NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Technical Memorandum 33-474

Volume II

Tracking and Data System Support for the Mariner Mars 1969 Mission

Midcourse Maneuver Through End of Nominal Mission

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PREFACE

The work described in this report was performed by the Tracking and Data Acquisition organization of the Jet Propulsion Laboratory and the NASA Communications Network (NASCOM) of Goddard Space Flight Center. This volume covers the Tracking and Data System Support for the Mariner Mars 1969 Mission from the midcourse maneuver through the end of the mission. Volume III covers the extended mission operations.

ACKNOWLEDGMENTS

The authors acknowledge the considerable assistance of the technical staffs of the NASCOM system of the Goddard Space Flight Center and of the Deep Space Network of the Jet Propulsion Laboratory, for providing tracking and data support. Information relative to the mission and the spacecraft was obtained from the Mariner Mission to Mars 1969 Project reports. Information regarding the DSN is based on material generated by the DSN Design Team for the Mariner Mars 1969 Project and the DSN Operations Staff. The authors are indebted to A. C. Belcher and M. E. Brinkley of the Office of Tracking and Data Acquisition, National Aeronautics and Space Administration for their support.

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ABSTRACT

The Tracking and Data System support for the Mariner Mars 1969 Project was planned and implemented in close cooperation with the Mission Operations and Spacecraft System of the project. The project requirements for tracking, telemetry, command, simulation, mission control, and compatibility testing were reviewed for matching to Deep Space Network (DSN) capabilities. The DSN capabilities to support the project were set forth in an Operations Plan describing the design of the DSN Systems formulated for the support of this particular project. Each of the systems is described. Unusual new features were the Multi-Mission Telemetry System, which eliminated need for mission-dependent equipment at the tracking stations, and an experimental High-Rate Telemetry System operating at 16,200 bits/s. This unusually high rate, employed for the first time in deep space missions, permitted return of low-resolution pictures in real time and full-resolution pictures played back from the spacecraft tape recorder in less than 3 h. Normal techniques and rates would have required 7 to 8 days of playback.

The 26-m antenna stations of the Deep Space Network provided the Deep Space Phase support throughout the mission. During the cruise portion of the Deep Space Phase, the DSN 64-m antenna at Goldstone, Calif., provided ranging data to planetary distances; during the planetary encounter, it provided the 16,200 bits/s capability by means of the block-coded, high-rate telemetry system.

Analysis of the support performance shows that virtually all tracking and telemetry data received on earth were acquired, processed, and delivered to the project. All commands delivered to the DSN by the project for transmission to the spacecraft were transmitted successfully.

I. INTRODUCTION

This document, Volume II, covers the Tracking and Data System (TDS) activities in support of the Mariner Mars 1969 Project from the midcourse maneuvers through the encounters by Mariners 6 and 7. With the inclusion of the system design phase through midcourse maneuver in Volume I and the extended operations in Volume III, this report constitutes the complete history of the TDS activities supporting the Mariner Mars 1969 Mission.

The primary mission objective of the Mariner Mars 1969 Project was to conduct flyby missions in order to make exploratory investigations of Mars to set the basis for future experiments, particularly those relevant to the search for extraterrestrial life. The six scientific investigations of the primary objective were (1) visual imaging by television, (2) ultraviolet spectrometry, (3) infrared spectrometry, (4) infrared radiometry, (5) planetary occultation of the S-band radio signals, and (6) celestial mechanics. The secondary mission objective was to develop technology needed for succeeding Mars missions.

The Mariner 6 flight began on GMT day 056 (February 25) at 0129:02.013, with the midcourse maneuver on day 059, and Mariner VII on day 086 (March 27) at 2222:01.198, with midcourse maneuver on day 098. The scheduled flight time of Mariners 6 and 7 to Mars was approximately 5 months, with Mariner 6 destined to fly by Mars near the equator to examine the dark regions in a zone east and west of Meridiani Sinus. The second flyby, Mariner 7, was aimed further south, sweeping down the same area and then on to view the south polar cap and a wheel-shaped light area called Hellas. The closest approach for each spacecraft was approximately 3200 km (2000 miles) above the Martian surface and was scheduled on day 212 (July 31) for Mariner 6 and day 217 (August 5) for Mariner 7. The Mariner Mars 1969 mission formally ended on November 1, 1969, from which time the extended operations proceeded. TDS support of the extended operations are described in Volume III.

The TDS support plan developed for implementation of the mission objectives was derived from the Mariner Mars 1969 Mission Plan. In February 1969, the mission plan was modified to change the standard encounter sequence. Mariner 6 was to obtain 50 far-encounter pictures (instead of the previously scheduled eight pictures) to be played back from the tape recorder in two groups at encounter E-28 h and E-7 h. Mariner 7 was to obtain 91 far-encounter pictures to be played back in three groups at E-52, E-27, and E-4 h. The number of near-encounter pictures remained the same (24 pictures) and would be stored on the tape recorder, since only telemetry and certain selected scientific data would be transmitted during this time (in real time at 8-1/3 and 66-2/3 bits/s, respectively). However, the rate at which the stored picture data would be played back after encounter was changed from 270 to 16,200 bits/s (science data would remain at the 270-bits/s playback rate) to utilize the newly developed high-rate telemetry equipment and to use the proven DSN 64-m-diameter antenna at Goldstone, California, instead of the 26-m-diameter antenna. Although these changes did not require changes to the basic TDS support commitments, some modifications were made to the DSN operations plan. These modifications will be discussed in later sections of this report.

The TDS organization for Mariner Mars 1969 (Fig. 1), utilized the resources and facilities of four major support agencies:

(1) The Air Force Eastern Test Range (AFETR) provided prelaunch, launch, and near-earth tracking and data acquisition support.

(2) The Manned Space Flight Network (MSFN) provided near-earth tracking and data acquisition support.

(3) The NASA Communications System provided ground communications circuits during mission operations.

(4) The Deep Space Network provided deep space tracking, metric and telemetry data acquisition, commands, and operational control support.

The DSN project engineering organization that continued to support the mission through encounter is shown in Fig. 2. A complete discussion of the TDS organization, requirements, and operational planning is given in Volume I of this document.

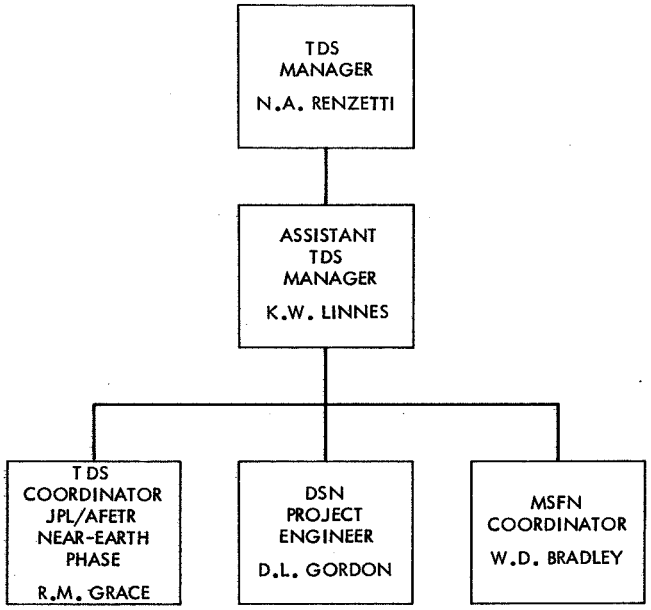


Fig. 1. TDS organization for MM69

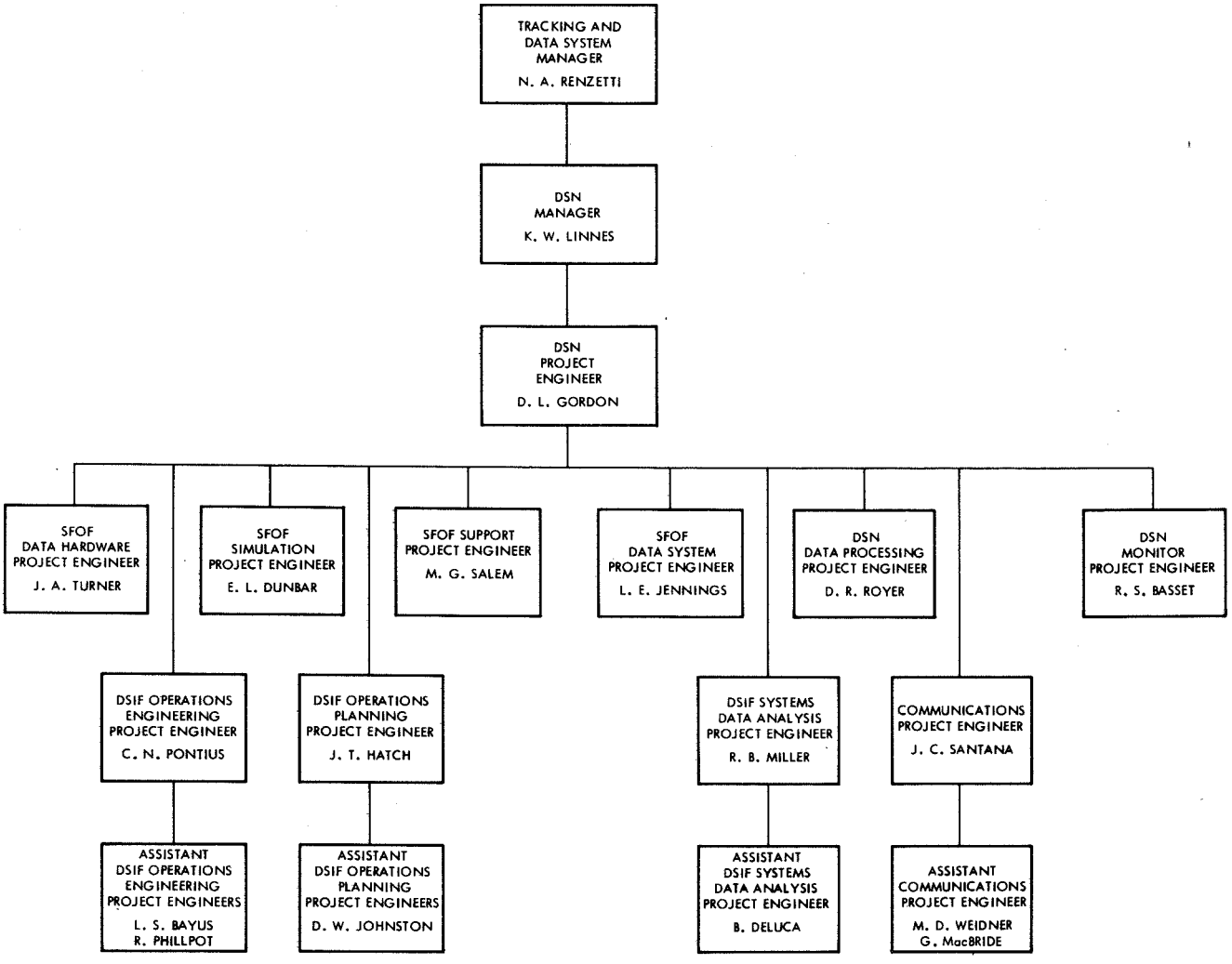


Fig. 2. DSN project engineering organization for MM69

Deserving of special emphasis because of the dominant interest in this phase of the mission, and because of the Mariner 7 anomaly that occurred during the Mariner 6 encounter, Mariner 6 and 7 encounter sequences and Mariner 7 pre-encounter anomaly data are given apart from other phases of the mission.

A. Encounter Sequences

1. Mariner 6. The start of the Mariner 6 far-encounter sequence was initiated with the transmission of direct command DC 25 on GMT Day 210 at 011623Z. Command DC 25 turned science power on and the first 33-picture-taking sequence began shortly thereafter. One analog tape recorder (ATR) playback was completed before the start of the near-encounter sequence. The start of Mariner 6 near-encounter sequence was coincidental with the transmission of DC 16 on GMT Day 212 at 045835Z. Mariner 6 entered occultation on GMT Day 212 at 053952Z and exited occultation at 055942Z. The time of closest approach of Mariner 6 to the surface of Mars was 051906.9 at a distance of 4260.4 km. Due to some transmitter problems of Deep Space Station (DSS) 14, the majority of the command activity during encounter was performed by DSS 12.

2. Mariner 7. The start of the Mariner 7 far-encounter sequence was initiated with the transmission of DC 25 on GMT Day 213 at 221230Z. The start of the Mariner 7 near-encounter sequence was coincidental with the transmission of DC 16 on GMT Day 217 at 043341Z. Mariner 7 entered occultation on GMT Day 217 at 051941Z and exited occultation at 051941Z and exited occultation at 054907Z. The time of closest approach of Mariner 7 to the surface of Mars was 050050.0Z at a distance of 4240.2 km.

Two additional ATR playbacks for Mariner 6 and three ATR playbacks for Mariner 7 were completed within the next 5 days. This terminated the high-activity encounter operations for Mariner 6 and 7.

B. Mariner 7 Pre-Encounter Anomaly

The complexity of supporting a normal Mariner 6 encounter was compounded when the Mariner 7 signal was lost 7 h before the near encounter of Mariner 6 (5 days before the near encounter of Mariner 7).

The explanation of the Mariner 7 anomaly has been presented in an earlier report*. All TDS support for this high-density operational period was successful, but it required an emergency allocation of some operations personnel to the second critical tracking operation. Also, DSSs 61 and 62 were released from Pioneer tracking to assist in the search.

The data in Table 1 are offered to present a time-sequenced summary of the events that occurred during the Mariner 7 pre-encounter anomaly. This references the best raw data source available for analysis.

Following the end of tracking at 07:29:52 GMT (see last entry in Table 1), the Mariner 7 spacecraft was commanded and acquired Canopus lock. The spacecraft was then commanded to high-gain antenna with normal operation except for the engineering telemetry channels, as shown in Table 2.

*Mariner Mars 1969 Project Report, Technical Report 32-1460, Volume II: Performance. Jet Propulsion Laboratory, Pasadena, Calif., Mar. 1, 1971.

Table 1. Mariner 7 pre-encounter anomaly (GMT Day 211)

GMT	DSS	Event	Source
Pre Cals	51	Rcvr 1 & 2 threshold - 172 dbm	Post track
2100	51	Rcvr 1 s/s - 139.8 dbm, rcvr 2 s/s - 140.1 dbm	Post track
2111000	51	DSIF rcvr s/s - 140.2 dbm (-5.7v from ais tape)	TRAKAD
212213	51	SDA 1 in lock	Post track
212213	51	Rcvr 2 in lock	Post track
212213	51	Xmtr on. (frq 2036130)	Post track
212213	51	SDA 2 in lock	Post track
212214	51	Rcvr 1 in lock	Post track
2200	51	SNR 23.8 db, uplink power 10 kw, Cmd and rng mod off, S/C received carrier power - 131.4 dbm	NAT TLM
220122	51	Rcvr 1 & 2 out of lock	FR-1400
220500	51	DSIF rcvr s/s - 140.2 dbm (-5.7v ais tape)	TRAKAD
220757	51	S/C agc dn 62	7044 FMT 402
220814	51	S/C agc dn 61	7044 FMT 402
220919	51	SNR 23.8 db	7044 FMT 402
221020	51	S/C 72 dsif telcomm dsif 51 rate hi frame 81 day 211 HHMMSS 11 15 09 119 AGCA SNR 221020 67 62 37 214 -385 242 221024 67 62 37 214 -385 243 217 0 221028 67 61 37 214 -385 238 221032 68 62 37 214 -385 238 221036 68 62 37 214 -383 240 221041 68 61 38 214 -383 232 221045 68 62 36 214 -383 240 221049 68 62 36 214 -383 245 213 85 221053 68 62 35 214 -383 56 214 0	7044 FMT 406
221057	51	S/C spe dn 69 (last readable channel).	7044 FMT 402
		221102 UNDA	7044 FMT 406
221102	51	SNR 5.6 db	DIS LP
221102	51	Fly	TCP I/O
	51	221103 OL OL 36 017 -383 223 217 0	7044 FMT 406

Table 1 (contd)

GMT	DSS	Event	Source
221107	51	SNR 23.5 db	DIS LP
		221108 OL OL 36 017 -383 200	
221112	51	SNR 22.4 db	DIS LP
		221112 OL OL 35 017 -383 200	7044 FMT 406
221114	51	DSS 51 lost the downlink from Mariner 7 S/C rcvr out of lock.	Track log
221116	51	Fil	TCP I/O
	51	221116 OL OL 36 017 -383 178	7044 FMT 406
221117	51	SNR 20.4 db	DIS LP
		221120 OL OL 36 017 -383 163	7044 FMT 406
221122	51	SNR 17.8 db	DIS LP
		221124 OL OL 38 017 -383 123	7044 FMT 406
221127	51	SNR 16.4 db	DIS LP
		221129 OL OL 38 017 -383 65 213 0	7044 FMT 406
221130	51	DSIF rcvr agc -5.45v from ais tapes (ais -5.7v = 140.2 dbm)	TRAKAD
221132	51	SNR 12.3 db 221133 UNDA	DIS LP 7044 FMT 406
221137	51	SNR 6.5	DIS LP
221141	51	Fly	TCP I/O
221142	51	SNR 1.4	DIS LP
221147	51	SNR 0.01	
221149	51	Rcvr 2 out of lock	TCP I/O
221150	51	Rcvr 1 out of lock	Post track
221152	51	Rcvr 1 in lock	Post track
221152	51	SNR 0.7 db	DIS LP
221154	51	Fol	TCP I/O
221155	51	Ril	
221157	51	SNR -0.03	DIS LP
221200	51	DSIF rcvr agc -4.9v from ais tape (ais 5.7v = 140.2 dbm)	TRAKAD

