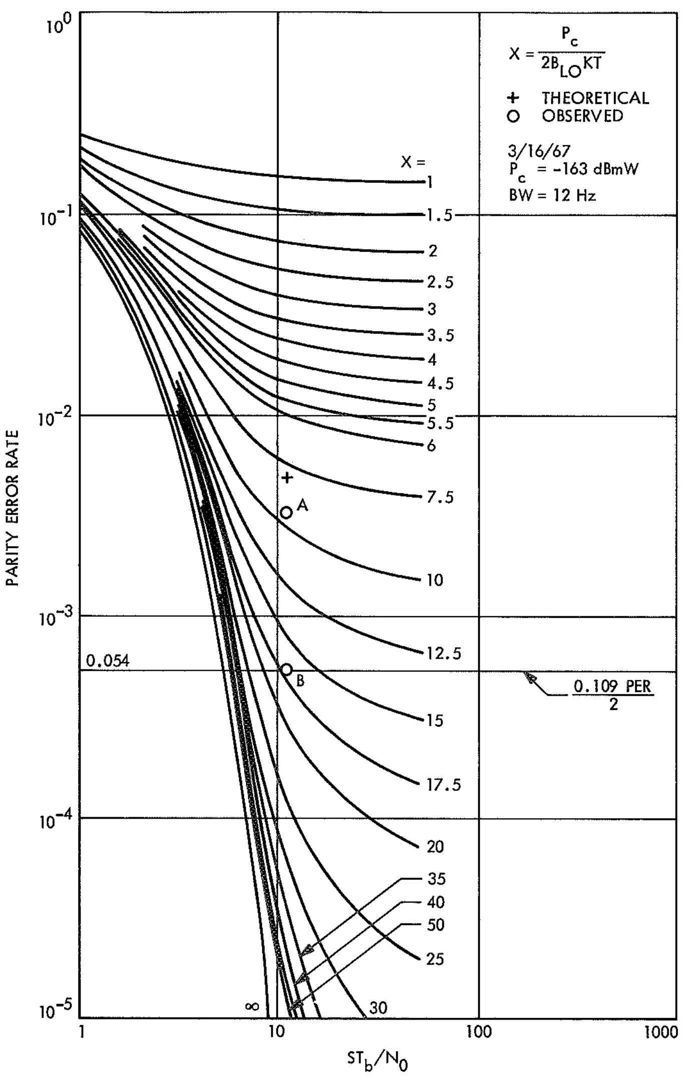

Fig. 6. Parity error rate vs ST_b/N_0, pass 212, DSS 12

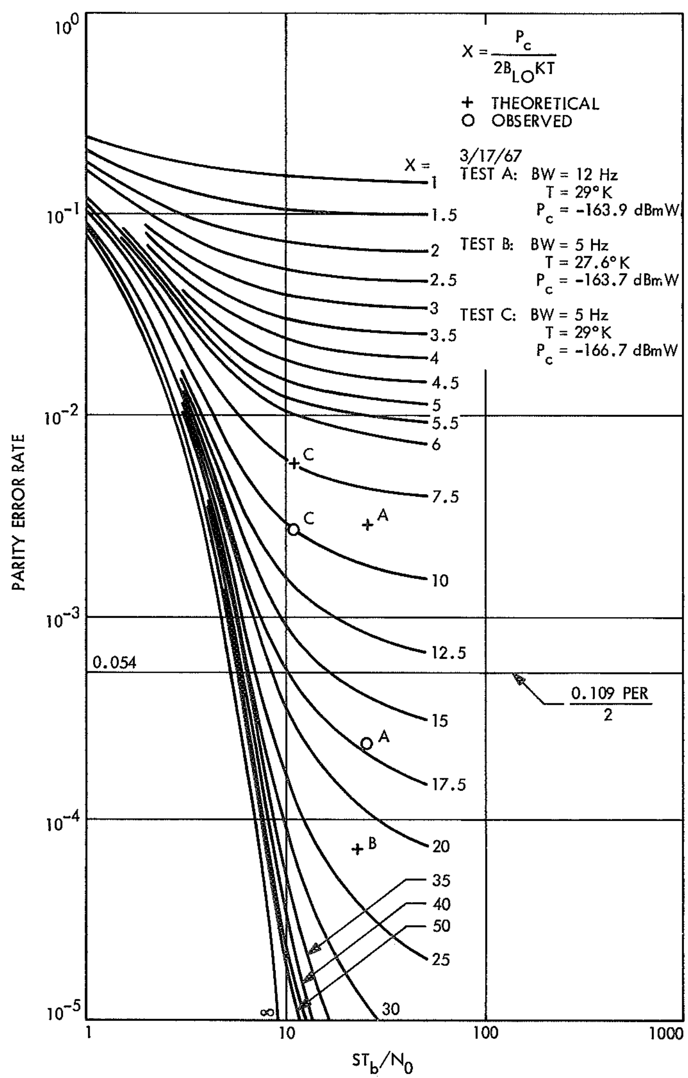

Fig. 7. Parity error rate vs ST_b/N_0, pass 213, DSS 12

NORMAL CONFIGURATION

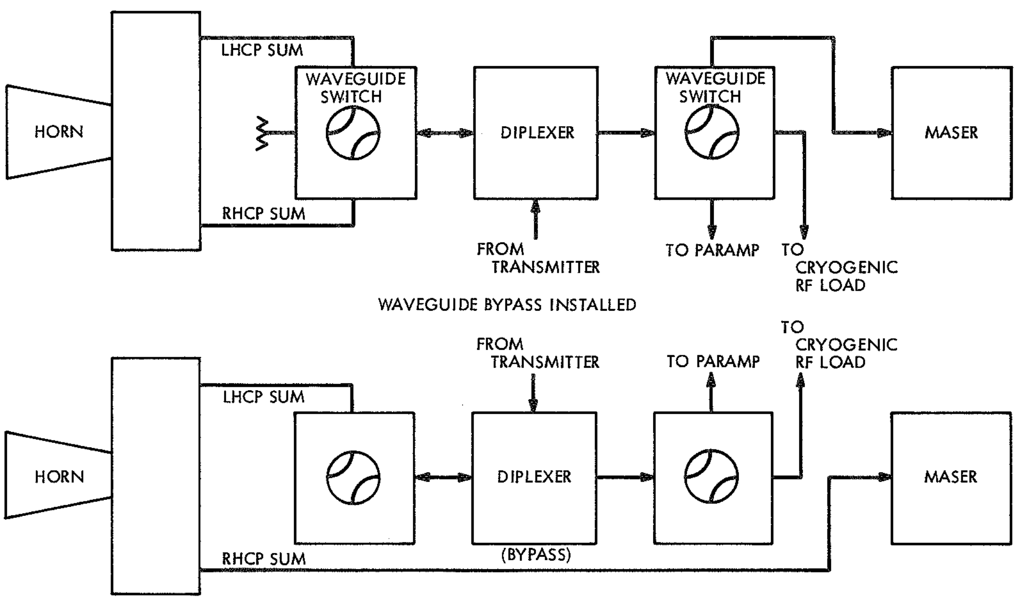

Fig. 8. Block diagram of waveguide bypass test

(1) During the early portion of the pass, with the waveguide bypass installed, the tracking loop bandwidth was set at 12 Hz at optimum signal. Results are identified by A in Fig. 7.

(2) Next the test was performed using the 5-Hz non-Goldstone duplicate standard (GSDS) tracking loop bandwidth. Results are identified by B in Fig. 7.

(3) Finally, the antenna was offset to obtain a signal strength of approximately −166 dBmW in order to simulate the expected signal strength during the months of June and July 1967. Results are identified by C in Fig. 7. Figure 8 illustrates a test setup performed during a subsequent pass linking the spacecraft in the two-way noncoherent mode (uplink on channel 7 and downlink on channel 6). For this setup, point A in Fig. 9 illustrates the results obtained using the 12-Hz tracking bandwidth, while point B illustrates the results obtained using the 5-Hz tracking loop bandwidth.

4. Additional testing. Other tests of a similar nature during the reporting period did not show significant results. These tests included the replacement of the GOE demodulator synchronizer with an experimental Type III demodulator and the reduction of the tracking loop bandwidth from 5 to 3 Hz. There was no significant difference at threshold signal levels in the comparison of the demodulators; the parity error rate improvement was slight through bandwidth reduction.

a. DSS 13 support. The DSN supported *Pioneer VII* from DSS 13, which had a system noise temperature of 30°K and a 3-Hz carrier tracking loop, during the first two weeks of May 1967. A signal improvement of approximately 3 dB was made possible by the station's linear polarized feedhorn. (*Pioneer* spacecraft transmitted linearly polarized S-band signals, and the standard 26-m antennas then had circularly polarized feedhorns. That configuration caused a 3-dB polarization loss, since the network had been optimized to track planetary spacecraft which operated with circularly polarized signals.)

The DSS 13 linear polarized feedhorn made it possible to track *Pioneer VII* spacecraft telemetry signals with no bit errors at an 8-bits/s rate.

b. DSS 51 modification. The mission was supported during the second half of May 1967 by DSS 51. A 3-Hz tracking loop bandwidth capability had been incorporated and a special waveguide modification had been made. However, the station was limited to *receive-only* operation in that configuration.

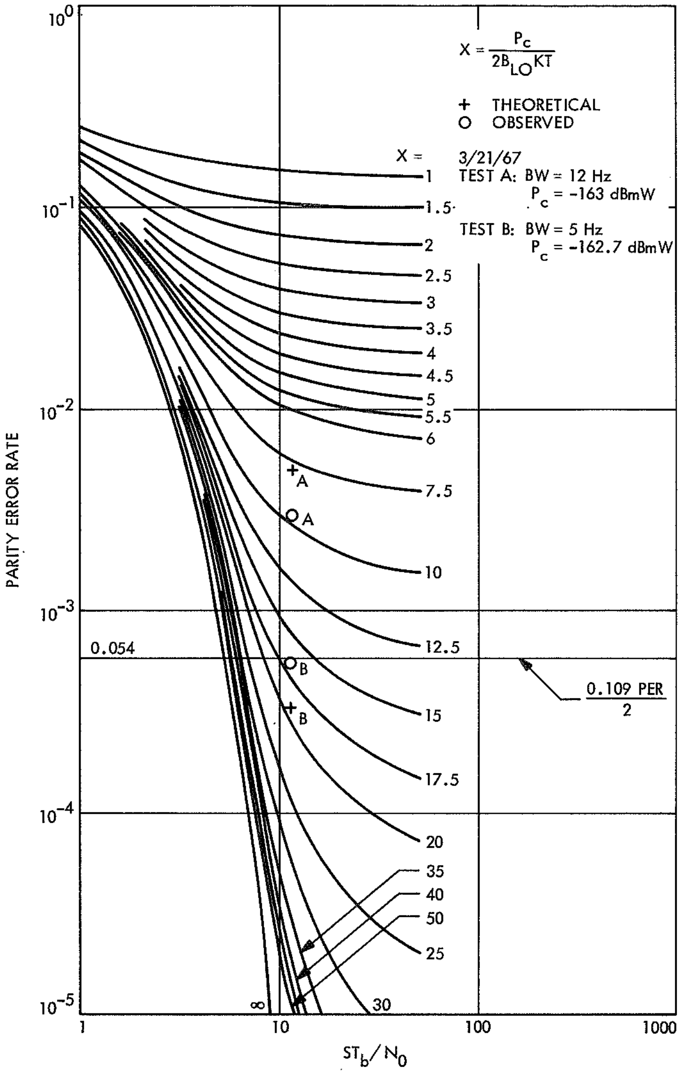

Fig. 9. Parity error rate vs ST_b/N_0, pass 217, DSS 12

After the waveguide installation was made, the system noise temperature was lowered to approximately 33.1°K from the station's standard noise temperature of 42.5°K. The receiver threshold after both modifications was −177.5 dBmW; the receiver threshold in standard configuration at the station had been approximately −173.5 dBmW. The overall system improvement resulting from both modifications, as derived using the parity error rate improvement, was equivalent to approximately 2.5 dB. The reduced system temperature was credited with 1.1 dB of the improvement; the remainder was credited to the 3-Hz tracking loop bandwidth.

Figure 10 shows the bit error rates obtained at DSS 51 during the latter part of May. The bit error rate for a normal pass was relatively constant for the middle of the pass, with a duration of approximately 4 to 6 h. The increase in error rate on either side of midpass was attributed to the noise contribution of the relatively large sidelobe sensitivity caused by damage to the antenna surface from hail storms. The antenna surface panels were replaced, and the bit error rate of the *Pioneer VII* telemetry subsequently improved, as shown in Fig. 11. DSS 14 also provided support during the same period and obtained telemetry with bit rates of 64 and 16 bits/s and a very low bit error rate. Stations 51 and 14 also provided most of the support until the end of 1967. DSS 14 gave the support after DSS 51 was phased out of *Pioneer VII* support on pass 542, February 9, 1968.

c. Polarizer development. The need for increased 26-m antenna station support for *Pioneer VII* also resulted in development of a polarizer for the Cassegrain feeds (Fig. 12). The polarizer converted the standard circular feed to a linear feed. Test data for a research and development model indicated an approximate 3-dBmW improvement in signal level at both receive and transmit frequencies. The data from a test of pass 446 on November 5, 1967, at DSS 12 is given in Table 4.

The first polarizer was installed at DSS 51, which was using the waveguide bypass modification, and the station was able to track two-way with acceptable parity error rate until February 1968. The spacecraft range started to increase rapidly at that time.

C. DSS 14 Shutdown and Antenna Modifications

1. Antenna. The most serious mechanical problem during the reporting period closed down DSS 14 from March 10 to April 28, 1967. During this time, major rework by JPL corrected a recurring hydrostatic thrust bearing anomaly that had previously caused short tracking interruptions. Reshimming between the annular ring and the bearing surface finally eliminated mechanical distortion that occurred when the pad passed over the

Table 4. Pass 446 test data

Parity error rate	Signal level (uplink), dBmW	Signal level (downlink), dBmW	Polarizer status
0.114	−130	−162	Attached
Bad	−133	−165.4	Not attached

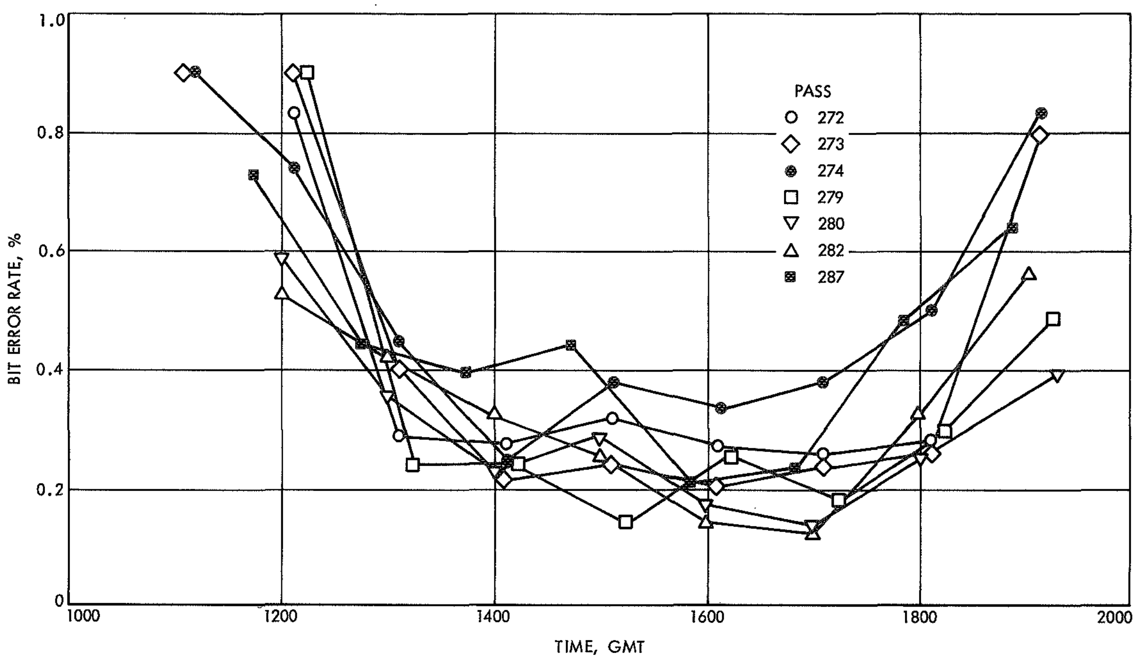

Fig. 10. Telemetry bit error rates estimated at DSS 51, May 15–31, 1967

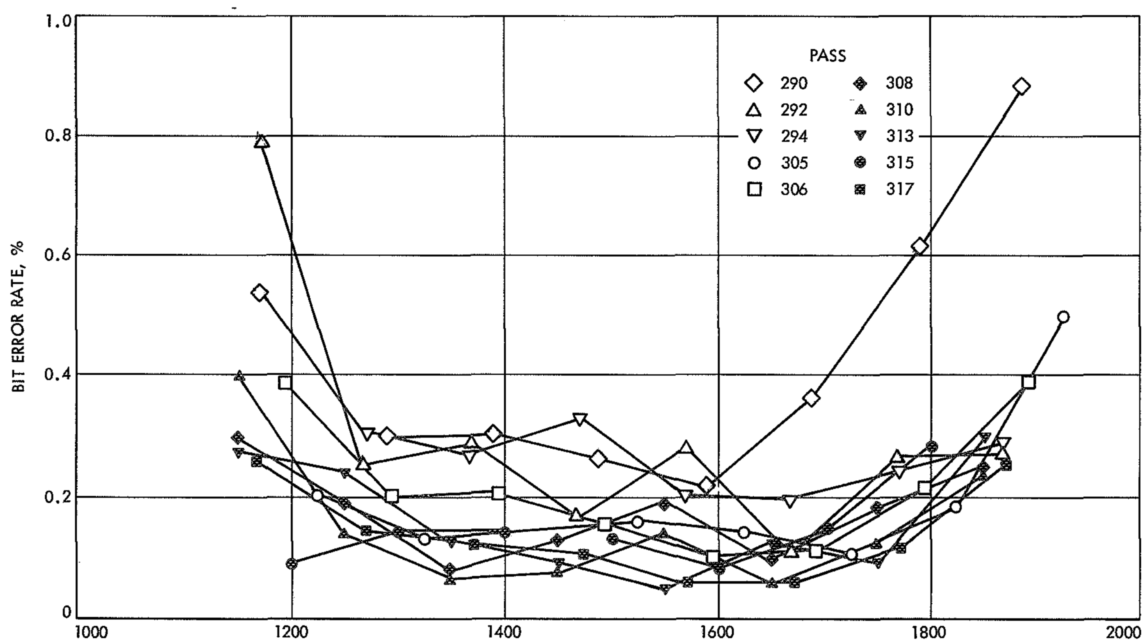

Fig. 11. Telemetry bit error rates estimated at DSS 51, June 1–30, 1967

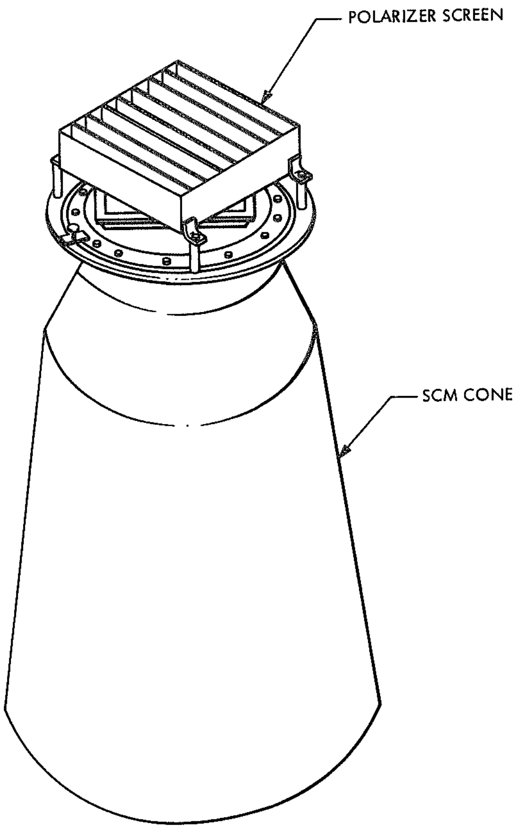

Fig. 12. SCM cone with polarizer attached

bearing surface. (During this rework period the antenna was put into normal operation for a 5-h period to provide maximum capability listening support during the *Surveyor III* terminal sequence and initial operation on the moon.)

After initial installation of the ground shims, the bearing film height was improved to a minimum of 0.011 cm, with 10 areas showing less than 0.012 cm. By comparison, on January 27, 1967, there were 21 areas in which film height was 0.007 cm or less. In addition, the overall height variation of the runner was reduced from 0.17 cm measured during construction to 0.038 cm, and "dramatic" improvements were made in the flatness in local areas During May 1967, engineering evaluation and appropriate local area reshimming were continued to improve the minimum film height and to attain a satisfactory bearing pump redundancy operating condition with permanent shims. Adjustments also were made to reduce the axis cross coupling of the infrared spectrometer (IRS) autocollimation in order to reduce the bias voltage used to offset the fixed alignment error in the cross elevation axis.

During the shutoff period, sensitive level measurements of the thermal stability of the instrument tower indicated the angular movement of the top of the instrument tower was greater than 15 arc-seconds. Plans were made to insulate the outside of the wind and thermal shield to reduce the heat transferred into the instrument tower. Additionally, a new reference groove was cut in the azimuth gear for measuring the runner profile.

2. Transmitter. The 20-kW transmitter was modified to make the transmitter usable at both the DSN operation frequency band, 2110–2120 MHz, and the DSN experimental frequency of 2388 MHz. The conversion consisted of replacing the klystron then in use with a klystron with a broader tuning range (2100–2400 MHz, now available). An additional waveguide directional coupler was added to the waveguide systems for power monitoring at 2388 MHz. An automatic switching circuit was used to switch the monitoring circuits to the directional coupler corresponding to the frequency being used. The 20-kW transmitter modification, which allowed operation at either 2110–2120 or 2388 MHz, increased flexibility, enabling the station to perform special scientific and advanced engineering experiments in addition to the two-way coherent tracking and/or command mission support.

The existing 20-kW waterload was moved to the position allocated for the 100-kW waterload. This move was required at DSS 14 so that the diplexer could be bypassed when the transmitter was operating at 2388 MHz. The waveguide was installed from the waterload position to the 2388 MHz transmitter input port of the special 2110–2120, 2290–2300, 2388-MHz feed cone.

D. RF Performance

1. Uplink, downlink signal strengths. Tables 5 and 6 (with parity error rates) present downlink receiver signal strengths compiled during the reporting period. Figures 13–22 present predicted and actual downlink signal strengths. Figures 23 through 26 present uplink signal strength information for various pass periods during the reporting time.

2. In-lock tracking performance. Tables 7–10 and Figs. 27 and 28 present information on the percentage of in-lock tracking for deep space stations. Some portions of out-of-lock conditions were attributed to testing; testing caused loss of two-way lock, but not loss of telemetry data.

Table 5. Downlink receiver signal strength

Pass	Station	Day	Predicted signal strength, dBmW	Average receiver signal strength, dBmW	Tracking loop bandwidth, Hz	Threshold,[a] dBmW
192	51	55	−162.4	−163.7	12	−171
192	12	55	−162.4	−163.5		−171
193	51	56	−162.4	−163.3		−170
194	42	57	−162.5	−163.3		−173
194	51	57	−162.5	−163.5		−170
195	51	58	−162.5	−164.3		−171
196	42	59	−162.6	−163.8		−174
196	51	59	−162.6	−164.1		−171
196	12	59/60	−162.6	−163.9		−171
197	42	60	−162.7	−164.0		−173
197	12	60/61	−162.7	−164.0		−172
198	42	61	−162.7	−163.5		−172
200	12	63/64	−162.8	−164.8		−173
202	12	65/66	−163.0	−163.3		−172
203	42	66	−163.1	−164.1		−171
204	42	67	−163.3	−164.4		−172
205	42	68	−163.4	−164.2		−173
205	12	68/69	−163.4	−163.5		−173
206	42	69	−163.4	−164.4		−174
207	42	70	−163.5	−164.0		−173
208	42	71	−163.5	−164.2		−173
208	12	71/72	−163.6	−163.7		−173
209	42	72	−163.6	−164.0		−173
210	12	73/74	−163.7	−163.7		−173
212	12	75/76	−163.8	−163.4		−174
214	42	77	−163.9	−164.6		−173
215	42	78	−164.0	−164.6		−173
216	42	79	−164.0	−165.0	12	−173
217	12	80/81	−164.1	−163.4	12/5[b]	−172
218	12	81/82	−164.1	−163.3	5	−172
221	42	84	−164.2	−165.5	12	−173
223	12	86/87	−164.3	−163.6	3	−178
225		88/89	−164.4	−164.3		−179
227		90/91	−164.5	−166.1		−179
230	12	93/94	−164.7	−167.8	3	−178

[a]Average value of pretrack and posttrack data.

[b]5 Hz from 0307 to 0635 GMT.

Table 5 (contd)

Pass	Station	Day	Predicted signal strength, dBmW	Average receiver signal strength, dBmW	Tracking loop bandwidth, Hz	Threshold,[a] dBmW
231	12	94/95	−164.7	−166.5	3	−179
237		100/101	−164.9	−166.4		−179
238		102	−165.0	−165.4		−178
240		104	−165.0	−166.0		−179
241		104/105	−165.1	−166.2		−179
245		108/109	−165.2	−165.8		−178
249		112/113	−165.3	−166.2		−179
251		114/115	−165.4	−167.0		−179
253		116/117	−165.4	−166.0		−178
256	12	119/120	−165.5	−166.5		−179
290	51	153	−165.9	−167.5		−178.0
292	51	155	−166.0	−166.5		−177.5
294	51	157	−166.0	−166.5	3	−175.5
297	14	160	−158.0	−158.9	12	−174.0
301	14	164	−158.0	−158.7		−174.0
304	41	167	−166.0	−166.8		−172.0
304	14	167	−158.0	−158.2	12	−174.0
305	51	168	−166.0	−166.5	3	−177.5
306	51	169	−166.0	−166.9	3	−176.0
307	41	170	−166.0	−166.1	12	−172.0
308	51	171	−166.0	−167.0		−177.5
308	14	171/172	−158.0	−158.6		−175.0
310	51	173	−166.0	−166.7		−178.0
313	51	176	−166.0	−166.6		−178.0
313	14	176	−158.0	−158.7	12	−174.0
315	51	178	−166.0	−166.8	3	−178.0
316	12	179	−166.0	−167.8	12	−172.0
317	51	180	−166.0	−166.6	3	−178.0
502	14	121	−162.4	−163.4	12	−174
505		124	−162.4	−163.8		−175
508		127	−162.5	−164.1		−175
510		129	−162.5	−163.4		−174
515		134	−162.5	−164.4		−175
517		136	−162.5	−164.0		−174
519		138	−162.6	−164.4		−173
522		141	−162.6	−163.9		−175
523	14	142	−162.6	−164.1	12	−174

Table 6. Downlink receiver signal strength, parity error rate

Pass	Station	Day	Tracking loop bandwidth, Hz	Predicted signal strength, dBmW	Average receiver signal strength, dBmW	Average parity error rate[a]		
						8 bits/s	16 bits/s	64 bits/s
381	51	244	3	−165.5	−165.6	0.050	NA	NA
382	51	245	3	−165.5	−165.5	0.150	NA	NA
382	14	245	12	−157.5	−158.4	NA	NA	0.055
383	51	246	3	−165.5	−165.8	(0.261)	NA	NA
384	41	247	12	−165.5	−166.8	CM	CM	CM
384	51	247	3	−165.5	−166.3	Bad data	NA	NA
384	14	247	12	−157.5	−158.1	NA	NA	0.060
385	14	248	12	−157.5	−157.8	NA	NA	0.025
388	14	251	12	−157.5	−158.8	Command	Command	Command
388	12	251	3	−165.5	−165.8	0.265	NA	NA
389	12	252/253	3	−165.5	−166.3	0.345	NA	NA
391	14	255	12	−157.5	−158.2	0.023	NA	0.109
392	51	255	3	−165.5	−165.7	Bad data	NA	NA
392	12	256	3	−165.5	−166.9	None recorded	None recorded	None recorded
393	41	256	12	−165.5	−166.8	CM	CM	CM
393	51	256	3	−165.4	−166.9	Bad data	NA	NA
393	12	256/257	3	−165.4	−166.1	Bad data	↓	NA
394	51	257	3	−165.4	−165.8	Bad data	↓	NA
394	12	257/258	3	−165.4	−166.5	0.353	↓	NA
395	51	258	3	−165.4	−165.5	Bad data	↓	NA
395	14	258/259	12	−157.4	−157.9	NA	↓	0.020
396	51	259	3	−165.4	−165.7	Bad data	↓	NA
396	14	259/260	12	−157.4	−157.1	0.015	↓	0.030
397	51	260	3	−165.4	−165.6	(0.538)	↓	NA
397	14	260/261	12	−157.4	−157.6	NA	↓	0.040
398	51	261	3	−165.4	−159.9	Bad data	↓	NA
398	14	261/262	12	−157.4	−157.8	NA	NA	0.075
399	12	262	3	−165.3	−167.2	CM	CM	CM
400	51	263	3	−165.3	−166.3	(0.550)	NA	NA
401	51	264	3	−165.3	−166.5	Bad data	NA	NA
402	51	265	3	−165.4	−166.3	(0.660)	NA	NA
402	14	265/266	12	−157.4	−157.6	NA	↓	0.040
403	51	266	3	−165.4	−165.8	Bad data	↓	NA
404	51	267	3	−165.4	−166.4	Bad data	↓	NA
404	14	267/268	12	−157.5	−158.1	NA	↓	0.070
405	51	268	3	−165.5	−166.2	0.045	↓	NA
408	51	271	3	−165.5	−165.0	0.040	NA	NA
408	11	271	12	−165.5	Uplink only	Command	Command	Command

[a]Values in parentheses fall outside the specified range. CM = coded mode.