Table 1 (contd)

GMT	DSS	Event	Source
221201	51	Rcvr 1 in lock	LJOB TWX 31/1220Z
221203	51	Rol	TCP I/O
221203	51	Rcvr 2 out of lock	Post track
221204	51	Rcvr 2 in lock	Post track
221204	51	Rcvr 1 out	Post track
221212	51	Ril	TCP I/O
221213	51	Fil	TCP I/O
221213	51	Rol	TCP I/O
221213	51	Both rcvr's in lock	TWX 31/1220Z LJOB
221217	51	Rcvr 2 out of lock	Post track
221217	51	Rcvr 1 out of lock	TWX 31/1220Z LJOB
221220	51	SDA 1 out	Post track
221221	51	SDA 2 out of lock	Post track
221225	51	Rcvr 2 in lock	Post track
221225	51	Rcvr 1 in	Post track
221228	51	Ril	TCP I/O
221230	51	DSIF rcvr agc -4.8v from ais tape (ais -5.7v = 140.2 dbm)	TRAKAD
221237	51	Rol	TCP I/O
221238	51	Rcvr 1 out	Post track
221239	51	Rcvr 1 in	Post track
221242	51	Fil	TCP I/O
221242	51	Ril	TCP I/O
221246	51	Fly	TCP I/O
221256	51	Rol	TCP I/O
FOLLOWING 221256	51	Many fils/fols, etc.	TCP I/O
221257	51	Rcvr 1 out of lock	Post track
221257	51	Rcvr 2 out of lock	Post track

Table 1 (contd)

GMT	DSS	Event	Source
221300	51	DSIF rcvr agc -4.7v from ais tape (ais -5.7v = 140.2 dbm)	TRAKAD
221330	51	DSIF rcvr agc -4.1v from ais tape	TRAKAD
222200	51	Rcvr 2 signal level -140.1 dbm	Post track
222200	51	Rcvr 1 signal level -139.7 dbm	Post track
222537	51	SDA 2 in lock	Post track
222539	51	Rcvr 2 in lock	Post track
222542	51	SDA 2 out of lock	Post track
222549	51	Rcvr 1 in lock	Post track
222551	51	Ril	TCP I/O
222605	51	Rol	TCP I/O
222606	51	Rcvr 1 out of lock	Post track
222621	51	Ril	TCP I/O
222625	51	Rol	TCP I/O
222625	51	Rcvr 2 out	Post track
222636	51	Rcvr 1 in lock	Post track
222639	51	Ril	TCP I/O
222639	51	Rcvr 2 in lock	Post track
222704	51	Rol	TCP I/O
222705	51	Rcvr 1 out of lock	Post track
222710	51	Rcvr 1 in lock	Post track
222713	51	Ril	TCP I/O
222724	51	Rol	TCP I/O
222725	51	Rcvr 1 out of lock	Post track
222725	51	Rcvr 2 out of lock	Post track
222728	51	Rcvr 1 out	Post track
222730	51	Rcvr 2 in lock	Post track
222747	51	Ril	TCP I/O
222754	51	Rcvr 1 in lock	Post track
222757	51	Ril	TCP I/O

Table 1 (contd)

GMT	DSS	Event	Source
222826	51	Rol	TCP I/O
222827	51	Rcvr 1 out of lock	Post track
222836	51	Rcvr 2 out of lock	Post track
2245	61	DSS 61 was called up. Attempted to acquire the downlink.	TRAKAD
2300		DSS 62 was called up and attempted to acquire the downlink. Using antenna pointing offsets DSS 62 did not acquire prior to spacecraft set.	TRAKAD
233240	51	Tuning xmtr to XA 6161.4 (Blind transfer)	Track log
2335		A blind uplink transfer from DSS 11 was accomplished (spacecraft setting at DSS 51).	
233500	11	Xmtr on, XA 6112.3 (blind uplink transfer) tuning rcvr 2 for approx 5 minutes for 2 way frequency and 5 minutes around 1 way frequency, rcvr 1 tuning entire band.	Track log
233502	51	Xmtr off	Track log
233757	51	Rcvr 1 in lock	Post track
233809	51	Rcvr 1 out of lock	Post track
234310	51	Ant to limit	Track log
Post Cal	51	Rcvr 1 & 2 threshold -171.5 dbm	Post track
212/0320	11	Noted small signal at 23402481 but can't obtain lock.	Track log
0330		DSS 42 was called up to assist DSS 11 in a freq search. Both one way and two way freqs were searched. DSS 11 searched frequencies in the next lower channel with rcvr 1 in consideration of spacecraft temperature change.	Track log
034413	42	Start of TCP log tape	Post track
0350	42	Started search for MAR 7 at three way doppler freq (DSS 11 has the uplink) one receiver set at 12 hz bandwidth. One receiver set at 152 hz bandwidth.	Track log
0351	11	Note small signal but could not lock rcvr	
035233	42	Start of "DATA" on TCP log tape	Track log

Table 1 (contd)

GMT	DSS	Event	Source
0438	11	Rcvr vco going down in frequency	TRAKAD
0440	42	Small traces of signal however DSS 42 not able to obtain a solid lock	Track log
0441	11	Maintain 2 sec lock while tuning to assist lock	TRAKAD
045515	11	Command modulation on	Track log
0449	42	Rcvr vco down in freq	TRAKAD
0457	42	Acquiring lock for 4 to 5 seconds at approx 9 minute intervals on 2 way freq. DSS 11 confirmed same.	TRAKAD
		Project personnel determined the spacecraft had lost Canopus lock and was rolling.	
0510	11	Rtlt 10 minutes, 18 seconds	TRAKAD
0510	11	DSS 11 commanded the spacecraft to low gain antenna. Started transmitting a sequence of 20 DC 10's.	Track log
052115	42	Rcvr in lock 3 way s/s -161.5 dbm	Track log
052123	11	Rcvr in lock signal level -163.0 dbm 2 way	Track log
052145	11	Rcvr in lock, signal -163.0 dbm	TRAKAD
0522		DSS 11 and DSS 42 acquired the downlink (DSS 11 two way). Data good except for some data numbers.	
052241	41	DSS 41 began tracking. S/S -161.0 dbm	TRAKAD
052521	42	TCP in lock	Track log
052551	42	Began receiving usable engineering data	TRAKAD
054755	42	SNR 4.9 db, 33-1/3 bps	TRAKAD
055149	42	Signal level -161.5 dbm	TRAKAD
061545	14	DSS 14 was called up to support track. Rcvr in lock. Signal -153.0 dbm	Track log
061628	41	Rcvr 2 in lock. Signal -163.4 dbm	Track log
061638	41	Rcvr 1 in lock	TRAKAD
061645	41	Good data	Track log
061832	14	Start of TCP log tape	Post track
061847	14	TCP lock	Post track

Table 1 (contd)

GMT	DSS	Event	Source
0621-0626		An uplink transfer from DSS 11 to DSS 41 was attempted but the spacecraft dropped lock	TRAKAD
062130	11	Command mod off	Track log
0623	11	Tuning to xfer XA	Track log
062422	11	On xfer XA	Track log
062444	41	On xfer XA of 6112.3	Track log
0625	41	XMTR on	Track log
0626	41	Tune to track syn frequency	Track log
062619	41	On track syn frequency	Track log
062837	41	Good data except for some data numbers.	Track log
0633	41	Data zero	TRAKAD
0633		The stations tracking acquired the downlink (one way) frequency but data was infinite bit	
063321	41	Recevier out of lock.	Track log
063325	11	Receiver out of lock - Glitch 1 way	Track log
063339	14	Rcvr out of lock	Track log
063340	11	Rcvr out of lock	Track log
063349	14	Rcvr out of lock	Track log
063400	14	Rcvr in lock 1 way s/s -153.0 dbm. Data all zero	Track log
0635	14	Data all zeros	TRAKAD
063559	41	Rcvr in lock, 1 way signal -161.3 dbm	Track log
0640	14	DI +242 Hz	Track log
064520	11	Rcvr in lock - rcvr level -162.4	Track log
0646	14	D1 = +242 Hz	Track log
065020	41	On XA	Track log
0650	14	D1 +238 hz	Track log
0655	14	24 kHz side bands s/s -157 dbm	TRAKAD
065954	41	Rcvr out of lock	Track log
065956	11	Rcvr out of lock	Track log
0700	14	Rcvr out of lock	Track log

Table 1 (contd)

GMT	DSS	Event	Source
0700		DSS 41 acquired the uplink. The stations tracking acquired the downlink (two way). Data still infinite bit.	
070012	14	Rcvr in lock, signal -153.6	Track log
070021	41	Rcvr in lock 2 way - data all zero	Track log
0702	41	S/S -163.5 dbm	TRAKAD
070606	11	Rcvr lock, 3 way, sda infinite bit - no apparent data.	Track log
071222	41	On track syn freq.	Track log
0719	41	Command mod on	Track log
0722		Tracking stations began receiving data from the spacecraft with exception of some data numbers.	TRAKAD
072250	41	To good data with the exception that some data numbers from S/C "O"	Track log
072428		Y1 cyclic observed - no redundant switching	TRAKAD
0725	11	Signal level -162.7, delta D_3 0 Hz	Track log
0725	14	D_3 = +0.1 Hz	Track log
072931	14	Ant to brake s/s -153.4 dbm	Track log
072952	14	End of track - rcvr out of lock	Track log

Table 2. Mariner 7 bad telemetry channels (as of GMT Day 213/1800Z)

Channel	Title
105	P. gyro rate/F. SS
106	Y. gyro rate/F. SS
107	R. gyro rate
108	Canopus int.
200	Scan K. pos., coarse
201	Scan C. pos., coarse
203	M/SB inv. O/P volts
204	M/SB inv. O/P curr.
205	400 Hz. inv. I/P curr.
206	Batt. volts
207	Scan C. ref. ang/C. pos F
208	FEPS cross-cone err.
209	FERS cone err.
300	PS&L curr. to rfs. & htrs.
302	TWT AN. #2 volts & TWT ind.
305	TCFM ch. #3
306	Exciter supply volts & ind.
307	Adaptive gate setting
308	TWT helix current
309	Canopus cone angle

For the encounter phase of the Mariner Mars 1969 mission, several revisions were required to the telemetry DSN and Deep Space Instrumentation Facility (DSIF) configurations and to the facility and operational procedures.

A. Configuration Revisions

Two DSN/spacecraft data flow configuration revisions and seven DSIF/CTA (Compatability Test Area) support modes were provided for the encounter phase.

1. DSN Telemetry System. The DSN telemetry system consists of those DSN elements, both hardware and software, that perform the basic function of providing telemetry data to the flight project in both real time and non-real-time. Figure 3 shows the DSS 14 telemetry configuration supporting Mariner Mars 1969.

2. DSN Command System. The DSN command system consists of those DSN elements, both hardware and software, that perform the basic function of transferring command data to the spacecraft. Figure 4 shows the command configuration supporting Mariner Mars 1969.

3. Encounter Support Modes. The seven modes for encounter support by DSSs 11, 12, and 14 and by the CTA configuration are shown in the encounter support matrix of Fig. 5. The Goldstone complex interface (DSSs 11, 12, 13, and 14 and CTA 21) for encounter is shown in Fig. 6.

Figures 7 and 8 graphically depict the GCF configuration attained and used during actual encounter operations. Although complex, the overall objective of a singular configuration was successfully achieved.

The encounter configuration for DSS 14 is shown in Fig. 9. The station was to process and record high-rate telemetry, using subcarrier demodulator assemblies (SDAs) (1 and 4) and the Alpha and Beta telemetry and command processors (TCPs). At the same time, the station was to microwave the high-rate telemetry (HRT) to CTA 21 via a special 6-MHz video line for real-time processing. A backup microwave link was also available for the transmission of HRT to CTA if needed. The station SDAs 2 and 3 were configured for 33-1/3 bits/s engineering telemetry. The engineering telemetry data from the SDAs were to be transmitted to DSS 12 via the intersite microwave link for processing and transmission to the space flight operations facility (SFOF) by high-speed data (HSD). A microwave link was provided for engineering telemetry data to be transmitted to CTA 21 (this backup link was not used).

The encounter configuration for DSS 12 is shown in Fig. 10. The prime station configuration was to process and record the 33-1/3 bits/s engineering telemetry data from SDA 1 and TCP Alpha. The station TCP Beta was to process the 33-1/3 bits/s engineering telemetry data received via the intrasite microwave system from DSS 14 and transmit the data by HSD to the SFOF. At the TCP patch panel (Fig. 11) at DSS 12, four streams of 33-1/3 bits/s engineering telemetry data were available (two streams from DSS 12 SDAs 1 and 2 plus two streams from DSS 14 SDAs 2 and 3) via the intersite microwave link. If any anomaly occurred with the prime data stream, the TCP technician at DSS 12 had only to type in the appropriate entry to process the backup stream of data.

During the encounter sequences, DSS 11 was to track the nonencountering spacecraft. The DSS 11 configuration, Fig. 12, did not have the TCPs to process the 33-1/3 bits/s engineering telemetry data. In order to process these data, a microwave link was set up to transmit the outputs of the DSS 11 SDAs 1 and 2 to CTA 21. The prime data stream (SDA 2) modulated a 70-kHz voltage-controlled oscillator (VCO) and was transmitted via the microwave link to CTA 21. Upon receipt of these data, CTA 21 removed the 70-kHz carrier by going through a 70-kHz discriminator. The output of the 70-kHz discriminator was patched to TCP Beta of CTA 21 for processing and transmission to SFOF in real time. The backup stream used a 40-kHz carrier and was processed the same as the 70-kHz carrier if an anomaly occurred with the prime link.

The CTA 21 configuration for encounter (Fig. 12) was to process high-rate telemetry being received via the 6-MHz video link from DSS 14 through their prototype model high-rate correlator to SFOF for real-time video. The HRT from DSS 14 was also to be processed and recorded on their TCP Alpha computer. The TCP Beta at CTA 21 was configured to process, record, and transmit to SFOF the nonencountering spacecraft 33-1/3 bits/s engineering telemetry data received via the microwave link from DSS 11. A backup microwave link from DSS 14 to CTA 21 was available should an anomaly occur on the 33-1/3 bits/s engineering telemetry data microwave link between DSS 14 and DSS 12 (this backup link was not used).

Deep Space Stations 41, 42, 51, 61, and 62 were configured the same for the encounter sequence (Fig. 13). The prime data stream consisted of receiver 2, SDA 2, and TCP Beta. The backup data stream consisted of receiver 2, SDA 1, and TCP Alpha. The stations were to process, record, and transmit to the SFOF the 33-1/3 bits/s engineering telemetry data for real-time analysis.

B. Facility and Operational Procedure Revisions

1. Command Planning and Procedures. Because of the limitations imposed by the read-write-verify (RWV) and teletype communications, it was agreed by DSN/Project before launch that the minimum time constraints applicable to Mariner Mars 1969 commands would be as follows:

(1) Direct and quantitative commands (DCs and QCs). The command message to be delivered to track chief at least 20 min prior to the scheduled transmission time of the first command. The

minimum spacing to be 5 min between commands.

(2) Coded commands (CCs). The command message to be delivered to track chief at least 20 min for a maximum of five commands, or 30 min for a maximum of 20 commands, prior to the scheduled transmission time of first command. The minimum spacing to be 1 min between commands.

During numerous emergencies throughout the mission, the above-listed times were compressed and the short emergency procedures utilized to enable commands to be transmitted without command messages and/or on reduced time spacing.

Before encounter it became apparent that use of the standard command tape library coupled with the time constraints above would not meet the requirements of the proposed command sequences for encounter. To meet these requirements, which included transmitting DCs from different library tapes on 1-min centers, a set of special encounter tapes (I through VIII) was generated and dispatched to stations 12 and 14 (see Table 3). These consisted of a series of commands arranged sequentially on a tape in the order required by a particular spacecraft encounter sequence. The DCs on each tape could then be transmitted on 1-min centers from a single tape.

Approximately 2 weeks prior to the Mariner 6 encounter, the spacecraft sequence was changed, requiring special tapes IV and V to contain 9 DC-16 commands in place of the previous 8 DC-16s, and also an additional tape (No. IX) to enable an alternate Mariner 7 sequence to be carried out if required (see Table 4). These new tapes were generated and dispatched to DSSs 12, 14, and 41.

One week before Mariner 6 encounter it was decided that a requirement existed for two additional tapes (Tables 5 and 6), one for each spacecraft, to enable a complete encounter sequence to be carried out via ground commands in the case of a central computer and sequencer (CC&S) failure. Due to the lack of time, the details of the commands were given to DSSs 12, 14, 41, and 62, and the two tapes were generated on site and verified using standard coded command tape procedure.

Special training exercises and operational verification tests were run using these tapes before encounter. Thanks to the careful attention given this matter, both at the DSSs and JPL, no problems were encountered with the special command tapes during actual encounter operations.

2. Special operational voice nets. The following coordination loops of the special Goldstone/CTA 21/SFOF voice nets were used for encounter and playback operations:

(1) DSIF HRT coordination loops (Fig. 14). This net was used to coordinate the real-time processing and flow of HRT data at DSS 14 and CTA 21 within the SFOF. It was patched into the simulation system (SIM) No. 1 net. An operations engineering advisor, located in the network analysis team (NAT) area, was the focal point of this activity and provided the DSIF interface within the SFOF for the overall real-time HRT/video coordination effort. At the station, those operators involved in the real-time video data processing functions monitored and talked on the net. The net also was used for intersite coordination of DSS 14/CTA 21 HRT equipment countdown and calibration.

(2) Intersite coordination loop (Fig. 15). These were separate nets connecting: (a) DSS 14 and DSS 12, and (b) DSS 14, DSS 11 and CTA 21. The nets were used by the station operations/shift supervisors to coordinate between themselves when working together, during countdown, calibrations, and flight or test support periods. The DSS 14/11/21 net was bridged in the SFOF to a netcon net, primarily to provide the operations advisors a talk/listen capability in the event the assigned DSIF net to DSS 14 was unavailable because of heavy command or other operational activities.

(3) Occultation coordination loop (Fig. 16) This net was used by the occultation principal investigator (OPI) to provide frequency information to and coordinate the activities of the R&D equipment operators at DSS 14, 12, and 13. The line was bridged to the AFETR net in the SFOF.

3. Guidelines for voice net operation. The availability of these new communication facilities necessitated the observance of strict net discipline and compliance with the following guidelines:

(1) The previously established normal modes of operations of the DSIF Operations Team were not changed. Direction to the station was given only by net control (DSS controller, DSIF chief, or a track advisor) over the assigned DSIF operational voice nets.

(2) If the DSIF net was not available for an advisor to talk with DSS 14, the DSIF chief could authorize use of the DSS 14/11/21 intersite coordination net for this purpose. If necessary, the DSIF chief also could authorize bridging the DSS 12 intersite coordination net to a netcon net.

(3) The operations planning advisor (Track ops) was responsible for monitoring all advisor conversations with the stations conducted on voice nets other than an assigned DSIF net.

(4) Call signs used on the special voice nets are shown in Table 7.

(5) Occultation information affecting operation of Goldstone duplicate standard (GSDS) equipment (TXR and closed-loop RCV) was passed over the appropriate voice net (netcon 2) in the SFOF by the SDA Project Engineer (PE) to the DSIF chief, and thence to the stations. The

SDA PE interfaced directly with the OPI in the Flight Path Analysis and Command (FPAC) area.

(6) Information and direction supplied on the DSIF HRT coordination loop could neither affect nor jeopardize the recording of HRT data at DSS 14.

(7) The intersite coordination nets were considered an extension of the station tactical intercom (TIC) systems. They were used primarily by the stations to coordinate their activities during the integrated countdown/calibrations and actual tracking operations. They also provided a backup voice capability with net control.

The above guidelines were incorporated into DSIF operational procedures in a SIM. A violation of these guidelines, which caused some problems during encounter operations, was unauthorized use of commercial telephone to contact the stations. A deleterious effect of this was that it not only distracted the DSS operations supervisor's attention from directing the station, but it also led to conflicting instructions to the station. On one occasion, the resultant confusion at the station led to loss of command loop lock during a command sequence.

Figure 17 depicts the method employed in DSIF net control to handle the large number of stations involved in encounter operations. The peak load occurred at beginning and end of the Goldstone view periods, when the station controllers were involved with a total of six stations at one time. As shown in the figure, four station controllers talked on the voice nets (DSIF "X") to the stations indicated. Their exceptional ability and teamwork were major factors in the successful handling of the Mariner 7 anomaly during the most critical part of Mariner 6 encounter.

4. Encounter phase predict strategy. Three types of predicts were to be generated for the encounter pass: encounter pass predicts, view period messages, and occultation predicts. The predicts were numbered sequentially starting with 6EO for Mariner 6, Encounter, Set O, and 7EO for Mariner 7, Encounter, Set O. The view period message contained the same number to identify which predict set it applied.

a. Encounter pass predicts. This predict set covered the entire encounter pass and was to be transmitted about 3 h before Goldstone rise to DSS 12, 14, and 41. This set would not contain a predicted enter or exit occultation, but was run for a transparent Mars.

The track synthesizer frequency contained in this set was to be used by all stations up to entrance to occultation. This set was to be used for pointing information during the entire encounter pass.

b. View period message. This message contained the updated predicted enter and exit occultation time and was to be transmitted just before or after each predict set transmitted during the encounter pass.

c. Occultation predicts. This type of predict set was to be generated after each orbit determination update during the encounter pass. These sets would cover from 15 min before to 3 min after predicted entrance to occultation and from 5 minutes before predicted exit until the end of the pass. They would not include a predicted enter and exit time but were accompanied by a view period message.

The track synthesizer frequencies contained in these predicts would be the same as in the encounter pass predicts up to 3 min after predicted entrance to occultation. The track synthesizer frequency in the remainder of each set was to be some multiple of 10 Hz for DSS 12 and 41 but was to be equal to the XA* of transmitter turn-on for DSS 14. In this way DSS 14 would nominally not have to tune its transmitter or reference frequency except during occultation, while DSS 12 and 41 three-way predicts would be correct and unbiased.

If an uplink search was required, DSS 14 was to have returned to the XA in the occultation predicts after confirming two-way lock.

5. Occultation Operational Procedures. Initial planning for Mariner 1969 consisted of trying to assess what went wrong during the previous Mariner 4 and 5 exit occultations. Two principal conclusions were derived:

(1) The operational system and procedures applicable to occultation should not be designed so rigidly that the result could be only complete success or complete failure.

(2) As many people involved as possible should be made aware of the risk inherent in whatever plan is established.

After launch, several informal meetings were held to discuss occultation. The principal investigator for the occultation experiment eventually established a weekly occultation planning group meeting.

An initial agreement of the group was that the occultation personnel, using a Hewlett Packard 9100 desk computer, would convert regular tracking predicts to desired frequency levels. In previous missions, a second special predict program for generating this information meant that two programs would be run during encounter, thus increasing confusion and the chance of error. For Mariner Mars 1969, only standard predicts would be needed.

*XA is a ground reference frequency defined as the frequency to transmit in order to reach the spacecraft at "best lock," allowing for doppler. The term is also used loosely to mean whatever frequency the station is currently transmitting. The track synthesizer frequency is the frequency selected as the reference for doppler extraction and transmission and is usually selected to minimize spacecraft loop stress during a track.

a. Frequency measurements, including handovers, in the encounter sequence. The occultation equipment required a prediction of one-way expected frequency at exit occultation to within 100 Hz at S-band. To obtain anything approaching this accuracy, it would be necessary to measure auxiliary oscillator frequency through the far-encounter sequence during and after spacecraft change of states that cause oscillator temperature variations. Thermal telemetry had insufficient resolution to satisfy this function completely.

Consequently, 10-min blocks of one-way frequency data were to be included in the encounter sequence to ensure command capability and two-way data near the planet.

The ground rules for these one-way blocks were as follows:

(1) Minimize loss of good one-way and two-way data.

(2) Minimize time-of-command outage.

(3) At the time of transmitter turnoff, minimize stress in spacecraft loop.

The TDH sample rates were set to allow assessment of auxiliary oscillator stability for two strategy exit occultation.

If at any time the spacecraft had failed to lock up two-way within 3 min of the RTLT during a measurement, the procedure instructed that an uplink search be initiated.

b. Acquisition strategy during occultation. The standard sequence published for Mariner Mars 1969 contained a decision point for remaining with standard or transferring over to nonstandard sequence.

In the standard sequence, DSS 14 was to turn off its transmitter after signal was lost at entrance to occultation. At exit from occultation, all stations were to acquire the one-way signal. DSS 14 would tune to the XA for turn-on prior to predicted exit and would turn on its transmitter without tuning at about 1 min after exit. When two-way signal was confirmed, DSS 14 would apply command modulation.

In the nonstandard sequence, DSS 14 was to leave its transmitter on after entrance to occultation and tune to a new XA. Since there would be a low probability of a fast two-way lock-up, all stations were to have one receiver set to predicted one-way frequency, and a second receiver set to predicted two-way (or three-way) frequency. If two-way lock were achieved, DSS 14 would hold at the same frequency and, 10 min after exit from occultation, would apply command modulation.

In the standard sequence, if two-way frequency were not achieved by 3 min after RTLT from turn-on time, an uplink search was to be initiated with instructions from track.

In both the standard and nonstandard sequences, the DSS 14 transmitter turn on XA served as track synthesizer frequency to end of track.

If the ground closed-loop receivers did not immediately lock up, operators would be allowed to tune the receivers for a downlink search.

6. Physical plant and displays. Discussed below are Public Information Office (PIO) requirements and real-time television capability.

a. Public Information Office support requirements. The mission-independent PIO mission commentary position within the SFOF in room 113B provided all the necessary capability required to adequately cover launch and maneuver operations of both spacecraft. However, the resources required of the Ground Communications Facility (GCF) had a marked update commensurate with the Project's decision to process and display spacecraft video in real time during encounter operations.

The SFOF/GCF operations manager created a special team to ensure that (1) all requirements were identified properly and (2) strict adherence to a resolute plan of implementation would prevail over any last-minute changes or additions.

Requirements under the cognizance of the GCF for implementation were not as broad as they were detailed and included specific configurations of both the Television (TVSA) and Voice Communication (VOCA) Assemblies within the real-time TV control area in room 137 and other areas external to the SFOF. Specific major tasks undertaken jointly by the GCF PE and the GCF cognizant operations engineer included the following:

(a) Provision and installation of video cables to the UNIVAC 1219 computer (10) and TV-1 (6) areas within the SFOF.

(b) Duplicate VOCA capability in rooms 113B and 137 for the origination of mission voice commentary.

(c) Installation of a special "zoom" TVSA camera and associated controls in room 137.

(d) Design and coordinate fabrication of special console mounts for TVSA monitors to be used in room 137.

(e) Installation of numerous TVSA monitors within the Main Cafeteria and Complementary Analysis Team (CAT) Areas.

(f) Coordination of the technical interface with the commercial television network pool mobile van located adjacent to the SFOF in addition to supplemented communications to von Karman auditorium.

The transmission medium for high-rate spacecraft video data was a common carrier-provided microwave line (4.5-MHz bandwidth) between the Goldstone area communications terminal (DSC 10) and CTA 21. An existing DSN wideband microwave channel from DSS 14 to DSC 10 was employed to complete the ground high-rate telemetry link.

The critical SNR required of this link precluded the use of existing GCF wideband circuit activation procedures in their present state. Once the tolerable performance parameters of the link were identified, it was a simple matter to devise a procedure using appropriate actions and steps contained in existing procedures as a guideline. Emphasis was placed on accurate measurement of link broad-band noise and subsequent correlation to an actual dB SNR.

Engineering tests had proved that the high-rate data could withstand a prevailing SNR of 15 dB and remain intelligible. The carrier SNR criterion of 30 dB provided a convenient nominal value for operating personnel to follow when activating the link. Operationally, the link did not experience SNR degradation below that of the latter value. The average of SNR values observed by communications operations personnel was 36.48 dB.

The external SFOF configuration that supported the PIO portion of high-rate telemetry processing is shown in Fig. 18.

b. Real-time television control room. When authorization was received to establish a real-time television capability for the Mariner Mars 1969 encounter, it was necessary to establish a control room in the SFOF to provide the principal investigators with the ability to review the pictures as they were returned from the spacecraft and processed in the computer. This control room provided the ability to look at all of the various picture displays, a remote control point for the computer, necessary voice communications with other parts of the SFOF and von Karman Auditorium, and a technical control area where the DSN and Project could monitor overall system performance and take any corrective steps necessary to ensure maximum quality.

To implement the requirements above, a design team was formed in early May. The control room design was completed by the last week in May and the room equipped by July 1, 1969. Because of the short lead time, existing equipment was used to make up the control center. Spare 48-cm (19-in.) console shells from Simulation were put together to form the control console (Fig. 19). This console housed 23-cm (9-in.) TV monitors connected to all of the computer outputs, a hard copy TV camera, switching controls which allowed one of these outputs to be distributed to the viewing public, and audio equipment for distribution of the experimenters' commentary. To sound-deaden the room, carpeted floor panels were installed and the walls were covered with curtain material.

Table 3. Mariner Mars 1969 encounter command tapes

Tape	No. of Commands	Commands	Purpose
I	2	1. DC-25	Enc. 1 Mode 66-2/3 bps
		2. DC-25	Enc. 1 Mode 66-2/3 bps
II	2	1. DC-3	PB 1. 270 Frm Dtr Stops A/D XFR
		2. DC-44	Toggle HRT ON/OFF
III	3	1. DC-23	ATR Tape Track Switch
		2. DC-23	ART Tape Track Switch
		3. DC-44	Toggle HRT ON/OFF
IV	(17)	1. DC-26	N/E Seq. Initiate
	(S/C 6)	2. DC-36	Far TV Pix REC on ATR
		3. DC-36	Far TV Pix REC on ATR
		4. DC-49	IRS Cool Down
		5. DC-49	IRS Cool Down
		6-14. DC-16 (9 ea)	Planet Acq. Starts ART and DTR
		15-17. DC-41 (3 ea)	Slew Platform to Final Cone Angle
V	(19)	1. DC-39	ATR Erase
		2. DC-26	N/E Seq. Initiate
		3. DC-36	Far TV Pix REC on ATR
		4. DC-36	Far TV Pix REC on ATR
		5. DC-49	IRS Cool Down
		6. DC-49	IRS Cool Down
		7. DC-46	TV Cover Deploy
		8-16. DC-16 (9 ea)	Planet Acq. Starts ATR and DTR
		17-19. DC-41 (3 ea)	Slew Platform to Final Cone Angle
VI	3	1. DC-23	ATR Tape Track Switch
		2. DC-23	ATR Tape Track Switch
		3. DC-9	Toggle Rng. ON/OFF
VII	2	1. DC-44	Toggle HRT
		2. DC-9	Toggle Rng. ON/OFF
VIII	3	1. DC-23	ATR Tape Track Switch
		2. DC-23	ATR Tape Track Switch
		3. DC-23	ATR Tape Track Switch

Table 4. Mariner 7 alternate command sequence (tape IX)

Item No.	Command	Purpose
1	DC-39	ATR erase
2	DC-26	N/E seq. initiate
3	DC-36	Far TV pix rec on ATR
4	DC-49	IRS cool down
5	DC-36	Far TV pix rec on ATR
6	DC-49	IRS cool down
7	DC-46	TV cover deploy
8-16	DC-16 (9 ea)	Planet acquisition starts ATR and DTR
17-19	DC-41 (3 ea)	Slew platform to final cone angle

Table 5. Mariner 7 case one, special command tape XI

Time (min)	Pic. No.	Command	Purpose
Initial DC-16 time	0.4	DC-16	Start NE data recording
+1	1.8	QC-1-4	Cone slew +4 deg
+2	3.3	DC-16	Backup initial DC-16
+3	4.7	DC-16	Second backup
+4	6.1	QC-1-3	Cone slew +3 deg
+5	7.5	QC-3-16	Clock slew ±16 deg
+6	8.9	QC-3-12	Clock slew +12 deg
+7	10.3	DC-16	Dummy command
+8	11.8	DC-16	Dummy command
+9	13.2	DC-41	Cone slew to 101 deg
+10	14.6	QC-4-13	Clock slew -13 deg to realign UVS
+11	16.0	DC-41	101 deg backup
+12	30.2	QC-3-9	Clock slew ±9 deg

Table 6. Mariner 6 special command tape X

Time (min)	Pic. No.	Command	Purpose
Initial DC-16 time	0.4	DC-16	Start NE data recording
+1	1.8	QC-1-4	Cone slew +4 deg
+2	3.3	DC-16	Backup initial DC-16
+3	4.7	QC-2-4	Cone slew back 4 deg
+4	6.1	DC-16	Dummy command
+5	7.5	QC-4-12	Clock slew -12 deg
+6	8.9	DC-16	Dummy command
+7	10.3	DC-16	Dummy command
+8	11.8	DC-16	Dummy command
+9	13.2	DC-41	Cone slew to 101 deg
+10	14.6	QC-3-18	Clock slew +18 deg to realign UVS
+11	16.0	DC-41	Backup slew to 101 deg
+12	17.5	QC-4-5	Clock slew -5 deg
+22	31.7	QC-3-9	Clock slew +9 deg

Table 7. Special encounter voice net call signs

Net Title	Locations and Call Signs				
	SFOF	DSS 12	DSS 14	DSS 13	CTA 21
Occultation	"O-P-1"	12 Receiver	14 Receiver	13 Computer	-
HRT	TRACKAD	-	14 Video	-	21 Video
Intersite	-	12 OPS	14 OPS	-	21 OPS