Table 6 (contd)

Pass	Station	Day	Tracking loop bandwidth, Hz	Predicted signal strength, dBmW	Average receiver signal strength, dBmW	Average parity error rate[a]		
						8 bits/s	16 bits/s	64 bits/s
410	12	273/274	3	−165.5	−166.1	0.250	NA	NA
503	14	2	12	−159.5	−158.2	No data	No data	No data
504	14	3	12	−159.5	−158.9	No data	No data	No data
505	51	3	03	−167.5	−165.5	0.50	NA	NA
505	14	4	12	−159.5	−158.0	Bad data	NA	NA
506	14	5	12	−159.6	−158.3	No data	No data	No data
507	14	5/6	12	−159.6	−158.6	NA	NA	0.08
508	14	6/7	12	−159.7	−158.9	NA	NA	Bad data
512	14	11/12	12	−159.8	−158.3	No data	No data	No data
514	14	13	12	−159.9	−158.8	No data	No data	No data
515	51	13	03	−167.9	−165.0	Bad data	NA	NA
515	14	13/14	12	−159.5	−158.5	NA	0.01	NA
516	51	14	03	−167.9	−165.2	0.55	NA	NA
516	14	14	12	−159.9	−159.3	0.00	NA	NA
517	51	15	03	−168.0	−165.9	0.23	NA	NA
517	14	16	12	−160.0	−159.0	No data	No data	No data
518	51	16	03	−168.0	−165.2	0.30	NA	NA
518	14	16	12	−160.0	−159.0	No data	No data	No data
520	51	18	03	−168.1	−165.3	0.28	NA	NA
520	14	19	12	−160.1	−158.6	No data	No data	No data
521	51	19	03	−168.1	−165.2	0.29	NA	NA
521	14	20	12	−160.1	−160.9	NA	0.00	NA
522	14	20	12	−160.1	−161.4	NA	0.00	NA
523	51	21	03	−168.2	−165.1	0.22	NA	NA
523	14	21/22	12	−160.2	−158.9	NA	0.01	NA
524	51	22	03	−168.2	−165.7	0.20	NA	NA
524	14	22	12	−160.2	−158.8	0.00	0.00	NA
525	14	23	12	−160.2	−156.7	NA	0.02	NA
526	51	24	03	−168.3	−165.8	0.22	NA	NA
526	14	24/25	12	−160.3	−155.9	0.00	NA	0.22
527	51	25	03	−168.3	−165.9	0.30	NA	NA
527	14	26	12	−160.3	−156.1	No data	No data	No data
528	14	26/27	12	−160.4	−156.5	NA	NA	0.16
529	14	28	12	−160.4	−156.9	NA	NA	0.16
530	51	28	03	−168.4	−166.0	0.44	NA	NA
530	14	28/29	12	−160.4	−160.2	NA	0.10	0.94
531	14	29	12	−160.5	−159.0	NA	NA	NA
532	14	30	12	−160.5	−159.7	0.00	0.00	NA
533	14	31	12	−160.5	−157.5	NA	NA	NA

Table 6 (contd)

Pass	Station	Day	Tracking loop bandwidth, Hz	Predicted signal strength, dBmW	Average receiver signal strength, dBmW	Average parity error rate[a]		
						8 bits/s	16 bits/s	64 bits/s
536	51	34	3	−168.6	−166.2	0.735	NA	NA
537		35		−168.68	−165.8	0.666	NA	NA
539		37		−168.75	−165.7	0.646	NA	NA
540		38		−168.8	−165.8	0.238	NA	NA
541		39		−168.82	−166.06	—	—	—
542	51	40	3	−168.88	−166.43	—	—	—
542	14	40	12	−160.85	−157.36	0.000	NA	NA
543		41/42		−160.9	−156.7	0.000	0.000	NA
544		42/43		−160.95	−156.43	NA	0.017	0.341
545		43/44		−160.98	−156.15		NA	0.407
546		44		−161.0	−157.0		0.000	0.366
547		45		−161.03	−156.96		0.049	0.447
548		46		−161.06	−157.5		NA	0.361
549		47/48		−161.1	−159.74		0.000	Bad data
550		48/49		−161.1	−160.01		0.020	NA
551		49/50		−161.15	−160.1		0.037	NA
552		50/51		−161.18	−157.9		NA	0.448
553		51		−161.2	−158.2		0.006	NA
554		52		−161.2	−157.6		0.023	NA
555		53		−161.23	−160.12		0.071	NA
556		54/55		−161.28	−159.85		NA	NA
557		55/56		−161.3	−156.87		NA	0.797
558		56/57		−161.3	−156.8		0.002	NA
559		58		−161.33	−157.2		0.006	0.595
560		58		−161.38	−159.6		0.000	NA
561		59		−161.4	−157.2		NA	0.777
562	14	60	12	−161.4	−155.7	NA	NA	0.812

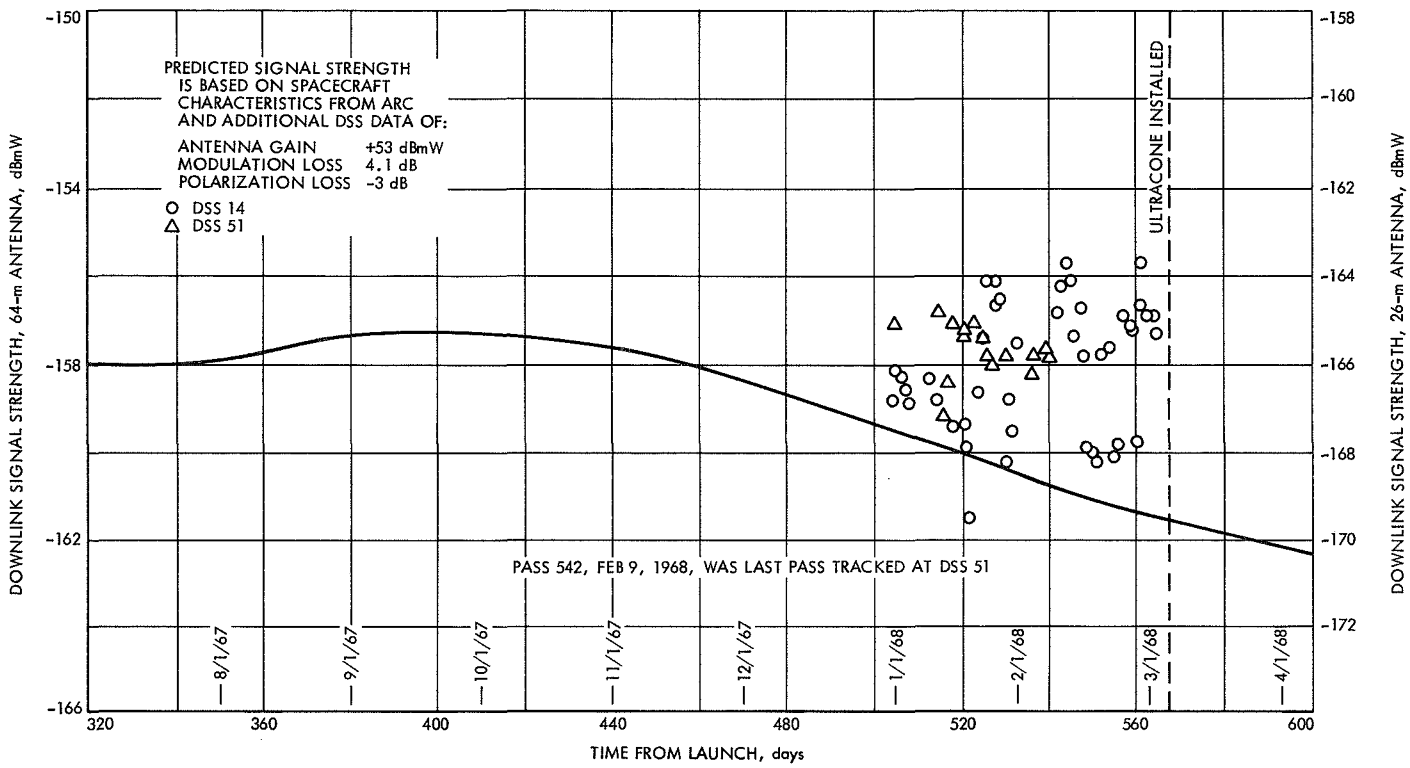

Fig. 13. Predicted and actual downlink signal strength vs days from launch, passes 536–562

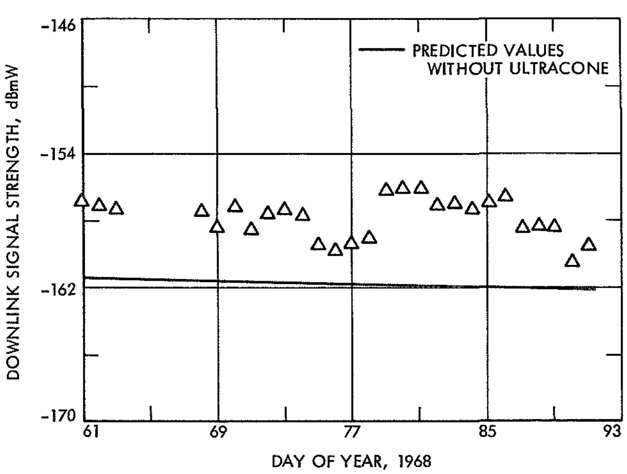

Fig. 14. Downlink signal strength vs day of year, passes 563–592, DSS 14

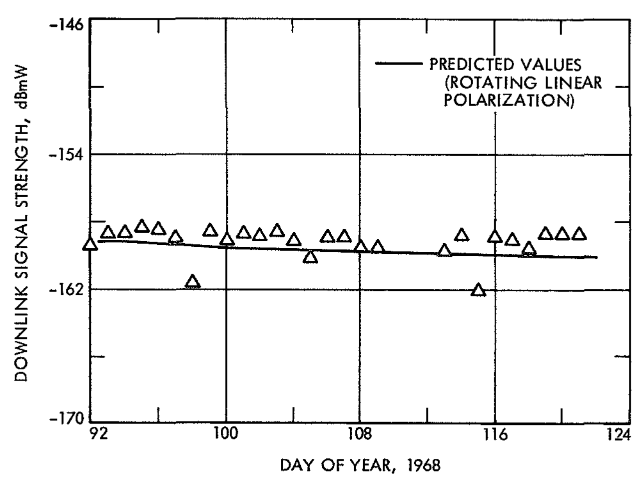

Fig. 15. Downlink signal strength vs day of year, passes 594–623, DSS 14

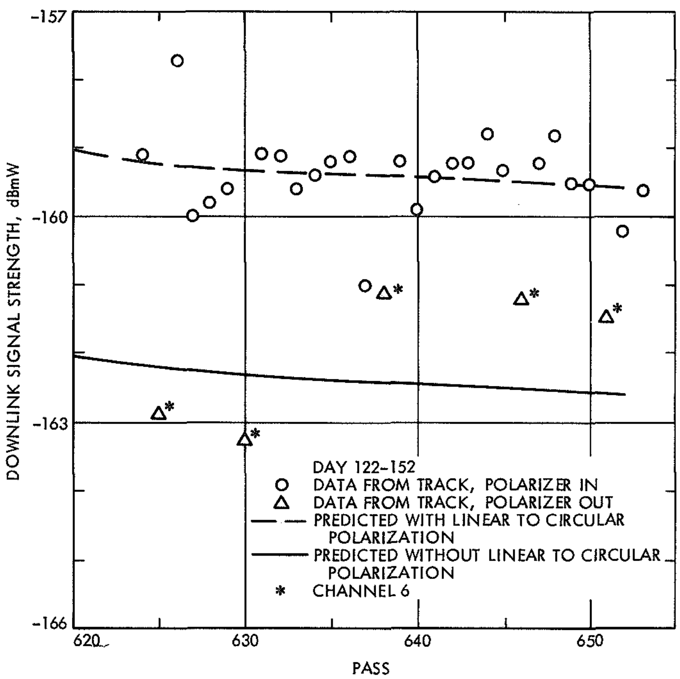

Fig. 16. Downlink signal strength, passes 624–652

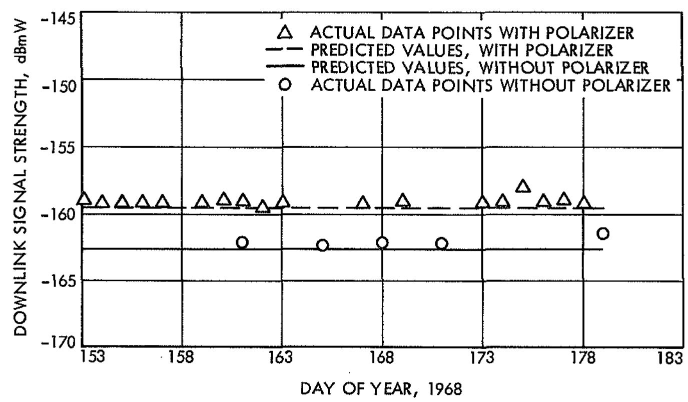

Fig. 17. Downlink signal strength vs day of year, passes 654–681, DSS 14

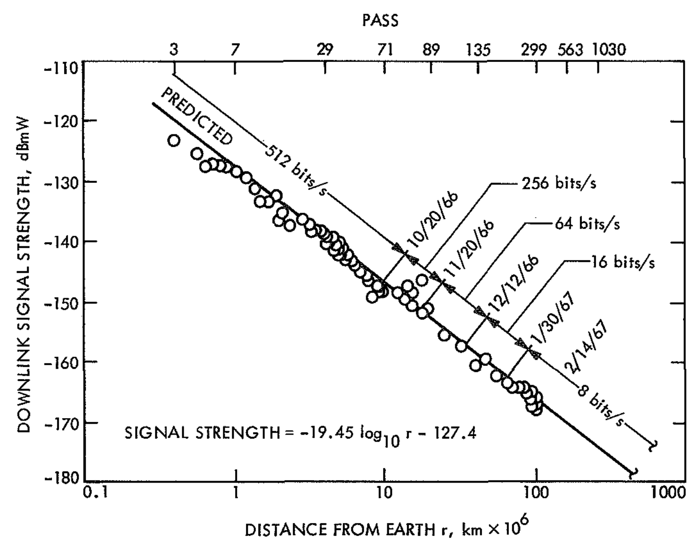

Fig. 18. Downlink signal strength for DSS 11 and DSS 12

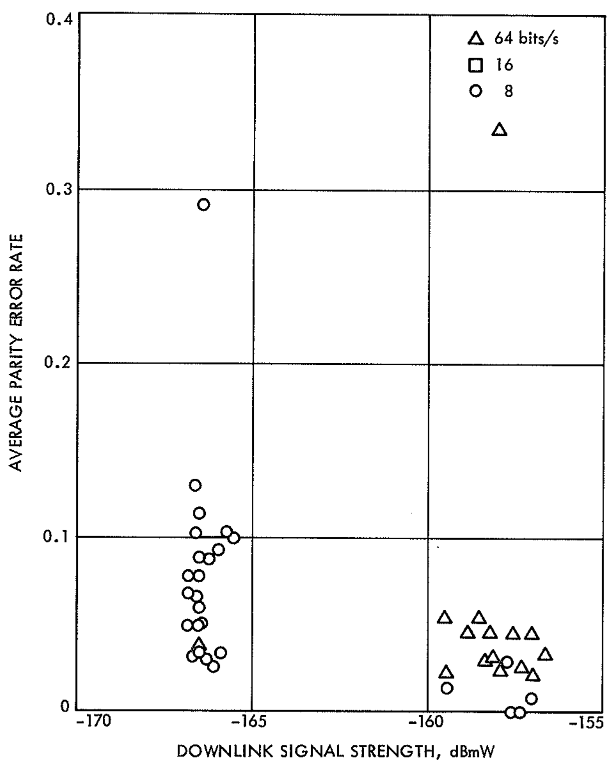

Fig. 19. Parity error rate vs downlink signal strength, passes 351–380

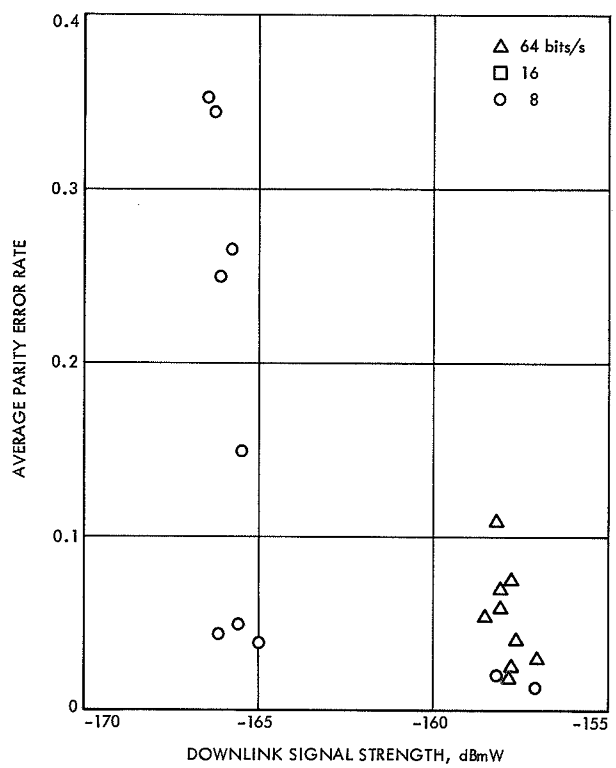

Fig. 20. Parity error rate vs downlink signal strength, passes 381–410

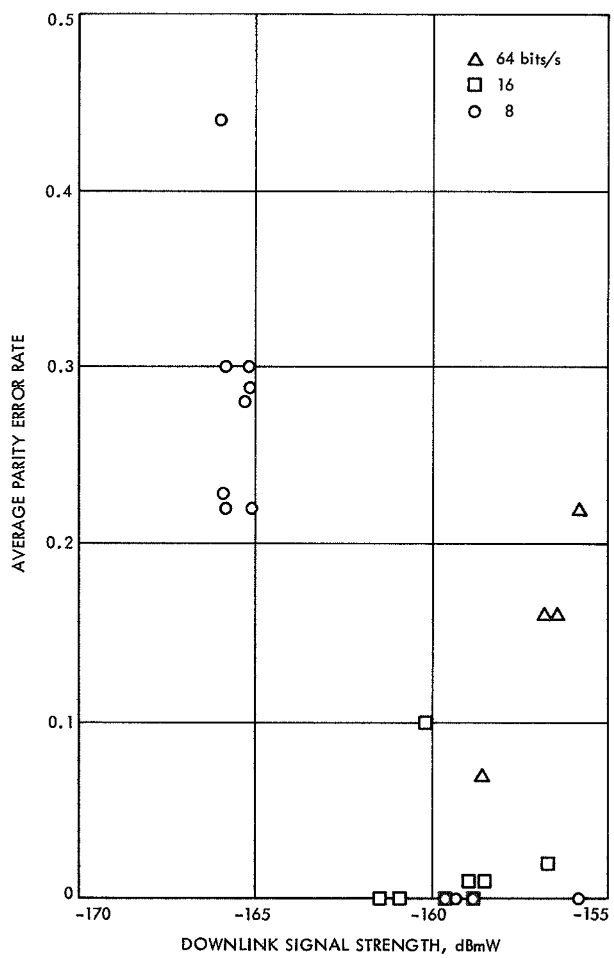

Fig. 21. Parity error rate vs downlink signal strength, passes 503–533

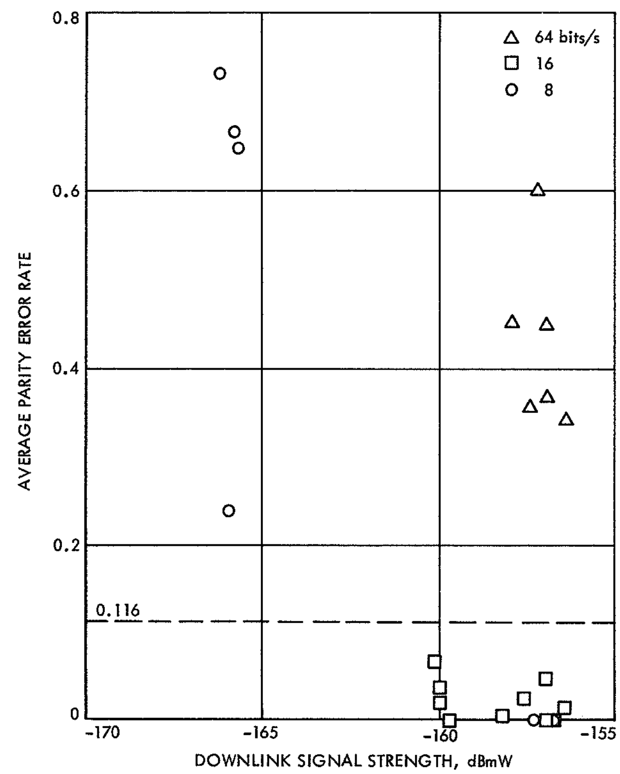

Fig. 22. Parity error rate vs downlink signal strength, passes 534–562

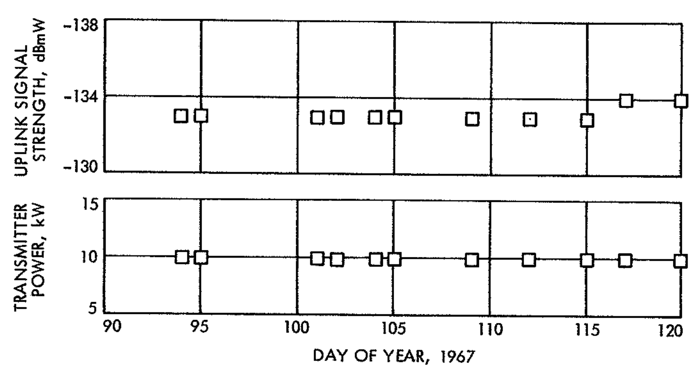

Fig. 23. Uplink signal strength and transmitter power vs time, passes 230–256, DSS 12

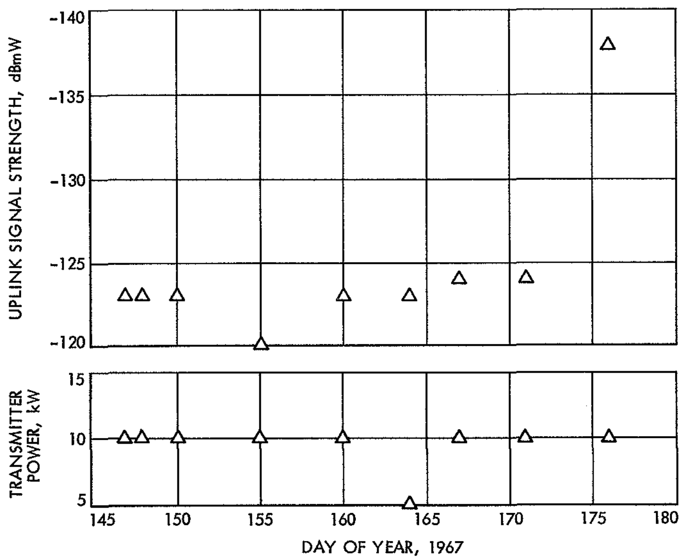

Fig. 24. Transmitter power vs uplink signal strength, passes 290–317, DSS 14

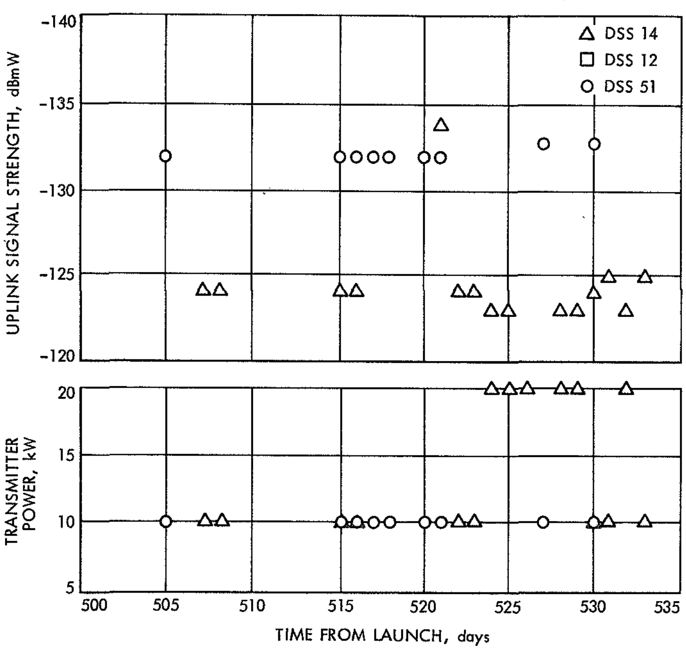

Fig. 25. Uplink signal strength transmitter power vs days after launch, passes 503–533

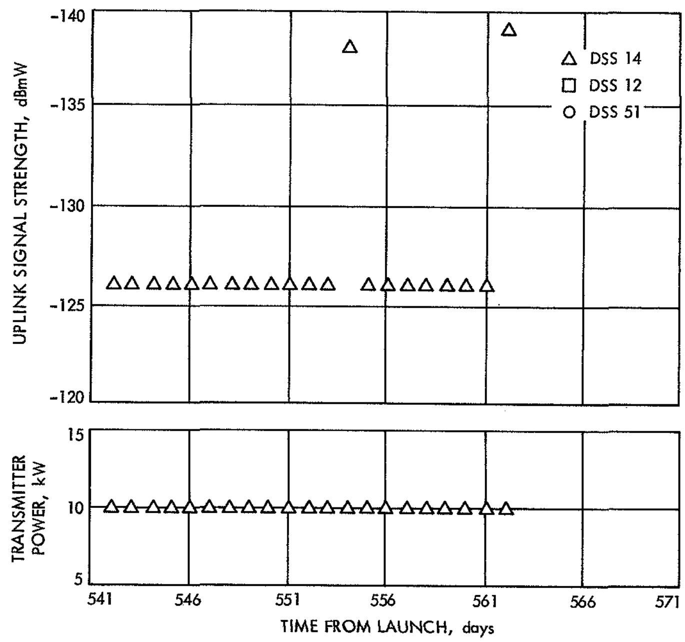

Fig. 26. Uplink signal strength transmitter power vs days after launch, passes 534–562

Table 7. In-lock tracking, passes 230–256

Tracking	Time, min	Percentage
Scheduled	6977	100.00
Actual	6458	92.56
Transmitter on	6362	91.18
Receiver in-lock (two-way)	2862	41.02

Table 8. In-lock tracking, passes 290–317

Tracking	Time, min	Percentage
Scheduled	8129	100.00
Actual	8163	100.41
Transmitter on	3302	40.62
Receiver in-lock (one- and two-way)	8117	99.85
Good tracking data	8063	99.18

Table 9. In-lock tracking, passes 503–533

Tracking	Time, min	Percentage
Scheduled	16,225	100.0
Actual	15,653	96.4
Transmitter on	8907	56.9[a]
Receiver in-lock (one- and two-way)	14,865	94.9[a]
Good tracking data	13,888	88.7[a]
FR-1400 in-lock	14,865	94.9[a]
TCP in-lock	14,863	94.9[a]
Demodulator in-lock	14,865	94.9[a]

Table 10. In-lock tracking, passes 534–562

Tracking	Time, min	Percentage
Scheduled	10,680	100.0
Actual	11,025	103.2
Transmitter on	5800	52.6[a]
Receiver in-lock (one- and two-way)	10,245	92.9[a]
Good tracking data	10,022	90.9[a]
FR-1400 in-lock	10,245	92.9[a]
TCP in-lock	10,209	92.5[a]
Demodulator in-lock	10,228	92.7[a]

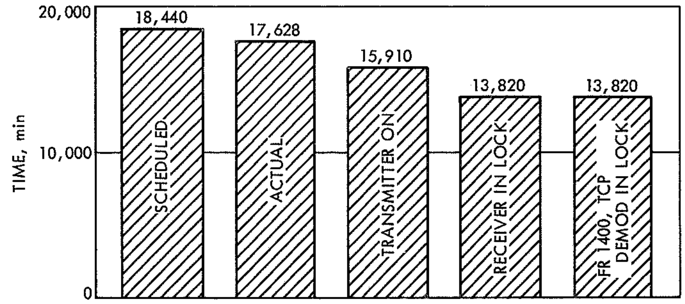

Fig. 27. In-lock tracking time, actual and scheduled, passes 192–227

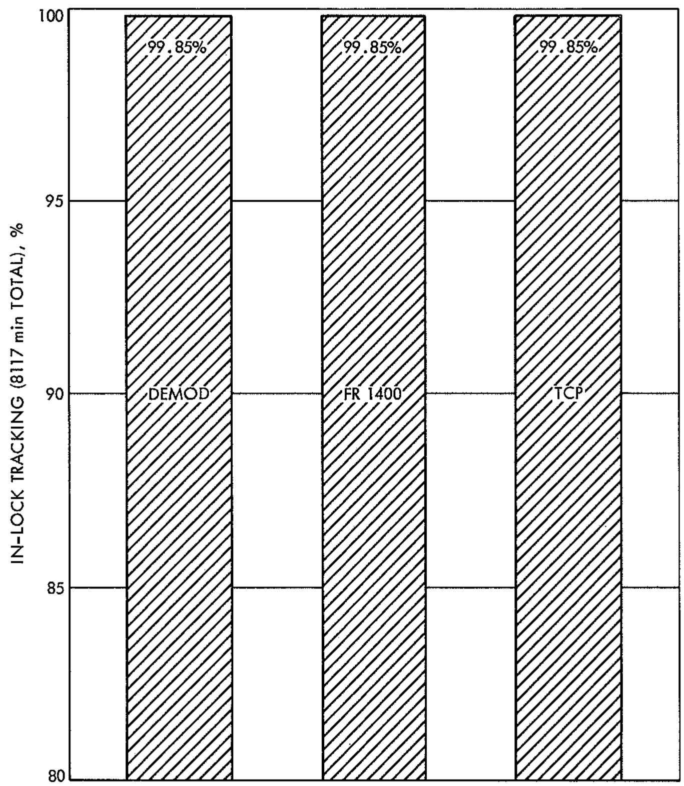

Fig. 28. In-lock tracking percent, passes 290–317, DSS 14

E. Fitterate Program

The fitterate program was an SDS 930 computer program which processed tracking data handling (TDH) subsystem data in posttrack time for purposes of quality analysis. For an interval of "legal" (correct, not garbled or distorted) printed doppler data with a constant sample interval, 1-s doppler frequencies were calculated and fit by a least-squares technique (with polynomial of degree n, where n may range from 1 to 9). Residual differences between actual data and the curve of the least squares polynomial were calculated; then the standard deviation about the curve was calculated. All residuals were tested to see whether they exceeded 3.5σ, in which case the corresponding points were discarded and a new curve fit to the remaining data. This process was repeated until all residuals for the last curve passed a 3.5σ test.

Where data for one pass was to be processed in multiple intervals, a composite σ was calculated according to the weighted root sum square formula

$$\sigma_{comp} = \left(\frac{\sum_{i=1}^{n} a_i \sigma^2}{\sum_{i-1}^{n} a_i} \right)^{1/2}$$

where

a_i = number of points in i interval

σ_i = standard deviation for the final curve for the ith interval

n = number of intervals for the pass

Pioneer VII fitterate doppler noise estimates for passes 597–623 are given in Table 11. A graph of the noise vs day-number is given in Fig. 29. The graph indicates that the noise at DSS 14 was very consistent throughout this report period. In fact, values calculated for the noise were almost all below their expected value; possibly, for a given pass one single noise value was not necessarily representative of that pass. In those cases where two or more noise values appear for one pass, the values noted are indicative of the noise existing on different intervals of the same pass. In general, the noise measurements taken at different intervals of the same pass, but at the same sample rate, should approximate each other.

Two noise readings were taken at a sample rate of 10 s. The noise value expected with resolver for data tracked at a 10-s sample rate was 0.02 Hz. Thus, the noise measured at DSS 14 for that sample rate was at a lower level.

Excessively high noise noted on day 95 had no apparent cause. Two exclusive runs (with and without resolver) were made; both runs estimated the magnitude of the noise to be large—approximately 0.041 Hz. Further investigation disclosed that the signal strengths received were normal. No known ground operation malfunctions were experienced. However, no station precalibrations were made prior to track; this could have been responsible for the abnormal noise recorded on that day.

Figure 30 is a plot of composite standard deviation vs pass numbers, where the composite standard deviation for passes with multiple intervals of data processed was calculated by the indicated formula.

The fitterate program was run for a number of *Pioneer VII* passes during May, and the results are shown in Fig. 31. Here standard deviation (σ) corresponding to the first curve generated for each pass is plotted as a function of pass number as well as the final σ corresponding to the last curve fit. A logarithmic scale was employed along the σ axis because of the large

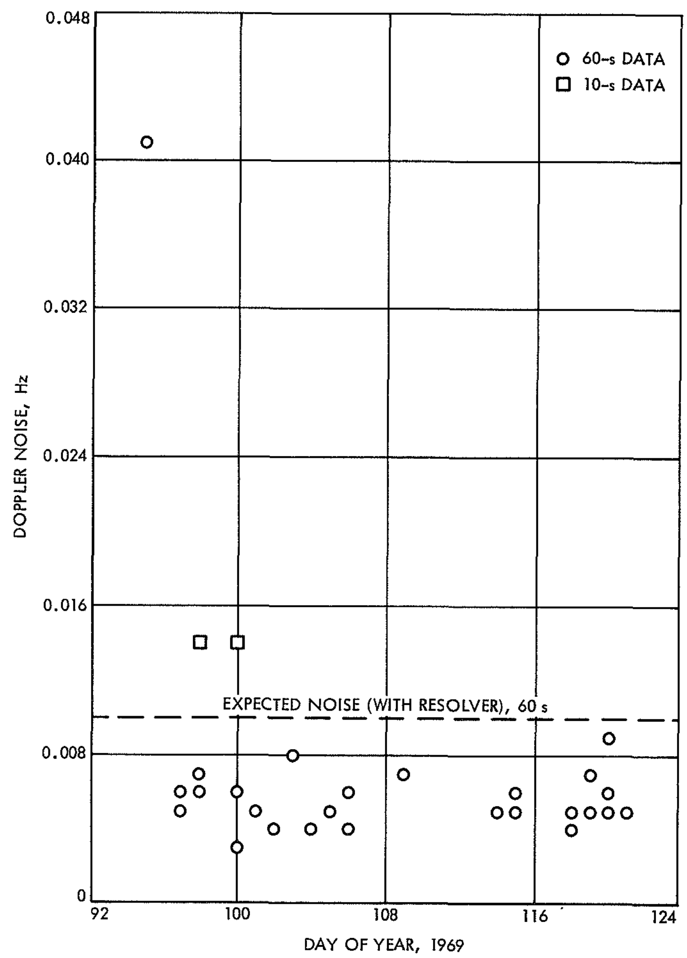

Fig. 29. Fitterate doppler noise estimates, passes 594–623, DSS 14

Table 11. Fitterate doppler noise estimates, DSS 14, passes 597–623

Pass	Day	Time interval, GMT	Sample period, s	Number of points	σ (noise)
597	95	201002–230002	60	137	0.041
598	97	004502–020902		55	0.006
598	97	054202–064702		47	0.005
599	97	211302–224802		54	0.005
600	98	211502–235702	60	135	0.006
600	98/9	235738–001138	10	83	0.014
600	98/9	001302–064602	60	298	0.007
601	99/100	235915–001125	10	48	0.014
601	100	001202–010502	60	32	0.006
601	100	022502–025502		29	0.003
602	100	2054402–225201		61	0.005
603	101/2	202402–223502		94	0.005
604	102	202302–230002		143	0.004
605	103/4	235102–064602		163	0.008
606	104	211902–224802		62	0.004
606	105	055102–064202		39	0.005
607	105	212002–224802		74	0.005
607	106	061402–064302		28	0.005
608	106/7	231902–011302		83	0.004
608	107	054802–064402		54	0.006
611	109/10	211202–020002		263	0.007
615	114	021402–064202		226	0.005
616	114	201302–225502		143	0.005
617	115	200302–225602		167	0.006
618	116/7	234502–013302		82	0.005
618	117	050002–064202		84	0.004
619	118	024602–034902		58	0.004
619	118	050902–064102		74	0.005
620	118/9	233302–003402		51	0.005
620	119	054902–064102		51	0.007
621	119	232102–004402		80	0.009
621	120	053702–064102		63	0.005
622	120	211402–030002		295	0.006
623	121	183402–194802		73	0.005
623	121	201802–225702	60	158	0.005

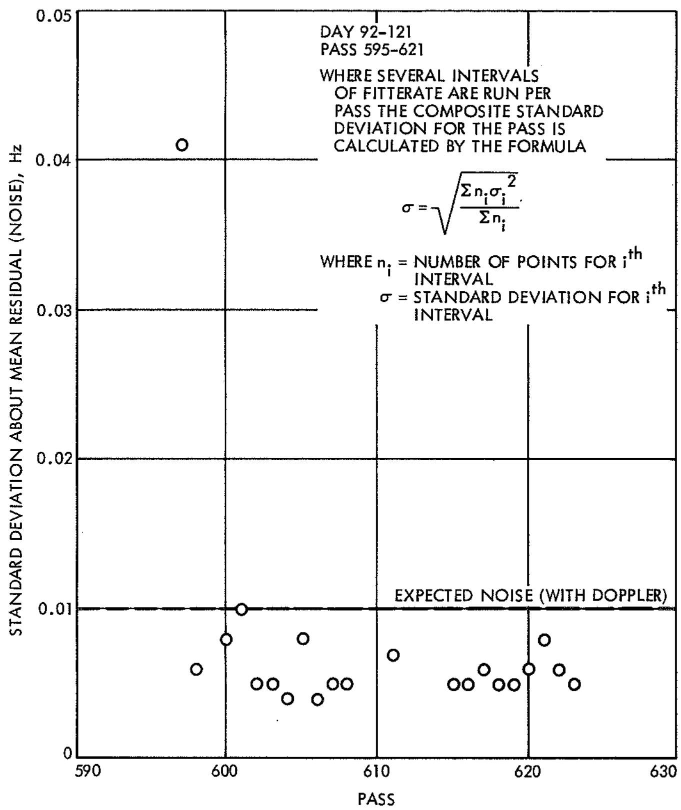

Fig. 30. Composite standard deviation vs pass numbers, DSS 14

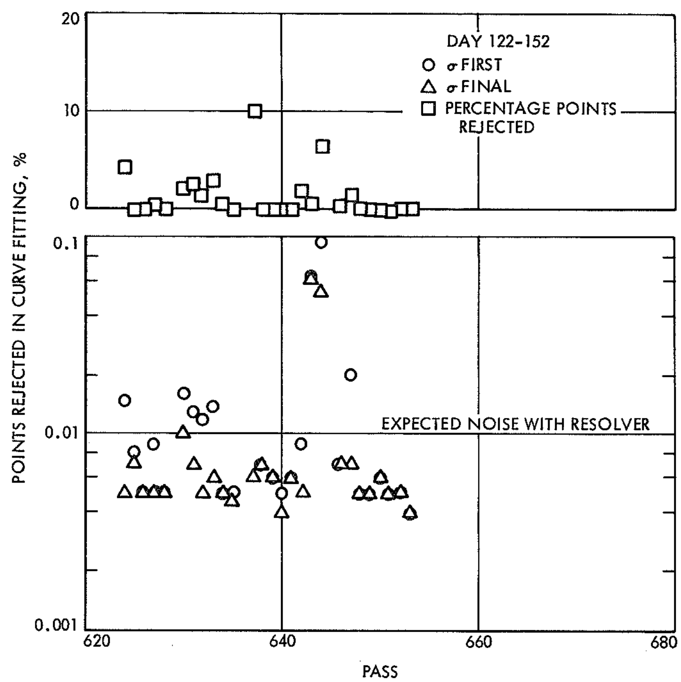

Fig. 31. Fitterate doppler noise, passes 624–652, DSS 14

spread in the magnitudes of σ. Above the plot of σ, but employing the same scale along the horizontal axis, the percentage of points rejected by the 3.5 σ tests is plotted.

Figure 31 shows that numerous passes during May (as contrasted to April) required the generation of multiple curves, and that values of σ ranged much higher than for April, particularly in passes 624, 637, and 644.

Pass 630 had an average parity error rate at 16 bits/s exceeding the threshold level of 0.117 corresponding to 1 error in 1000 bits of information. This correlated with the low downlink signal strength on pass 630. Virtually all data transmitted at 64 bits/s had parity error rates exceeding 0.116, suggesting that the threshold for good telemetry of this bit rate had been reached.

Passes 624, 637, and 644 were flagged by the fitterate program as having high noise levels in spite of good two-way data condition code. No specific hardware or software anomalies were found which could provide an explanation. The general increase in doppler noise in May 1968 over April 1968 suggests that there may have been a gradual deterioration of some of the components in the overall data collecting and processing system. Passes 630 had very low signal strengths, owing to the fact that tracking was done on channel 6 with the linear-to-circular polarizer out.

The σ_F and the percentage of rejected points per pass are plotted in Fig. 32. Pass 662 showed excessively high values of noise σ_F. The same two passes where characterized by R, which represents fairly high percentages of rejected points (greater than 5%). Pass 671 is characterized also by a value of $R > 5\%$, but the final noise σ_F was quite acceptable. Investigation did not reveal any source of unusually high noise for these three passes.

F. Telemetry Performance

Table 12 and Figs. 33 through 39 present parity error rate information for the period covered by this document. A parity error rate of 0.116 was equivalent to one error in 1000 consecutive bits of information and was regarded as the limiting value for the uncoded and convolution-coded unit modes of information.

G. Predicted Frequency Performance

Accumulated information on best-lock rest frequency and auxiliary oscillator frequency is presented in Figs. 40 through 65.

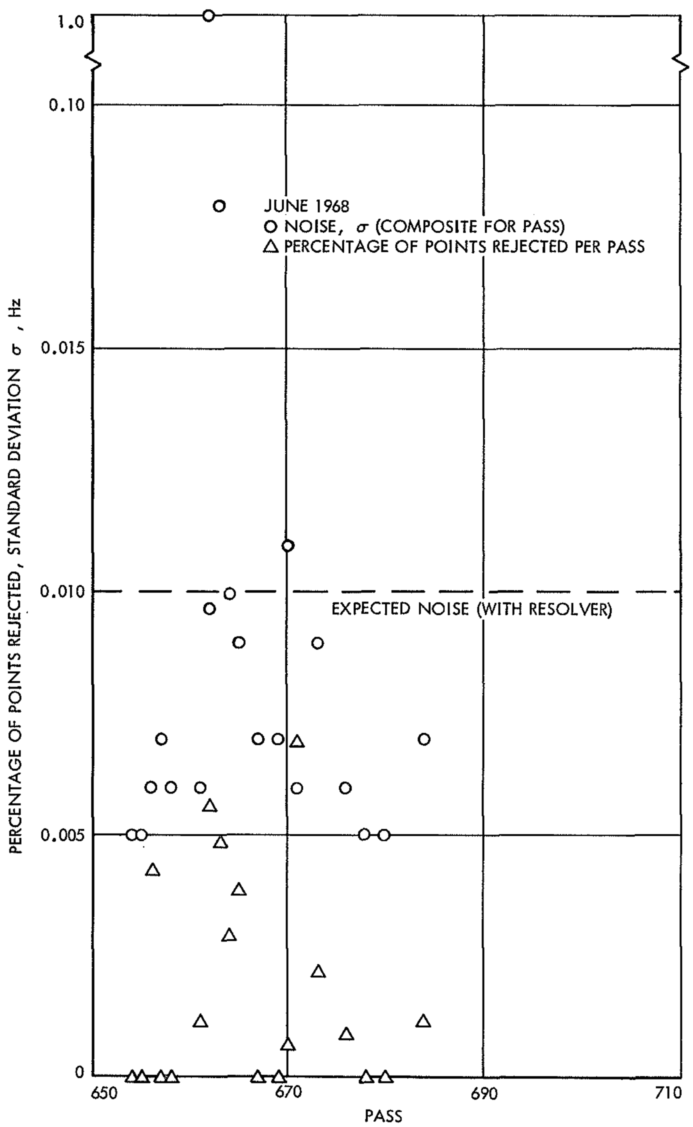

Fig. 32. Percentage of points rejected vs pass number, passes 654–681, DSS 14

Table 12. Parity error rate, passes 290–317

Pass	Day	Average parity error rate	Bit rate, bits/s	Average signal strength, dBmW	Station
290	153	0.331	8	−167.5	51
292	155	0.268	8	−166.5	51
294	157	0.299	8	−166.5	51
297	160	0.026	8, 64	−158.9	14
301	164	0.015	8, 64	−158.7	14
304	167	NA[a]	NA[a]	−166.8	41
304	167	0.029	8, 64	−158.2	14
305	168	0.194	8	−166.5	51
306	169	0.193	8	−166.9	51
307	170	NA[a]	NA[a]	−166.1	41
308	171	0.167	8	−167.0	51
308	171/2	0.030	8, 16, 64	−158.6	41
310	173	0.115	8	−166.7	51
313	176	0.140	8	−166.6	51
313	176	0.021	8, 16, 64	−158.7	14
315	178	0.146	8	−166.8	51
316	179	NA[b]	NA[a]	−167.8	12
317	180	0.120	8	−166.6	51

[a]Coded mode pass; telemetry data is taken.