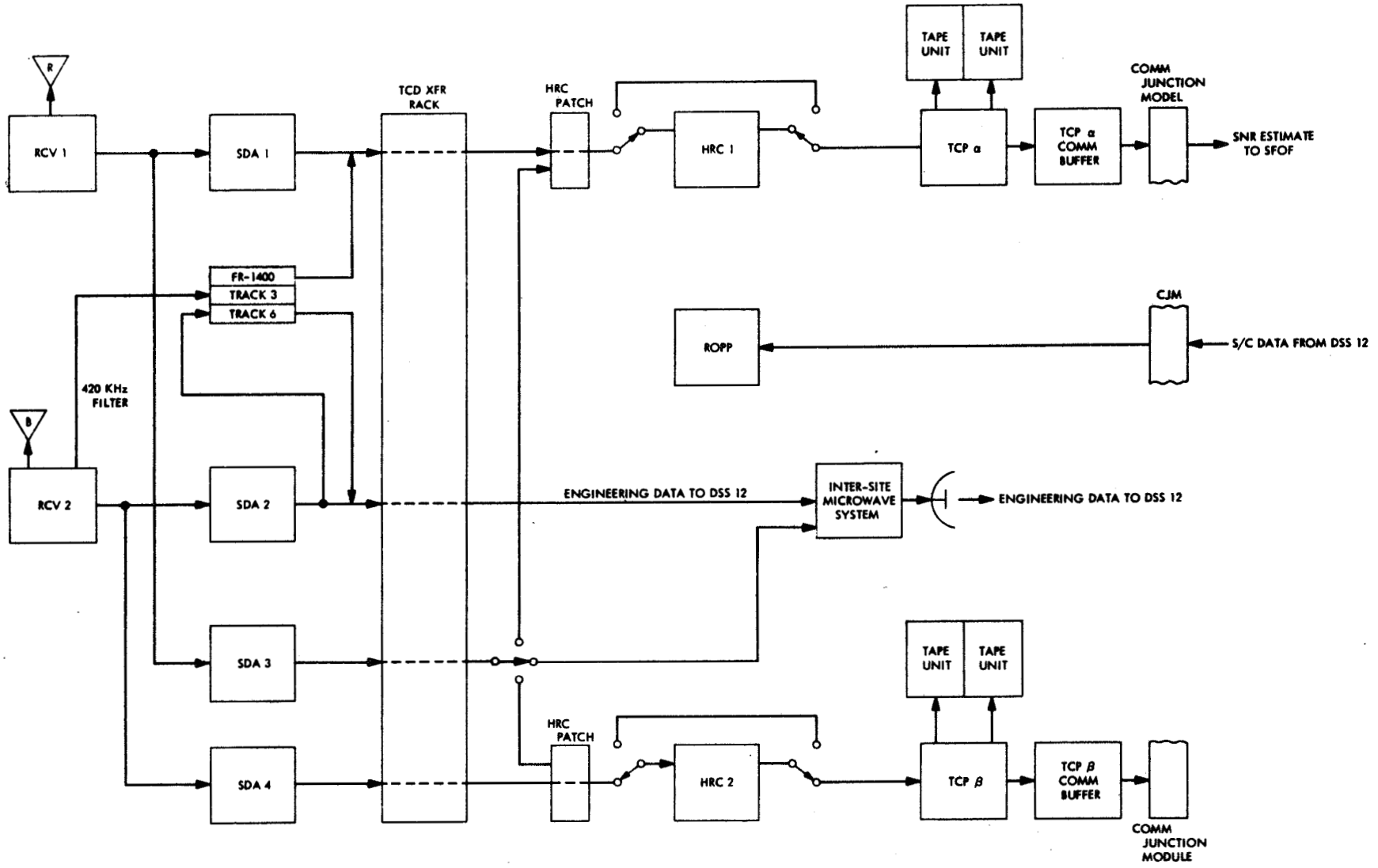


Fig. 3. DSS 14 telemetry configuration

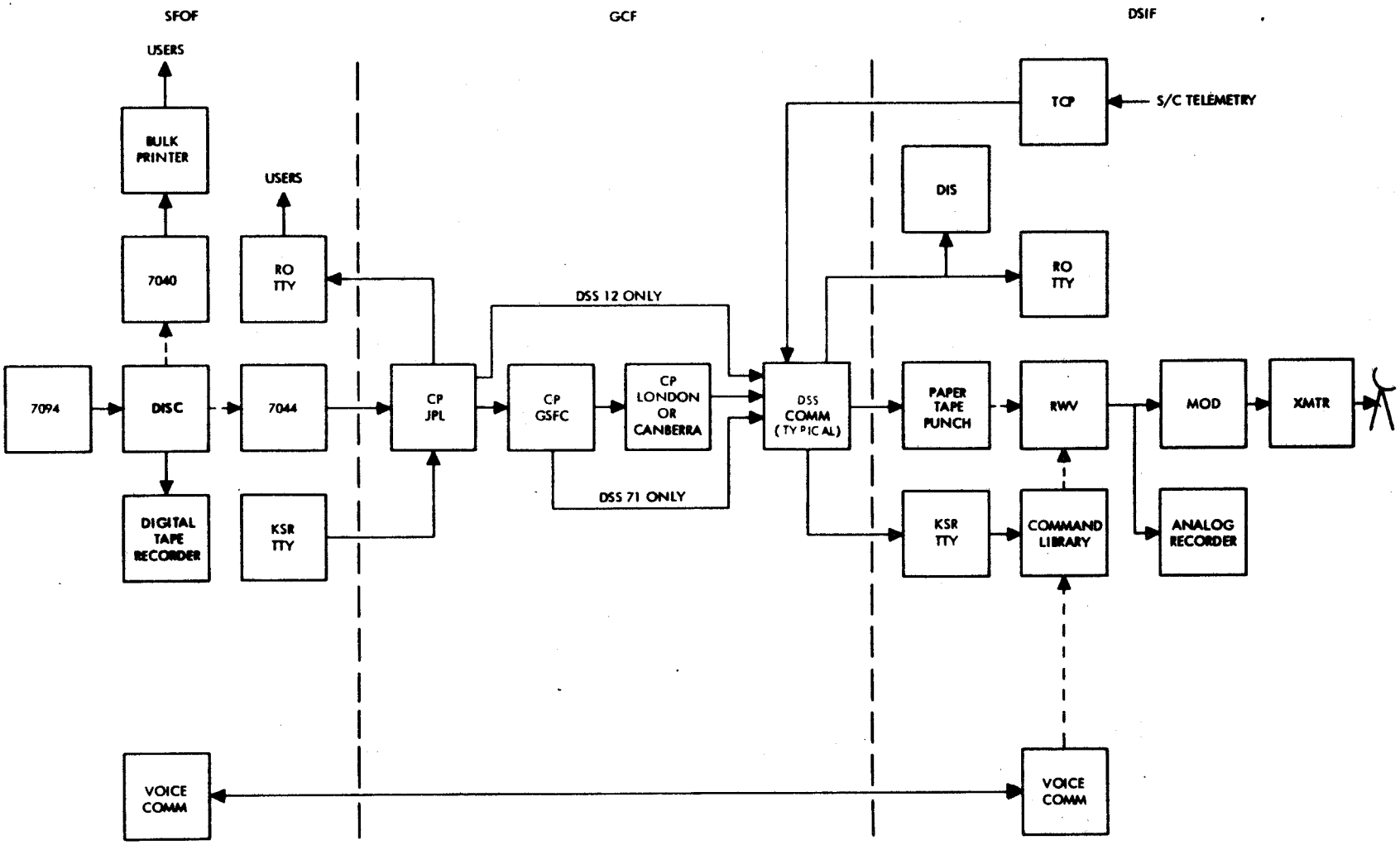


Fig. 4. DSN command configuration

MODE	DSS 12				DSS 14				DSS 11	CTA 21	
	TCP		DIS	RWV	TCP		DIS	RWV	RWV	TCP	
	α	β			α	β				α	β
1	12 ENGR	14 ENGR	MONITOR	BACK UP	HRT	HRT	MONITOR	PRIME	NE S/C	HRT	11 ENGR
1A	12 SCIENCE	14 ENGR	MONITOR	BACK UP	X	BACK UP DSS 12	MONITOR	PRIME	NE S/C	X	11 ENGR
2	12 ENGR	12 ENGR	MONITOR	NE S/C	HRT	HRT	MONITOR	PRIME	N/A	HRT	14 ENGR
2A	12 SCIENCE	12 ENGR	MONITOR	NE S/C	HRT	HRT	MONITOR	PRIME	N/A	HRT	14 ENGR
3	12 SCIENCE	12 ENGR	MONITOR	NE S/C	14 ENGR	14 ENGR	MONITOR	PRIME	N/A	X	14 ENGR
3A	12 SCIENCE	12 ENGR	MONITOR	NE S/C	14 SCIENCE	14 ENGR	MONITOR	PRIME	N/A	X	14 ENGR
4	12 SCIENCE	14 ENGR	MONITOR	BACK UP	14 SCIENCE	14 ENGR	MONITOR	PRIME	NE S/C	X	11 ENGR