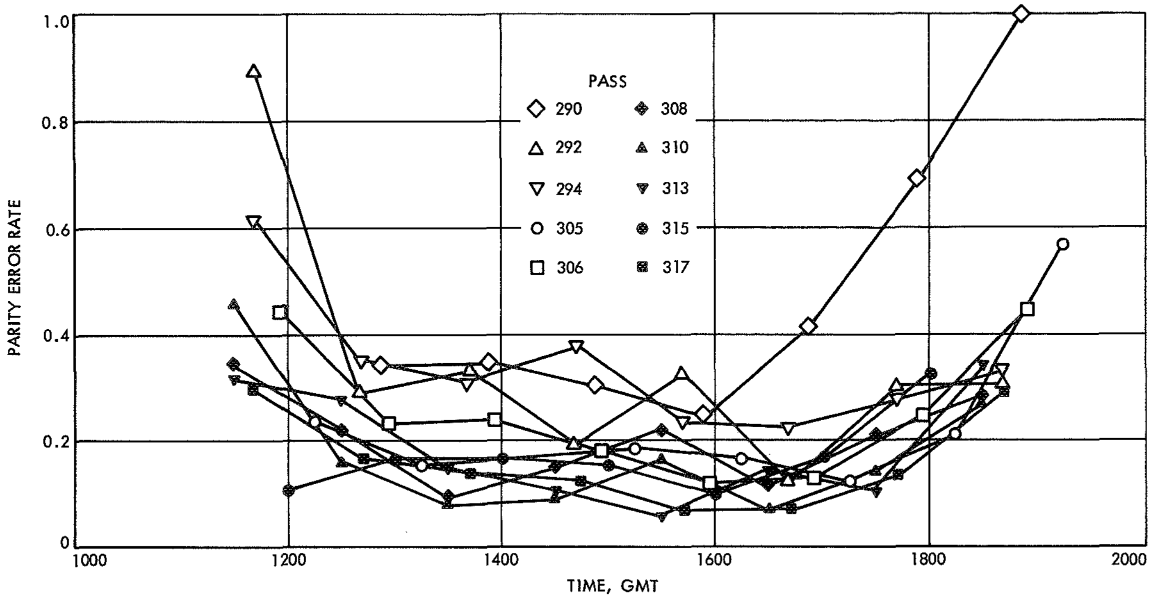

Fig. 33. Parity error rates, June 1–30, 1967

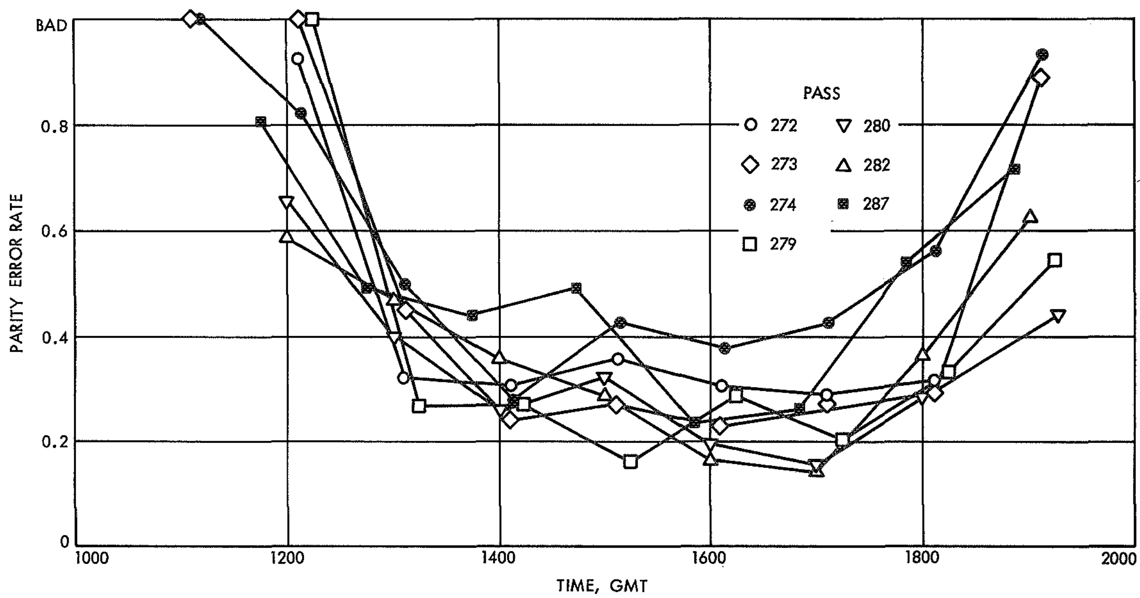

Fig. 34. Parity error rates, May 15–31, 1967

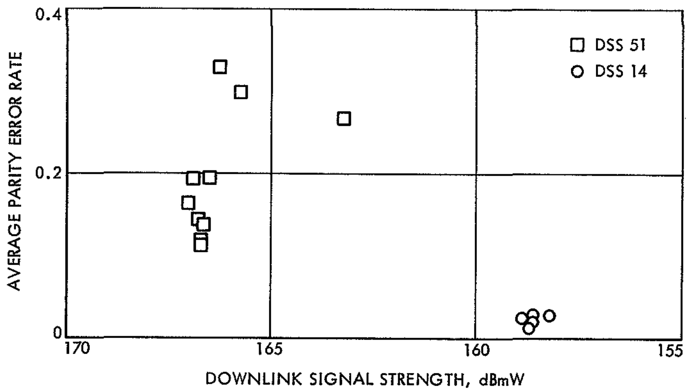

Fig. 35. Parity error rate vs signal strength, passes 290–317

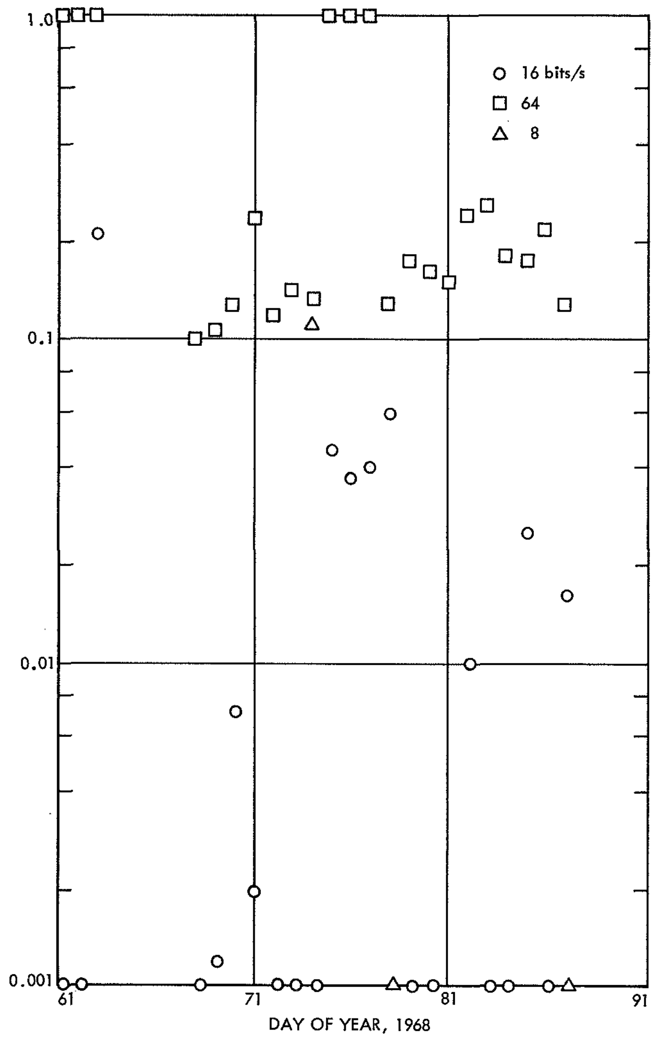

Fig. 36. Parity error rate, passes 563–592, DSS 14

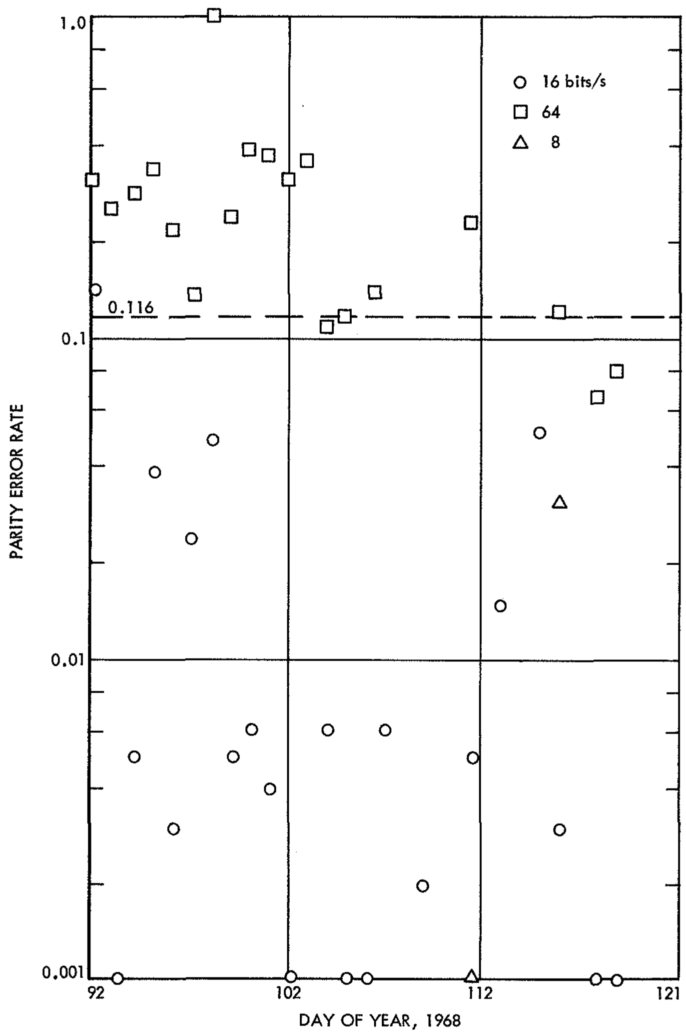

Fig. 37. Parity error rate vs day of year, passes 594–623, DSS 14

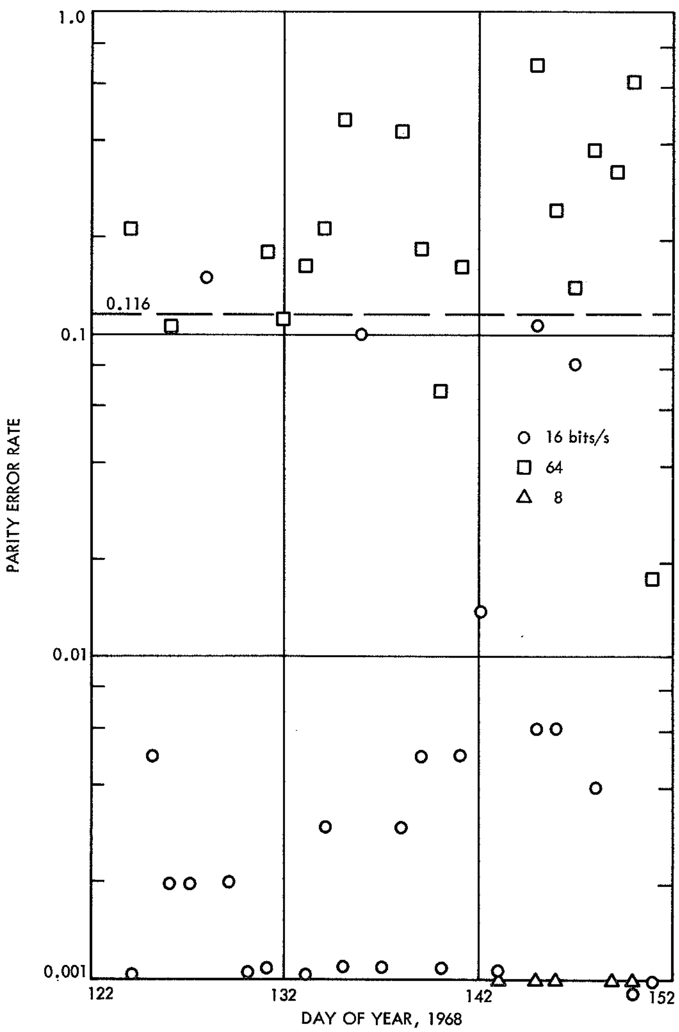

Fig. 38. Parity error rate vs day of year, passes 624–653, DSS 14

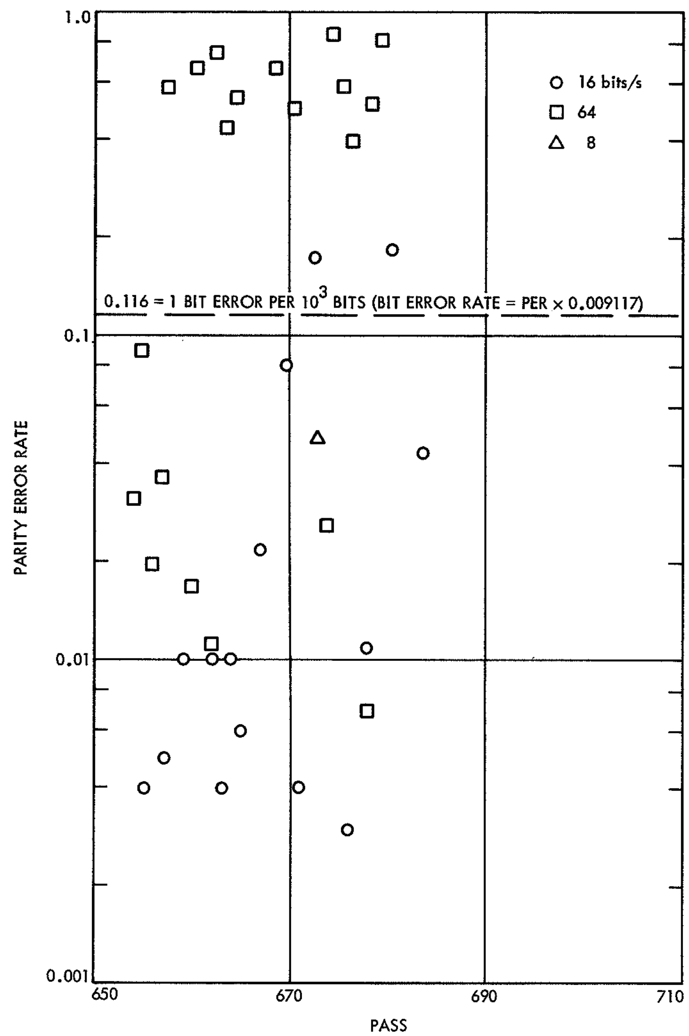

Fig. 39. Parity error rate vs pass number, passes 654–684, DSS 14

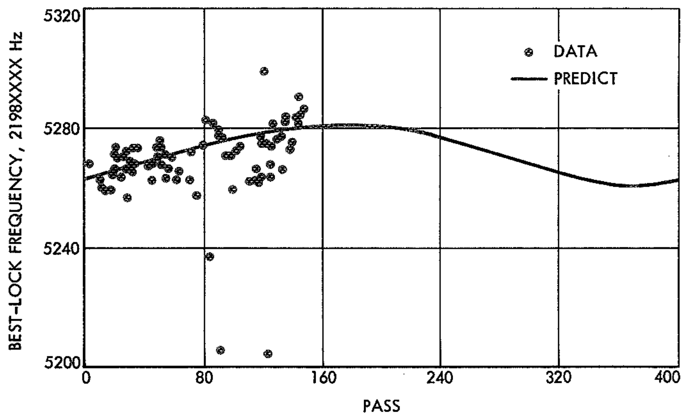

Fig. 40. Channel 6 rest frequency vs pass number, passes 192–227

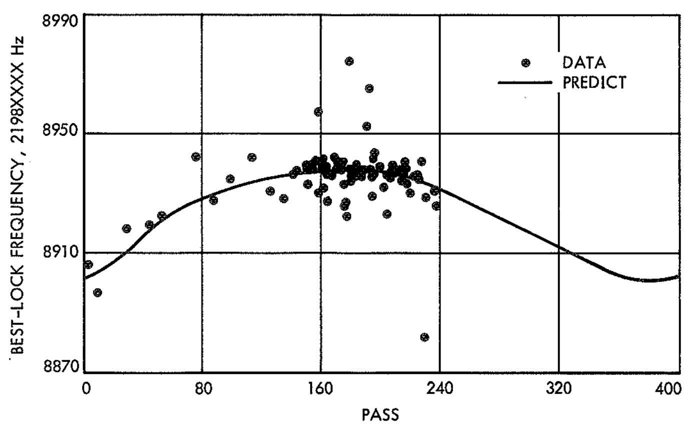

Fig. 41. Channel 7 rest frequency vs pass number, passes 192–227

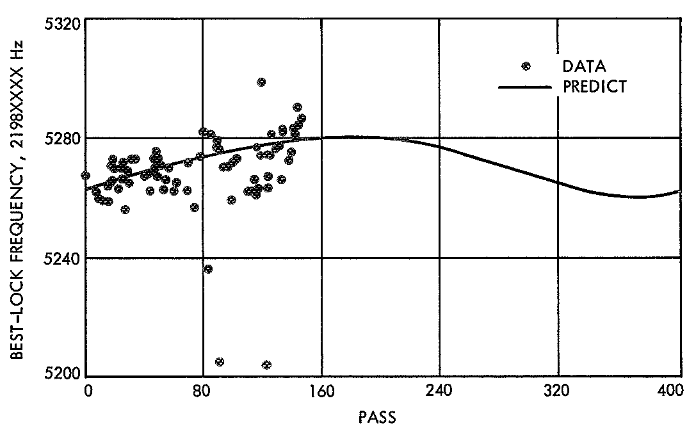

Fig. 42. Channel 6 rest frequency vs pass number, passes 230–256

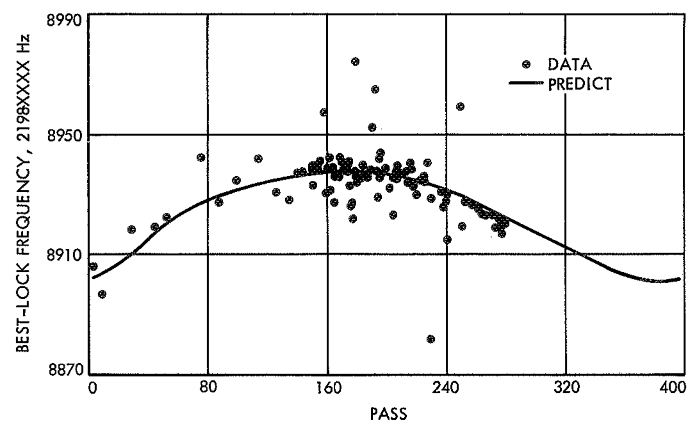

Fig. 43. Channel 7 rest frequency vs pass number, passes 230–256

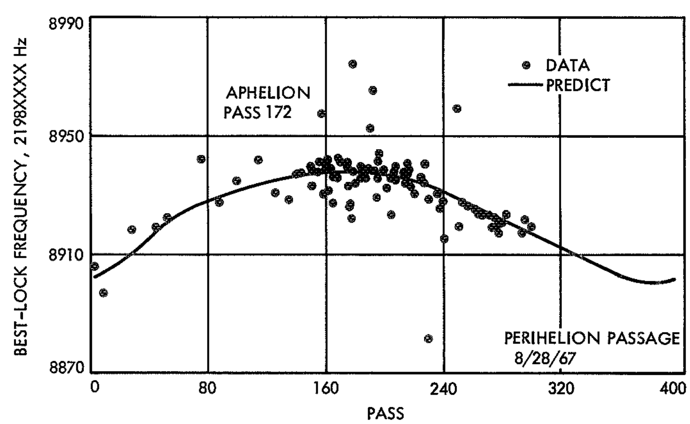

Fig. 44. Channel 7 rest frequency vs pass number, passes 258–287

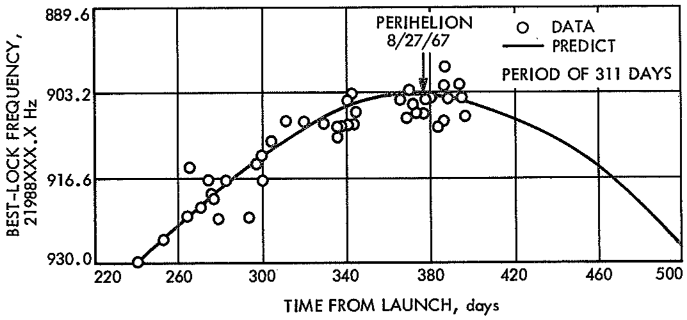

Fig. 45. Channel 7 best-lock rest frequency vs days after launch, passes 351–380

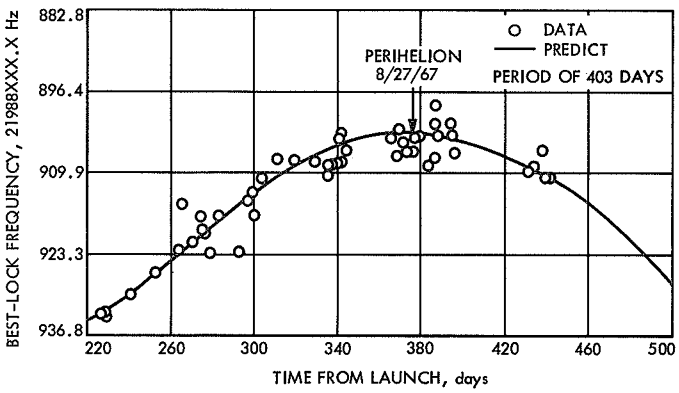

Fig. 46. Channel 7 best-lock rest frequency vs days after launch, passes 381–410

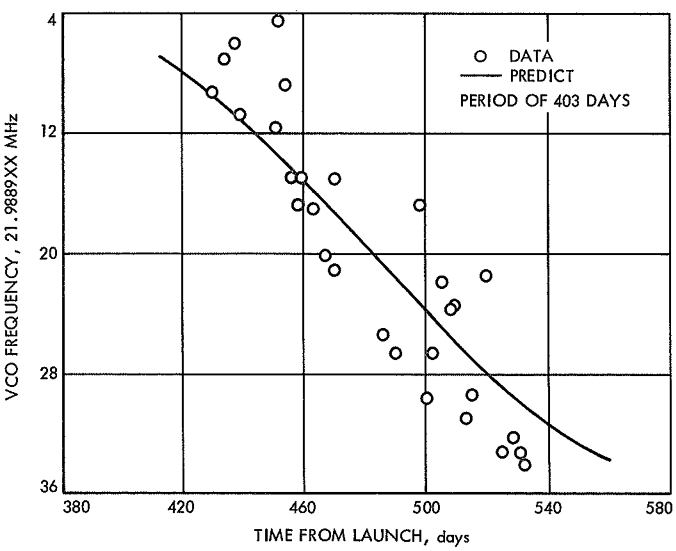

Fig. 47. Channel 7 best-lock rest frequency vs days after launch, passes 414–502

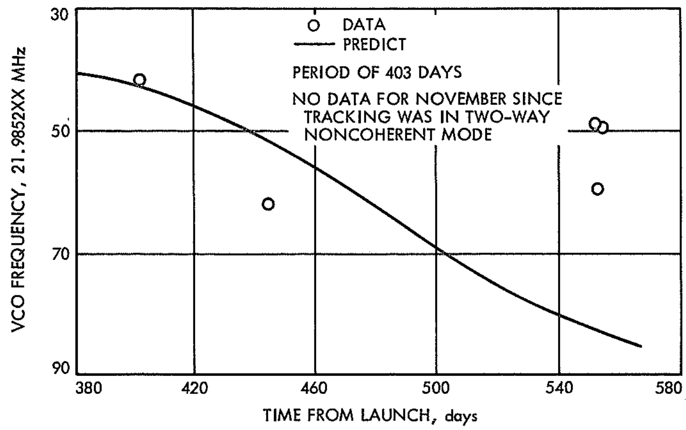

Fig. 48. Channel 6 best-lock rest frequency vs days after launch, passes 503–533

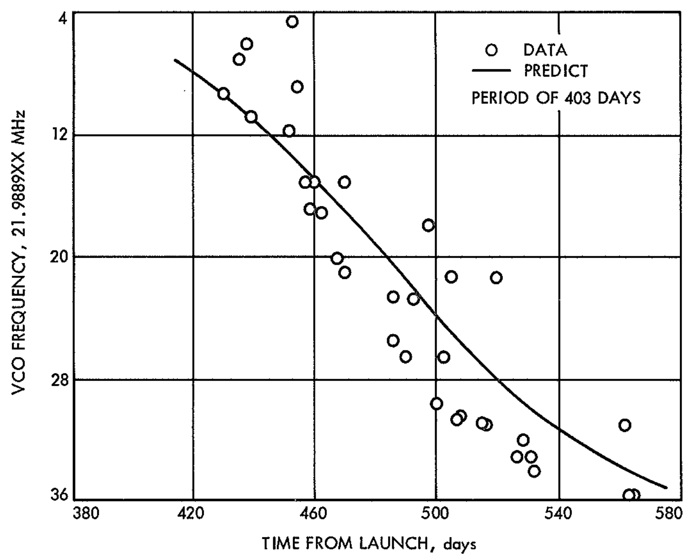

Fig. 49. Channel 7 best-lock rest frequency vs days after launch, passes 503–533

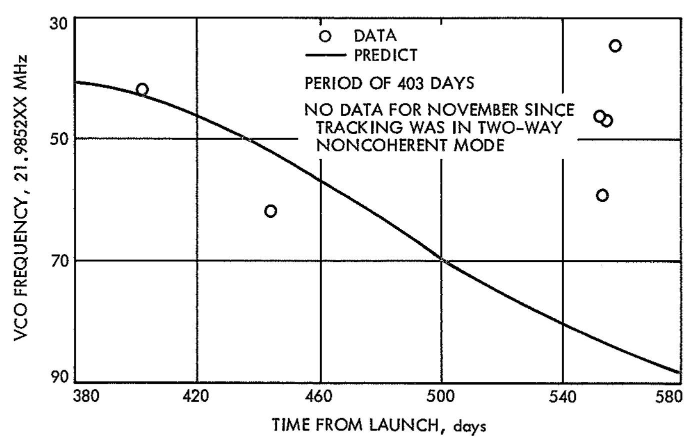

Fig. 50. Channel 6 best-lock rest frequency vs days after launch, passes 536–562

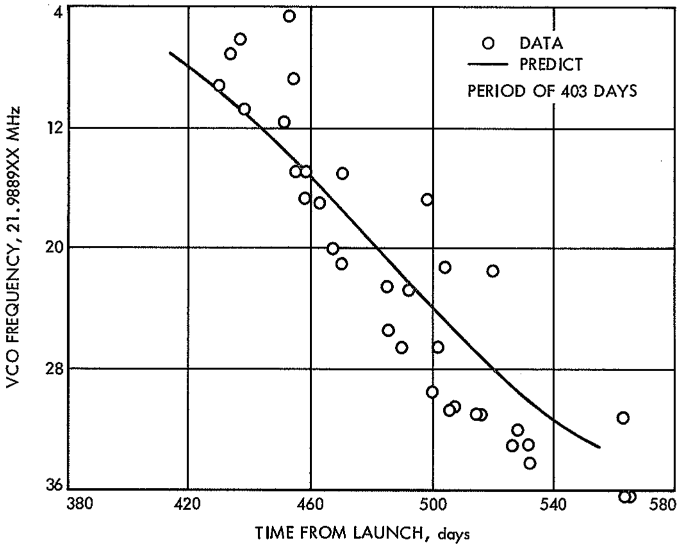

Fig. 51. Channel 7 best-lock rest frequency vs days after launch, passes 536–562

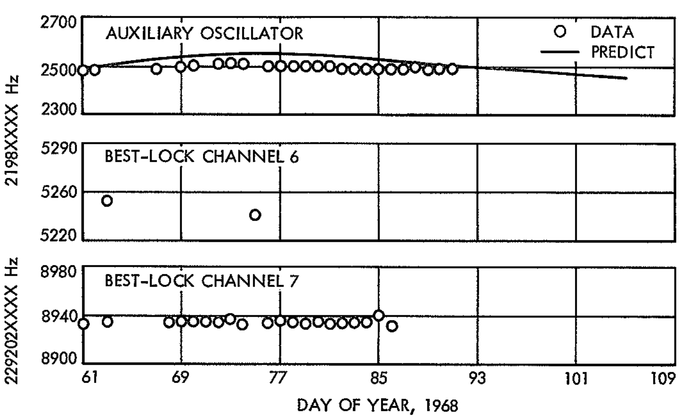

Fig. 52. Channels 6 and 7 best-lock frequencies, passes 563–592, DSS 14

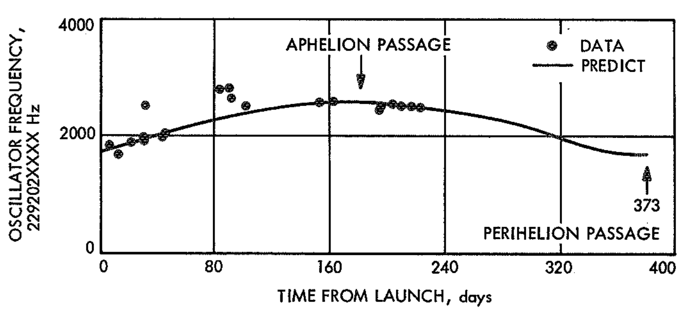

Fig. 53. Auxiliary oscillator frequency vs days after launch, passes 192–227

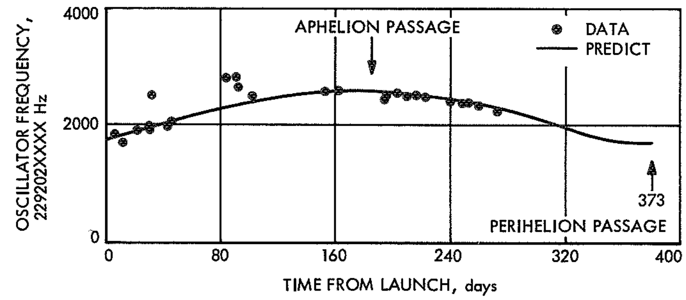

Fig. 54. Auxiliary oscillator frequency vs days after launch, passes 230–256

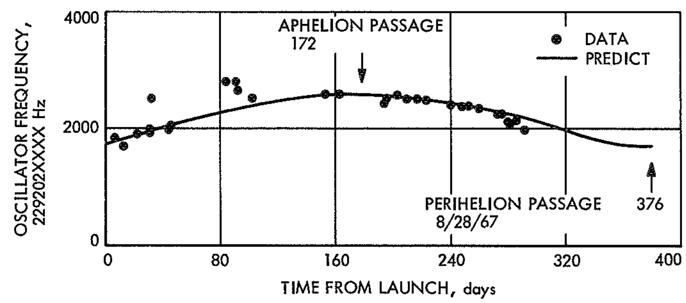

Fig. 55. Auxiliary oscillator frequency vs days after launch, passes 258–287

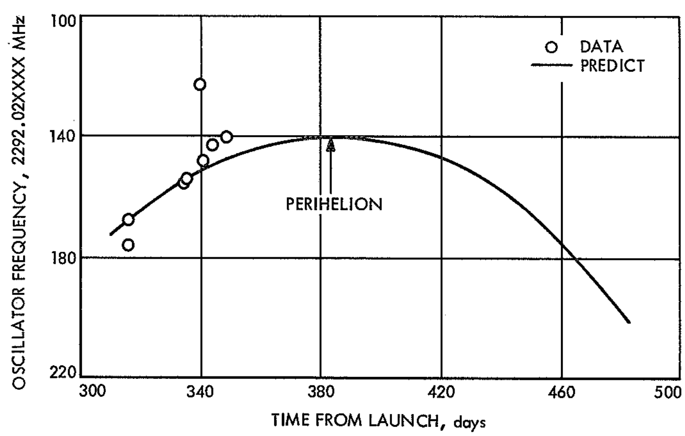

Fig. 56. Auxiliary oscillator frequency vs days after launch, passes 290–317

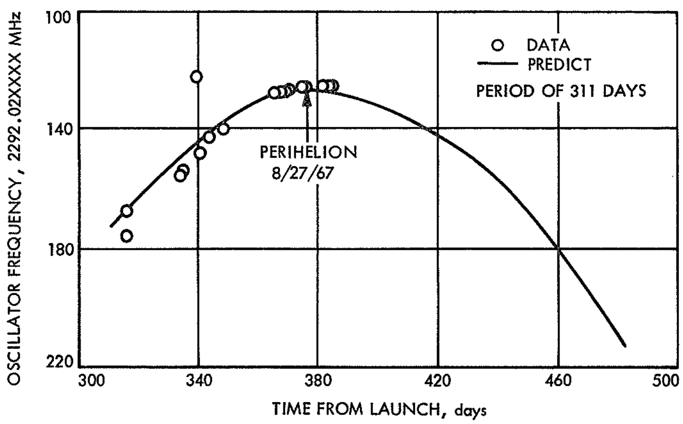

Fig. 57. Auxiliary oscillator frequency vs days after launch, passes 320–349

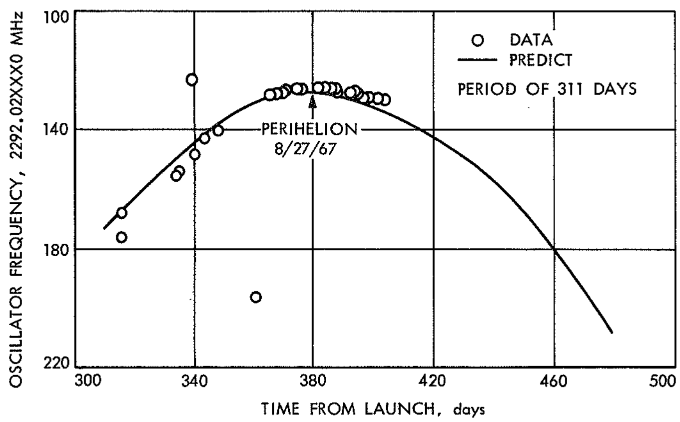

Fig. 58. Auxiliary oscillator frequency vs days after launch, passes 351–380

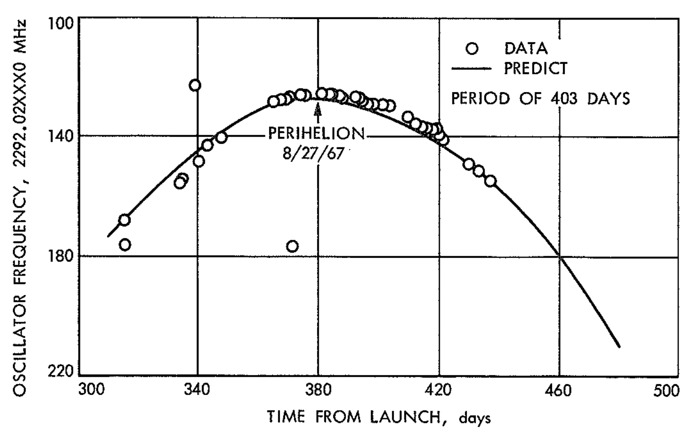

Fig. 59. Auxiliary oscillator frequency vs days after launch, passes 381–410

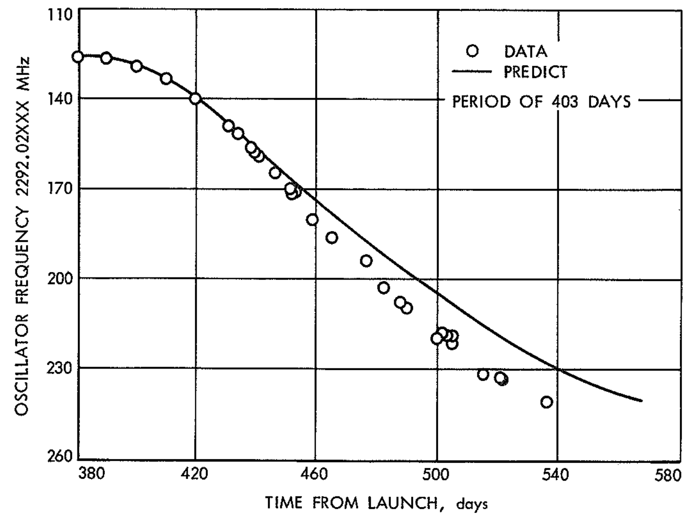

Fig. 60. Auxiliary oscillator frequency vs days after launch, passes 414–502

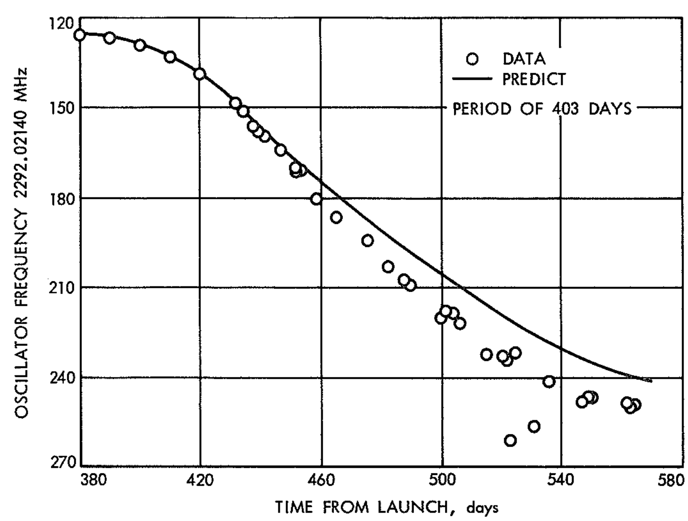

Fig. 61. Auxiliary oscillator frequency vs days after launch, passes 503–533

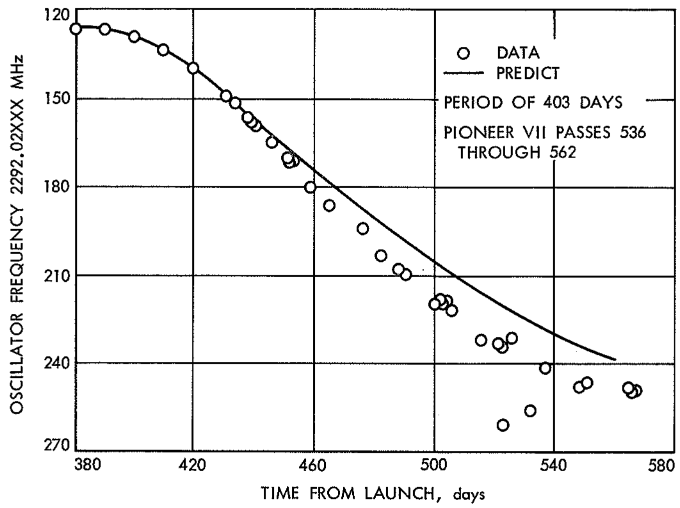

Fig. 62. Auxiliary oscillator frequency vs days after launch, passes 536–562

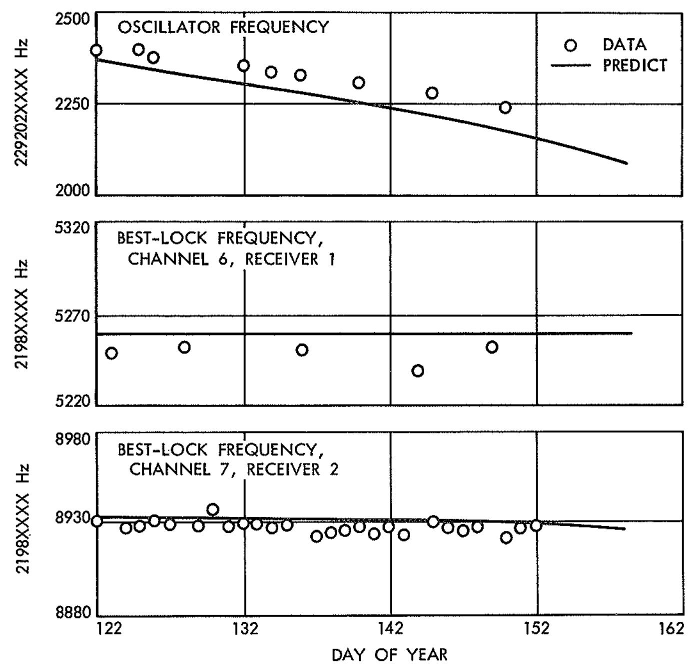

Fig. 64. Frequencies, passes 624–652, DSS 14

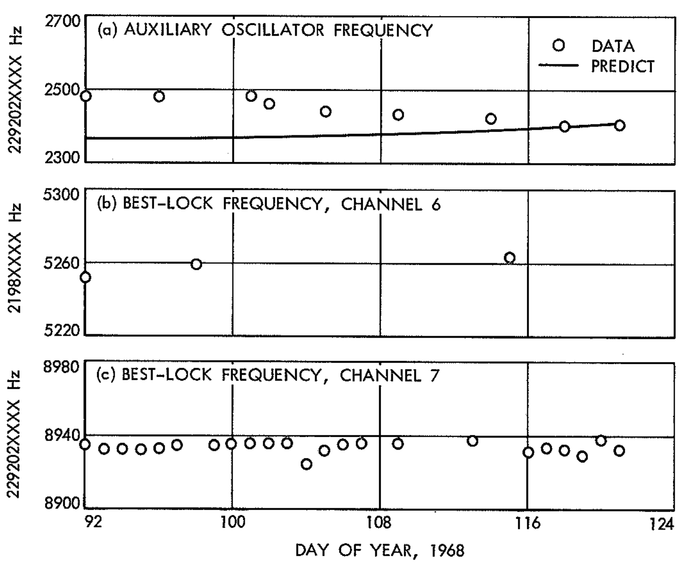

Fig. 63. Frequencies, passes 594–623, DSS 14

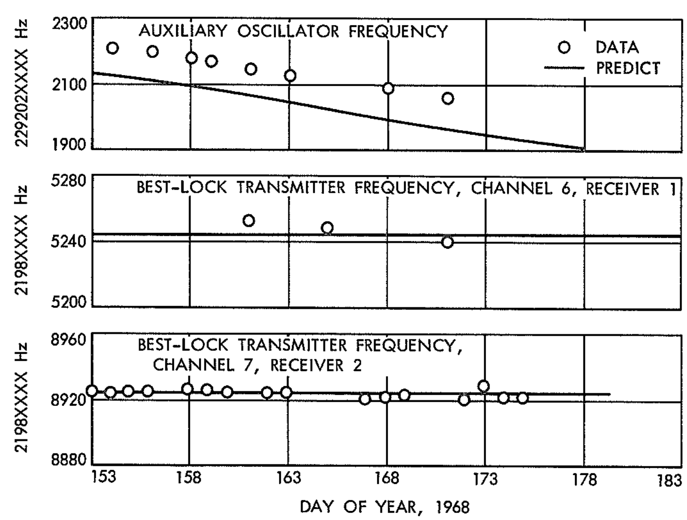

Fig. 65. Frequencies, passes 654–684, DSS 14

H. Interim Monitor Program Mean Residuals

Figures 66 and 67 are plots of mean residuals X from the Interim Monitor Program (IMP) as a function of pass number for one-way tracking. The IMP computes the difference of the observed (O) one-way doppler frequency and the predicted (P) one-way frequency and prints out the mean for a prescribed sample interval as a function of time during the pass. In Fig. 66, the slope of the mean, which is about -16.2 Hz/day, indicates the rate at which the spacecraft auxiliary oscillator changed frequency. In Fig. 67, the slope of the mean is roughly 8 Hz/day, which is somewhat larger than the rate at which the actual and predicted auxiliary oscillator frequency curves are deviating in Fig. 61, i.e., roughly 2 Hz/day.

Figures 68 and 69 are plots of IMP mean residuals for two-way coherent tracking. These residuals represent the difference between the observed values of doppler frequency D_{oi} and the predicted value of doppler frequency D_{pi}.

In Fig. 69, the small order of magnitude (less than 0.35 Hz) of this data indicates that the predictions for the state vector were excellent.

The mean was computed each second. After 10 or 60 s from the start of sampling, the first mean was printed out based on the first data samples (assuming no blunder points in the interval). The eighth data sample was used

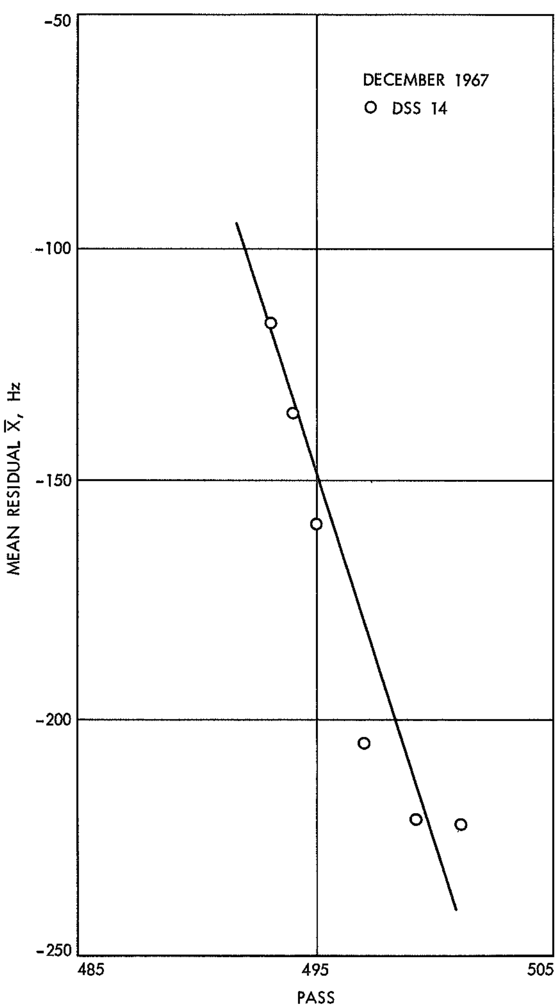

Fig. 66. IMP mean residual vs pass number, one-way mode, passes 470–502

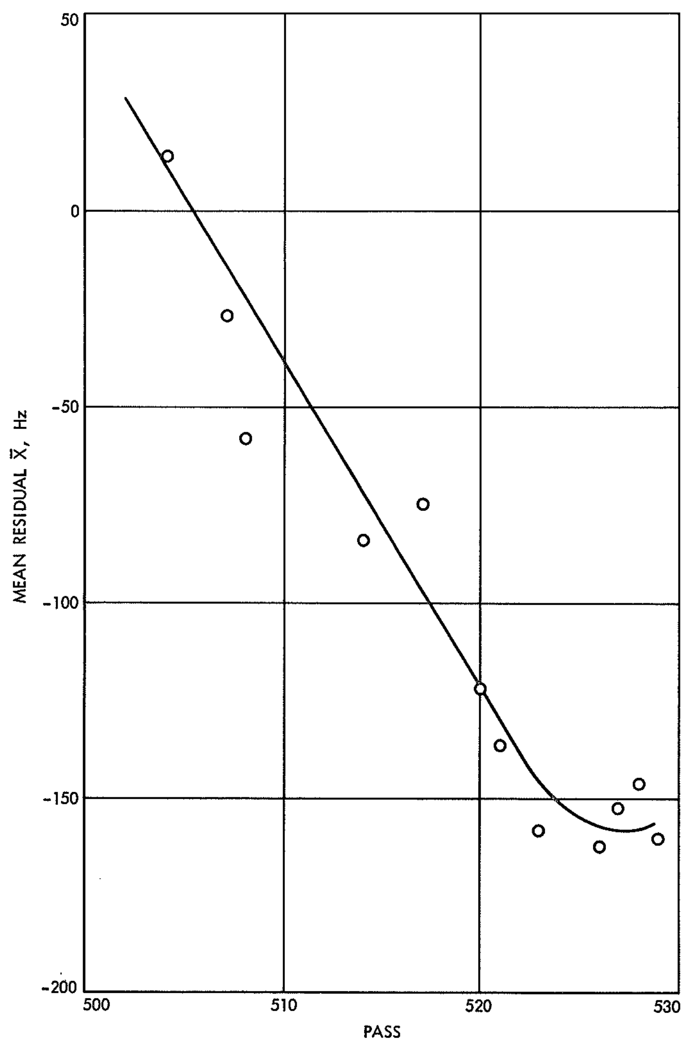

Fig. 67. IMP mean residual vs pass number, one-way mode, passes 503–533

with the previous six data samples and the next mean computed, etc. For example, the first printed mean was equal to:

$$X = \frac{\left[\sum_{i=4}^{10} (D_{oi} - D_{pi})\right]}{7}$$

The mean residual was an indication of how much the predicted doppler frequency deviated from the actual. The values recorded in Fig. 66 are small in comparison to a tolerance of 5 Hz.

The same basic assumption used for the mean was applicable for the standard deviation (SD) calculations. The SD was likewise computed each second and printed at 10- or 60-s intervals; e.g., for a sample interval of 7 points:

$$SD(7) = \frac{\left\{\sum_{i=4}^{10} (D_{oi} - D_{pi})^2 - \left[\frac{\sum_{i=4}^{10} (D_{oi} - D_{pi})^2}{7}\right]\right\}^{1/2}}{6}$$

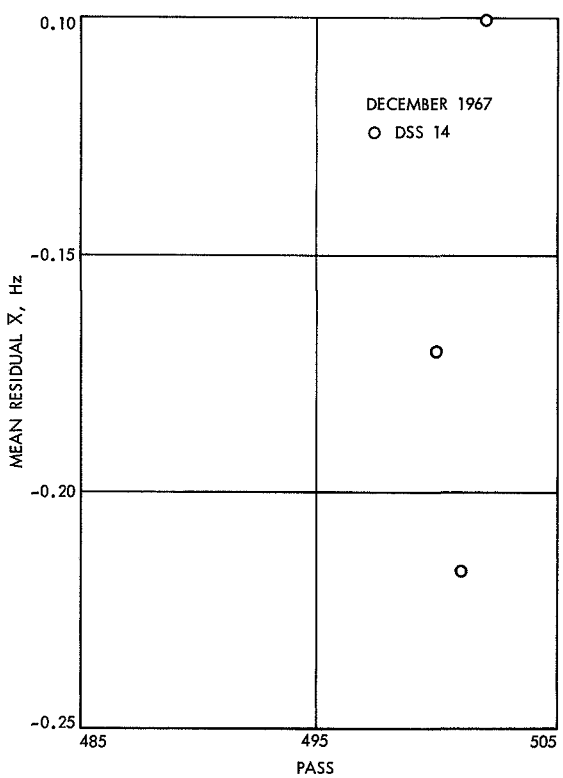

Fig. 68. IMP mean residual vs pass number, two-way coherent mode, passes 470–502

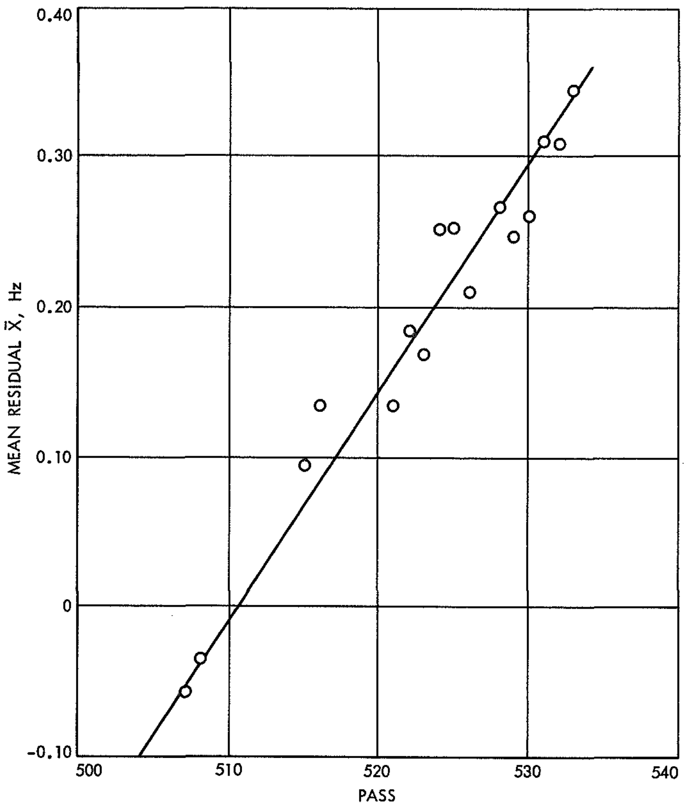

Fig. 69. IMP mean residual vs pass number, two-way coherent mode, passes 503–533

Figures 70 and 71 are plots of the SD about the mean residual as a function of pass number and round trip light time (RTLT) to and from the spacecraft. The magnitude of SD is an indication of the amount of noise on the doppler data, which in turn is a function of RTLT. Two of the available points lie above the expected noise level, 0.02 Hz, in Fig. 70.