Fig. 5. Encounter support mode matrix

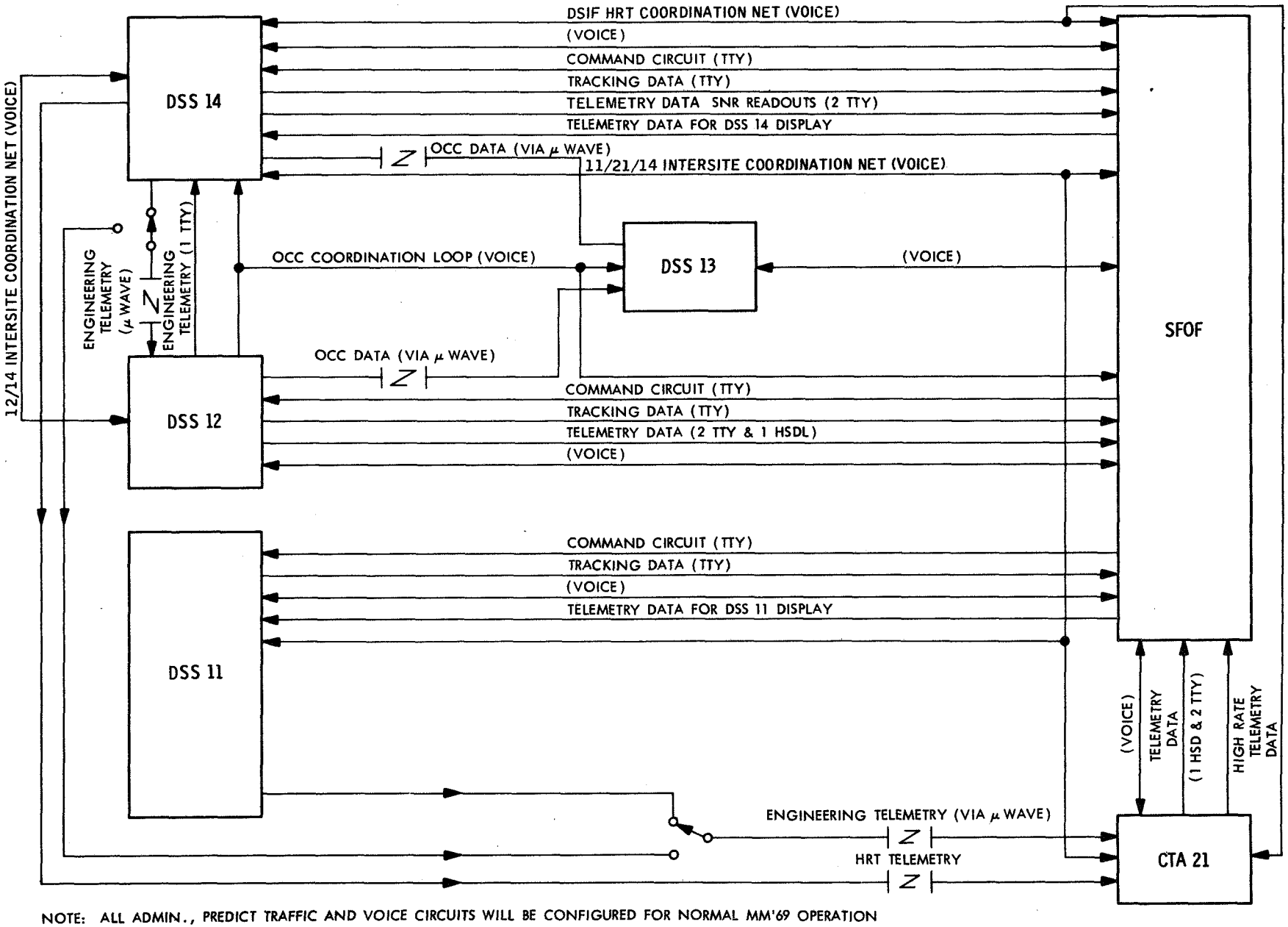


Fig. 6. Goldstone complex interface for MM69 encounter

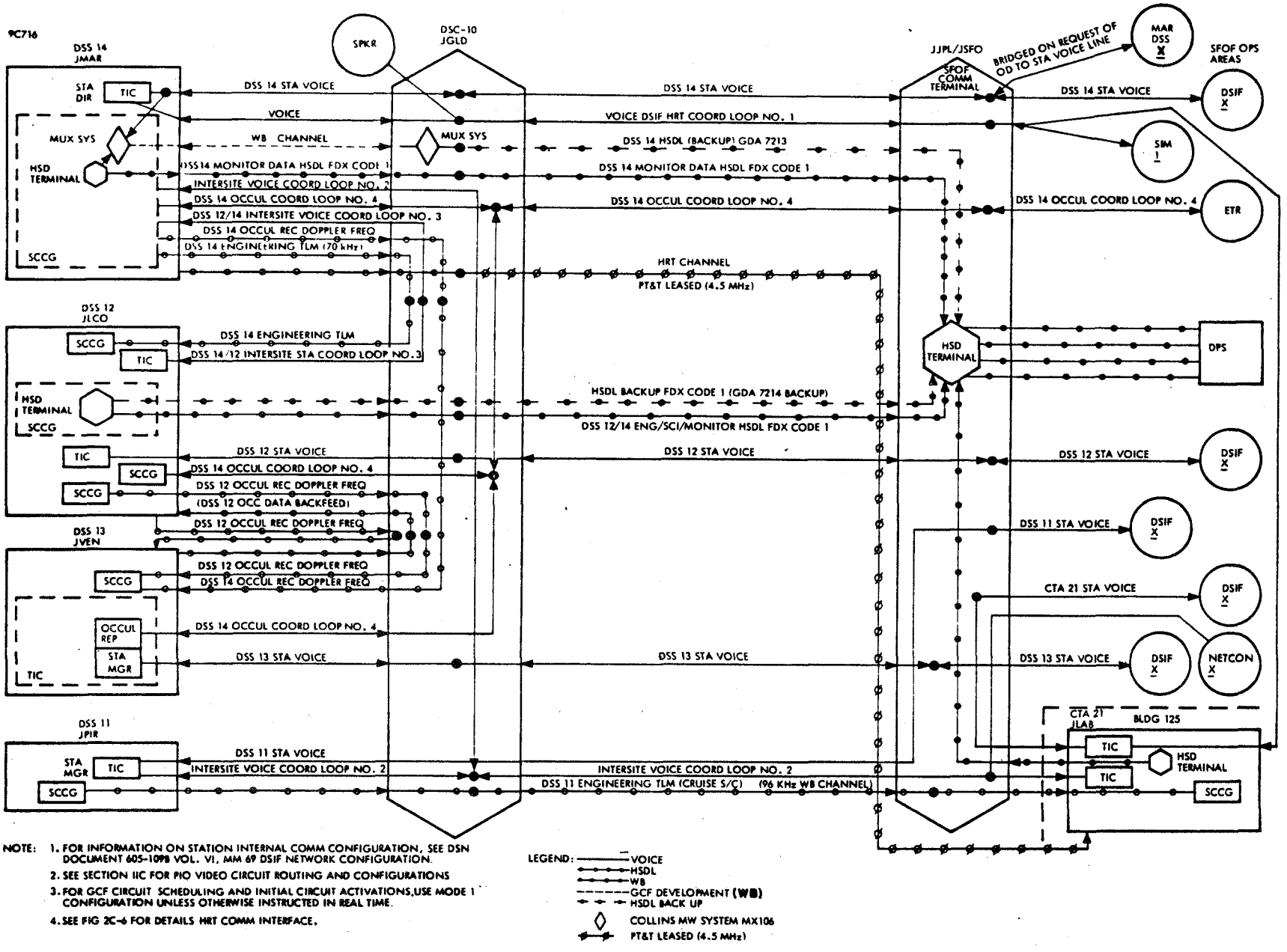


Fig. 7. Goldstone GCF encounter configuration, HSD, voice, and wideband

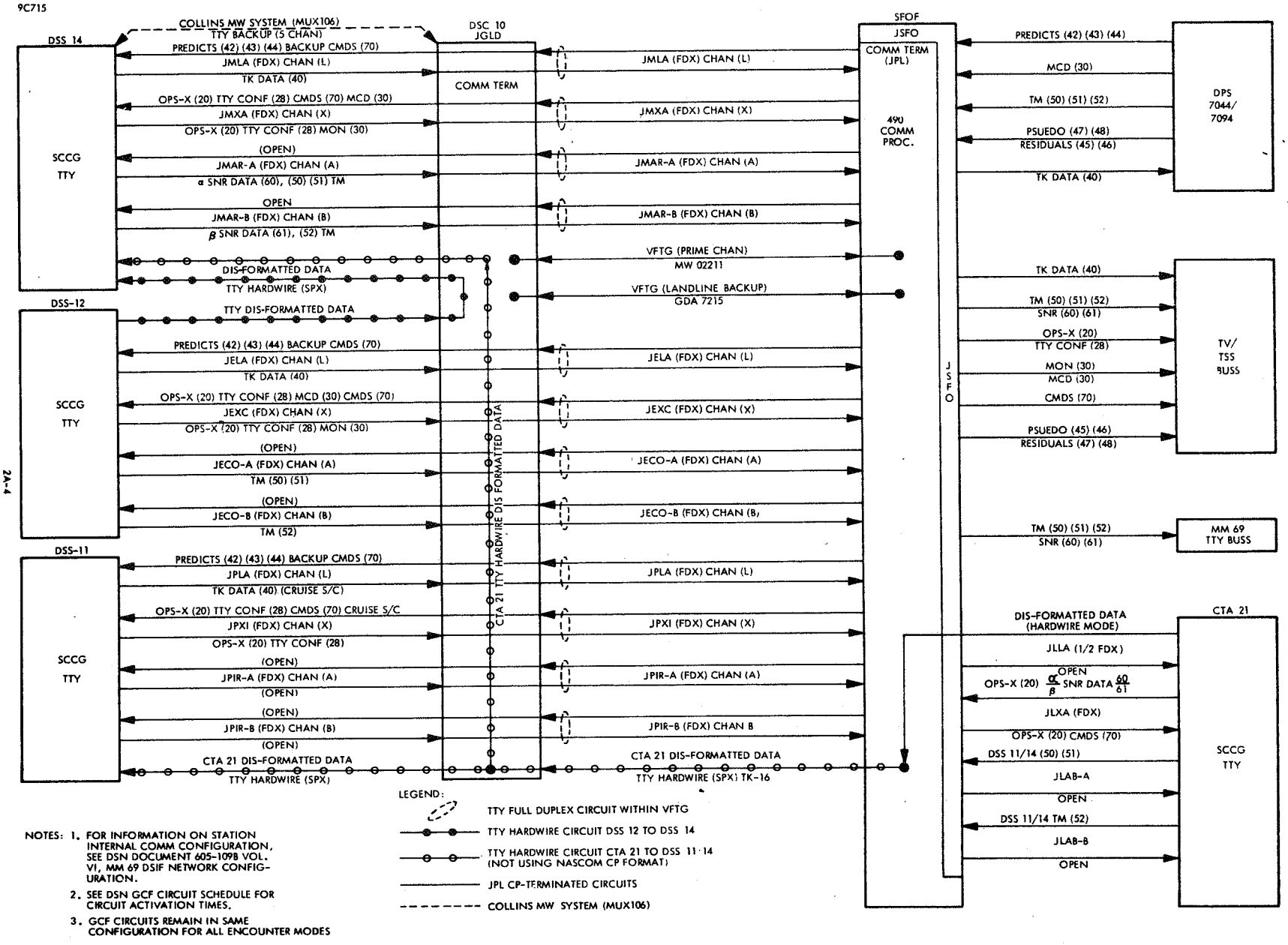


Fig. 8. Goldstone GCF encounter configuration, TTY

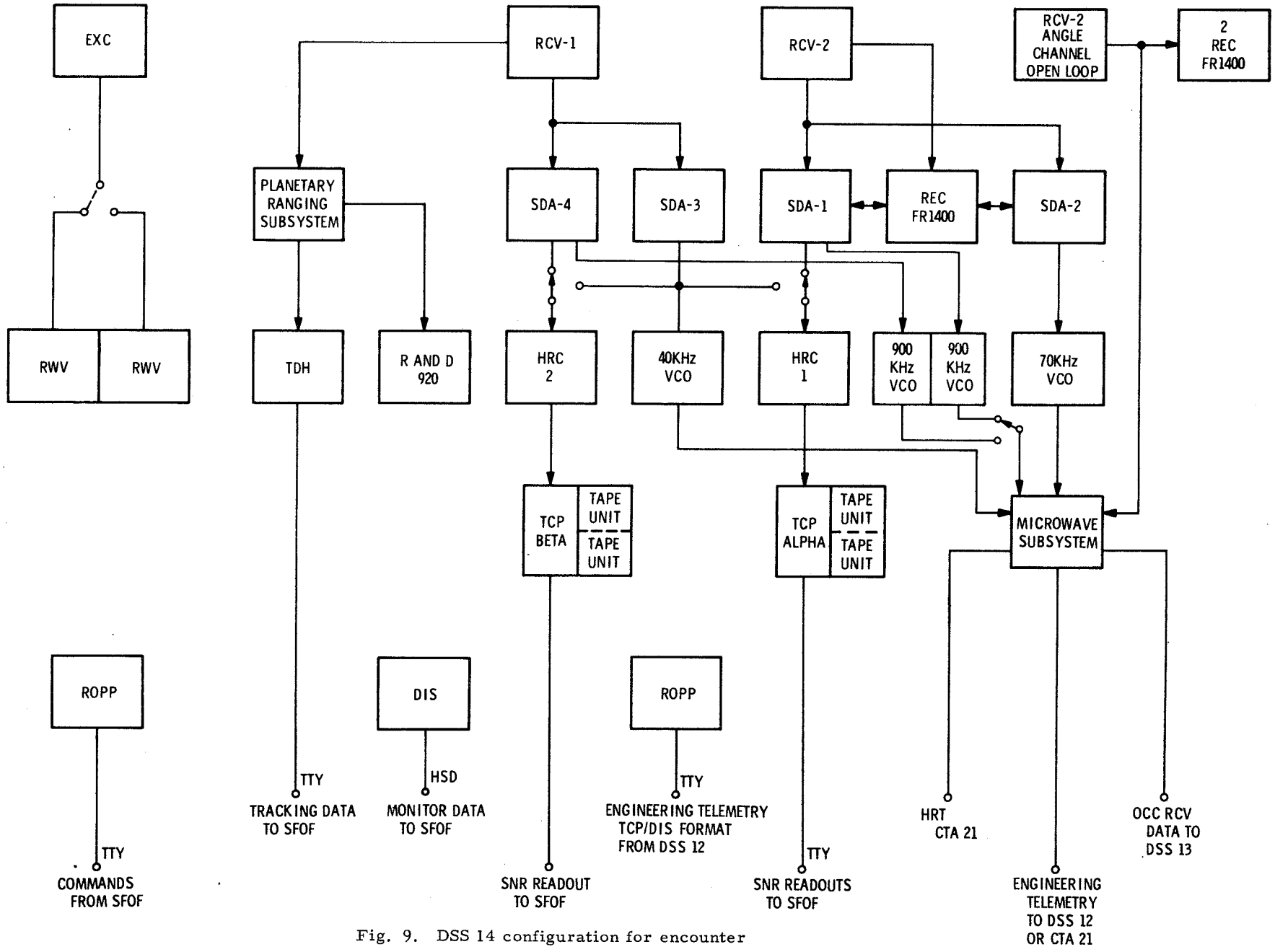


Fig. 9. DSS 14 configuration for encounter

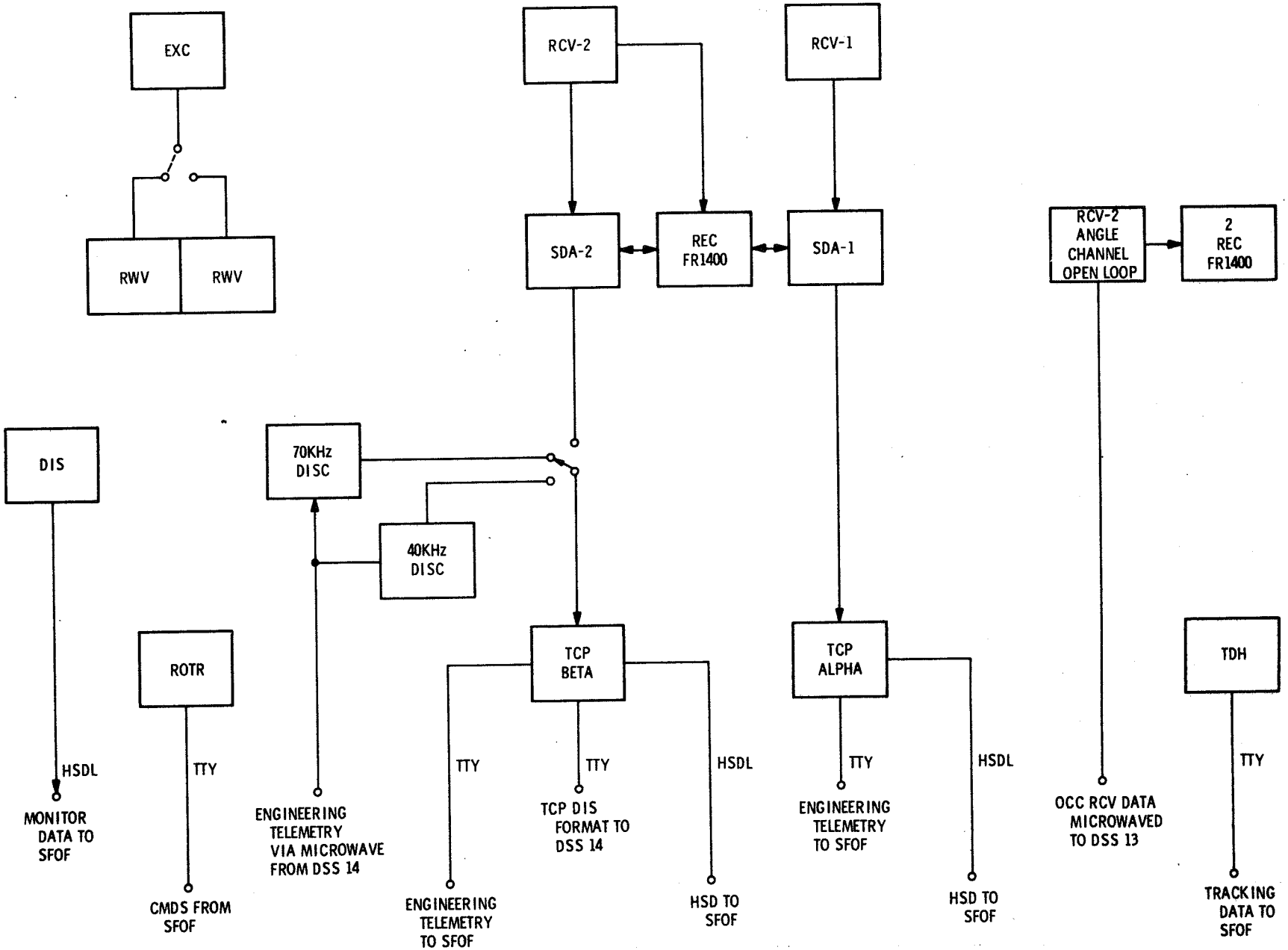


Fig. 10. DSS 12 configuration for encounter

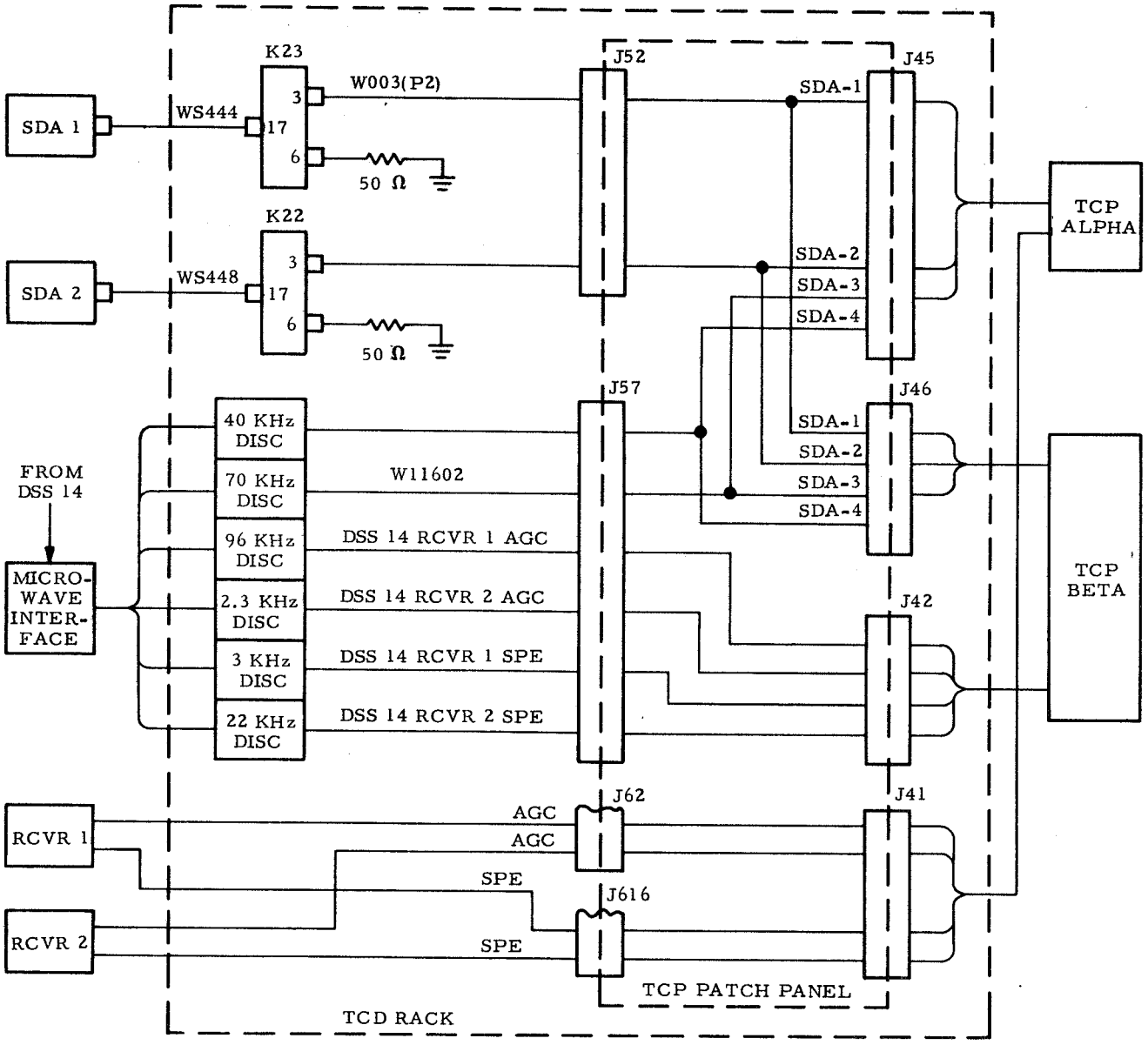


Fig. 11. DSS 12 encounter patch configuration

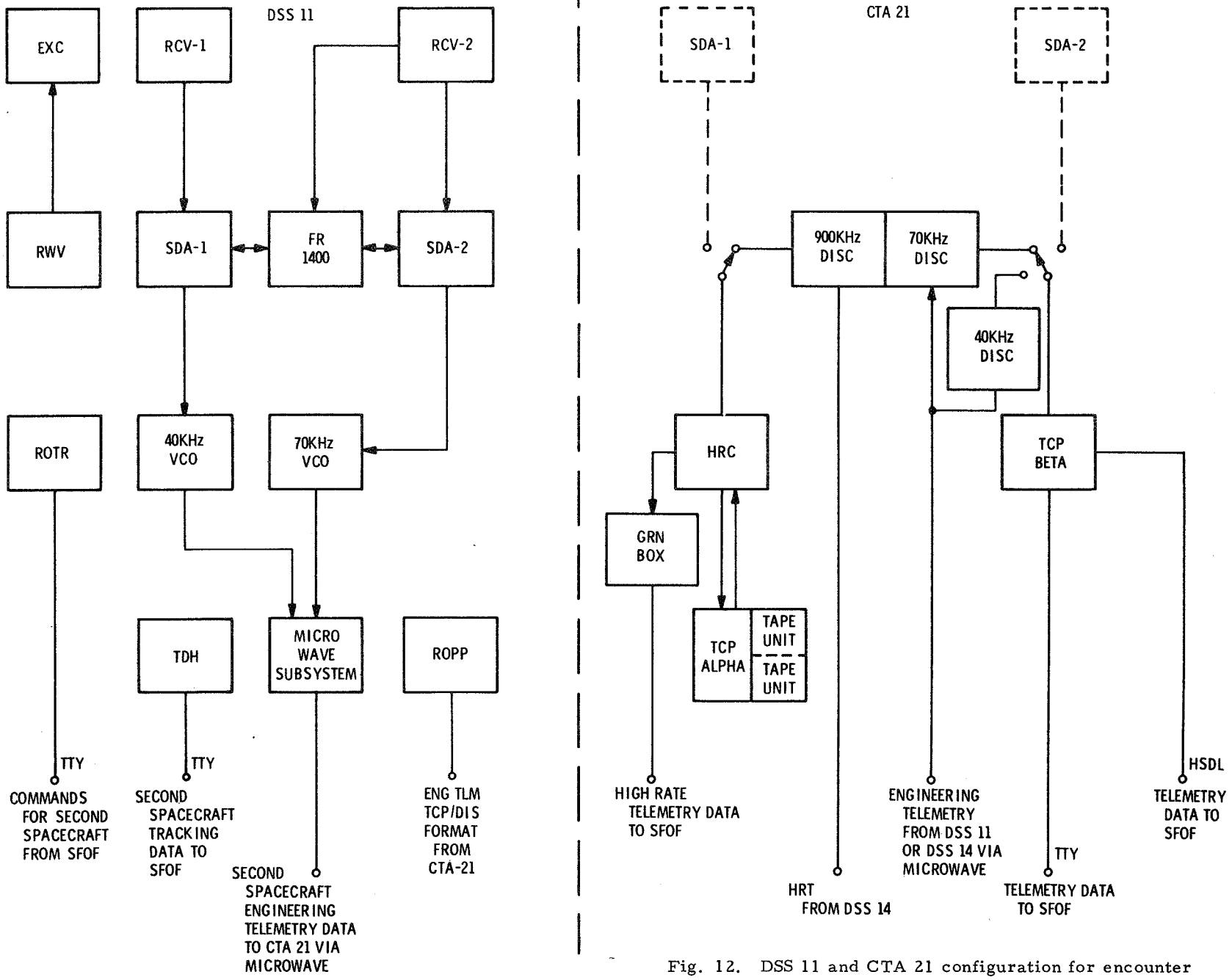