I. Predicts

Predicts generated for *Pioneer VII* during the period of this document are summarized in Table 13. The table includes the predict number, the stations for which the predicts were generated, the spacecraft auxiliary oscillator frequency (T freq), the ground transmitter synthesizer frequency for test lock at zero doppler (XMT ref), dates for which predicts are effective, and the sample rate, which is the interval between predicts printouts. The predicts number has two parts. The first part is a two-digit number that gives the run generated. The second part is an alphabetic letter which indicates the channel for which the predicts were generated. In Table 13,

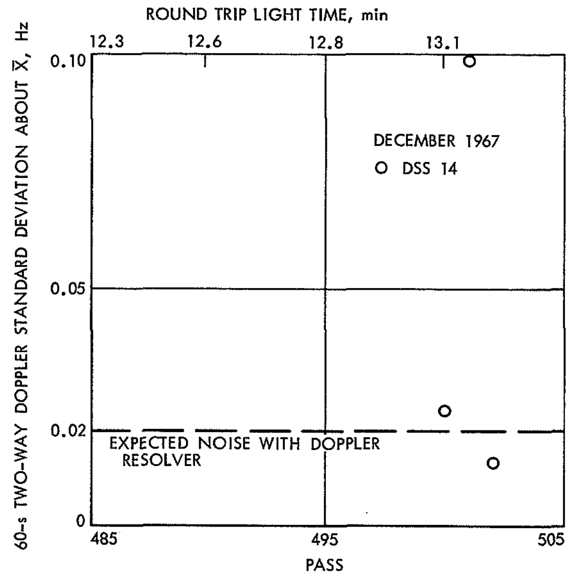

Fig. 70. IMP standard deviation about mean residual vs RTLT, two-way mode, passes 470–502

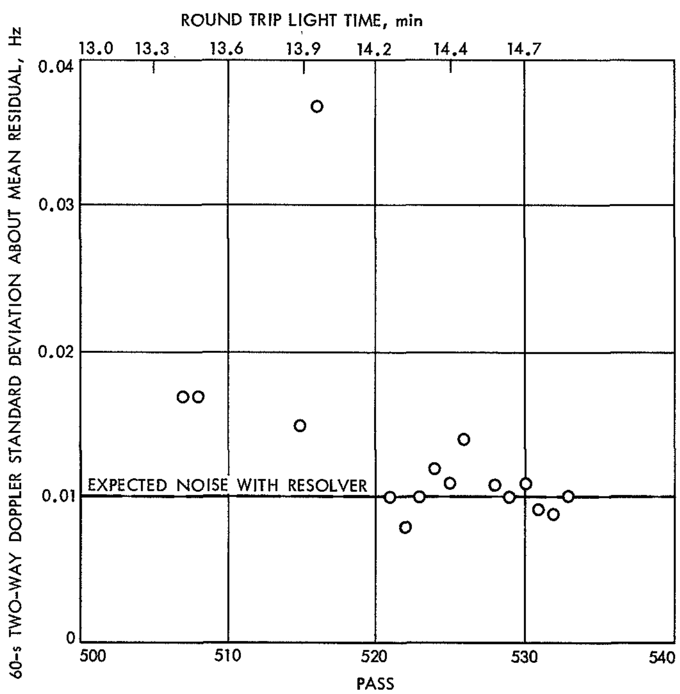

Fig. 71. IMP standard deviation about mean residual vs RTLT, two-way mode, passes 504–533

X designates channel 6, Y designates channel 7, and Z designates Stanford University. Other letters, as explained in the table, are used to signify special runs. Predicts types are geocentric Cartesian of date.

Table 13. Prediction summary

Pred. No.[a]	Stations	T freq,[b] MHz	XMT ref,[c] MHz	Coverage	Sample rate, s
49X	14, 41, 42, 51, 61	2292.022500	21.985285	2/12–3/1/67	900
49Y	14, 41, 42, 51, 61	2292.022500	21.988945	2/12–2/1/67	900
49Z	Stanford	2292.022500	21.985285	2/12–3/1/67	300
50X	14, 41, 42, 51, 61	2292.022600	21.985285	2/28–3/16/67	900
50Y	14, 41, 42, 51, 61	2292.022500	21.988945	2/28–3/16/67	900
50Z	Stanford	2292.022500	21.985285	2/28–3/16/67	300
51X	14, 41, 42, 51, 62	2292.022700	21.985285	3/15–4/1/67	900
51Y	14, 41, 42, 51, 62	2292.022700	21.988935	3/15–4/1/67	900
51Z	Stanford	2292.022700	21.985285	3/15–4/1/67	300
52X	14, 41, 42, 51, 62	2292.022500	21.985277	3/30–4/15/67	900
52Y	14, 41, 42, 51, 62	2292.022500	21.988932	3/30–4/15/67	900
52Z	Stanford	2292.022500	21.985277	3/30–4/15/67	300
53X	14, 41, 42, 51, 62	2292.022000	21.985275	4/14–5/01/67	900
53Y	14, 41, 42, 51, 62	2292.022000	21.988929	4/14–5/01/67	900
53Z	Stanford		21.985275	4/14–5/01/67	300
57Y	14, 51, 62		21.988915	6/14–7/1/67	600
AA	41		21.988915	6/16–6/19/67	900
57X	14, 51, 62		21.985266	6/14–7/1/67	600
56Z	Stanford		21.985266	6/1–12/31/67	900
DE1	13, 14		21.985266	6/1–7/11/67	300
56Y	14, 51, 62		21.988918	6/1–6/15/67	600
56X	14, 51, 62		21.985268	6/1–6/15/67	600
58Y	14, 51, 62	2292.021800	21.988911	7/1–7/15/67	600
59Y	14, 51, 62	2292.021780	21.988907	7/14–8/1/67	600
DE2	14, 14	2292.021700	21.988903	7/26–7/30/67	300
60X	14	2292.021450	21.985243	8/8–8/18/67	600
60Y	14, 51, 62	2292.021600	21.988901	8/15–9/1/67	600
61Y	14, 41, 51	2292.021600	21.988901	8/8–8/18/67	600
VP3	11, 12, 14, 41, 42, 51, 62	2292.02300	21.985275	8/1/67–1/1/68	86400

[a]X = channel 6; Y = channel 7; Z = Stanford; other letters designate special runs.

[b]Spacecraft auxiliary oscillator frequency.

[c]Ground transmitter synthesizer frequency for best lock at zero doppler.

Table 13 (contd)

Pred. No.[a]	Stations	T freq,[b] MHz	XMT ref,[c] MHz	Coverage	Sample rate, s
62X	14	2292.021450	21.985245	9/1–10/1/67	900
62Y	14, 41, 51	2292.021450	21.988900	9/1–10/1/67	900
DE4, DE4 POLY	13, 14, 14	2292.021450	21.988900	9/1–10/3/67	300
63X	14	2292.021500	21.985250	10/1–11/1/67	900
63Y	14, 41, 51	2292.021500	21.988909	10/1–11/1/67	900
64X	12, 14	2292.021800	21.985263	11/1–12/1/67	900
64Y	12, 14, 41, 51	2292.021800	21.988915	11/1–12/1/67	900
65X	14, 41, 51	2292.021970	21.985265	12/1/67–1/1/68	900
65Y	14, 41, 51	2292.021970	21.988921	12/1/67–1/1/68	900
DE5	13, 14	2292.021500	21.988909	10/1–11/3/67	600
DE5 POLY	14				
DE5 POLY	13				
DE6	13, 14	2292.021800	21.988915	11/1–12/1/67	600
66X	14, 41			1/1–2/1/68	900
66Y	14, 51			1/1–2/1/68	900
67X	12, 14	2292.022465	21.985280	2/1–3/1/68	900
67Y	12, 14, 41, 51	2292.022465	21.988932	2/1–3/1/68	900
68X	14	2292.022550	21.985280	3/1–4/1/68	900
68Y	14	2292.022550	21.988937	3/1–4/1/68	900
70X		2292.022550	21.985247	4/1–5/1/68	
70Y		2292.022550	21.988936	4/1–5/1/68	
71X		2292.022100	21.985247	5/1–6/1/68	
71Y		2292.022100	21.988936	5/1–6/1/68	
72X		2292.025500	21.985240	6/1–7/1/68	
72Y	14	2292.022550	21.988936	6/1–7/1/68	900

J. Commands

A total of 3515 commands were transmitted during the reporting period (passes 192–684), bringing the total of commands transmitted to *Pioneer VII* spacecraft since launch (August 17, 1966) to 7852.

K. Pass Chronology

Viewing periods covered are identified by pass number, which is the number of times since launch that the spacecraft has been above the horizon of a particular station. For *Pioneer VII* spacecraft, the No. 1 pass station was DSS 42, Tidbinbilla, Australia. The first pass of this reporting period was pass 192.

Pass 192. There were numerous receiver glitches at DSS 51 on this pass (also pass 193). This was an abbreviated pass for DSS 12 because of a defective VCO potentiometer.

Pass 197. Solar flare activity was recorded on this pass at DSS 12. At DSS 42, the circuit breaker supplying power to the generator tripped while wiring was being installed for new air conditioners; this caused generators to overheat and shut off. The circuit breaker was reset.

Pass 210. Type I reorientation commands were sent from DSS 12. The telemetry indication from the spacecraft data on reorientation maneuver success was studied.

Pass 214. At DSS 42, data failure of the GOE/DEMOD appeared; however, Project failed to place the spacecraft in proper command mode for real-time telemetry data after a special test at DSS 12. Appropriate commanding was made in real-time.

Pass 217. Threshold for 8 bits/s for the 26-m antenna was reached on 12-Hz receiver loop bandwidth. The bandwidth was changed to 5 Hz at 0307:37 (all times are GMT). The parity error rate dropped to 0.138 at 8 bits/s; at 0635:35, the receiver loop was changed to 12 Hz, and the parity error rate was 0.412 at 8 bits/s.

Pass 223. At DSS 12, the receiver loop bandwidth was changed to 3 Hz.

Passes 230 and 231. DSS 12 tracked the spacecraft in noncoherent two-way mode. The spacecraft was configured to continue transmitting its downlink on channel 6, using its auxiliary oscillator, while the uplink signal was received on channel 7, both on the spacecraft high-gain antenna. The averaged parity error readouts were 0.110 and 0.160, respectively.

Pass 237. Optimizing signal strength on an hourly basis to correct for possible deviations from the antenna pointing predicts, DSS 12 offset the antenna in HA and DEC angles in an effort to peak up the signal strengths in the respective axes. In order to establish peak, the signal on each side of the maximum was reduced; this resulted in an increased error rate at those times. Expected error rate was 0.150, but actual error rate was averaging 0.250 as the result of periodic peaking. Offsets used were obtained by averaging those obtained during the preceding pass. The resultant error rate average was 0.650 for the pass, and the technique was discontinued.

Pass 240. This was an experimental pass, it was used to correlate data from the two previous passes. The antenna pointing was optimized early and the offsets maintained. Parity error rate averaged 0.158 at −165.6 dBmW average signal strength. The tracking loop bandwidth for this and subsequent passes was maintained at 3 Hz at DSS 12.

Pass 253. DSS 12 tracked in the two-way coherent mode for the celestial mechanics experiment. The GOE/TCP parity error rate indicated bad data (one or more detected parity errors per frame). DSS 13 also tracked the spacecraft on an experimental basis for approximately 3 h in a three-way mode with DSS 12. The phase-detected telemetry signal was sent via microwave from DSS 13 to the GOE at DSS 12. The parity error rate indicated 0.000 errors. The spacecraft bit rate was then increased from 8 to 16 bits/s, and the resulting error rate was 0.078. The DSS 13 configuration was as follows: The R & D cone polarization, adjusted for linear polarization at 2388 MHz, had an ellipticity ratio of 9.8 dB at 2295 MHz. (The *Pioneer* spacecraft antenna was linearly polarized.) The system noise temperature at 2295 MHz was 30 ±5°K with a maser gain of 40 dB. Antenna efficiency was 55%, resulting in an antenna gain of slightly over 53 dB. The tracking loop bandwidth was 2 Hz.

Pass 278. This was a Class 3 solar flare activity pass by DSS 14.

Pass 286. This was a solar flare pass tracked by DSS 14.

Pass 292. The VCO tuner dial at DSS 51 inadvertently moved at 1302, resulting in the receiver losing lock for 4 min.

Pass 294. Starting at 1111, erroneous VCO frequency recorded for 17 min. During this pass, the exciter was inadvertently switched to channel 4; 4 min of bad data resulted at DSS 51.

Pass 307. DSS 41 reduced its TX power to 9 kW to prevent reflected power relay from tripping.

Pass 308. The DSS 14 doppler counter times 2 was inoperative; the doppler counter was times 1 throughout pass.

Pass 313. The DSS 12 TDH doppler counter was inoperative. This pass was a combined effort by DSS 12 and 14, with DSS 12 providing the uplink and DSS 14 maintaining the downlink because DSS 12 was unable to hold good lock on the spacecraft.

Pass 322. The receiver dropped lock three times at DSS 51. There was no known reason.

Pass 326. At 1544, the DSS 51 receiver dropped lock for 2 min. There was no apparent reason.

Pass 333. At DSS 14, the receiver was unable to reacquire two-way lock at 0052 because of an inoperative maser RF pump station. A klystron failure, at 0116, resulted in the pass being cut off 4 h for repairs.

Pass 347. A type II orientation pass was performed from DSS 14, with the station transmitting 32 commands. The doppler counter dropped least significant digit intermittently.

Pass 362. A special power test was performed at DSS 14 to measure the effect upon the ground station automatic gain control of a 10-kW power increase above the normal 10 kW.

Pass 366. A special orientation test was performed at DSS 14 to orient the spacecraft so that the high-gain antenna faced earth.

Pass 373. DSS 14 was brought up to change the spacecraft bit rate to 8 bits/s for DSS 51, pass 374.

Pass 374. DSS 14 performed a special test to ascertain the amount of signal degradation when the transmitter power was varied from 10 to 20 kW while using the diplexer for both receiving and transmitting. Normally, when tracking *Pioneer* spacecraft, DSS 14 used the diplexer for transmitting only, while feeding the received signal to the maser from LHCP port ahead of the diplexer, the transmitted signal being RHCP. This was possible because the spacecraft had linear polarized antennas. An approximately 2-dBmW drop in signal strength was noted when the power was raised from 10 to 20 kW. The signal degradation was attributed to the lack of a harmonic filter between the transmitter and the diplexer in the experimental cone assembly; a harmonic filter was installed.

Pass 384. For a special celestial mechanics pass, two-way track was performed by DSS 41 while DSS 51 was in a receive-only configuration.

Pass 388. DSS 14 made a real-time change from the *Surveyor* configuration in order to transmit a special command to the spacecraft. This was to enable a one-way track from DSS 12.

Pass 408. DSS 11 tracked for a special commanding pass for the University of Chicago's cosmic ray telescope experiment.

Pass 414. The downlink signal was received at DSS 12. Science data revealed that none of the four commands sent were effective.

Passes 431 and 434. At DSS 14, the transmitter power was reduced in steps from 10 kW, and the uplink signal strength at the spacecraft was recorded. Commands were sent to determine the threshold.

Pass 446. The polarizer was tested in a two-way configuration at DSS 12. The first part of the test was with the polarizer on; the second part was with the polarizer off. Data indicated a 3-dBmW improvement in signal level was achieved at both the received and transmitted frequencies.

Passes 470 and 471. These passes initiated two-way tracking for DSS 51, using the linear-to-circular polarizer.

Passes 500 and 501. DSS 14 acquired the spacecraft in a three-way mode while it was being tracked two-way by DSS 51; then DSS 14 transferred to two-way. This procedure was not continued.

Pass 563. DSS 14 antenna went on brake at 1921 because the re-use flow on Pad 2 kicked out the pump circuit breaker. At 0112, the transmitter was shut down because of beam overcurrent. It was back in two-way mode at 2012.

Pass 564. Maser 2 was off from 0049 to 0051 because of circuit overload.

Pass 569. DSS 14 was a record-only pass because communications lines were accidentally cut.

Pass 576. At DSS 51, there was a delay in acquisition caused by a leak in the high-pressure pipe of the declination angle drive of the antenna.

Pass 577. At 0207, DSS 14 attempted to transmit command 061, but the command was not transmitted because of a GOE malfunction.

Pass 579. The GOE operator at DSS 14 inadvertently initiated command 061 instead of 101.

Pass 585. Two-way acquisition by DSS 14 was delayed to allow work on transmitter instability problem reported earlier during *Pioneer VI* track.

Pass 586. The DSS 14 doppler resolver counter failed at 2007.

Pass 590. DSS 14 continued to encounter transmitter instrumentation problems.

Pass 591. At 0212, a GOE encoder error stopped transmission of commands.

Pass 592. The TCP was interrupted.

Pass 601. A communications cable to DSS 14 caused loss of real-time data; however all data was retrieved from tape.

Pass 605. Data (56 min) was lost as a result of a 100-word/min teletype modification at DSS 14. Circuit readjustment corrected the problem.

Passes 635 and 636. Maser 2 had to be used because of an intermittent fluctuating signal-level problem on maser 1. DSS 14 corrected the intermittent problem by replacing the klystron pump power supply.

Pass 641. The antenna servo system A failed. The DSS 14 antenna should have been automatically switched to servo system B upon failure of A, but instead was placed in brake because the pressure regulator was out of adjustment. The switch was performed manually, resulting in 5 min of loss of data.

Pass 649. The polarizer motor was accidentally turned on. This rotated the DSS 14 polarizing section of the waveguide antenna and caused approximately 15 min of receiver glitching before being discovered and turned off.

Pass 653. Table 14 presents an abbreviated telecommunication design control for this pass (May 31, 1968). The calculated (predicted) carrier signal strength agreed with the actual values recorded.

Table 14. Abbreviated telecommunication design control table, pass 653

No.	Parameter	Value	Tolerance, dB
1	Total transmitter power	38.4 dBmW	0.2–0.2
2	Transmitting circuit loss	1.5 dB	0.5–0.6
3	Transmitting antenna gain	11.0 dB	0.5–0.5
4	Transmitting antenna pointing loss	Included in (3)	
5	Space loss — 2292 MHz, $R = 1.82 \times 10^8$ km	264.8 dB	
6[a]	Polarization loss	3.0 or 0 dB	0.3–0.3
7	Receiving antenna gain (64 m)	61.8 dB	0.5–0.5
8	Receiving antenna pointing loss	0 dB	
9	Receiving circuit loss	0.2 dB	0.1–0.1
10[a]	Net circuit loss	196.7 or 193.7 dB	1.9–2.0
11[a]	Total received power	−158.3 or −155.3 dBmW	2.1–2.2
12	Receiver noise spectral density (N/B) T system = 29°K	184.0 dBmW	0.7–0.9
13	Carrier modulation loss	4.1 dB	0.5–0.5
14	Received carrier power	−162.4 or −159.4 dBmW	2.6–2.7
15	Carrier APC noise bandwidth ($2B_{LO}$ = 12 Hz)	10.8 dB	0.0–0.5
16	Measured carrier power	−159.4 dBmW	
17	Calculated (14) and measured (16) with polarizer unit installed	0 dB	

[a]Circular or linear configuration

Pass 661. DSS 14 was unable to transmit commands because of an intermittent 24-V relay that affected the 400 Hz to the focus magnet power supply. This was corrected by cleaning the relay contacts.

Passes 664, 670, and 673. The DSS 14 50-kW generators developed short-duration power surges. A transmitter ac overload relay operated and caused the transmitter to shut down; the relay was manually reset for each pass.

Passes 677 and 678. DSS 14 had intermittent warmups on masers 1 and 2; each time the masers were purged and cooled down. All problems were traced to a contaminated helium bottle.

L. Operations by Passes

Tables 15–18 give a summary of operations data for the reporting period. Figure 72 shows the *Pioneer VII* sun–earth line trajectory.

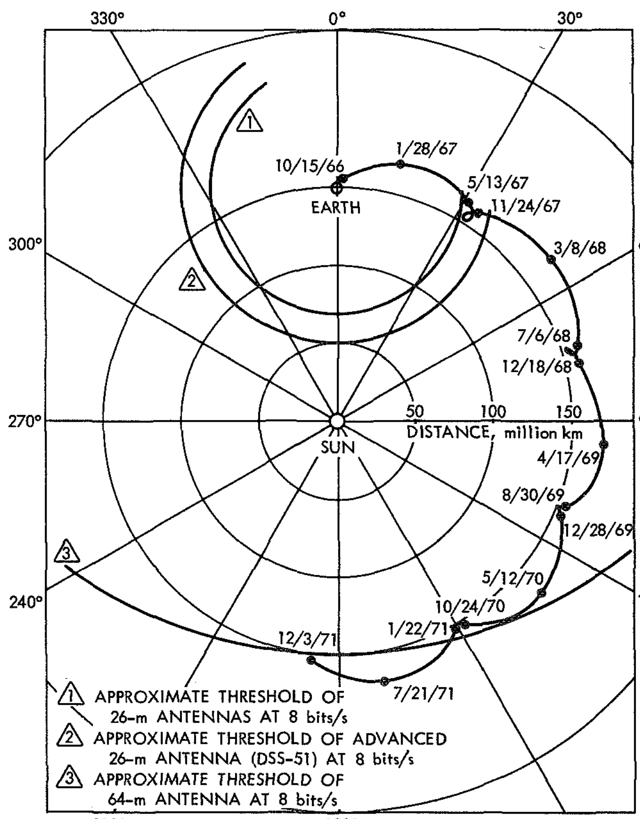

Fig. 72. Pioneer VII fixed sun–earth line trajectory

Table 15. Operations summary, passes 192–257

Pass No.	Station (DSS)	Day of Year (GMT)	Acq. (GMT)	End of Track (GMT)	Ground Modes (Start and End Times GMT) 1-Way	2-Way	3-Way	Avg. Recd. Sig. Level (dbm)
192	51	055	114204	2041	114204 115933	120757 203001	2038 2041	-163.1
	12	055	200543	001830	205009 201150	203820 204610	200543 203820	-163.1
					211857 225625	225649 001830		
193	51	056	113447	2044	113447 120420	120807 2044		-163.2
194	42	057	043815	1246	043815 045819	050008 122400	122400 123240	-163.3
	51	057	113646	2055		1224 2049	113646 123233	-163.3
196	42	059	0425	1248	0425 044804	045610 122001	122001 1248	-163.8
	51	059	113930	2051		122000 2050	113930 122000	-164.1
	12	059/060	215345		215345 221245	222600 0500		-164.2
197	42	060	043141	1238	050843 053428	054622 1238	043141 044533	-164.0
	12	060	2200	0510	2200 221758	222844 045350	045350 051000	-163.8

Commands Total	Equipment Failures and Anomalies; Significant Events; Remarks
11	TXR at 10 kw. TLM bit rate 8 bps.
4	Abbreviated pass due to defective VCO potentiometer. TXR at 10 kw, bit rate 8 bps. S/S -163.6, 2150Z error rate 0.250.
18	TXR at 10 kw, bit rate of 16 bps.
13	TXR at 10 kw, bit rate of 8 and 16 bps.
12	TXR at 10 kw, bit rate of 8 bps.
18	TXR at 10 kw, bit rate of 8 and 16 bps.
19	TXR at 10 kw, bit rate of 8 bps.
19	TXR at 10 kw, bit rate of 8 bps.
20	TXR at 10 kw, bit rate of 8 bps. Circuit breaker supplying power to generator tripped while installing wiring for new air conditioners, causing generators to overheat and shut off. Remedy was resetting of circuit breaker.
18	TXR at 10 kw, bit rate of 16 and 8 bps.

Table 15 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acq. (GMT)	End of Track (GMT)	Ground Modes (Start and End Times GMT)			Avg. Recd. Sig. Level (dbm)
					1-Way	2-Way	3-Way	
198	42	061	042800	123300		045350 050300 051240 123200	042800 045350	-163.7
200	12	063	1959	0651 DAY 064	1959 201917	202625		-164.5
202	12	65	2118	0745	2118 213817	214618 0745		-163.3
203	42	66	0742	1227		0742 1227	0653 0726	-164.0
204	42	67	0430	1226	043000 050147	050147 1226		-164.5
205	42	68	0429	1226	042906 045827	050115 1226		-164.2
	12	068/069	2232	0746	223415 225342	230122		-163.4
206	42	069	0651	1216		074440 121630	065100 074440	-164.4
207	42	070	0423	1229	041226 044713	044713 121920		-163.7

Commands Total	Equipment Failures and Anomalies; Significant Events; Remarks
23	TXR at 10 kw, bit rate of 8 bps.
29	TXR at 10 kw, bit rate of 8 bps.
32	TXR at 5, 8, and 10 kw; bit rate of 8 bps.
17	TXR at 10 kw, bit rate of 8 bps. Due to operator error the command modulation was off for two commands.
20	TXR at 10 kw, bit rate of 8 and 16 bps.
21	TXR at 5 to 10 kw, bit rate of 8 bps.
26	TXR at 10 kw, bit rate of 8 bps.
15	TXR at 10 kw, bit rate of 8 bps.
21	TXR at 10 kw, bit rate of 8 bps.

Table 15 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acq. (GMT)	End of Track (GMT)	Ground Modes (Start and End Times GMT)			Avg. Recd. Sig. Level (dbm)
					1-Way	2-Way	3-Way	
208	42	071	041631	1225	041631 0438	045319 121916		-164.1
	12	071	200150	0555	200150 203700	203700 0445	0447	-163.2
209	42	072	042012	1227		0445 122440	042012 044500	-164.0
210	12	073	195630	0735	195630 201704	202417 2027 2028		-163.3
212	12	075	200640	073440	200640 203009	204215 073440		-163.2
214	42	077	0626	1225	0626 070359	070621 1225		-164.6
215	42	78	040928	1221	040928	044211 1221		-164.6
216	42	79	040810	1223	040810	045004 1222		-165.5
217	12	080	1953	0727	1953 20285	203827 0726		-163.5

Commands Total	Equipment Failures and Anomalies; Significant Events; Remarks
19	TXR at 10 kw, bit rate of 8 and 16 bps.
18	TXR at 10 kw, bit rate of 8 bps.
21	TXR at 10 kw, bit rate of 8 bps.
28	TXR at 10 kw, bit rate of 8 bps. Type I reorientation command sequence. 2-way non-coherent at 024010; coherent at 0641.
22	TXR at 10 kw, bit rate of 8 bps. First two commands not transmitted. Command modulation off due to operator error.
17	TXR at 10 kw, bit rate of 8 bps.
21	TXR at 10 kw, bit rate of 16 and 8 bps.
22	TXR at 10 kw, bit rate of 8 bps.
22	TXR at 10 kw, bit rate of 16 bps.

Table 15 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acq. (GMT)	End of Track (GMT)	Ground Modes (Start and End Times GMT)			Avg. Recd. Sig. Level (dbm)
					1-Way	2-Way	3-Way	
218	12	081	1952	0728	1952 202514 023920 050255	2035 020912 050855 0727		-163.3
221	42	084	041550	1210	041550 043835 1144	044409 044810 044843 113348		-165.4
223	12	086	1950	0100	1950			-163.5
225	12	088	1950	0720	1950 2018	2025 2205 0712 0720		-164.5
227	12	090	1950	0722	1950 2023 2223 0545	2026 2053 2053 2211 2211 2223 0549 0722	 NON COHER	*-165.9

Commands Total	Equipment Failures and Anomalies; Significant Events; Remarks
21	TXR at 10 kw, bit rate of 8 bps (2037Z).
20	TXR at 10 kw, bit rate of 8 bps.
1	Pass abbreviated by 6 hours due to failure of heat exchanger. Bit rate of 8 bps.
35	TXR at 10 kw, bit rate of 8 bps. Receiver loop was 3 Hz for R&D testing. Two-way non-coherent at 2206 to 0710.
5	Special 3 Hz test pass. TXR at 10 kw, bit rate of 8 bps. D-1 at 24 Hz, D-2 at 10 Hz. *Optimum signal level average at station. Ran post calibrations to verify. TDH-017 repaired prior to track. MSR-007 repaired prior to track.