Fig. 12. DSS 11 and CTA 21 configuration for encounter

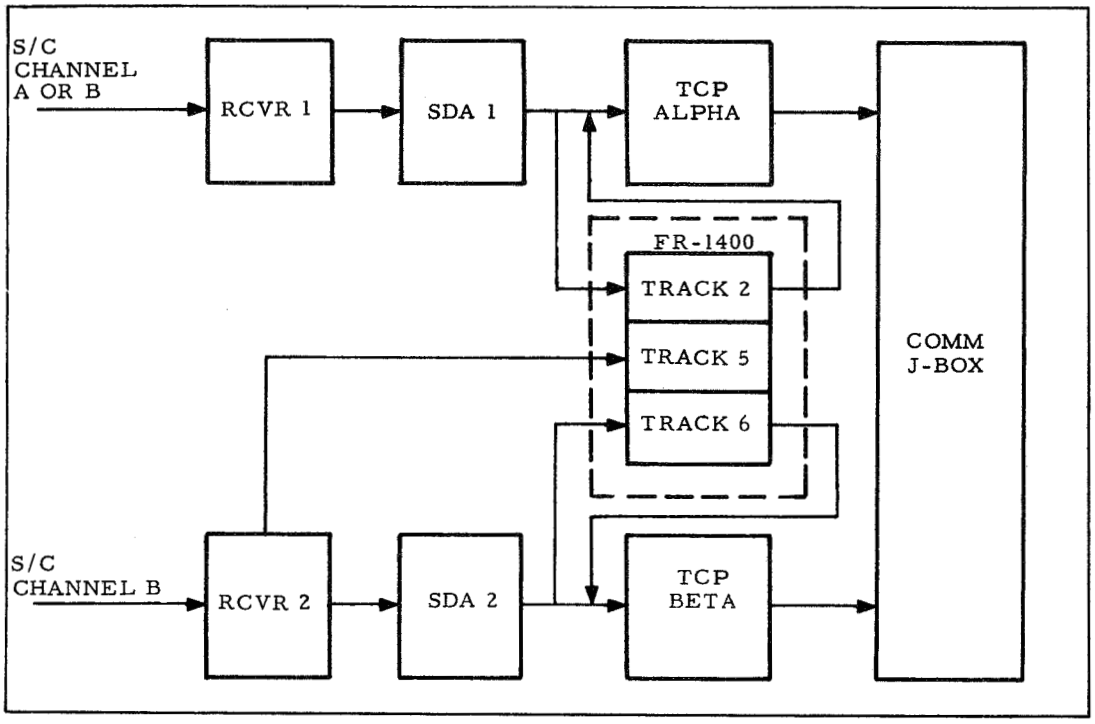


Fig. 13. Standard telemetry configuration for DSS 41, 51, and 62

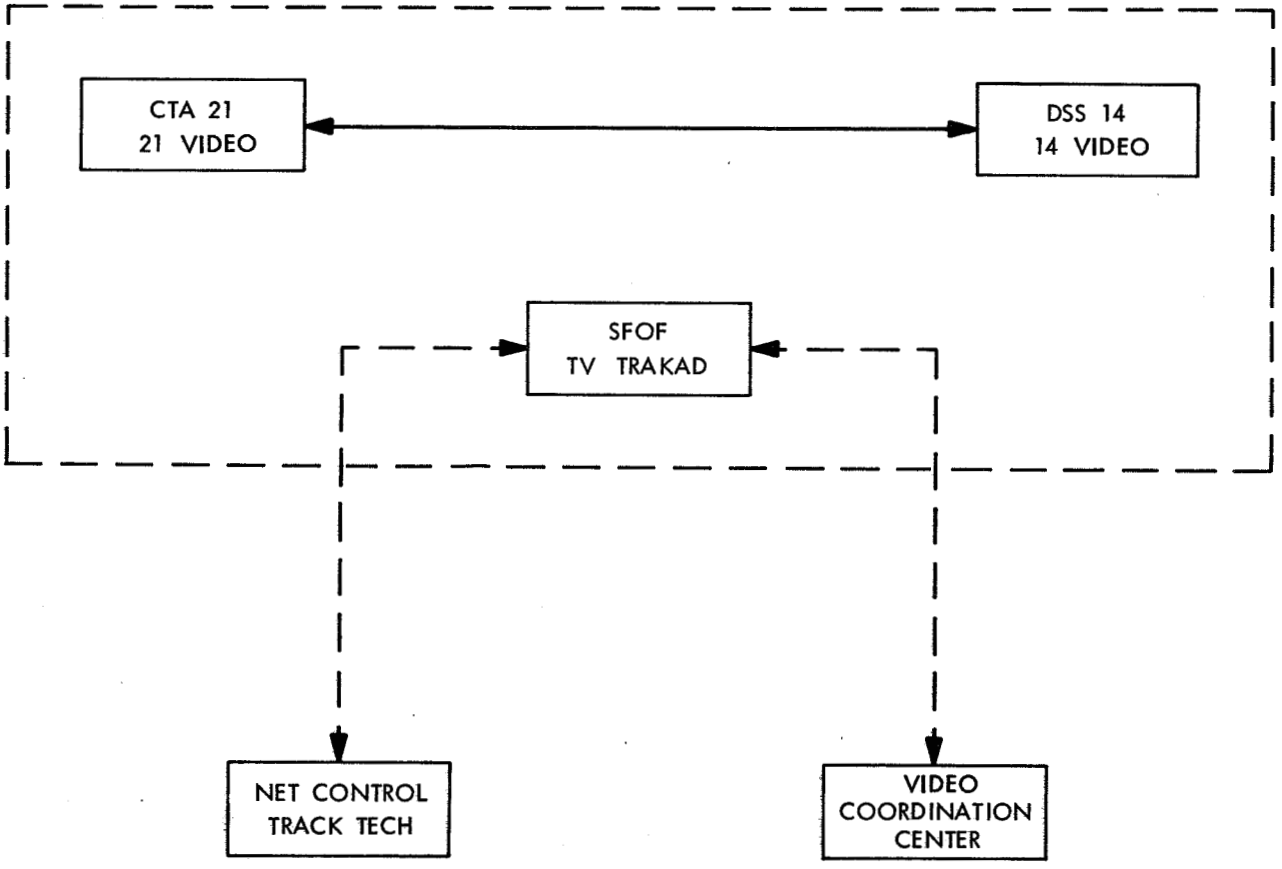
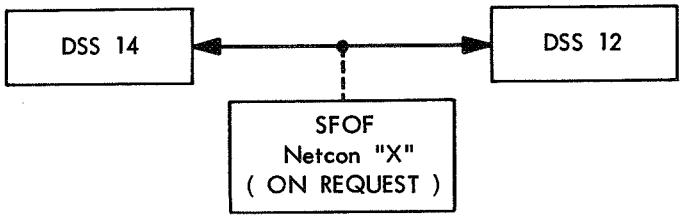


Fig. 14. DSIF HRT coordination loop



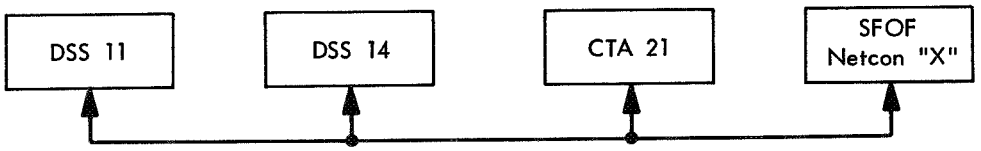


Fig. 15. Intersite coordination loops

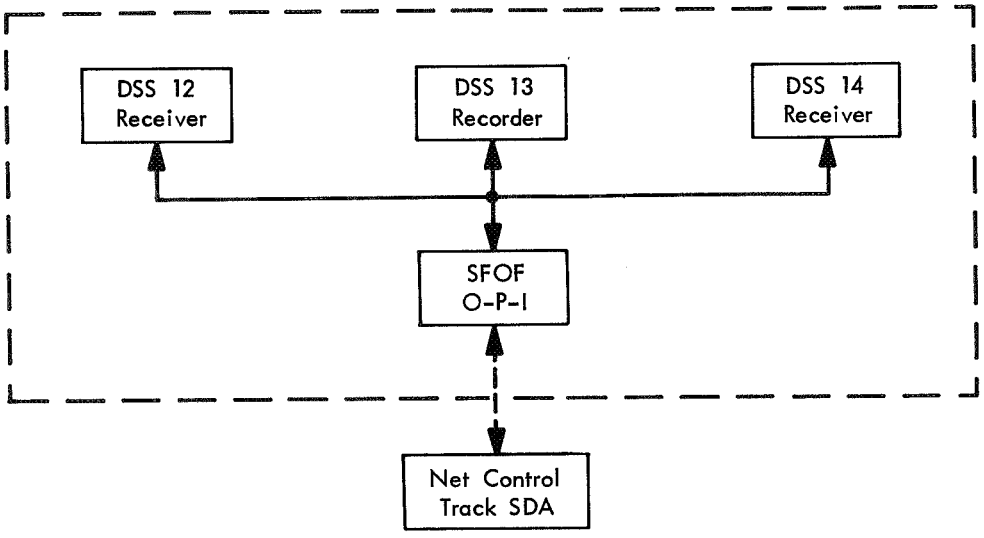


Fig. 16. Occultation coordination loop

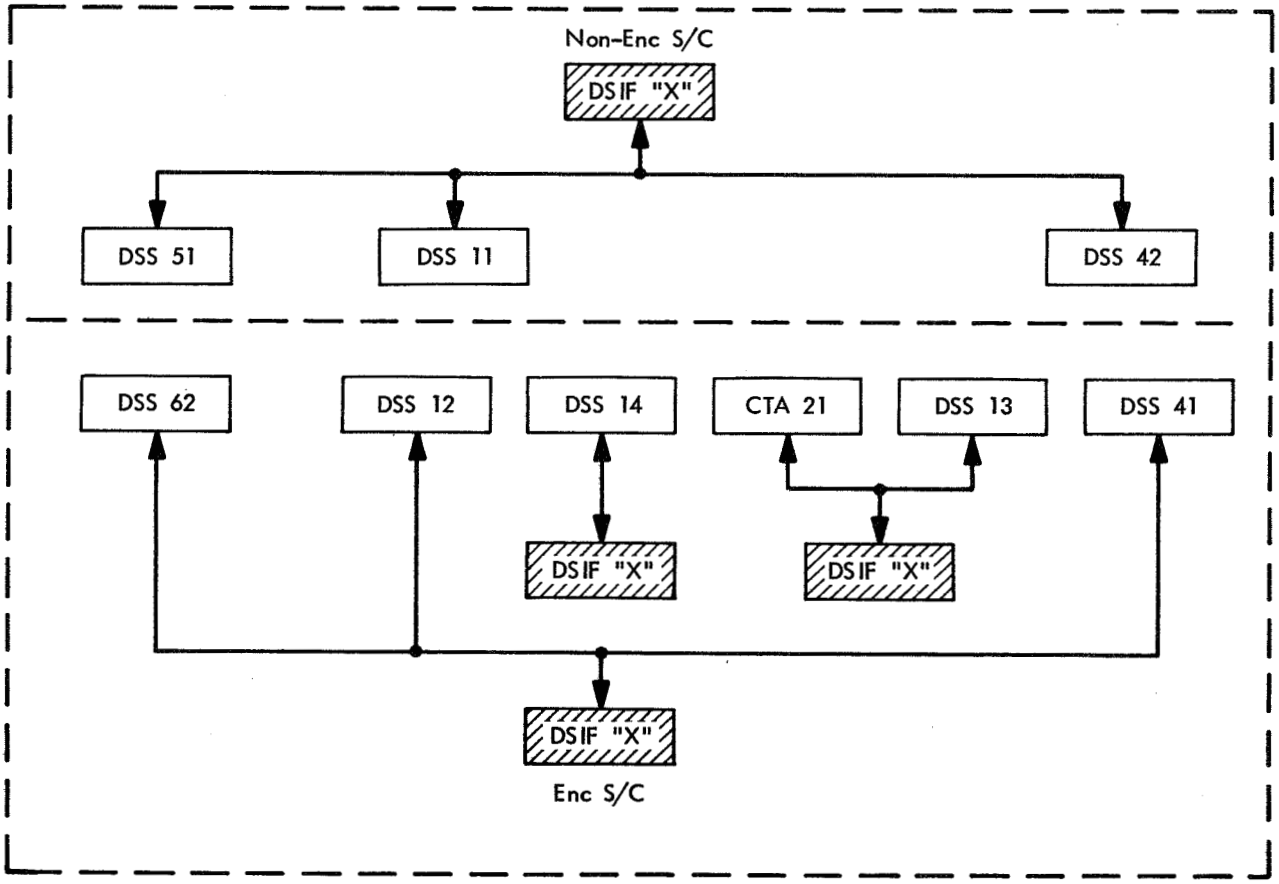


Fig. 17. DSIF/DSS voice net bridging

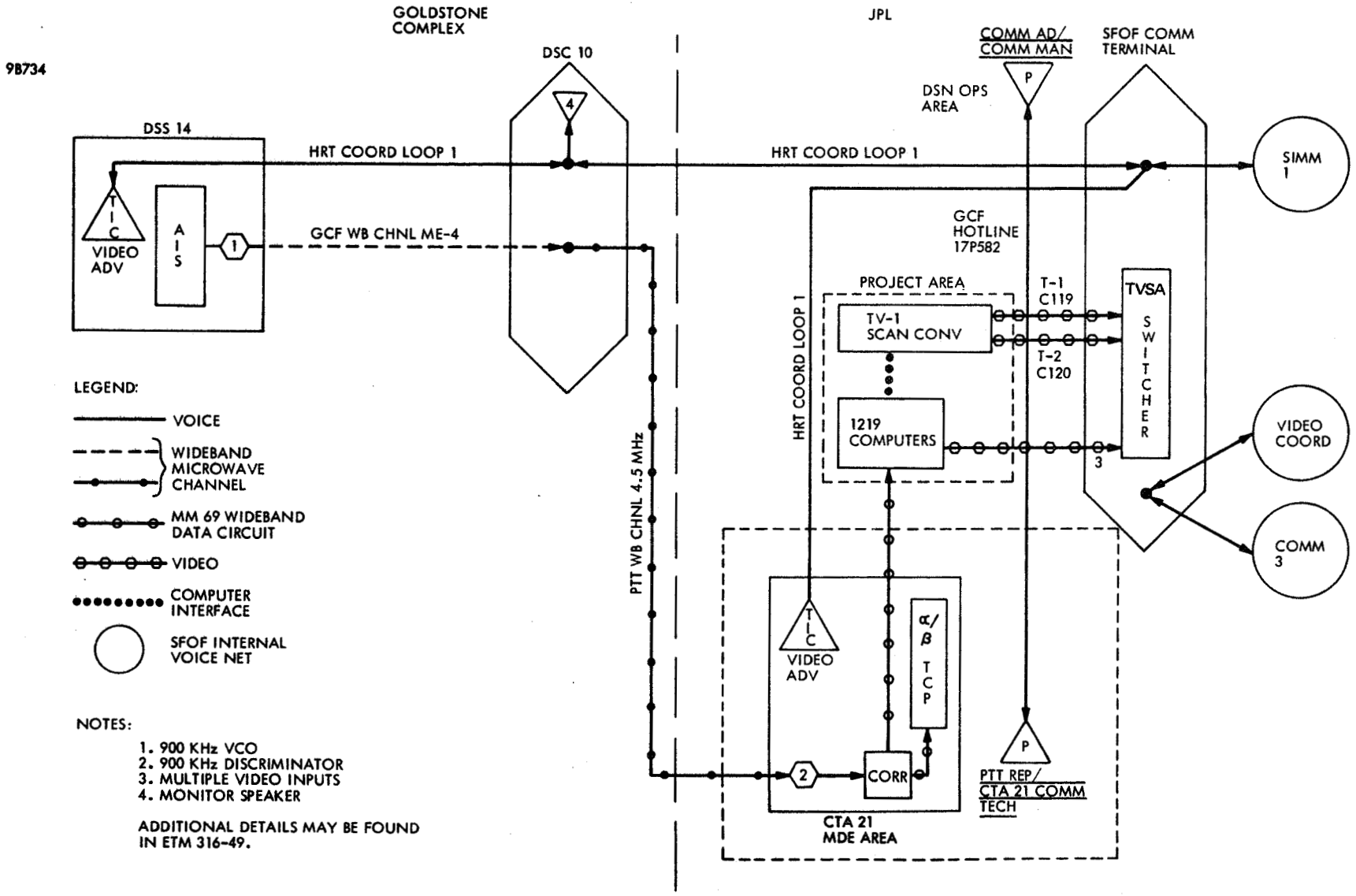


Fig. 18. SFOF external configuration supporting PIO high rate telemetry processing