Table 15 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acq. (GMT)	End of Track (GMT)	Ground Modes (Start and End Times GMT)			Avg. Recd. Sig. Level (dbm)
					1-Way	2-Way	3-Way	
230	12	093	1950	0715	1950 2016	2016 2121 2121 0614 0641 0715	 2-Way non coher.	-165.5
231	12	094	194615	0717	194615 201451	202215 214603 0510 0513 0716	2-Way non coher. 2-Way non coher.	-165.8
237	12	107 100	1941	072003	1941	2003 2050 054922 655520 0716	2-Way non coher. 2-Way coher.	165.0
238	12	101	0037	0713	003742 005750	005943 014022 014211 054023 054109 071123	 2-Way non coher. 2-Way coher.	165.9
240	12	104	032618	071840	032618	042220 043527 043611 0650 065400 071810	 2-Way non coher. 2-Way coher.	165.6

Commands Total	Equipment Failures and Anomalies; Significant Events; Remarks
21	3 Hz pass - non coherent mode track. TXR at 10 kw Bit rate 16-8 bps
22	3 Hz pass. Bit rate 16-8
21	TXR at 10 kw. Bit rate 8 bps
15	TXR at 10 kw. Bit rate 8 bps
10	TXR at 10 kw. Bit rate 8 bps

Table 15 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acq. (GMT)	End of Track (GMT)	Ground Modes (Start and End Times GMT)			Avg. Recd. Sig. Level (dbm)
					1-Way	2-Way	3-Way	
241	12	104	1938 2015	0713	2015 2056	2056		165.8
245	12	108	195630	0713	195630 2032	2039 0713		166.0
249	12	112	195030 1959	071219	1959 2027	2027 2103 2103 060545 060722	 2-Way non coher. 2-Way coher.	166.5
251	12	114	1933	012707	1933 200007	2017 204046 002548 002949 0126	 2-Way non coher. 2-Way coher.	-166.4
253	12/13	116	1930	065700	1930 1955	2002 0656		-165.8
256	12	119	1928	0700	1928 1959	1959 2046 2046 052957 0530 0700	 2-Way non coher. 2-Way coher.	166.3
257	12	120	192505	0700	1925 1948	1948		167.7

Commands Total	Equipment Failures and Anomalies; Significant Events; Remarks
24	3 Hz coherent pass. Celestial mechanics TXR at 10 kw. Bit rate 8 bps
14	None
20	Non coherent pass. TDH plan D
13	TXR 10 kw. Bit rate 16-8 bps
18	DSS 13 was used for data signal source 2136 to 0034 to determine suitability of DSS 13 for tracking Pioneer.
27	TXR at 10 kw. TLM bit rate 8 bps
27	TXR at 10 kw. Bit rate 8 bps

Table 16. Operations summary, passes 258–349

GROUND MODE					CONFIGURATION							
									AVG $\overline{SS}$ (DBM)[2]		TELEMETRY DATA	
PASS NO.	DSS NO.	DAY OF YEAR	ACQ TIME[1]	END OF TRACK[1]	RCVR LOOP BW (HZ)	SYS TEMP PRE/POST (°K)	SYS THRESHOLD PRE/POST (DBM)	XMTR REF FREQ 2198 XXXX HZ	DOWN LINK	UP LINK	AVERAGE PER/FRAME[3]	BIT RATE (BPS)
258	14	121	214743	0731	12		Not recorded	9120	-158.3		0.020	64, 16
261	14	124	2042	2300	12		-174	9110	-158.5		0.012	16
261	13	124	231156	0500	12				-163.5			8
262	13	125	230000	0500	12				-165.5			8
266	14	129	1849	2110	12		-173	9091	-158.6		0.097	16
266	13	129/130	2100	0105	12				-163.9			16
267	42	130	0333	1212	12		-171	9090	-165.3		N/A	
267	13	130	1856	0100	12				-163.1			8
268	13	131	1859	0100	12				-163.6			8
272	14	135	192423	000000	3		-173	9060	-159.0		0.244	

(1) ALL TIMES GMT HRS/MIN/SEC (Note : SEC may be dropped)

(2) UPLINK POWER 10 KW, UNLESS OTHERWISE SPECIFIED

TRACK SUMMARY										
TRACKING SUMMARY									NO. COMMANDS XMTD	COMMENTS
START/STOP DATA TIME[1]			SAMPLE INTRVL (SEC)			QUAL CODE[4]				
1 WAY	2 WAY	3 WAY	1 WAY	2 WAY	3 WAY	1 WAY	2 WAY	3 WAY		
	2228- 0724			60			10		17	
	2135- 2239			60			10		6	
									0	
									0	
	1929 2109			60			10		7	
									0	
	0410- 0443 0618- 1212			60 10			7		0	Celestial mechanics pass. No telemetry data, commands, or FR 1400 recording. TXR at 10 kw. Rx loop B/W at 5 Hz. Station reported Rx glitches approximately every 15 seconds throughout entire pass.
									0	
									0	
1928- 1933	2005- 0000		60	60		10	10		11	

(3) 0.116 = 1 BIT ERROR PER 10^3 BITS (Note : Bit Error Rate = PER x 0.009117)

(4) 10 = PERFECT, 9 = 2-3 ERRORS, 8 = 7 ERRORS, ETC., 0 = UNUSABLE DATA

4

Table 16 (contd)

GROUND MODE					CONFIGURATION							
									AVG $\overline{SS}$ (DBM)[2]		TELEMETRY DATA	
PASS NO.	DSS NO.	DAY OF YEAR	ACQ TIME[1]	END OF TRACK[1]	RCVR LOOP BW (HZ)	SYS TEMP PRE/POST (°K)	SYS THRESHOLD PRE/POST (DBM)	XMTR REF FREQ 2198 XXXX HZ	DOWN LINK	UP LINK	AVERAGE PER/FRAME[3]	BIT RATE (BPS)
272	51	135	103049	1957	3		-178	5410	-167.3		0.244	
273	14	136	213130	2305	12		-174	9060	-159.5		0.000	8
273	51	136	103048	2023	3		-176	5410	-166.48		0.379	8
274	51	137	103705	2030	3		-178	5400	-166.5		0.427	8
277	42	140	031340	120601	12		-171	9040	-165.6		N/A	
278	14	141	230925	072325	12		-174	5380	-158.63		0.093	64, 16
279	14	142	194810	0629	12		Not recorded	5380, 9030	-158.5		0.045	16

(1) ALL TIMES GMT HRS/MIN/SEC (Note : SEC may be dropped)

(2) UPLINK POWER 10 KW, UNLESS OTHERWISE SPECIFIED

TRACK SUMMARY										
TRACKING SUMMARY									NO. COMMANDS XMTD	COMMENTS
START/STOP DATA TIME[1]			SAMPLE INTRVL (SEC)			QUAL CODE[4]				
1 WAY	2 WAY	3 WAY	1 WAY	2 WAY	3 WAY	1 WAY	2 WAY	3 WAY		
1034- 1543			60			9			0	
2134- 2138 2212- 2302			60 60			10 10			3	
1034- 1534 1544- 1602 1603- 2011			60 60 60			9 8 9			0	
	1039- 2023			60			7			
	0350- 0506 0506- 0610 0610- 0655 0656- 0905 0921- 1025 1025- 1205			10 5 10 5 10 5			5 8 6 8 6 8		0	Celestial Mechanics pass. No telemetry taken. Antenna ran away in both HA and DEC. This was due to TDH operator switching off rack 1014/TDH4 to change format boards - thus cutting inputs to DIS for IAPS.
2310- 2322	2346- 0255 0256- 0723		60	60 60		10	10 10		23	Solar flare pass.
1949- 1954	2029- 0629		60	60		10	10		28	Unscheduled pass called up for solar flare coverage. TXR power reduced to 5 kw.

(3) 0.116 = 1 BIT ERROR PER 10^3 BITS (Note : Bit Error Rate = PER x 0.009117)

(4) 10 = PERFECT, 9 = 2-3 ERRORS, 8 = 7 ERRORS, ETC., 0 = UNUSABLE DATA

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Table 16 (contd)

GROUND MODE					CONFIGURATION							
									AVG $\overline{SS}$ (DBM)[2]		TELEMETRY DATA	
PASS NO.	DSS NO.	DAY OF YEAR	ACQ TIME[1]	END OF TRACK[1]	RCVR LOOP BW (HZ)	SYS TEMP PRE/POST (°K)	SYS THRESHOLD PRE/POST (DBM)	XMTR REF FREQ 2198 XXXX HZ	DOWN LINK	UP LINK	AVERAGE PER/FRAME[3]	BIT RATE (BPS)
279	51	142	104330	192500	3		-177	5380	-166.8		0.273	
280	51	143	112930	1930	3		-177		-166.8		0.262	8
282	14	145	185140	2312	12		-175	9020	-159.5		0.000	16,8
282	51	145	112850	1927	3		-179	5370	-166.5		0.252	
286	14	149	1852	0713	12		-174	9000	-158.6		0.075	64,16
287	51	150	1116	1916	3		-179	5350	-170.0		0.489	8

(1) ALL TIMES GMT HRS/MIN/SEC (Note : SEC may be dropped)

(2) UPLINK POWER 10 KW, UNLESS OTHERWISE SPECIFIED

TRACK SUMMARY

TRACKING SUMMARY									NO. COMMANDS XMTD	COMMENTS
START/STOP DATA TIME[1]			SAMPLE INTRVL (SEC)			QUAL CODE[4]				
1 WAY	2 WAY	3 WAY	1 WAY	2 WAY	3 WAY	1 WAY	2 WAY	3 WAY		
1048-1310 1310-1930			60 60			9 9			0	Unscheduled pass called up for solar flare coverage.
1131-1929			60			7			0	
	1936-2312			60			10		8	
1132-1147 1202-1922			60 60			8 9			0	
	1929-0711			60			10		35	Solar flare pass.
1123-1916			60			9			0	Poor signal level attributed to two factors: (1) Drop in maser gain, during tracking, from 42 db to 37.5 db. (2) Overcast and light rain.

(3) 0.116 = 1 BIT ERROR PER 10^3 BITS (Note : Bit Error Rate = PER x 0.009117)

(4) 10 = PERFECT, 9 = 2-3 ERRORS, 8 = 7 ERRORS, ETC., 0 = UNUSABLE DATA

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Table 16 (contd)

GROUND MODE					CONFIGURATION							
									AVG $\overline{SS}$ (DBM)[2]		TELEMETRY DATA	
PASS NO.	DSS NO.	DAY OF YEAR	ACQ TIME[1]	END OF TRACK[1]	RCVR LOOP BW (HZ)	SYS TEMP PRE/POST (°K)	SYS THRESHOLD PRE/POST (DBM)	XMTR REF FREQ 2198 XXXX HZ	DOWN LINK	UP LINK	AVERAGE PER/FRAME[3]	BIT RATE (BPS)
290	51	153	111650	1914	3	Not avail.	-178.0	5340	-167.6	-153	0.331	8
292	51	155	1116	1916	3	Not avail.	-177.5	5330	-166.6	-153	0.268	8
294	51	157	110940	1916	3	Not avail.	-175.5	5320	-166.4	-153	0.299	8
297	14	160	191850	2314	12	.../30.2	-174.0	8960	-158.7	-123	0.026	8 64
301	14	164	1857	2327	12	.../29.2	-174.0	8940	-158.7	-123	0.015	16 64
304	41	167	022752	1322	12	50.7/47.9	-172.0	8930	-166.5		N/A	N/A
304	14	167	191630	2230	12	.../29.4	-174.0	8930	-158.2	-124	0.029	8 16 64
305	51	168	1118	1919	3	Not avail.	-177.5	5280	-166.6	-153	0.194	8
306	51	169	1119	1919	3	Not avail.	-176.0	5270	-166.8	-153	0.193	8
307	41	170	0216	1313	12	45.8/48.0	-172.0	8920	-166.3	-153	N/A	N/A

(1) ALL TIMES GMT HRS/MIN/SEC (Note : SEC may be dropped)

(2) UPLINK POWER 10 KW, UNLESS OTHERWISE SPECIFIED

TRACK SUMMARY										
TRACKING SUMMARY									NO. COMMANDS XMTD	COMMENTS
START/STOP DATA TIME[1]			SAMPLE INTRVL (SEC)			QUAL CODE[4]				
1 WAY	2 WAY	3 WAY	1 WAY	2 WAY	3 WAY	1 WAY	2 WAY	3 WAY		
1120-1855			60			7			0	
1116-1302 1308-1915			60 60			9 9			0	
1112-1257 1306-1915			60 60			9 8			0	
	2001-2314			60			10		11	
	1935 2326			60			10		14	
0228-0231	0257-0302 0303-0307 0308-1322		60	10 10 10		10	10 10 9		0	Celestial mechanics pass for tracking data only.
1925-1933	2006-2229		60	60		10	9		10	
1120-1126 1131-1918			60	60		10	9		0	
1128-0000			60			9			0	
0220-0226	0255-1313		60	60		9	10		0	Tracking data was only data taken.

③ 0.116 = 1 BIT ERROR PER 10^3 BITS (Note : Bit Error Rate = PER x 0.009117)

④ 10 = PERFECT, 9 = 2-3 ERRORS, 8 = 7 ERRORS, ETC., 0 = UNUSABLE DATA

Table 16 (contd)

GROUND MODE					CONFIGURATION							
									AVG $\overline{SS}$ (DBM)[2]		TELEMETRY DATA	
PASS NO.	DSS NO.	DAY OF YEAR	ACQ TIME[1]	END OF TRACK[1]	RCVR LOOP BW (HZ)	SYS TEMP PRE/POST (°K)	SYS THRESHOLD PRE/POST (DBM)	XMTR REF FREQ 2198 XXXX HZ	DOWN LINK	UP LINK	AVERAGE PER/FRAME[3]	BIT RATE (BPS)
308	51	171	105853	1900	12	Not avail.	-177.5	5270	-167.0	-153	0.167	8
308	14	171	191358	02222	12	29.5/29.5	-175.0	8930	-158.47	-124	0.030	16 64
310	51	173	105945	1900	12	Not avail.	-178.0	5260	-166.7	-153	0.115	8
313	51	176	1100	1900	12	Not avail.	-178.0	5250	-166.6	-153	0.140	8
313	14/12	176	191225	2335	12	28.1/28.2	-174.0	8900	-158.6	-138	0.021	8 16 64
315	51	178	112857	1902	3	32.0/32.0	-178.0	5250	-166.8	-153	0.146	8
316	12	179	1912	0629	12	38.8/37.4	-172.0	8890	-166.6		N/A	N/A
317	51	180	110250	1900	3	31.9/32.1	-178.0	5240	-166.6	-153	0.120	8

(1) ALL TIMES GMT HRS/MIN/SEC (Note : SEC may be dropped)

(2) UPLINK POWER 10 KW, UNLESS OTHERWISE SPECIFIED

TRACK SUMMARY										
TRACKING SUMMARY									NO. COMMANDS XMTD	COMMENTS
START/STOP DATA TIME[1]			SAMPLE INTRVL (SEC)			QUAL CODE[4]				
1 WAY	2 WAY	3 WAY	1 WAY	2 WAY	3 WAY	1 WAY	2 WAY	3 WAY		
1100-1858			60			9			0	
1916-1922	1958-0222		60	60		10	10		23	
1101-1900			60			9			0	
1102-1859			60			8			0	
1915-1934		1941-2334	60		60	10		00	10	DSS 12 uplink, DSS 14 downlink (XMTR Modification being done at DSS-14)
1130-1857			60			9			0	
	1959-0622			60			6		0	Tracking data is only data taken.
1114-1859			60			10			0	

(3) 0.116 = 1 BIT ERROR PER 10^3 BITS (Note : Bit Error Rate = PER x 0.009117)

(4) 10 = PERFECT, 9 = 2-3 ERRORS, 8 = 7 ERRORS, ETC., 0 = UNUSABLE DATA

Table 16 (contd)

GROUND MODE					CONFIGURATION							
									AVG $\overline{SS}$ (DBM)[2]		TELEMETRY DATA	
PASS NO.	DSS NO.	DAY OF YEAR	ACQ TIME[1]	END OF TRACK[1]	RCVR LOOP BW (HZ)	SYS TEMP PRE/POST (°K)	SYS THRESHOLD PRE/POST (DBM)	XMTR REF FREQ 2198 XXXX HZ	DOWN LINK	UP LINK	AVERAGE PER/FRAME[3]	BIT RATE (BPS)
320	51	183	1055	1900	3	35.6/36.5	-179/-178	8880	-166.8	-153	.145	8
320	14	183	1935	2340	12	---/28.3	---/-174	8880	-158.8	-124	BAD .000	64 16
321	12	184	1857	0625	12	39.0/38.2	---/-172	8880	-165.7	N/A	N/A	N/A
322	51	184	1054	1900	3	Not Avail.	-178	8870	-166.4	-153	.077	8
323	14	185	1912	2343	12	28.2	-174	8870	-159.9	-124	.000 .035	16 64
325	14	188	1913	2345	12	---/27.6	---/-174	8870	-158.7	-124	.010 N/A	8 64
326	14	189	1910	2348	12	---/27.8	---/-174	8860	-158.7	-124	.000 .015	8 16 64
326	51	189	1051	1900	3	33.5/33.34	178.5/-179	8860	-166.7	-153	.200	8
333	14	196	0011	0557	12	28.7/---	-169/---	8840	-158	-139	Not Avail.	8
335	51	198	1031	1330	3	31.5/33.4	-178/---	8840	-166.3	-153	.142	8
335	14	199	0150	0553	12	29.2/---	Not Taken	8840	-157.8	-123	.000 .050	8 64

(1) ALL TIMES GMT HRS/MIN/SEC (Note : SEC may be dropped)

(2) UPLINK POWER 10 KW, UNLESS OTHERWISE SPECIFIED

TRACK SUMMARY										
TRACKING SUMMARY									NO. COMMANDS XMTD	COMMENTS
START/STOP DATA TIME[1]			SAMPLE INTRVL (SEC)			QUAL CODE[4]				
1 WAY	2 WAY	3 WAY	1 WAY	2 WAY	3 WAY	1 WAY	2 WAY	3 WAY		
1057-1900			60			10			0	
	2012-2340			60			9		17	Ops Planning: No precals performed.
	1936-0617			60			7		0	Celestial Mechanics pass. SDA: Data to be processed through "Fitterate" program.
1056-1900			60			9			0	Ops Planning: RCV dropped lock three times. No apparent reason. Station training new antenna man on aided track operations.
	1940-2343			60			10		18	
1918-1932	2006-2344		60	60		10	10		8	Ops Planning: No precals performed.
1916-1928	2000-2339		60	60		10	9		12	Ops Planning: No precals performed.
1053-1859			60			9			0	Ops Planning: RCV dropped lock 1544Z-1546Z. No apparent reason.
0034-0030	0547-0555		60	60		10	10		1	Ops Planning: Command pass. (1) Station had klystron power supply failure; units replaced. (2) Pass cut off until repairs were completed at 0500.
1035-1329			60			9			0	
0152-0200	0232-0553		60	60		10	10		12	Ops Planning: (1) No TDH circuit available. (2) Station loading prevented acquisition at 0030.

(3) 0.116 = 1 BIT ERROR PER 10^3 BITS (Note : Bit Error Rate = PER x 0.009117)

(4) 10 = PERFECT, 9 = 2-3 ERRORS, 8 = 7 ERRORS, ETC., 0 = UNUSABLE DATA

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Table 16 (contd)

GROUND MODE					CONFIGURATION							
									AVG $\overline{SS}$ (DBM)[2]		TELEMETRY DATA	
PASS NO.	DSS NO.	DAY OF YEAR	ACQ TIME[1]	END OF TRACK[1]	RCVR LOOP BW (HZ)	SYS TEMP PRE/POST (°K)	SYS THRESHOLD PRE/POST (DBM)	XMTR REF FREQ 2198 XXXX HZ	DOWN LINK	UP LINK	AVERAGE PER/FRAME[3]	BIT RATE (BPS)
336	51	199	0953	1330	3	31.0/31.5	-178/-178	8840	-166.3	-153	.173	8
336	14	199	1915	2200	12	---/24.5	---/-174	8840	-158.9	-124	.000 .040 ---	8 64 512
337	51	200	1314	1700	3	33.5/32.8	-178/-178	8840	-166.5	-153	.050	8
340	51	203	1305	1700	3	N/A	-177/-177	8830	-166.1	-153	.045	8
341	14	205	0334	0549	12	28.3/29.9	-174/-175	8830	-158.4	-123	.180 BAD	8 64
342	51	205	1318	1700	3	32.6/33.1	-178/-178	8830	-166.3	-153	.050	8
342	12	205/206	1909	0551	12	38.7/38.5	---/-172	8830	-166.3	---	N/A	N/A
343	51	206	1300	1700	3	Not Avail.	---/-177	8830	-166.3	-153	.246	8
344	51	207	1330	1700	3	31.8/31.8	-178/-178	8830	-167	-153	.061	8

(1) ALL TIMES GMT HRS/MIN/SEC (Note : SEC may be dropped)

(2) UPLINK POWER 10 KW, UNLESS OTHERWISE SPECIFIED

TRACK SUMMARY										COMMENTS
TRACKING SUMMARY									NO. COMMANDS XMTD	
START/STOP DATA TIME[1]			SAMPLE INTRVL (SEC)			QUAL CODE[4]				
1 WAY	2 WAY	3 WAY	1 WAY	2 WAY	3 WAY	1 WAY	2 WAY	3 WAY		
0956-1329			60			9			0	Ops Planning: Incorrect Class I printout, program reload corrected problem.
1907-1928	2008-2200		60	60		10	9		12	
1316-1650			60			10			0	
1307-1700			60			9			0	Ops Planning: No precals performed.
	0420-0544			60			10		7	
1320-1700			60			9			0	
	1948-0017 0018-0029 0031-0514 0535-0548			60 10 60 1			7 10 7 10		0	Ops Planning: Celestial mechanics pass. Acquisition late due to weak signal. VCO, DEC, and HA garbling on TDH from 0430 to 0446. Trigger adjustment of sync counter on negative should be positive pulse. No TFR. SDA: TDH mod kit expected to eliminate the above problem. Also, station countdown may correct problem. Refer to Telecon to J. Patterson, DSS 12.
1302-1700			60			10			0	SDA: Parity error rate was BAD. STP tuned T/M phase detector and parity error rate improved.
1332-1406 1416-1659			60 60			10 9			0	Ops Planning: Late acquisition due to turnaround configuration.

(3) 0.116 = 1 BIT ERROR PER 10^3 BITS (Note : Bit Error Rate = PER x 0.009117)

(4) 10 = PERFECT, 9 = 2-3 ERRORS, 8 = 7 ERRORS, ETC., 0 = UNUSABLE DATA

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Table 16 (contd)

GROUND MODE					CONFIGURATION							
									AVG $\overline{SS}$ (DBM)[2]		TELEMETRY DATA	
PASS NO.	DSS NO.	DAY OF YEAR	ACQ TIME[1]	END OF TRACK[1]	RCVR LOOP BW (HZ)	SYS TEMP PRE/POST (°K)	SYS THRESHOLD PRE/POST (DBM)	XMTR REF FREQ 2198 XXXX HZ	DOWN LINK	UP LINK	AVERAGE PER/FRAME[3]	BIT RATE (BPS)
344	14	207	1921	2130	12	Not Avail.	-174	8830	-157.8	-124	.050	64
345	51	208	1301	1701	3	31.8/32.2	-178	8830	-166.3	-153	.085	8
345	14	208/209	2332	0531	12	30.8/---	-174	8830	-158.0	-123	.000 .086	8 64
347	51	210	1306	1700	3	31.8	-178.5	8820	-166.9	-153	.072	8
347	14	210	1915	0534	12	31.2/31.3	-174/-174	8820	-157	-124	.030	8 64 256
348	51	211	1302	1701	3	32.0/32.9	-178/-177.5	8820	-166.9	-153	.084	8
349	51	212	1122	1906	3	Not Avail.	-178	8820	-166.7	-153	.090	8
349	14	212	1937	2201	12	30.4	-174	8820	-157.8	-124	.035 .080	8 64

(1) ALL TIMES GMT HRS/MIN/SEC (Note : SEC may be dropped)

(2) UPLINK POWER 10 KW, UNLESS OTHERWISE SPECIFIED

TRACK SUMMARY										
TRACKING SUMMARY									NO. COMMANDS XMTD	COMMENTS
START/STOP DATA TIME[1]			SAMPLE INTRVL (SEC)			QUAL CODE[4]				
1 WAY	2 WAY	3 WAY	1 WAY	2 WAY	3 WAY	1 WAY	2 WAY	3 WAY		
1923-1928	2002-2130		60	60		10	9		5	
1303-1700			60			10			0	
2334-2338	0005-0531		60	60		10	10		10	Ops Planning: Voice communications marginal from 0000 to 0031. SDA: Good doppler started at 0024. Station was in TDH test mode until 0024.
1308-1659			60			10			0	
1917-1918			60			10			32	Ops Planning: (1) Reorientation test pass. (2) Doppler counter dropping least significant digit intermittently.
1304-1700			60			9			0	
1124-1906			60			9			0	
1939-1943	2016-2201		60	60		10	10		8	

(3) 0.116 = 1 BIT ERROR PER 10^3 BITS (Note : Bit Error Rate = PER x 0.009117)

(4) 10 = PERFECT, 9 = 2-3 ERRORS, 8 = 7 ERRORS, ETC., 0 = UNUSABLE DATA

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Table 17. Operations summary, passes 351–681

Pass No	DSS No	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time			Signal Strength Avg (dbm)
					1-Way	2-Way	3-Way	
351	14	214	1945	2202	1945 2006	2007 2202	---	-157.3
352	51	215	1000	1900	1000 1900	---	---	-166.8
353	51	216	1103	1900	1103 1900			-166.5
353	14	216	2335	0401	2335 2400	0001 0401		-157.7
355	14	218	1948	0519	1948 2032	2032 0519		-158.8
354	51	217	1130	1902	1130 1902			-166.2
356	51	219	0900	1400	0900 1400			-166.7
357	51	220	0901	1401	0901 1401			-166.5
357	14	220	1921	2200	1921 2005	2005 2200		-158.6
358	51	221	0900	1400	0900 1400			-166.6
358	14	221	1922	2200	1922 2000	2000 2200		-158.2
359	51	222	0859	1330	0859 1330			-166.5
360	51	223	0905	1329	0905 1329			-166.8
360	14	223	2325	0213	2325 0025	0026 0213		-158.3

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
12	30.0	-174	8	.010 .373 .010	8 16 64	
3	N/A	-177	0	.050	8	
3	31.9 35.8	-177 -177	0	.160	8	
12	29.7 29.2	-174 -175	11	.016	64	
12	29	-174	15	.000 .075	8 64	
3	32.2 37	-178.5 -178.0	0	.050	8	
3	31.6 31.6	-178 -175	0	.224	8	
3	31.6 31.8	-177 -177.5	0	.150	8	
3	29.9	-174	7	.060	8	
3	32	-177	0	.291	8	
12	29.3	-174	7	.029	8	
3	31.7	-178	0	.180	8	
3	31.4 32	-178.5 -178.0	0	.200	8	
12	29.8 29.7	-174 -174	7	.040	8	

Table 17 (contd)

Pass No	DSS No	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time			Signal Strength Avg (dbm)
					1-Way	2-Way	3-Way	
361	51	224	1048	1840	1048 1840			-166.6
362	14	225	1923	2201	1923 1952	1953 2201		-157.9
363	51	226	0915	1401	0915 1401	---	---	-165.5
364	51	227	0911	1348	0911 1348	---	---	-166.4
365	51	228	0850	1343	0850 1343	---	---	-166.5
366	14	229	2344	0501	0018	0018 0501	---	-158
366	51	229	0913	1337	0913 1337	---	---	-166.5
367	51	230	0906	1632	0906 1632	---	---	-166.5
368	14	232	0200	0500	0200 0256	0257 0500	---	-157.5
368	51	231	0845	1326	0845 1326	---	---	-166.5

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
3	31.9 31.8	-177 -177	0	.095	8	Demod went out of lock due to spurious signal produced by Test Transponder.
12	30 30	-174 -175	7	.090	8	At 2034, command 101 sent one minute late due to momentary interruption of GOE "ENABLE" circuit.
3	31.2	-177.5	0	.160	8	Gradual Maser warm-up experienced at 0920.Z. Temp. peaked at 0950.Z, then quickly returned to a slightly lower level than it had been during AGC precals. A faulty Crosshead Bearing is suspected. TFR A 51-UWV-015 applies. Post track calibrations cancelled to facilitate repairs.
3	36.5 40.0	-176 -176	0	.300	8	Wide Band FM carrier cut off on both A & B Recorders. Over modulation suspected. Carrier was reset. Units tested O.K. TFK 51-REC-039. High error rate due to heavy rains at station.
3	31.4 31.4	-178 -178	0	.070	8	At 0904Z, Computer failed for no apparent reason. At 1011Z, Computer failed again. Transferred to 920 Computer. TFR-51-DIS-044.
12	28.8 29.0	-174 -175	41	.100	8 64 256	Orientation pass. TDH failure - missing tenths of seconds in print-out only. Cleaned connections on strobe pulse cards of PC-143. Corrected problem. TFR-14-TDH-100288.
3	32.6 32.2	-177 -176	0	.140	8	
3	31.0 30.5	-178 -178	0	.140	8	
12	29.7 29.0	-174 -174	8	.200	64	
3	31.7 31.4	-178 -177	0	.140	8	CEC Recorded experienced paper jam. TFR-51-AIS-030.

Table 17 (contd)

Pass No	DSS No	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time			Signal Strength Avg (dbm)
					1-Way	2-Way	3-Way	
369	14	232	1944	0200	1944 2033	2033 0200	---	-156.6
370	51	233	0910	1345	0910 1345	---	---	-166.1
370	14	233	1930	2200	1930 2004	2005 2200	---	-157
372	51	235	0909	1330	0909 1330	---	---	-166.5
372	14	235	1954	2220	1954 2033	2034 2200	---	-157
373	14	236	2254	0001	2254 2327	2327 0001		-157
374	51	237	0902	1322Z	0902 1322	---	---	-165.7
374	14	237	2324	0201	2324 0014	0017 0201	---	-159.5
375	51	238	0909	1316	0909 1316	---	---	-166
375	14	239	0141	0500	0141 0208	0209 0500	---	-159.5
376	51	239	0907	1310	0907 1310	---	---	-165.9
377	14	240	1944	2204	1944 2018	2019 2204	---	-158.5

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/Post (°K)	Thres Pre/Post (dbm)				
12	30.2	-174	15	.050	64	Microwave Patch Panel Cable failed. Replaced. TFR-14/AIS/100233. MMSA Recorder ran out of FR-1400 tape on reel 1A. Started reel 1B - operator error.
3	31.2	-178	0	.160	8	
12	31.6	-173	7	.050	8 64	
3	36.6 33.9	-176 -176	0	.070	8	
12	30.2 29.8	-174 -174	8	.030	8 64	Special RF power test performed.
12	N/A	N/A	2	.008	8 16	Command track to place S/C (PN-7) in 8 BPS for DSS51 acquisition.
3	31.7 31.6	-177 -177	0	.120	8	No precals performed on Recorder 13. Recorder B experienced excessive tape tension TFR-51-Rec 043.
12	36.7 37.4	-169 -170	7	.200	64	
3	33.4 33.0	-177 -175	0	.120	8	
12	29.2 28.4	-169 -169	12	.100	8 64	0115Z, New APS Control Panel did not accept S/C Data. At 01320 interim Control Panel installed and working. TFR-14-100234.
3	32 N/A	-178 -178	0	.130	8	At 1222 A-1 Tape Recorder was taken off line due to a poor signal level. Heads cleaned and back on line again at 1223 - no recorded data lost.
12	29.8	-174	7	.050	8 64	

Table 17 (contd)

Pass No	DSS No	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time			Signal Strength Avg (dbm)
					1-Way	2-Way	3-Way	
377	51	240	0905	1304	0905 1304	---	---	-166.5
379	51	242	0907	1253	0907 1253	---	---	-166.2
379	14	242	2018	2209	2018 2058	2900 2209	---	-158.2
380	51	243	0950	1250	0950 1250	---	---	-166.2

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
3	32.9 33.2	-177.5 -177.5	0	.100	8	At 093500 the 910 Computer printed random letters and figures. Program reloaded. TFR-51-DIS-046. At 1118 the 910 Computer printed randomly again. Problem corrected itself when IMP was stopped.
3	32.3 32.4	-178 -178	0	.150	8	
12	28.8 N/A	-174 N/A	7	.070	8 64	Delayed acquisition due to antenna offsets not available when station forced to go to Computer drive due to master Equatorial outage. Antenna search necessary to acquire S/C.
3	32.1 N/A	-177 N/A	0	.200	8	The station noted excessive amount of time spent in acquiring S/C downlink. DSS 51 stated new predicts were positive 193 for doppler deviation. Normally it is approximately 60 to 80 cycles off for each new set. No problems at DSS 14 or DSS 41 in acquisition using same set of predicts. (62Y)

Table 17 (contd)

Pass No	DSS No	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time			Signal Strength Avg (dbm)
					1-Way	2-Way	3-Way	
381	51	244	0909	1345	0909 1345	---	---	-165.6
382	14	245	1943	2159	1943 2020	2020 2159	---	-158.4
382	51	245	0907	1236	0907 1236	---	---	-165.5
383	51	246	0912	1230	0912 1230	---	---	-165.8
384	51	247	0926	1220	1153 1220	---	0926 1153	-166.3
384	14	247	1944	2157	1944 2018	2019 2157	---	-158.1
384	41	247	0259	1327	0259 0342	0342 1327		-166.5
385	14	248	1946	2256	1946 2022	2022 2256	---	-157.6
388	12	251	1926	2325	1926 2026	2143 2325	2026 2140	-165.8
388	14	251	1949	2130	1949 2026	2027 2130	---	-158.8
389	12	252	1927	0100	1927 0100	---	---	-166.3

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/Post (°K)	Thres Pre/Post (dbm)				
3	33.2 / 33.8	-178 / -176.5	0	.150	8	First prime mag tape inadvertently placed on Bravo recorder. Prime tapes shipped in data package to JPL are Bravo 1 and Alpha 2.
12	36.0 / N/A	-174 / N/A	9	.060 .250	8 64	
3	34 / N/A	-177 / N/A	0	.160	8	
3	31.6 / 22.9	-177 / -176	0	.200	8	
3	32.5 / 32.5	-178 / -175.5	0		8	Celestial mech pass at DSS-41 Two-Way. DSS 51 acquired CH-7-3 Way. REC glitches experienced. Dropped 3 way lock at 1153 at DSS 51. Unable to regain solid downlink until 1216 when REC 2 loop B/W switched to 12 Hz.
12	28.6	-175	12	.050	8 64	
12	44.4 / 45.11	-174 / -174	0			Celestial mech pass.
12	29.4 / 29.0	N/A / -175	11	.022	8	
3	27.0	---	0	.250	8	CMD-3-027 Transmitted by DSS 14. DSS 12 could not lock up Demod on CH. 7 when DSS 14 was 2-way.
12	---	---	1	---	---	Special Command pass to change S/C Bit Rate from 16 bps to 8 bps - no post track report required.
3	PRE Rec 1 67.3 Rec 2 28.3 POST 70.97 27.9	N/A	0	.300	8	

Table 17 (contd)

Pass No	DSS No	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time			Signal Strength Avg (dbm)
					1-Way	2-Way	3-Way	
391	14	255	0116	0448	0116 0219	0220 0448	---	-158.2
392	51	255	0842	1135	0842 1135	---	---	-165.7
392	12	256	0010	0100	0010 0100			-167
393	12	256	2235	0458	2235 0458	---	---	-166.1
393	41	256	0125	1328	0125 0155	0203 1326		-166.8
393	51	256	0842	1130	0842 1130	---	---	-166.9
394	51	257	0844	1115	0844 1115			-165.8
394	12	257 258	2300	0457	2300 0457	---	---	-166.5
395	51	258	0844	1100	0844 1100	---	---	-165.5
395	14	258	2336	0420	2336 0006	0006 0420		-157.9
396	14	259	2324	0200	2324 0016	0017 0200		-157.1
396	51	259	0844	1100	0844 1100			-165.7

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/Post (°K)	Thres Pre/Post (dbm)				
12	29.7/29.5	-174/-174	10	.080/.230	8/64	
3	31.4/31.9	-177/-176	0	---	8	BIT RATES 0918 - .812 1018 - BAD 1118 - .169 B recorder required maintenance of Heads on 3 occasions during pass. TFR-51-REC-10363/103634/103635
3	29.6	-180	0	N/A	8	Record-only track
3	28.2/28.8	-181	0	.094	8	No data taken from 2235 to 0328 due to error in receiver phasing. Station performed Class C precals for this pass after tracking Mariner S/C.
12	44.7	-174/-172	0	N/A	N/A	Celestial mechanics tracking. No telemetry taken.
3	32.3/32.1	-176.5/-176.5	0	---	8	PARITY ERRORS: 0920 - .921 1020 - .441 1120 - .124
3	32.4/32.3	-176	0	.350	8	
3	30.4/28.9	N/A/-180	0	.340	8	
3	32.0	-177	0	*.549	8	*PER: Only readings available at 0916/BAD, and at 1016/.549
12	28.3	-174	10	.025	64	
12	29.2	-174	13	.040	64	
3	31.8	-176	0	.262	8	

Table 17 (contd)

Pass No	DSS No	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time			Signal Strength Avg (dbm)
					1-Way	2-Way	3-Way	
397	14	260	2000	0201	2000 2032	2032 0200		-157.6
397	51	260	0846	1110	0846 1110			-165.6
398	14	261 262	2330	0400	2330 2357	2359 0400	---	-157.8
398	51	261	0845	1100	0845 1100	---	---	-166
399	12	262	1939	2330	1939 2006	2009 2330	---	-167.2
400	51	263	0847	1110	0847 1110	---	---	-166.3
401	51	264	0846	1058	0846 1058	---	---	-166.5
402	51	265	0849	1053	0849 1053	---	---	-166.3
402	14	265	2014	0401	2102 2133	2135 0401	---	-157.6
403	51	266	0848	1049Z	0848 1049	---	---	-165.8
404	14	267	2025	0410Z	2025 2057	2058 0410	---	-158.1
404	51	267	0848	1045	0848 1045	---	---	-166.4
405	51	268	0849	1648	0849 1649	---	---	-166.2

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
12	29.7	-174	7	.075	64	
3	32.1	-176	0	.175	8	
12	29.2 / 29.3	-175 / -174	14	.050	64	
3	32.8 / 32.3	-177 / -177	0	.700	8	*
12 3	39.0	N/A	0	---	---	Celestial mechanic pass, telemetry data recorded from RCV 2 at 3 Hz from 2258 to 2330.
3	31.6 / 33.0	-177 / -176	0	.550	8	*
3			0	.604	8	*
3	31.7 / 32.9	-178 / -177	0	.500	8	* High parity error rate caused by tracking at low elevation and ensuing degraded signal level.
12	28.9 / N/A	-175 / N/A	12	.000 .040	8 64	At 2024 Transmitter outage due to faulty H. V. cable. Cable repaired. TFR No. 101600
3	31.6	-177.0	0	.496	8	
12	28.4 / 30.2	N/A / -174	8	.050	64	
3	31.8 / 32.4	-176.5 / -177	0	.335	8	
3	31.2 / 32.7	-175 / -176	0	.050	8	

Table 17 (contd)

Pass No	DSS No	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time			Signal Strength Avg (dbm)
					1-Way	2-Way	3-Way	
408	51	271	1243	2051	1243 2051	---	---	-165
408	11	271	1916	2058	1916 2017	2017 2058 (Uplink only)	---	
410	12	273	1944	0456	1944 0456	---	---	-166

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/Post (°K)	Thres Pre/Post (dbm)				
3	33.7/32.7	-177.0/-176.5	0	.050	8	Bravo Recorder on late due to investigation of poor response. Alpha tapes included in data package. TFR 51 REC-103670
12			1	---	---	
3	29.6/32.1	-180	0	.250	8	

Table 17 (contd)

Pass No	DSS No	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time			Signal Strength Avg (dbm)
					1-Way	2-Way	3-Way	
414	11	277	2332	0353	2332 0202	0213 0353		-166.3
414	12	277	2235	0455	2235 0455			-166.5
416	12	279	1946	0455	1946 0455			-166.5
417	51	280	0957	2000	0957 2000			-165.3
417	12	280	1945	0445	1945 0445			-166
418	51	281	0959	2000	0959 2000			-165.8
419	51	282	0958	2002	0958 2002			-165.4
420	51	283	0954	2000	0954 2000			-165.7
422	51	285	0958	2000	0958 2000			-166
423	51	286	0955	2000				-166.2
424	51	287	0957	2001	0957 2001			-165.8
425	51	288	0953	2001	0953 2001			-166.4
426	51	289	0901	2100	0901 2100			-165.5

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/Post (°K)	Thres Pre/Post (dbm)				
12	46.3	-171	4			Command pass. Commands not accepted by S/C. Apparently the S/C transponder dropped lock during command reception - reason undetermined.
3	29.83	-179	0	.300	8	
3	28.6	-180	0	.100	8	TCP out from 1946 to 2113 - cause unknown.
3	32.7 32.4	-176.5 -177	0	.100	8	
3	28.6	-179	0	.150	8	
3	32.0	-177	0	.150	8	TCP operations intermittent - cause unknown
3	33.8	-176	0	.350	8	High parity error throughout passes. Reason unknown.
3	34.1	-176	0	.200	8	
3	34.8	-176.5	0	.120	8	While entering eng. data into the 910 computer, the carriage return light would not come one. Changed to 920 comp. TFR-51-011-103690. At 1217 920 hung up - reloaded.
3	33.3/32.0	-177.5/-176.5	0	.207	8	
3	32.5/32.0	-177/-177	0	.200	8	
3	32.4/34.0	-176/-176	0	.150	8	
3	33.7/33.7	-176/-176.5	0	.070	8	

Table 17 (contd)

Pass No	DSS No	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time			Signal Strength Avg (dbm)
					1-Way	2-Way	3-Way	
427	51	290	0902	1719	0902 1719			-166
431	14	294	2139	0154	2139 2224	2225 0154		-155.5
434	14	297 298	2315	0156	2315 2358	0000 0156		-155.8
435	51	298	0959	2008	0959 2008			-165.5
436	51	299	0958	2006	0958 2006			-165.2
438	14	301	2026	0200	2026 2206	2206 0200		-155.9
438	51	301	1001	1206				
439	51	302	0959	2000	0959 2000			-165.9
439	14	302	2310	0450	2310 0003	0003 0450		-156.1
440	51	303	0958	2000	0958 2000			-166.5
440	14	303	2146	0203	2146 2220	2221 0203		-157.2
441	51	304	1000	2000	1000 2000			-165.4

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/Post (°K)	Thres Pre/Post (dbm)				
3	32.1/32.0	-178/-178	0	.080	8	
12	29.2	-173	21	.000 .050	8 64	RX Threshold Test
12	28.7	-173	6	.060	64	Ant went to brake emergency stop at 0153Z-cause unknown. TFR-14-101819.
3	34	-177	0	.240	8	Parity error rate erratic due to sta being in aided track. Difficult for station operator to maximize antenna pointing manually. IMP could be used to help maximize age.
3	33.1 36.2	-177	0	.238	8	Parity error rate erratic due to sta being in aided track. Difficult for station operator to maximize antenna pointing manually. IMP could be used to help maximize agc.
12	27.8	-174	12	.000 .020	8 64	
	36	-175.5	0			Station unable to lock up receiver solidly due to low signal level caused by water in waveguide (storm damage). Track terminated early.
3	37.4	-176.5	0	.200	8	
12	N/A	N/A	13	.000 .052	8 64	
3	33.2	-176	0	.180	8	Special instructions sent to improve error rate performance.
12	28.2	-173	11	.000 .032	8 64	
3	32.5	-177	0	.200	8	

Table 17 (contd)

Pass No.	DSS No.	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time 1-Way	Ground Mode Start/Stop Time 2-Way	Ground Mode Start/Stop Time 3-Way	Signal Strength Avg (dbm)
442	51	305	0958	2000	0958 2000			-165.8
444	14	308	0054	0516	0054 0131	0132 0516		-156.5
446	12	309	2342	0526	2342 0013 0220 0302	0016 0156 0302 0526		-163
451	14	314	2119	0525	2119 2159	2200 0525		-155.9
452	14	315	2023	0530	2023 2103	2104 0530		-155.7
453	51	316	0959	2000	0959 2000			-165.3
454	51	317	0958	2000	0958 2000			-165.8
454	14	317	2042	0529	2042 2123	2124 0529		-155.5
456	14	319	2028	2301	2028 2108	2109 2301		-156.5
457	51	320	0958	2000	0958 2000			-165.8
457	14	320	2113	0531	2113 2145	2146 0531		-155.8
458	14	322	0053	0533	0053 0124	0125 0533		-155.8

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
3	32.6	-177	0	0.200	8	
12	28.3	-172	14	0.000 0.070	8 64	
3	48.2	-178	9	Varying		Polarizer Test and S/C Threshold Test conducted. A gain of 3 db uplink and downlink was indicated.
12	28.5	-172	10	0.000 0.062	8 64	Command 3-100 sent instead of Command 3-101 as a result of operator error. A contributing cause was insufficient time allowed between commands in a series. Suggest following TIM for times.
12	28.2	-173	16	0.000 0.075	16 64	
3	34	-176.5	0	0.180	8	
3	34.2	-178	0	0.190	8	
12	28	-174	12	0.000 0.029	8 64	Command 4-005 sent instead of Command 4-006 as a result of operator error. Contributing cause was insufficient time allowed in preparation.
12	N/A	N/A	2	0.000 0.101	8 64	
3	32.1	-177	0	0.100	8	
12	28.7	-173	15	0.000 0.038	8 64	
12	28.6	-172	7	0.091	64	

Table 17 (contd)

Pass No.	DSS No.	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time 1-Way	2-Way	3-Way	Signal Strength Avg (dbm)
459	14	322	2021	0535	2021 2109	2110 0535		-156.4
463	51	326	0958	2000	0958 2000			-164.3
463	14	327	0026	0536	0026 0103	0105 0536		-156.4
464	51	327	0959	2000	0959 2000			-165.9
465	51	328	0956	2003	0956 2003			-164
465	14	328	2015	0542	2015 2102	2104 0542		-156.7
466	51	329	0955	1952	0955 1952			-164.3
467	14	330	2010	0544	2010 2056	2057 0544		-156.8
468	51	331	0955	2000	0955 2000			-163.8
470	51	333	0956	2000	0956 1038 1057 1058	1043 1057 1058 2000		-164.8
470	14	333	2012	2303	2012 2054	2056 2303		-156.5
471	51	334	0957	2001	0957 1036 1513 1521	1044 1509 1522 2001		-165

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
12	28.6	-173	7	0.047	64	
3	32.2	-176.5	0	0.200	8	
12	27.5	-173	7	0.000 0.090	8 64	
3	31.9	-176.7	0	0.300	8	
3	34.1	-176.5	0	0.038	8	
12	27.2	-173	11	0.000 0.039	8 64	
3	32.9	-177	0	0.120	8	
12	27.9	-174	11	0.000 0.130	8 64	
3	45	-175.5	0	0.400	8	
3	44.9	-174	8	0.500	8	
12	29	-173	7	0.000 0.110	8 64	
3	46	-175	13	0.150	8	

Table 17 (contd)

Pass No	DSS No	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time			Signal Strength Avg (dbm)
					1-Way	2-Way	3-Way	
472	51	335	1002	2005	1002 1033	1040 2005		-162.6
473	51	336	0959	2000	0959 1034	1046 2000		-164
474	51	337	0959	1955	1040 1122	1138 1955		-163.5
474	14	337/338	2349	0551	2349 0551			
476	51	339	0959	2003	0959 1039	1052 2003		-163.1
477	51	340	0959	1955	0959 1046	1058 1955		-163.6
478	51	341	0958	1957	0958 1039	1046 1957		-163.7
481	14	344/345	0057	0558	0057 0140	0141 0558		-156.5
482	14	346	0010	0559	0010 1102	0103 0559		-156.9
488	14	351	2028	0601	2028 0601			-157.4
490	14	353	2016	2301	2016 2056	2057 2301		-157.7
492	14	356	0156	0608	0156 0608			-157.3
493	14	357	0030	0609	0030 0609			-158.2
494	14	358	0247	0610	0247 0610			-157.5
495	14	358/359	2013	0610	2013 2101 0113 0610	2101 0113		-158.0

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/Post (°K)	Thres Pre/Post (dbm)				
3	45.1	-173	14	0.135	8	
3	45	-174	13	0.177	8	
3	45.8	-175	11	0.210	8	TXR problem - reflected power (TXR 107008) delayed acquisition by 41 minutes.
12	28.0	-173	0			Record only pass.
3	47.2	-174.5	11	0.210	8	
3	46.4	-175	8	0.200	8	
3	44.3	-175.5	10	0.200	8	
12	36.4	-172	10	0.030	16/64	At 64 bit rate P/E (parity error) prints bad.
12	28.3	-173	9	0.089	8	
12	27.9	-172	0	N/A	N/A	Record only.
12	27.8	-173	5	0.000 0.140	16 64	
12	27.6	-173	0			Record only.
12	27.8	-173	0			Record only.
12	27.8	-173	0			Record only pass.
12	27.7	-172	6	0.200	8	At 2020 ANT to sideral drive - computer failure indicated. Reset computer operation normal - no loss of data.

Table 17 (contd)

Pass No	DSS No	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time			Signal Strength Avg (dbm)
					1-Way	2-Way	3-Way	
497	14	361	0105	0612	0105 0612			-158
498	51	361	0959	1953	0959 1036	1045 1953		-165
499	51	362	0957	2000	0957 1010	1010 2000		-164.7
500	14	363	1930	0101	1930 1959	1959 0101		-157.4
500	51	363	0959	2000	0959 1051	1105 1945	1945 2000	-164.7
501	14	364	1929	0601	0101 0601	1956 0101	1929 1955	-156.3
501	51	364	1000	1955	1000 1049	1049 1955		-165.4
502	14	365	1931	2301	1931 2008	2008 2301		-158.3

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
12	28	-173				Record only pass.
3	43.0	-171	10			
3	43.9	-175	7			
12	28.6	-173	7	0.015 0.280	8 64	
3	43	-175	7	0.500	8	
12	28	-172	5			Record only 0100-0601.
3	43.8	-176	7		8	Excessive parity error, STA investigating
12	28.2	-172	5			

Table 17 (contd)

Pass No.	DSS No.	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time			Signal Strength Avg (dbm)
					1-Way	2-Way	3-Way	
503	14	002	0128	0601	0128 0601			N/A
504	14	003	0118	0601	0118 0601			N/A
505	51	003	1004	2000	1004 1047	1047 2000		-165.4
505	14	004	0126	0300	0126 0300			
507	14	005	2011	0618	2011 2102 0116 0618	2102 0116		-158.6
508	14	007	2004	0619	2004 2037	2037 0619		-158.4
512	14	011	0052	0300	0052 0300			-158.5
514	14	013	0056	0622	0056 0622			N/A
515	51	013	1018	1930	1018 1122	1122 1930		-164.8
515	14	013	2015	0623	2015 2058 0114 0623	2058 0114		-158.5
516	14	014	2015	2315	2015 2057	2057 2315		-159.3
516	51	014	1046	1941	1046 1127	1132 1941		-165.1

N/A Not applicable

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
12	28.1	-172	0			Record only.
12	27.8	-172	0			Record only.
3	42.9	-176	9		8	Parity error excessive, station investigating.
12	28.3	-173				Record only.
12	27.6	-172	8	0.100 0.700	16 64	
12	27.8	-173	8	0.040	16	
12	28.0	-173	0			Record only - GOE supporting Pioneer VIII.
12	28.3	-173	None			Record only.
3	42.6	-176.5	7	0.700	8	Punch A2 faulty - changed. TFR-51-TDH-107056. Jammed paper in Punch 1; fault corrected. Parity error excessive.
12	28.0	-173	5	0.000	16	
12	28.2	-172	3	0.000	8	
3	41.2	-176	7	0.700	8	Acquisition delayed due to Dec hydraulic line rupture. 0910 to 1035, antenna not operational. TFR-51-ANT-107058. Parity error excessive.

Table 17 (contd)

Pass No.	DSS No.	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time			Signal Strength Avg (dbm)
					1-Way	2-Way	3-Way	
517	51	015	0958	2005	0958 1032 1405 1712	1043 1403 1712 2005		-165.6
517	14	016	0123	0624	0123 0624			-159
518	51	016	0954	2000	0954 1033 1315 1639 1844 1923	1033 1314 1654 1841 1938 2000		-166
518	14	017	0112	0624	0112 0624			-159
520	51	018	1000	2000	1000 1030	1041 1144 *1145 1444 1445 1549 *1550 1929 1930 2000		-165.5
520	14	019	0110	0626	0110 0626			
521	51	019	0954	2000	0954 1031 1112 1929	1034 1111 1930 2000		-165.2
521	14	019	2227	0400	2227 2258	2258 0400		-161.4
522	14	020	2014	2300	2014 2056	2056 2300		-161.5

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
3	40.6	-176.5	9	0.700	8	Two-way coherent versus downlink only, checks at DSS 51, indicate cause of excessive parity error due to threshold operations, when station is in two-way coherent operations.
12	28.2	-173				Record only pass.
3	40.2	-177	9	0.400	8	TFR-51-RCV-107065. C1 was not shown at TDH printout due to faulty switch at RCV.
12	28	-173				Record only pass.
3	40.6	-176	6	0.300	8	*Two-way noncoherent. Discovered on post track calibration that no AGC VCO deviations had been recorded on Track 7 due to a patching error. No other data lost. AGC readings on CEC available at station. TFR-51-AIS-107070.
12	29.0	-173				Record only.
3	45.0	-177	3	0.336	8	
12	28.5	-173		0.000	16	
12	28.2	-173	4	0.000	16	

Table 17 (contd)

Pass No.	DSS No.	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time			Signal Strength Avg (dbm)
					1-Way	2-Way	3-Way	
523	14	021	2011	0627	2011 2055 0114 0627	2055 0114		-158.5
523	51	021	1001	1958	1001 1958			-165.3
524	14	022	1852	2257	1852 1940	1940 2257		-158.6
524	51	022	0957	2000	0957 1940		1946 2000	-165.5
525	14	023	1853	2310	1853 1930	1930 2310		-156.5
526	51	024	1000	2000	1000 2000			-165.5
526	14	024	2148	0530	2148 2222 0125 0530	2222 0125		-156
527	51	025	0958	2000	0958 1032 1251 1944	1042 1249 1946 2000		-165.7
527	14	026	0155	0530	0155 0530			Unknown
528	14	026/027	2012	0530	2012 2056 2239 0530	2056 2239		-156.5
529	14	027/028	2027	0530	2027 2106 0041 0530	2106 0041		-156.5

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/Post (°K)	Thres Pre/Post (dbm)				
12	28.2	-173	7	0.100	16	
3	39.5	-176.6	0	0.400	8	High parity error due to threshold operations.
12	28.5	-173	7	0.000	8/16	At 2121 a power failure at DSS 12 covered interruption of GOE and TCP; no data lost.
3	41.2	-176	0	0.200	8	TFR-51-REC-107072. Dirty heads and bad tape. Magnetic tape playback poor.
12	28.2	-173	6	0.023	16	At 2108, switched to linear feed - dual Maser operations. Commenced with a 3 dbm improvement noted from 158 to 155 dbm.
3	43.8	-176.5		0.380	8	
12	28.7	-173	7	0.080 0.240	8 64	
3	39.7	-176.5	11	0.300	8	TFR-51-TDH. Secondary punch sample rate followed master sample rate.
12	28.3	-173				Record only pass.
12	28.4	-173	5	0.150	64	
12	28	-173	4	0.350	64	TXR off at 0026. Lost 400 cycle power. TFR-105300. Maser 2 started warming up. Receiver on Maser 1. TFR-105301. DTS input typewriter hanging up. Interim Monitoring Program inoperative. TFR-105303.

Table 17 (contd)

Pass No.	DSS No.	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time			Signal Strength Avg (dbm)
					1-Way	2-Way	3-Way	
530	51	028	0955	2000	0955 1033 *1154 1945	1042 1153 1947 2000		-165.7
530	14	028	2030	0100	2030 2111	2111 0100		-160.1
531	14	029	1910	2130	1910 1942	1942 2130		-158.8
532	14	030	1843	2300	1843 1932	1932 2300		-159.5
533	14	031	1840	2130	1840 1917	1917 2130		-157.3

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
3	44.3	-176	9	0.400	8	*S/C noncoherent mode.
12	27.8	-174	7	Bad	64	
12	28.5	-173	9	0.000	16	
12	28.5	-173	8	0.004	16	
12	29.0	-122	7	0.000	8/16	

Table 17 (contd)

Pass No.	DSS No.	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time			Signal Strength Avg (dbm)
					1-Way	2-Way	3-Way	
536	51	034	0951	2000	0951 2000			-166.2
537	51	035	1002	2001	1002 2001			-166.3
539	51	037	1059	1900	1059 1900			-166.2
540	51	038	1101	1901	1101 1901			-165.9
541	51	039	1100	1900	1100 1900			Unknown
542	51	040	1108	1900	1108 1900			-166.5
542	14	040	2012	0300	2012 2059 2219 0300	2059 2219		-156.5
543	14	041/ 042	2015	0635	2015 2114 2215 0635	2114 2215		-157
544	14	042	2012	0635	2012 2050 2216 0635	2050 2216		-156.5
545	14	043	1911	0300	1911 2008	2008 0300		-156.8
546	14	044	1910	2258	1910 1958	1958 2258		-157.5
547	14	045	1911	2300	1911 1959	1959 2300		-157.0
548	14	046	1912	2353	1912 1959	1959 2353		-157.8

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
3	41.2	-176	0	0.800	8	
3	42	-176.5	0	0.800	8	
3	41.8	-175.5	0	0.800	8	
3	32.4	-177	0	0.300	8	
3	33.8	-177	0	Unknown	Unknown	Record only track.
3	33.0	-146.5	0			Polarizer and waveguide bypass in operations. Record only pass.
12	29.0	-173	2	0.010	8	Waveguide in dual Maser. Record only at 2203.
12	28.3	-174	1	0.000	64	Waveguide in dual Maser configuration went to record only at 2200.
12	28.0	-173	3	0.010/ 0.370	16/ 64	Station to record only at 2200.
12	27.0	-173	6	0.000	16/ 64	Doppler resolver counter not counting. Replaced unit. TFR -11695.
12	27.2	-173	9	0.350	16/ 64	Waveguide in dual Maser. Spacecraft in duty cycle store at 225650.
12	28.7	-173	9	0.300	16/ 64	Dual Maser configuration.
12	28.6	-173	5	0.000/ 0.560	16/	At 2102 TDH lost power due to faulty trouble lamp cord being plugged into TDH power source. TFR-105481.

Table 17 (contd)

Pass No.	DSS No.	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time 1-Way	2-Way	3-Way	Signal Strength Avg (dbm)
549	14	047	2117	0630	2117 2159	2159 0630		-159.7
550	14	048	1911	0300	1911 1958	1958 0300		-159.9
551	14	049	1911	0632	1911 1948	1948 0632		-160.1
552	14	050	1839	0300	1839 1923 2152 2203	1923 2152 2203 0300		-157.7
553	14	051	1914	2400	1914 2006 2054 2109	2006 2054 2109 2400		-157.7
544	14	052	1914	2258	1914 1950	1950 2258		-157.6
555	14	053	1946	2358	1946 2034	2034 2358		-160.1
556	14	054/ 055	2121	0400	2121 2214	2214 0400		-159.8
557	14	055/ 056	1911	0400	1911 2000	2000 0400		-156.8
558	14	056/ 057	1911	0630	1911 2005	2005 0630		-156.6
559	14	058	0124	0600	0124 0200	0200 0600		-157.2
560	14	058	1911	2305	1911 2005	2005 2305		-159.8

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
12	29.2	-173	11	*0	64/ 16	Maser 2 out. No linear polarization mode. *Parity Error Rate (PER) bad in 64 bps.
12	28.0	-174	12	0.05/ Bad	16/ 64	Maser 2 inoperative.
12	29.0	-174	12	0.06	16	Maser 2 inoperative.
12	27.0	-174	11	0/ 0.5	16/ 64	Dual Maser linear polarization configuration.
12	27.6	-173	10	0/ 0/ Bad	8/ 16/ 64	CMD 4/027 went 1 minute late at 233700 due to error in Ground Operating Equipment (GOE) dual Maser configuration.
12	27.6	-173	10	0.030/ Bad	16/ 64	Dual Maser configuration.
12	29.7	-172	9	0.026/ 0.199	8/ 16	Maser 2 inoperative. No linear polarization mode.
12	27.3	-173	7	0.000	16	Standard configuration. Maser 2 down.
12	26.7	-174	13	0.000/ 0.761	16/ 64	Dual Maser linear configuration.
12	27.4	-173	12	0.000/ 0.019	8/ 16/ 64/	Dual Maser linear configuration.
12	28.8	-173	9	0.000/ 0.970	16/ 64	Dual Maser linear configuration. *022500 to 023300 the three most significant digits of doppler read out zero (0) at random. Replaced card all in doppler frequency counter. TFR-105331.
12	27.5	-173	10	0.000/ Bad	16/ 64	Standard configuration. Maser 2 down. TFR-105331.

Table 17 (contd)

Pass No.	DSS No.	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time			Signal Strength Avg (dbm)
					1-Way	2-Way	3-Way	
561	14	059	1909	2303	1909 1959	1959 2303		-156.8
562	14	060	1912	2300	1912 1950	1950 2300		-155.9

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
12	27.8	-173	9	0.000/ 0.990	16/ 64	Dual Maser linear configuration.
12	27.6	-173	9	0.000/ 0.863	16/ 64	Dual Maser linear configuration.

Table 17 (contd)

Pass No.	DSS No.	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time			Signal Strength Avg (dbm)
					1-Way	2-Way	3-Way	
563	14	061	1910	0635	1910 2003 0129 0141	2003 0129 0141 0635		-157.0
564	14	062	1914	0643	1914 2003	2003 0643		-157.0
565	14	063	1913	0643	1913 2003	2003 0643		-157.4
569	14	067	2017	2300	2017 2300			No AGC Curve
570	14	068	2015	2300	2015 2109	2109 2300		-157.4
571	14	069	2013	2300	2013 2104	2104 2300		-158.3
572	14	070	2012	2300	2012 2103	2103 2300		-157.2
573	14	071	1917	0304	1917 2004	2004 0303		-158.3
574	14	072	1920	2310	1920 2016	2016 2310		-157.6
575	14	073	2002	0030	2002 2039	2039 0030		-157.4
576	14	074	1928	2310	1928 2008	2008 2310		-157.5
577	14	076	0020	0645	0020 0104	0104 0645		-159.2

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
12	27.5	-173	11	0/BAD	16/64	At 1921 to 1931 RCU 0/2, Ant. on brake, C/B failed. At 0129 to 0141, one-way, TXR beam over-current failure. Dual maser configuration.
12	27.8	-172	13	0/0.850	16/64	Dual maser configuration. Maser 2 off from 0049 to 0051.
12	27.4	-173	13	0.000/BAD	16/64	Dual maser configuration.
12	NA	NA	0		16	Record only pass one to loss of communications after contractor cut underground communication cable. Station went two-way to check out XMTR. Maser 1 down at 2249.
12	21.2	-173	7	0/0.100	16/64	Linear polarization.
12	23.2	-173	9	0	16	Linear polarization.
12	28.8	-173	9	0.000/0.157	16/64	Linear diplexer configuration.
12	20.2	-173	9	0/0.250	16/64	Linear diplexer configuration.
12	23.7	-173	11	0.000/0.121	16/64	Linear diplexer configuration. DSS 12 supporting for TLM. TFR-105325.
12	29.2	-173	9	0.000/0.142	16/64	Linear diplexer configuration. XMTR manually adjusted for 10 kw for this pass. Ref TFR-105336. DSS 12 support for TLM.
12	30.8	-173	8	0.000/0.150	16/64	Linear diplexer configuration.
12	30.0	-172	9	0.060/BAD	16/64	020711; command not sent on time. GOE malfunction.

Table 17 (contd)

Pass No.	DSS No.	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time 1-Way	Ground Mode Start/Stop Time 2-Way	Ground Mode Start/Stop Time 3-Way	Signal Strength Avg (dbm)
578	14	076	2359	0645	2359 0039 0453 0525	0039 0248 0525 0645		-159.8
579	14	077	2323	0645	2323 0009	0009 0645		-159.3
580	14	078	2013	2400	3013 2110	2110 2400		-156.9
581	14	079	1915	2300	1915 1959	1959 2300		-156.3
582	14	080	1915	2303	1915 1959	1959 2303		-156.1
583	14	081	1914	2300	1914 1949	1949 2300		-156.3
584	14	082	2106	0646	2106 2200	2200 0646		-157.3
585	14	083	2044	0647	2044 2120	2120 0647		-157.4
586	14	084	2012	0646	2012 2016 2347 0600	2106 2347 0600 0646		-157.5
587	14	085	2044	0300	2044 2130 2331 0206	2130 2331 0206 0300		-157.4

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/Post (°K)	Thres Pre/Post (dbm)				
12	29.0	-172	11	0.000 / BAD	16/64	At 024830 to 045327; stopped tracking due to extreme wind conditions. At 232304 ant. to precision 1 mode with wrong 3-day data.
12	29.0	-173	11	0.039 / BAD	16/64	At 005705; GOE operator inadvertently initiated command 061 instead of command 101. Command 101 initiated at 005925. Command 061 and 101 part of CRUU-2 sequence. Commands sent out of sequence, confusion caused by project adding command 016 CRUU-3 ahead of CRUU-2.
12	28.7	-173	9	0.000 0.000 0.168	8/16/64	Linear diplexer feed.
12	29.9	-173	10	0.000 / 0.234	16/64	Linear diplexer feed.
12	29.5	-173	9	0.000 / 0.160	8/16/64	Linear diplexer feed.
12	29.3	-172	9	0.000 / 0.000 / 0.185	8/16/64	00/00/00
12	28.6	-173	11	0 / 0.250	16/64	00/00/00
12	29.5	-173	27	0 0.300	16/64	P1/W0/B12. Acquisition 14 min late due to TXR problem.
12	29.2	-173	9	0.000 / 0.198	16/64	At 2030, FR-1400A servo not operating properly. Realigned unit. TFR-105345.
12	29.2	-173	9	0.000 / 0.168	16/64	P1/W0/B12.