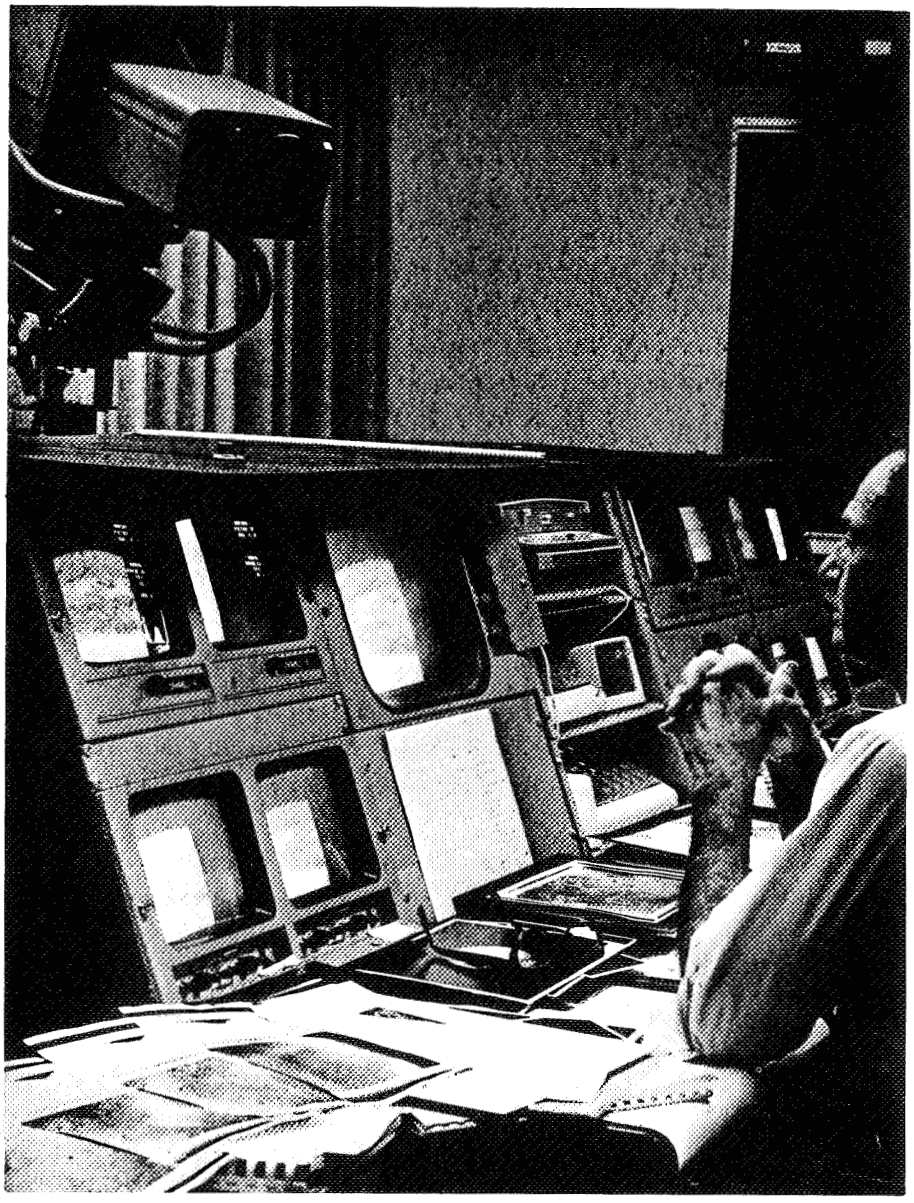


Fig. 19. Real-time TV control console

The testing and training program discussed in Volume I was continued during the cruise phase of the mission before encounter to demonstrate the operational readiness of all personnel and systems necessary for the encounter phase of Mariners 6 and 7. The planned schedule for this portion of the program as delineated by the Mission Operations Master Test Plan, DSN Test Plan, and Space Flight Operations Plan, is given in Fig. 20.

A series of internal training and test exercises was to be completed by TDS before supporting encounter operations. The various types of testing were standardized to apply to all TDS elements supporting this mission. Testing followed a building block approach, starting at facility level and proceeding through to a system level testing. This approach applied to both engineering and operationally oriented testing. Training was designed to include classroom instruction as well as simulated operations.

A. TDS Testing Plan

This approach was applied to the following guidelines for conducting the training and operational tests in which DSIF would be involved during the encounter phase.

1. Telemetry simulation data. Data from remote sites and from Goldstone were simulated.

a. Remote sites. Simulation of encounter and playback data rates at DSSs 41, 51, and 62 were accomplished by using the Mariner Mars 1969 telemetry simulator and the DSIF/GCF interface (DGI), with SDCC or CTA 21 serving as a data source. No simulation of spacecraft data rate changes was possible at DSS 42; therefore, any tests involving that station were, as in the past, conducted during actual Mariner tracks.

b. Goldstone/CTA 21 configuration. The following considerations and constraints apply to the simulation of telemetry data flow functions during tests involving the Goldstone/CTA 21 configuration:

(1) In the standard encounter configuration, both TCPs at CTA 21 are required to process spacecraft telemetry data, making it impossible to utilize the station as a data source (providing M69-4 spacecraft data to DSS DGIs) during exercises involving the entire complex in the encounter configuration.

(2) DSS 14 is not equipped with a DGI.

(3) DSS 11 has neither a telemetry simulator nor a TCP.

(4) There are no provisions for microwaving HRT test data from DSS 14 to CTA 21 during tests. The HRT test set will be used as a data source at DSS 14, where the data will be recorded only on the TCP magnetic tape. CTA 21 will process M69-4 HRT data and transmit it to the SFOF for real-time television display.

c. DGI initialization procedures. Tracking or pretest instruction messages from DSIF operations planning will specify the types of DGI initialization (standard or nonstandard) to be used. For accepting standard DSN-ADSS (automatic data switching system) headers, the nonstandard DGI mode initialization procedure will be used.

2. Encounter operational verification tests. Special operational verification tests (OVT) will be required to verify the ability of the DSIF to:

(1) Operate in the various station configurations and modes peculiar to the encounter and playback phases of the mission, using the DSIF operating procedures for Mariner Mars 1969 developed for this purpose.

(2) Cope with telemetry mode changes.

(3) Operate the simulation system, utilizing the various data sources to be employed during the mission operations system (MOS) encounter tests.

(4) Support MOS encounter operational tests.

To facilitate encounter testing by the DSN, it was planned to combine DSN system tests with the concurrently conducted OVTs by GCF, SFOF and DSIF.

a. Schedule. Two encounter OVTs were planned for the Goldstone/CTA 21 complex, and one for each of the other DSSs. The planned dates for these tests are shown in Fig. 20.

b. Sequence of events. The weekly tracking and prepass instruction message or a separate pretest briefing teletypewriter exchange contained a sequence of events (SOE) for each OVT. For tests involving the Goldstone/CTA 21 configuration, the SOE provided for exercising the five standard and three ground failure mode encounter configurations, to the extent possible.

c. Occultation experiment. The occultation voice coordination loop and on-site receiver and recorder operator functions were exercised to the maximum extent possible.

d. Inter- and intra-site communications. Station TIC and voice coordination loops terminated in station control and monitor consoles of the Goldstone/CTA 21 stations were exercised.

3. Command operational verification tests. These command OVTs were conducted periodically during scheduled Mariner Mars 1969 tracking periods in accordance with the planned dates given in Fig. 20.

a. Command messages. A simulated spacecraft identification number (81 or 82) was used on command messages. Old CC messages from previous tests could be used; if this was the case, net control up-dated the message by voice and provided any additional instructions that may have been required.

b. Command modulation. Both the station and net control took every precaution to preclude the inadvertent turn-on of command modulation. The RWV was terminated into the dummy load at all times during these exercises.

c. Communications. If voice circuits were being shared with another station, a separate voice circuit could be requested for the duration of the exercise. Simulation of voice and teletype circuit outages were coordinated by the track chief with the communication man, data control (DACON), and orbit determination (OD), as required, to avoid confusion and to preclude interference with normal cruise tracking functions.

d. Operations Control Team Interface. The track chief adhered to standard Mariner Mars 1969 practices and procedures and observed the normal operational interfaces with those elements of the DSN and project that participated in each OVT. Normally, the DSN OD not only performed his usual functions, but represented the project (SFOD) as well.

e. Evaluation. An evaluation record of the results of each OVT was made by the on-duty track chief. These records were used by the DSIF operations planning project engineer to determine the need for further testing and to assure that maximum coverage of all DSS shifts was achieved.

4. Encounter Training. Special training for encounter operations was required primarily at Goldstone, in support of the high-rate telemetry, occultation, and R&D planetary ranging experiments. While responsibility for these experiments lay with the respective Cognizant Development Engineers (CDEs) of the telecommunications division, the station directors supported the following training requirements:

(1) HRT. Personnel involved were the DSS 14 telemetry and command processor (TCP) and RCV/SDA operators. The normal complement of operators on each shift was trained. TCP operators were trained on the correlator/software system

(2) Occultation. One or more receiver operators at both DSS 12 and 14 were trained in the operation of the open-loop receivers, as backup to the CDE personnel who were to operate the equipment during occultation. The FR-1400 recorder operators at DSSs 12 and 14 were made available for training necessary to assure proper maintenance and operation of the machines.

(3) Planetary ranging. Two operators at DSS 14 were trained to operate the R&D ranging subsystem. Training was conducted during regularly scheduled Mariner passes whenever the ranging link was turned on in the spacecraft.

An important part of the encounter training consisted of lectures to be conducted by the DSIF Operations PEs at Goldstone and JPL. The Goldstone personnel were thoroughly briefed on the station configurations, special command requirements, operational procedures, SOEs, and the R&D experiments for encounter.

B. TDS Training and Tests

Testing was, in general, completed in mid-June 1969, verifying TDS readiness to support the combined mission operations testing, which started in mid-June. TDS continued running operational tests throughout the mission to ensure that proficiency was maintained at a high level.

Included in the TDS testing were training lectures, operational verification tests, and configuration verification tests.

1. Mission-dependent hardware and software. A series of lectures was completed in early July 1969, related to the theory of operation of mission-dependent hardware and software peculiar to encounter.

2. Orientation lectures. Orientation lectures covering overall encounter sequence were conducted at Goldstone for key supporting personnel. Special emphasis was placed on encounter configuration modes, real-time video, high-rate telemetry, the occultation experiment, and special command sequences. At JPL, the DSIF station controllers and other members of the DSIF operations team received several hours of classroom orientation on all pertinent aspects of encounter operations. A marked improvement was observed in the operational performance of the DSIF following this part of the training program.

3. Operational verification tests. Operational verification tests were completed to demonstrate that hardware could be operated in conjunction with procedures. Testing was completed independently from mission sequence, since TDS may be called upon at any place in the sequence to provide a committed response time for a certain operation.

DSIF OVTs, performed to prepare for encounter support, were primarily directed to the extensive command activity planned. TDS participation in operational testing, most of which occurred during scheduled Mariner tracking periods, is given in Table 8. All facility OVTs were supported by GCF and DPS.

4. Configuration verification tests. Although testing for Mariner Mars 1969 terminated in November 1968, to ensure that the configuration tested still existed at encounter, DSIF configuration verification tests (CVTs) were run as close to encounter as possible. A station configuration freeze was then put into effect.

a. DSIF configuration verification tests. DSIF CVTs were performed on June 15 and 16, 1969, to exercise operational interfaces between the Goldstone Complex, CTA 21, and the SFOF in every possible encounter configuration for Mariner Mars 1969.

On the first day of the tests, configuration Modes 1 and 2 (Fig. 5) were successfully

tested with the following minor deviations from test procedure:

(1) The method of zeroing microwave isolation amplifiers was refined.

(2) The Mariner Mars 1969 simulator at DSS 14 was used instead of the multiple-mission telemetry (MMT) simulator.

(3) DSS 11 tracked Mariner 7 using the spacecraft as the data source. The initial configuration used the MMT simulator.

No serious problems occurred during this phase of the test. Considerable time was spent familiarizing operational personnel with the new encounter configurations.

On the second day of the tests, configuration Modes 3 and 4 (Fig. 5) were successfully tested with the following problems noted:

(1) The addition of the 10-dB attenuator in the receiver caused confusion at the stations during mode changes; using SIM MM69/E-08 eliminated this confusion.

(2) Some difficulty occurred in determining which TCD patchboard to use during the different modes; indicating the correct patchboard in the configuration document eliminated this problem.

(3) At the start of the test, SFOF was not receiving the "001" HSD blocks from DSS 14. It was discovered that the 1-pulse/s signal in the TCP at DSS 14 was being loaded by the moon bounce equipment; normal TCP operation was restored.

(4) Ability to transfer science data to the beta computer was a problem at both DSS 14 and DSS 12. It was realized that the MM69 Simulator does not provide the unique bits for the TCPs to achieve unique frame detection when operating in the Playback I or Encounter I telemetry mode. By forcing the TCP into a condition where five allowable pseudorandom noise errors were accepted, the stations were able to transfer science data.

The remaining modes were not exercised as an individual part of the CVT. However, all interfaces that would have been used in these modes were exercised in Modes 1, 2, 3, and 4.

Test objectives were met, including verifying the operational feasibility of the various encounter modes and providing useful training and familiarization for station and operational personnel.

b. Data processing system CVTs. After preventive maintenance periods and before encounter on July 25 and on August 2 and 3, 1969, DPS CTVs were performed. No major problems were encountered.

C. Level Two Combined System Integration Tests

Combined system integration tests were designed to verify DSN systems compatibility through DSN facilities, DSIF, GCF, and SFOF. Level Two tests were conducted with SFOF, GCF, CTA 21, and four tracking stations participating concurrently. The stations were DSS 11, 12, 13, and 14 (Goldstone Deep Space Communication Complex).

The tests were run on June 17 and 18, 1969. The intent was to have the entire configuration tested in Mode 1 (see Fig. 5 for all modes), then exercise the variation for a spacecraft data change and the change to Mode 4. An equivalent sequence was done for Modes 2 and 3. Finally, switches to modes appropriate for ground failures were accomplished.

As a result of having complete modes tested, system integration tests and CVTs were satisfied with ample time to conduct OVTs. Specific objectives of the combined tests were to verify the following:

(1) Throughput for each DSN system (to project interface).

(2) DSN facility interface capability.

(3) DSN response to configuration mode changes.

(4) DSN operational procedures and software.

(5) Proper operation of simulation configuration for MOS tests.

Generally speaking, the tests were successful. Objectives were met, or problems that precluded completely meeting objectives were identified. None of the problems was serious; all related to operational matters rather than to configuration.

D. Special Tests and Measurements

1. DSIF Pre-encounter frequency measurements. Auxiliary oscillator frequencies are measured directly whenever the spacecraft is tracked in one-way mode. The spacecraft receiver VCO REST position, or best-lock frequency, is more difficult to determine. Several methods are available. A method that uses a frequency corresponding to the average static phase error (SPE) value in the telemetry fails because of insufficient resolution in the telemetry. A method that uses temperature telemetry and a nominal slope of frequency versus temperature is only partially successful because of the resolution in the telemetry plus a difference in reaction time between an indicated temperature change and a frequency change. However, the temperature telemetry does give a guideline for large changes.

To follow temperature changes more accurately, the auxiliary oscillator frequency was used with partial success as a temperature measurement. This was done by measuring a change of frequency, then converting this to a temperature change using the nominal slope of the frequency-vs-temperature curves. It was assumed that the same temperature change occurred in the VCO, and the change in VCO frequency was determined by a second nominal slope. The technique is only partially successful because of spatial separation in the auxiliary oscillator and VCO, and differing

characteristics that cause heat source changes to affect them by differing amounts and with different reaction times.

Once an estimate of best-lock frequency was made, it was tested at that frequency and the time the spacecraft required to detect and lock up to the signal was measured. If the lockup time were long, the frequency estimate would be adjusted for the next acquisition. This last technique of "guess and try, and guess again" is really the only way to determine a meaningful and accurate best-lock frequency while in flight. Other available techniques, some of which are described above, are actually just ways of establishing a first guess and getting the ± sign of subsequent guesses.