Table 17 (contd)

Pass No.	DSS No.	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time			Signal Strength Avg (dbm)
					1-Way	2-Way	3-Way	
588	14	086	1910	2300	1910 2014	2014 2300		-156.5
589	14	087	1913	2300	1913 2009	2009 2300		-158.8
590	14	088	1935	2300	1935 2014	2014 2300		-158.9
591	14	090	0037	0647	0037 0119	0119 0647		-158.7
592	14	090	2012	0647	2012 2109 2259 0531	2109 2259 0531 0647		-160

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
12	30.6	-173	9	0.000 / 0.237	16/64	P1/W0/B12. At 1910 to 2300.
12	30.4	-174	9	0.018 / 0.212	16/64	P1/W0/B12. At 191315 to 2300. TDH doppler counter and resolver not working properly from 2007 - 2300. Replaced strobe card in PC-143. Back-up at 088/0100.
12	30.3	-174	9	0.000 / 0.285	8/16/64	P1/W0/B12. At 1935 to 2300. TXR instrumentation inoperative. TFR-105350.
12	29.6	-174	9	0.000 / 0.712	16/64	P1/D1/B12. At 0037 to 0647. 021228. GOE encoder error stopped transmission of command. Problem under investigation. TFR-105353.
12	29.0	-173	9	N/A	16/64	P1/D1/B12. At 0037 to 0647. At 0609. TCP interrupted; cause unknown. Restarted at 0621. TFR-105345. Command 061 was stopped because it was not verified after TCP restart. Scheduled power outage at SFOF.

Table 17 (contd)

Pass No. PN-7	DSS No.	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time 1-Way	2-Way	3-Way	Signal Strength Avg (dbm)
593	14	091	2011	0647	2011 2110 0005 0500	2110 0005 0500 0647		-160
594	14	092	2013	0300	2013 2102 2127 2218 2227 2245	2102 2127 2218 2227 2245 0300		-159.5
595	14	093	1910	2300	1910 2000	2000 2300		-158.8
596	14	094	1910	2258	1910 1959	1959 2258		-158.8
597	14	095	1910	2300	1910 1959	1959 2300		-158.4
598	14	096	2319	0647	2319 0010 0210 0532	0010 0210 0532 0647		-158.1
599	14	097	2020	0647	2020 2106 2249 0504	2106 2249 0504 0647		-159.5
600	14	098	2021	0646	2021 2111	2111 0646		-161.8
601	14	099	2014	0256	2014 2307 0106 0206	2307 0106 0206 0256		-158.4
602	14	100	1917	2252	1917 2252			-159
603	14	101	1914	2251	1914 2251			-159

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
12	28.8	-174	11	N/A	16/24	P1/D1/B12 from 2011 to 0145. P1/D1/B12 from 0145 to 0425. P1/D1/B12 from 0425 to 0647.
12	29.7	-174	10	0.038 0.228	16/64	P1/D1/B12 from 2013 to 0300. 2109027 XMTR off, high voltage rectifier air failure (TFR-105355). 2253 TDH doppler resolver failed (TFR-105356).
12	28.2	-175	9	0.000 0.266	16 64	P1/D1/B12 from 1910 to 2300. Maser 1 down.
12	28.6	-174	9	0.019 0.295	16 64	P1/D1/B12 from 1910 to 2258.
12	28.5	-173	9	0.175 0.281	16 64	P1/D1/B12 from 1910 to 2300.
12	30.3	-174	9	0.050	64	P1/D1/B12 from 2319 to 0151. P1/D0/B12 from 0151 to 0455. P1/D1/B12 from 0455 to 0647.
12	33.2	-174	10	0.050	64	P1/D1/B12 from 2020 to 2231. P1/D0/B12 from 2231 to 0425. P1/D1/B12 from 0425 to 0647.
12	29.5	-174	10	Bad 0.010	64 16	P0/D1/B12.
12	29.5	-174	9	0 0.250	16 64	Record only until 2225. P1/D0/B12 from 2014 to 2224. P1/D1/B12 from 2224 to 0256.
12	29.8	-174	9	0.000 0.400	16 64	P1/D1/B12.
12	30.8	-174	9	0.000 0.400	16 64	P1/D1/B12.

Table 17 (contd)

Pass No. PN-7	DSS No.	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time			Signal Strength Avg (dbm)
					1-Way	2-Way	3-Way	
604	14	102	1915	2300	1915 1950	1950 2300		-159.1
605	14	103	2252	0646	2252 2327	2327 0646		-158.7
606	14	104	2019	0643	2019 2110 2249 0532	2110 2249 0532 0643		-158.8
607	14	105	2012	0644	2012 2110 2249 0530 0545 0553	2110 2249 0530 0545 0553 0644		-159.7
608	14	106	2213	0645	2213 2249 0114 0532	2249 0114 0532 0645		-159.5
609	14	107	2012	2058	2012 2049	2049 2058		-159.1
611	14	109	1935	0200	1935 2044	2044 0200		-159.6
615	14	114	0109	0643	0109 0153	0153 0643		-159.8
616	14	114	1910	2255	1910 1939	1939 2255		-158.9
617	14	115	1910	2256	1910 1959	1959 2256		-162.1

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
12	30.3	-174	9	0 0.300	16 64	P1/D1/B12.
12	29.0	-174	11	0.000 0.321	16 64	P1/D1/B12 from 2252 to 0646. No output of engineering data due to loop current adjustment in buffer. As a result of 100 wpm mod. loosing 56 minutes of real-time engineering data. (TFR-105370).
12	29.2	-174	11	0.000 0.013	16 64	P1/D1/B12 from 2019 to 2230. P1/D0/B12 from 2230 to 0455. P1/D1/B12 from 0455 to 0643.
12	19.4	-174	11	0.000 0.038	16 64	P1/D1/B12 from 2012 to 2230. P1/D0/B12 from 2230 to 0455. P1/D1/B12 from 0455 to 0644. TXR off - focus under current, body over current, at 052615 (TFR-105371).
12	19.4	-174	9	0.000 0.050	16 64	P1/D1/B12 from 2213 to 0056. P1/D0/B12 from 0056 to 0455. P1/D1/B12 from 0455 to 0645.
12	29.0	-174	0	0.000	16	P1/D1/B12 from 2012 to 2058. Track discontinued at 205725 due to high winds, average 55 mph.
12	19	-176	7	0.000	16	P1/D1/B12 from 1935 to 0200.
12	30.5	-174	9	0 0.340	16 64	P1/D1/B12 from 0109 to 0643.
12	29.8	-174	9	0.000 0.265	16 64	P1/D1/B12 from 1910 to 2255. 223500 TCP program stopped at same time. GOE switched bit rate reinitialized and operation normal.
12	29.6	-174	8	0.000 0.076	8 16	P1/D1/B12 from 1910 to 2256. 2225 lost TCP program, reason unknown (Channel 6 track).

Table 17 (contd)

Pass No. PN-7	DSS No.	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time			Signal Strength Avg (dbm)
					1-Way	2-Way	3-Way	
618	14	116	2215	0643	2215 2311 0135 0502	2311 0135 0502 0643		-159.0
619	14	118	0121	0642	0121 0208 0349 0503	0208 0349 0503 0642		-159.2
620	14	118	2224	0641	2224 2310 0035 0532	2310 0035 0532 0641		-159
621	14	119	2212	0642	2212 2300 0045 0518	2300 0045 0518 0642		-159.8
622	14	120	1941	0300	1941 2043 2217 2218	2043 2217 2218 0300		-159.7
623	14	121	1729	2258	1729 1802 2002 2012	1802 2002 2012 2258		-158.8

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
12	18.8	-176	9	0 0.008	16 64	P1/D1/B12 from 2215 to 0115. P1/D0/B12 from 0115 to 0425. P1/D1/B12 from 0425 to 0643.
12	Maser 1, 18.6 Maser 2, 29.3	-176	9	0.000 0.023	16 64	P1/D1/B12 from 0121 to 0330. P1/D0/B12 from 0330 to 0428. P1/D1/B12 from 0428 to 0642. 0510, engineering data garbled. Bad keyer at station (TFR-105415). Switched lines.
12	Maser 1, 18.9 Maser 2, 28.9	-176	11	0.000 0.035	16 64	P1/D1/B12 from 2224 to 0015. P1/D0/B12 from 0015 to 0457. P1/D1/B12 from 0457 to 0642.
12	Maser 1, 20.0 Maser 2, 30.0	-175	10	0.000 0.023	16 64	P1/D1/B12 from 2212 to 0025. P1/D0/B12 from 0025 to 0442. P1/D1/B12 from 0442 to 0642.
12	29.2	-174	7	0.000	16	P1/D1/B12 from 1941 to 0300. 215748 antenna lost optical lock. Caused by noise in auto-collimator (TFR-105418).
12	Maser 1, 19.0 Maser 2, 30.0	-175	7	0.000	16	P1/D1/B12 from 1729 to 2258. 194230, TXR failure. No fault indicated (TFR-105419). Back on at 194900.

Table 17 (contd)

Pass No.	DSS No.	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time			Signal Strength Avg (dbm)
					1-Way	2-Way	3-Way	
624	14	122	1727	2257	1727 1802	1802 2257		-158.6
625	14	123	1727	2259	1727 1813 2048 2102	1813 2048 2102 2259		-162.6
626	14	124	2358	0600	2358 0033 0249 0455	0033 0249 0455 0600		-159.3
627	14	125	1751	0157	1751 1824 1937 0009	1824 1937 0009 0157		-160
628	14	126	2021	0558	2021 2059 2304 0443	2059 2304 0443 0558		-159.5
629	14	127	1725	2132	1725 1828	1828 2132		-159.7
630	14	128	1728	2127	1728 1814	1814 2127		-163.3
631	14	129	1723	2157	1723 1802	1802 2157		-159.2
632	14	131	0004	0553	0004 0111	0111 0553		-159.2

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
12	31.6	-174	7	0.000	16	P1/D1/B12 from 1727 to 2257.
12	30.8	-174	8	0.250	16	P0/D1/B12 from 1727 to 2259. Channel 6 track. At 202810, the antenna main hydraulic pump was accidentally shut off by a personnel depressing the emergency stop button (TFR-105420).
12	Maser 1 18.6 Maser 2 31.7	D0/ -176 D1/ -174	9	0.000/ 0.038	16/ 64	P1/D1/B12 from 2358 to 0230, P1/D0/B12 from 0230 to 0428, and P1/D1/B12 from 0428 to 0600.
12	Maser 1 19.5 Maser 2 31.6	D0/ -176 D1/ -174	7	0.000	16	P1/D1/B12 from 1751 to 1917, P1/D0/B12 from 1917 to 2340, and P1/D1/B12 from 2340 to 0157. At 1845, the CMD encoder malfunctioned causing TCP interrupt; replaced diode in CMD encoder (TFR – 105421).
12	Maser 1 18.8 Maser 2 31.6	D0/ -176 D1/ -174	9	0.000/ 0.013	16/ 64	P1/D1/B12 from 2021 to 2244, P1/D0/B12 from 2244 to 0412, and P1/D1/B12 from 0412 to 0558.
12	31.7	-174	8	0.000	16	P1/D1/B12 from 1725 to 2132. At 174113, the TXR went off – lost 400-cycle motor-generator sets (TFR – 105423).
12	31.9	-174	8	0.000/ 0.293	8/ 16	P0/D1/B12 from 1728 to 2127. Channel 6 pass.
12	31.6	-176	8	0.000	16	P1/D1/B12 from 1723 to 2157. At 1830, the TDH had an extra character on the printout; tightened loose screw on high speed punch (TFR-105428).
12	29.6	-174	8	0.000	16	P1/D1/B12 from 00042 to 0553. Intermittent Comm problems through track.

Table 17 (contd)

Pass No.	DSS No.	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time 1-Way	2-Way	3-Way	Signal Strength Avg (dbm)
633	14	131	1725	0156	1725 1802 2104 0010	1802 2104 0010 0156		-159.9
634	14	132	1725	0457	1725 1804 1950 0332	1804 1950 0332 0457		-159.8
635	14	133	1724	0152	1724 1804 2005 0023	1804 2005 0023 0152		-159.5
636	14	134	1724	0157	1724 1803 2010 0033	1803 2010 0033 0157		-160
637	14	135	1724	2158	1724 1802	1802 2158		-161
638	14	136	1724	2158	1724 1904	1904 2158		-162
639	14	137	1724	2200	1724 1801	1801 2220		-159
640	14	139	0023	0600	0023 0104 0335 0434	0104 0335 0434 0600		-160

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
12	Maser 1 16.7 Maser 2 30.0	-176 -174	9	0.000/ 0.042	16/ 24	P1/D1/B12 from 1725 to 2044, P1/D0/B12 from 2044 to 2338, and P1/D1/B12 from 2338 to 0156. TCP halted several times.
12	Maser 1 16.8 Maser 2 30.0	-176 -174	9	0.000/ 0.380	16/ 64	P1/D1/B12 from 1725 to 1930, P1/D0/B12 from 1930 to 0255, and P1/D1/B12 from 0255 to 0457.
12	Maser 1 16.7 Maser 2 30.7	-175 -176	9	0.000/ 0.023	16/ 64	P1/D1/B12 from 1724 to 1945, P1/D0/B12 from 1945 to 2336, and P1/D1/B12 from 2336 to 0152. At 2315, the signal started fluctuating ±1.5 db; switched to Maser 2 (TFR – 105431).
12	30.5	-174	9	0.000/ 0.227	16/ 64	P1/D1/B12 from 1724 to 1950, P1/D0/B12 from 1950 to 2242, and P1/D0/B12 from 2242 to 0157. At 2235, the signal level started fluctuating from -159.0 to -163.6 dbm on Maser 1; switch to Maser 2 at 224240 (TFR – 105431).
12	30.5	-173	10	0.000/ Bad	16/ 64	P1/D1/B12 from 1724 to 2158.
12	31.2	-174	8	0.057	16	P1/D1/B12 from 1724 to 2158. Channel 6 pass.
12	31.0	-174	8	0.000	16	P1/D1/B12 from 1724 to 2200.
12	30.5	-174	9	0.000/ 0.059	16/ 64	P1/D1/B12 from 0023 to 0315, P1/D0/B12 from 0315 to 0355, and P1/D1/B12 from 0355 to 0600.

Table 17 (contd)

Pass No.	DSS No.	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time 1-Way	2-Way	3-Way	Signal Strength Avg (dbm)
641	14	139	1725	0200	1725 1804 2007 0029	1804 2007 0029 0200		-159.2
642	14	140	1725	0500	1725 1806 1950 0333	1806 1950 0333 0500		-159
643	14	141	1725	0200	1725 1804 1950 0011	1804 1950 0011 0200		-159.
644	14	142	1725	2157	1725 1805	1805 2157		-158.6
645	14	143	1725	2157	1725 1800	1800 2157		-159.2
646	14	145	0024	0600	0024 0114	0114 0600		-161.3
647	14	145	1725	0157	1725 1806 1950 2121 2225 0104	1806 1950 2121 2225 0104 0157		-159.0
648	14	146	1726	0158	1726 1806 2135 0055	1806 2135 0055 0158		-158.8

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
12	Maser 1 18.4 Maser 2 31	-176 -173	11	0.000/ 0.019	16/ 64	P1/D1/B12 from 1725 to 1950, P1/D0/B12 from 1950 to 2355, and P1/D1/B12 from 2355 to 0200. At 225950, the antenna went to brake when the elevation lube system did not switch from A to B when the system failed (TFR — 105434).
12	Maser 1 20 Maser 2 30.8	-176 -174	9	0.000/ 0.000/ 0.018	8/ 16/ 64	P1/D1/B12 from 1725 to 1930, P1/D0/B12 from 1930 to 0255, and P1/D1/B12 from 0255 to 0500.
12	Maser 1 17.9 Maser 2 30.8	-176 -174	13	0.000/ 0.013	16/ 64	P1/D1/B12 from 1725 to 1930, P1/D0/B12 from 1930 to 2345, and P1/D1/B12 from 2345 to 0200.
12	31.2	-175	8	0.000/ 0.095	16/ 64	P1/D1/B12 from 1725 to 2157. TXR kicked off due to high voltage ac interlock (TFR — 105438).
12	30.7	-174	12	0.000/ 0.000	8/ 16	P1/D1/B12 from 1725 to 2157. Track using precision Mode 2 TFR — 105439).
12	30.8	-174	15	0.076	16	P0/D1/B12 from 0024 to 0600. Channel 6 track.
12	Maser 1 17.2 Maser 2 30.8	-176 -174	9	0.000/ 0.000/ 0.203	8/ 16/ 64	P1/D1/B12 from 1725 to 1930, P1/D0/B12 from 1930 to 2054, P1/D1/B12 from 2054 to 2205, P1/D0/B12 from 2205 to 0029, and P1/D0/B12 from 0029 to 0157.
12	Maser 1 17.5 Maser 2 31.0	-176 -176	15	0.000/ 0.000/ 0.008	8/ 16/ 64	P1/D1/B12 from 1726 to 2115, P1/D0/B12 from 2115 to 0029, and P1/D1/B12 from 0029 to 0158.

Table 17 (contd)

Pass No.	DSS No.	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time 1-Way	2-Way	3-Way	Signal Strength Avg (dbm)
649	14	147	1726	0557	1726 1805 1905 1933 2222 0449	1806 1905 1933 2222 0449 0557		-159.5
650	14	149	0009	0557	0009 0059	0059 0557		-159.2
651	14	149	1726	2158	1726 1814	1814 2158		-161.5
652	14	150	1744	2157	1744 1837	1837 2157		-160
653	14	154	1736	0600	1736 1813 2050 0504	1813 2050 0504 0600		-158.8

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
12	Maser 1 17.9 Maser 2 31.4	-176 -173	12	0.000/ 0.018	16/ 64	P1/D1/B12 from 1726 to 1844, P1/D0/B12 from 1844 to 1849, P1/D1/B12 from 1849 to 2230, P1/D0/B12 from 2230 to 0410, and P1/D1/B12 from 0410 to 0557. At 1834, the polarizer motor accidentally turned on causing receiver glitching.
12	30.7	-173	9	0.000/ 0.547	16/ 64	P1/D1/B12 from 0009 to 0557.
12	30.0	-174	8	0.000/ 0.095	8/ 16	P1/D1/B12 from 1726 to 2158. Channel 6 pass.
12	29.5	-174	9	0.000/ 0.941	16/ 64	P1/D1/B12 from 1744 to 2157.
12	16.9 31.8	-176 -174	12	0.000/ 0.033	16/ 64	P1/D1/B12 from 1736 to 2031, P1/D0/B12 from 2031 to 0425, and P1/D1/B12 from 0425 to 0600.

Table 17 (contd)

Pass No. PN-7	DSS No.	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time			Signal Strength Avg (dbm)
					1-Way	2-Way	3-Way	
654	14	153	0016	0600	0016 0114 0251 0459	0114 0251 0459 0600		-158.8
655	14	153/ 154	1742	0200	1742 1837 2016 0102	1837 2016 0102 0200		-159.2
656	14	154/ 155	1741	0557	1741 1843 2015 0345	1843 2015 0345 0557		-159
657	14	156	0016	1557	0016 0113 0320 0501	0113 0320 0501 0557		-159
658	14	156	1728	2200	1728 1813	1813 2200		-159.3
659	14	157	1729	1810	1729 1810			-159.8
660	14	158/ 159	1729	0550	1729 1812 1951 0452	1812 1951 0452 0550		-160
661	14	160	0007	0553	0007 0236	0236 0553		-159

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
12	17.5	-176	9	0.300	64	P1/D1/B12 from 0016 to 0230, P1/D0/B12 from 0230 to 0425, and P1/D1/B12 from 0425 to 0600.
12	17.1	-176	9	0.000/ 0.030	16/ 64	P1/D1/B12 from 1742 to 2000, P1/D0/B12 from 2000 to 0030, and P1/D1/B12 from 0030 to 0200.
12	18.4 31	-176 -174	11	0.000/ 0.023	16/ 64	P1/D1/B12 from 1741 to 2000, P1/D0/B12 from 2000 to 0313, and P1/D1/B12 from 0313 to 0557. At 043320 the Telemetry Command Processor (TCP) lost word frame synchronization for approximately 20 seconds – reason unknown.
12	17.8 30.8	-176 -174	9	0.000/ 0.450	16/ 64	P1/D1/B12 from 0016 to 0300, P1/D0/B12 from 0300 to 1429, and P1/D1/B12 from 0429 to 0557. The receiver was out-of-lock from 014920 to 015047 and from 024432 to 024652 – reason unknown.
12	31.6	-174	9	0.000/ 0.000/ 0.623	8/ 16/ 64	P1/D1/B12 from 1728 to 2200.
12	31.0	-174	0	0.000	16	P1/D1/B12 from 1729 to 1810. ANT to stow at 1810 because of high winds in excess of 50 mph.
12	16.9 30.0	-176 -174	9	0.000/ 0.031	16/ 64	P1/D1/B12 from 1729 to 1931, P1/D0/B12 from 1931 to 0415, and P1/D1/B12 from 0415 to 0555.
12	33.0	-174	9	0.000/ 0.665	16/ 64	P1/D1/B12 from 0007 to 0553. At 0040, unable to turn TXR on due to intermittent 24 volt on K4, (TFR 105448).

Table 17 (contd)

Pass No. PN-7	DSS No.	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time 1-Way	2-Way	3-Way	Signal Strength Avg (dbm)
662	14	160/ 161	1729	0200	1729 1812 2021 0032	1812 2021 0032 0200		-159.5
663	14	161/ 162	1729	0600	1729 1817 2355 0010 0152 0212	1817 2355 0010 0152 0212 0600		-160
664	14	163	0004	0556	0004 0052 0413 0414	0052 0413 0414 0556		-159.7
665	14	163	1736	2257	1736 1823	1823 2257		-159.0
667	14	165	1749	2013	1749 1841	1841 2013		-162.4
669	14	167	1737	2157	1737 1819	1819 2157		-159.2
670	14	168	1852	0555	1852 1934	1934 0555		-161.9
671	14	170	0026	0554	0026 0113 0246 0433	0113 0246 0433 0554		159.0
673	14	171	1747	2158	1747 1843	1843 2158		-161.5
674	14	172	1737	0544	1737 1834 2016 0003 0058 0418	1834 2016 0003 0058 0418 0544		-159.5

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
12	18.4 31.0	-176 -174	9	0.000/ 0.008	16/ 64	P1/D1/B12 from 1729 to 2000, P1/D0/B12 from 2000 to 2355, and P1/D1/B12 from 2355 to 0200.
12	16.8 31.2	-176 -175	29	0.156/ 0.771	16/ 64	P0/D1/B12 from 1729 to 0134, and P1/D1/B12 from 0134 to 0600. Solar flare activity.
12	29.0	-173	11	0.000/ 0.582	16/ 64	P1/D1/B12 from 0004 to 0556. At 035225 TXR kicked off due to ac overload condition (TFR 116873).
12	31.0	-174	11	0.000/ 0.500	16/ 64	P1/D1/B12 from 1736 to 2257.
12	18	-174	6	0.153	16	P0/D1/B12 from 1749 to 2013.
12	31.4	-174	9	0.006/ 0.721	16/ 64	
12	31.4	-174	11	0.039/ Bad	16/ 64	TXR off at 2227 – cause unknown.
12	31.0	-173	10	0.625	64	
12	31.9	-174	8	0.333/ 0.049	16/ 8	TXR off at 2057 due to high voltage overcurrent.
12	29.7	-174	11	0.508	64	

Table 17 (contd)

Pass No. PN-7	DSS No.	Day of Year	Acq. Time	End of Track	Ground Mode Start/Stop Time 1-Way	2-Way	3-Way	Signal Strength Avg (dbm)
675	14	174	0032	0543	0032 0113	0113 0543		-159.0
676	14	174	1735	0542	1735 1842	1842 0542		-157.0
677	14	175	1735	0543	1735 1822 2000 0419	1822 2000 0419 0543		-158.5
678	14	177	0030	0543	0030 0115 0251 0414	0115 0251 0414 0543		-158.9
679	14	177	1750	2200	1750 1842	1842 2200		-159.0
680	14	178	1736	2200	1736 1832	1832 2200		-159.1
681	14	179	1752	2200	1752	1850 2200		-162.0

Configuration			No. of Cmds	Average PER	Bit Rate	Comments
Loop BW (Hz)	Temp Pre/ Post (°K)	Thres Pre/ Post (dbm)				
12	29.2	-173	9	0.000/ 0.700	16/ 64	P1/D1/B12 from 0032 to 0543. Maser 1 down.
12	Not taken	Not taken	9	0.000/ 0.500	16/ 64	P1/D1/B12 from 1735 to 0542. No post track calibrations due to Maser 1 maintenance.
12	29.1	-173	12	0.000/ 0.500	16/ 64	P1/D1/B12 from 1735 to 1939, P1/D0/B12 from 1939 to 1956, and P1/D1/B12 from 1956 to 0543. Maser 1 down from 1956 to 0543.
12	17.3	-176	9	0.000/ 0.300	16/ 64	P1/D1/B12 from 0030 to 0230, P1/D0/B12 from 0230 to 0338, and P1/D1/B12 from 0338 to 0543. Maser 2 down at 0600. No post track calibrations on Maser 2.
12	18.4	-176	9	0.000/ 0.400	16/ 64	P1/D1/B12 from 1750 to 2200.
12	18.3	-177	9	0.000/ 0.800	16/ 64	P1/D1/B12 from 1736 to 2200.
12	28.8	-174	8	0.300/ 0.100	16/ 64	P0/D1/B12 from 1752 to 2200.

Table 18. *Pioneer* calendar

July 1967

Calendar date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Day of year	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212
Pioneer VI pass	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593
Pioneer VII pass	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349

August 1967

Calendar date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Day of year	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243
Pioneer VI pass	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624
Pioneer VII pass	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380

September 1967

Calendar date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Day of year	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	364	265	266	267	268	269	270	271	272	273
Pioneer VI pass	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654
Pioneer VII pass	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410

October 1967

Calendar date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Day of year	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	394	295	296	297	298	299	300	301	302	303	304
Pioneer VI pass	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685
Pioneer VII pass	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441

November 1967

Calendar date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Day of year	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334
Pioneer VI pass	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715
Pioneer VII pass	442	443	444	445	446	447	448	449	450	451	452	453	454	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472

December 1967

Calendar date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Day of year	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	256	357	358	359	360	361	362	363	364	365
Pioneer VI pass	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746
Pioneer VII pass	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503
Pioneer VIII pass													1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

Table 18 (contd)

January 1968																															
Calendar date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Day of year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Pioneer VI pass	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777
Pioneer VII pass	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533
Pioneer VIII pass	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50

February 1968																													
Calendar date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Day of year	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Pioneer VI pass	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806
Pioneer VII pass	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562
Pioneer VIII pass	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79

March 1968																															
Calendar date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Day of year	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91
Pioneer VI pass	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837
Pioneer VII pass	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593
Pioneer VIII pass	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110

April 1968																														
Calendar date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Day of year	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121
Pioneer VI pass	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867
Pioneer VII pass	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623
Pioneer VIII pass	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140

May 1968																															
Calendar date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Day of year	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152
Pioneer VI pass	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898
Pioneer VII pass	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654
Pioneer VIII pass	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171

Table 18 (contd)

June 1968

Calendar date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Day of year	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182
Pioneer VI pass	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928
Pioneer VII pass	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684
Pioneer VIII pass	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201

July 1968

Calendar date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Day of year	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213
Pioneer VI pass	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959
Pioneer VII pass	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715
Pioneer VIII pass	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232

August 1968

Calendar date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Day of year	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244
Pioneer VI pass	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990
Pioneer VII pass	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746
Pioneer VIII pass	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263

September 1968

Calendar date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Day of year	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274
Pioneer VI pass	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020
Pioneer VII pass	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776
Pioneer VIII pass	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293

October 1968

Calendar date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Day of year	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305
Pioneer VI pass	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051
Pioneer VII pass	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807
Pioneer VIII pass	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324

November 1968

Calendar date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Day of year	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335
Pioneer VI pass	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081
Pioneer VII pass	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837
Pioneer VIII pass	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354

Note: The pass is associated with the calendar date in which the view period starts.

Glossary

ACQ	acquisition
AGC	automatic gain control
AFETR	Air Force Eastern Test Range
AOS	acquisition of signal
APC	automatic phase control
APS	antenna pointing subsystem
ARC	Ames Research Center
AZ	azimuth
AZ-EL	azimuth-elevation
B12	bandwidth 12 Hz
CDC	command and data handling console
CDU	command distribution unit
CM	coded mode
CMD	command
DEC	declination angle
Demod	demodulator
DI	diplexer in, one- and two-way operation
DIS	digital instrumentation subsystem
DO	diplexer out or bypassed; one-way operation only; reduces system noise temperature
DSIF	Deep Space Instrumentation Facility
DSN	Deep Space Network
DSS	Deep Space Station
DSU	data storage unit
DTU	data transmission unit
GCF	Ground Communications Facility
GMT	Greenwich mean time
GOE	ground operational equipment
HA-DEC	hour angle/declination
HSD	high speed data
IMP	Interim Monitor Program
IRS	infrared spectrometer
LCP	left circular polarization
MMSA	multimission support area
MSFN	Manned Space Flight Network
NASCOM	National Aeronautics and Space Administration Communications Network
OCC	operations control chief
PER	parity error rate
PI	polarizer in, eliminating 3-dB circular polarization loss
PIN	paralleled input
PO	polarizer out
RCV	receiver-exciter subsystem
RCVR	receiver
RCP	right circular polarization
RTLT	round-trip light time
SDA	systems data analysis
SFOF	Space Flight Operations Facility
SMF	S-band multiple frequency
SNR	signal-to-noise ratio
SPE	static phase error
TCP	telemetry command processor
TDA	tracking and data acquisition
TDH	tracking data handling subsystem
TDP	tracking data processor
TDS	Tracking and Data System
TFR	Trouble/Failure Report
T freq	spacecraft auxiliary oscillator frequency
TLM	telemetry
TTY	teletype
TWT	traveling wave tube
TXR	transmitter subsystem
W/F	word/frame
XMT ref	ground transmitter synthesizer frequency for best lock at zero doppler

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NASA — JPL — Coml., L.A., Calif.

71-27456

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No. 33-426, Vol. VI	2. Government Accession No.	3. Recipient's Catalog No.

4. Title and Subtitle TRACKING AND DATA SYSTEM SUPPORT FOR THE PIONEER PROJECT PIONEER VII. EXTENDED MISSION: FEBRUARY 24, 1967--JULY 1, 1968

5. Report Date April 15, 1971

6. Performing Organization Code

7. Author(s) N. A. Renzetti

8. Performing Organization Report No.

9. Performing Organization Name and Address
JET PROPULSION LABORATORY
California Institute of Technology
4800 Oak Grove Drive
Pasadena, California 91103

10. Work Unit No.

11. Contract or Grant No.
NAS 7-100

13. Type of Report and Period Covered
Technical Memorandum

12. Sponsoring Agency Name and Address
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Washington, D.C. 20546

14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

The Tracking and Data System supported the deep space phase of the Pioneer VII mission, which is in an outward trajectory from the earth in a heliocentric orbit. During the period of this report, six scientific instruments aboard the spacecraft continued to register information relative to interplanetary particles and fields, and radio metric data generated by the network continues to improve our knowledge of the celestial mechanics of the solar system. In addition to detail network support activities, network performance and special support activities are covered.

17. Key Words (Selected by Author(s))
Pioneer Project
Telemetry and Command
Tracking

18. Distribution Statement
Unclassified -- Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	152	

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