Several times during the special mission tests, best-lock determination was made by this lockup time method by increasing the frequency of one-way to two-way transfers.

During the first few days after the Mariner 6 launch, the change in best-lock frequency due to the SPE anomaly was determined using the SPE offset to establish a 50- to 70-kHz frequency change (at S-band), and then applying the lockup time method to confirm best-lock frequency.

In the encounter sequence, both the temperature telemetry and auxiliary oscillator frequency were used to determine temperature and frequency changes.

Auxiliary oscillator stability was assessed during flight using short sample rate tracking data and Pseudo-Residual or Orbit Determination Programs. By these means, a period of instability was discovered on Mariner 6, and continued stability was assessed during encounter.

2. DPS special engineering test. A special engineering test was conducted on July 8, 1969, to identify and correct a problem in the communications processor (CP)/7044 interface. The problem manifested itself as missing lines of formatted telemetry data on the teletype machines during periods of high teletype activity associated with science encounter testing. The special engineering test was successful in duplicating the problem. The solution was to optimize the value of the CP drum reread timer.

E. Mission Operations Tests and Support

The mission operations training and testing schedule during the cruise phase of the Mariner Mars 1969 mission before encounter is shown in Fig. 20. The DSIF participation in the combined mission operations tests is indicated in this schedule. A brief discussion of the mission operations tests conducted during the pre-encounter period is provided in Table 9.

During the MOS encounter testing, it was determined that more than one DSIF chief was needed to handle the critical encounter commanding and coordinating activities of the DSS controllers in operation of the Goldstone/CTA 21 encounter configuration. Accordingly, both assistant operations planning project engineers were scheduled to work together as DSIF chiefs on the swing shift (with the spacecraft in view of Goldstone). One DSIF chief would conduct the command activities, while the other would interface with the DSN operations director and other members of the DSN operations team.

Table 8. DSIF command OVTs

Date	DSS
(Week of) 21 April	41, 62
(Week of) 28 April	12, 14, 41, 51, 62
17 May	62
19 May	51
24 May	62
25 May	14
27 May	51
28 May	42
29 May	12
3 June	51, 62
4 June	41, 42
5 June	12
5 June (Science TLM Data OVT)	62, 51
16 June	11
(Week of) 23 June	11, 12, 14, 41, 51, 62
30 June	14

Table 9. Mission operations tests

TITLE	NO.	DATE	OBJECTIVES	OBJECTIVES MET	PROBLEMS/REMARKS
SSAC TRAINING	1	6 MAY	TRAIN PERSONNEL IN READING ALL SCIENCE DATA DISPLAYS AND USING VOICE COMMUNICATIONS	YES	SEVERAL MINOR PROBLEMS WERE NOTED: NET USAGE, DATA DISPLAY FORMATS, AND SSAA CONFIGURATION; NONE WERE MAJOR.
SSAC TRAINING	2	13 MAY	SAME AS TEST 1	YES	REPORTING PROCEDURES WERE SATISFACTORY, BUT WERE MODIFIED SLIGHTLY FOR SSAC TEST 3 TO BETTER SSAC EFFICIENCY. CHANGES IN DISPLAY FORMATS FROM TEST 1 COULD NOT BE INCORPORATED INTO 7044 PROGRAM; HOWEVER, EXISTING FORMATS WERE ADEQUATE.
SSAC TRAINING	3	15 MAY	SAME AS TEST 1	YES	PROBLEMS IN PREVIOUS TESTS WERE RESOLVED AND SOLUTIONS TESTED IN THIS EXERCISE. REQUESTED CHANGES IN DISPLAY FORMATS WERE MADE AND PROVED SATISFACTORY. PROBLEM OF MARINER 7 SPACECRAFT SCIENCE PROCESSOR PORTION OF 7044 PROGRAM WAS CORRECTED BEFORE TEST 3; NO PROBLEMS WITH 7044 PROGRAM DURING TEST 3.
MARINER 6 ENCOUNTER TRAINING	1	22 MAY	TRAIN PERSONNEL IN CONVERTING SPACECRAFT FROM CRUISE TO FAR ENCOUNTER CONFIGURATION, IN OBSERVING FAR ENCOUNTER DATA, AND IN PERFORMING ENCOUNTER OPERATIONS PER SEQUENCE OF EVENTS	YES	ONLY MAJOR OPERATIONAL PROBLEM WAS WITH THE 1219 SOFTWARE; PROBLEM DETECTED AND CORRECTED IN REAL TIME.
MARINER 6 ENCOUNTER TRAINING	2	28-29 MAY	TRAIN PERSONNEL FOR FUNCTIONS DURING HIGH ACTIVITY OF FAR AND NEAR ENCOUNTER, ASSESS TECHNICAL ANALYSIS PROCEDURES AND INTERFACES, AND ASSESS SEQUENCE OF EVENTS	YES	SOME MINOR PROBLEMS IN SOFTWARE AND PROCEDURES WERE DISCLOSED.
MARINER 6 ENCOUNTER OPERATIONAL	1	11-13 JUNE	DETERMINE READINESS OF ALL COMMITTED RESOURCES FOR THE MARINER 6 ENCOUNTER	YES	SEVERAL MINOR PROBLEMS INDICATED THE NEED FOR ADDITIONAL TRAINING AND IMPROVED COMMUNICATIONS AND PLANNING.
MARINER 7 ENCOUNTER TRAINING	1	18 JUNE	TRAIN PERSONNEL FOR MARINER 7 ENCOUNTER DAY SEQUENCE, INCLUDING SCIENCE DATA HANDLING, AND ASSESS STANDARD SEQUENCE OF EVENTS	YES	NO MAJOR OPERATIONAL PROBLEMS DEVELOPED DURING 35-PICTURE-TAKING SEQUENCE. TWO MINOR PROBLEMS AFFECTING DSS 14 AND CTA 21 DETECTED BY CTA 21.
MARINER 7 ENCOUNTER OPERATIONAL	1	25-27 JUNE	DETERMINE READINESS OF ALL COMMITTED RESOURCES FOR THE MARINER 7 ENCOUNTER	YES	MOST PROBLEMS ENCOUNTERED WERE HARDWARE AND SOFTWARE TYPES, SUBSEQUENTLY CORRECTED; NO MAJOR PROCEDURAL OR OPERATIONAL PROBLEMS DETECTED.
MARINER 7 NON-STANDARD ENCOUNTER TRAINING	1	16 JULY	EXERCISE AND EVALUATE PROCEDURES TO BE FOLLOWED DURING ENCOUNTER OPERATION FOR A SPACECRAFT WITH A FAILED CC&S	YES	ALTHOUGH FORMAL TECHNICAL ANALYSIS GROUP PROCEDURES WERE NOT AVAILABLE IN ALL CASES, ENCOUNTER PLANS WERE MODIFIED, A GROUND COMMAND STRATEGY WAS DEVELOPED, AND COMMAND MESSAGES WERE PREPARED. NO SIGNIFICANT PROBLEMS WERE DETECTED; COMMAND DENSITY ASSOCIATED WITH A FAILED CC&S IN ENCOUNTER SEQUENCE DID NOT APPEAR EXCESSIVELY HIGH.
MARINER 6 NON-STANDARD ENCOUNTER TRAINING	1	17 JULY	EXERCISE PROCEDURES IN THE EVENT OF SCAN PLATFORM FAILURE	YES	A HIGH COMMAND DENSITY OCCURRED FOR THE SCAN PLATFORM FAILURE BECAUSE THE SIMULATED ANOMALY WAS INSERTED LESS THAN 7 HOURS BEFORE NEAR ENCOUNTER, LEAVING LITTLE TIME TO COMPLETELY UPDATE THE CC&S.
MARINER 7 ENCOUNTER OPERATIONAL	2	9 JULY	DETERMINE READINESS OF ALL COMMITTED RESOURCES FOR THE MARINER 7 ENCOUNTER, USING REVISED PROCEDURES FROM TEST 1	YES	SPAC, SSAC, AND FPAC USED REVISED INTERFACE PROCEDURES FOR COORDINATING CC&S AND SCAN SUBSYSTEMS UPDATES DURING NEAR ENCOUNTER; THESE PROCEDURES IMPROVED THE UPDATE OPERATIONS. TEST WAS TERMINATED EARLY TO TRANSMIT COMMANDS TO MARINER 7 FROM DSS 14.

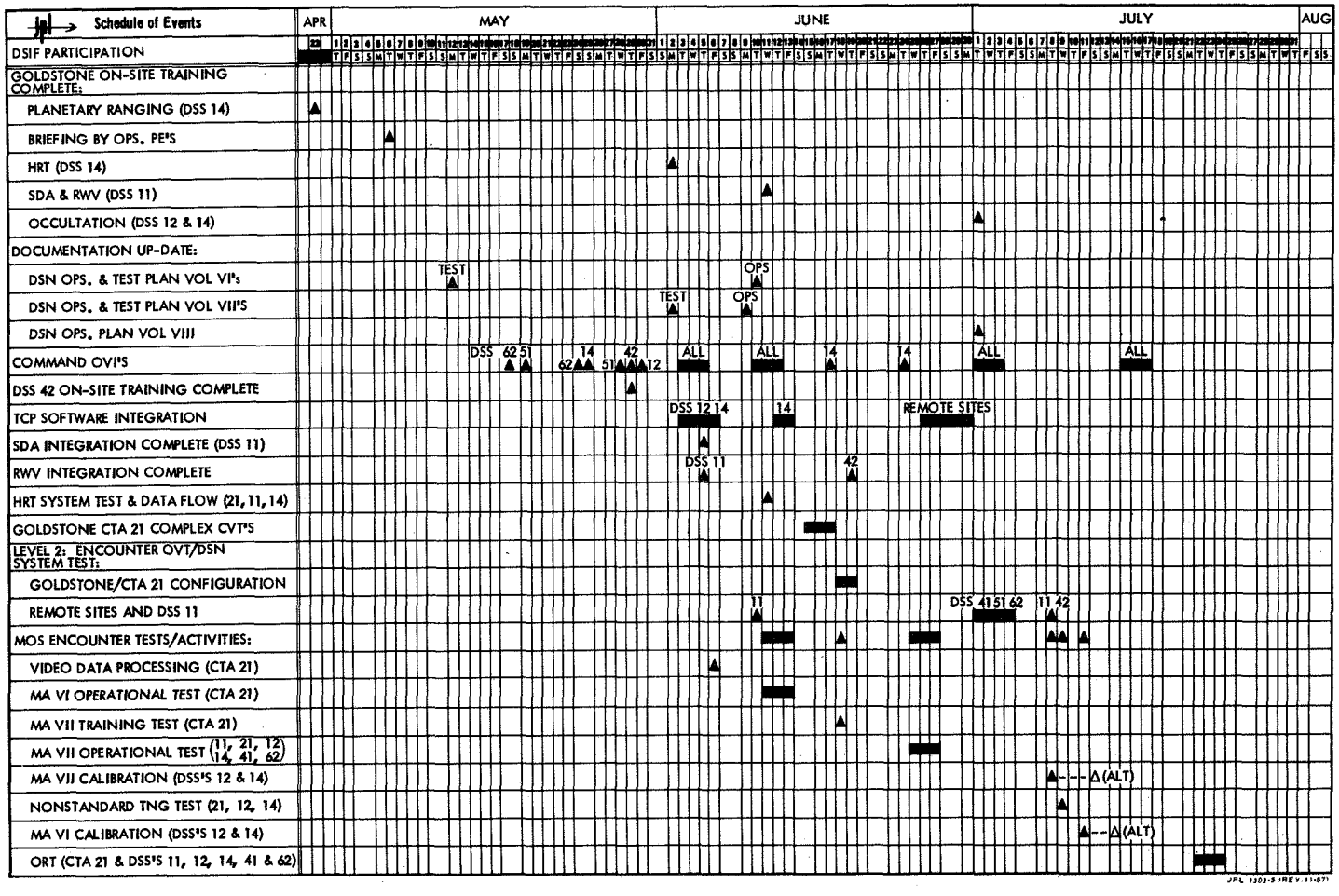


Fig. 20. DSN and DSIF operations, pre-encounter schedule for Mariner Mars 1969

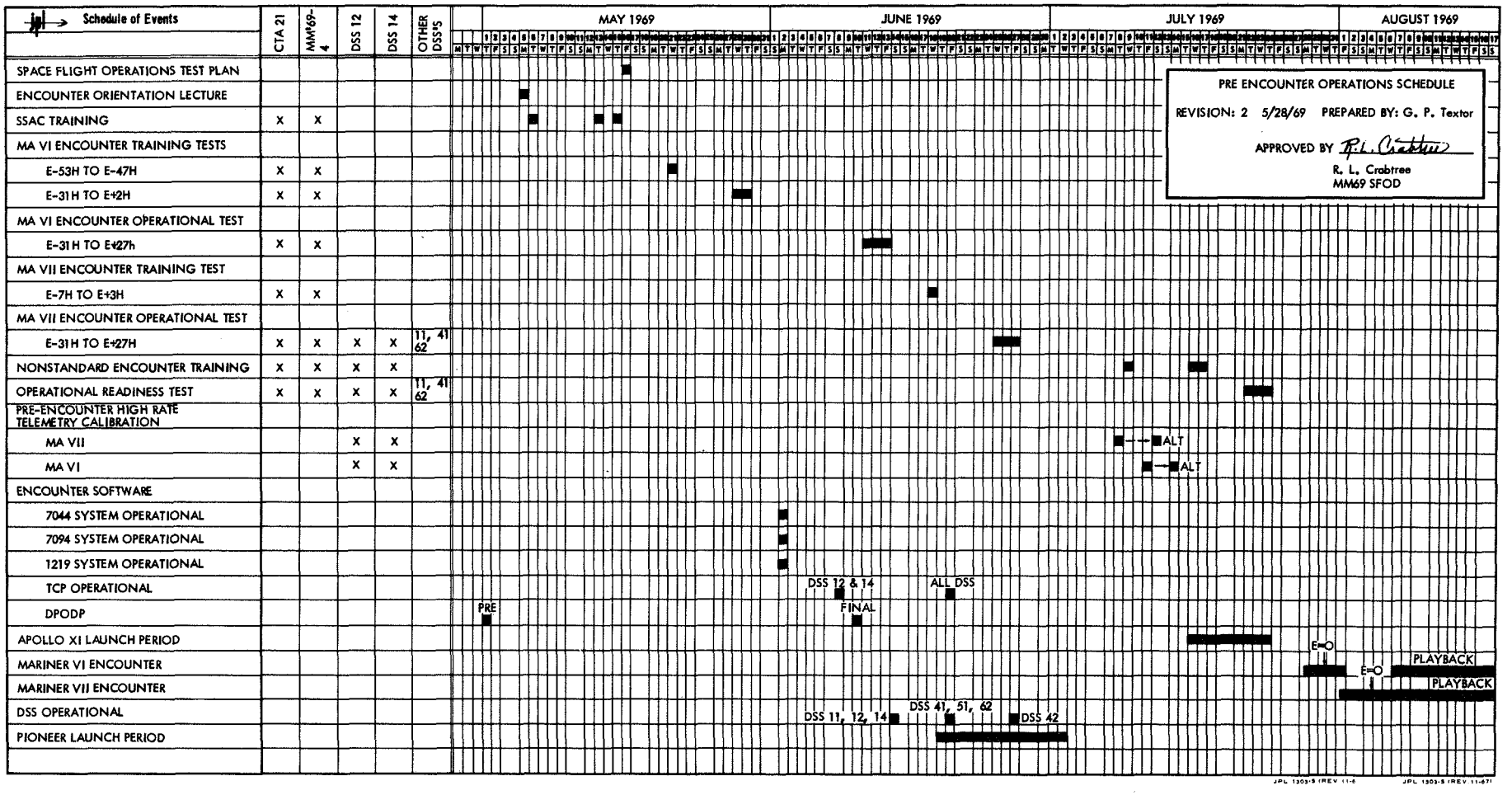

Schedule of Events
CTA 21
MM'69-4
DSS 12
DSS 14
OTHER DSS'S
MAY 1969
JUNE 1969
JULY 1969
AUGUST 1969
SPACE FLIGHT OPERATIONS TEST PLAN
ENCOUNTER ORIENTATION LECTURE
SSAC TRAINING
MA VI ENCOUNTER TRAINING TESTS
E-53H TO E-47H
E-31H TO E+2H
MA VI ENCOUNTER OPERATIONAL TEST
E-31H TO E+27h
MA VII ENCOUNTER TRAINING TEST
E-7H TO E+3H
MA VII ENCOUNTER OPERATIONAL TEST
E-31H TO E+27H
NONSTANDARD ENCOUNTER TRAINING
OPERATIONAL READINESS TEST
PRE-ENCOUNTER HIGH RATE TELEMETRY CALIBRATION
MA VII
MA VI
ENCOUNTER SOFTWARE
7044 SYSTEM OPERATIONAL
7094 SYSTEM OPERATIONAL
1219 SYSTEM OPERATIONAL
TCP OPERATIONAL
DPODP
APOLLO XI LAUNCH PERIOD
MARINER VI ENCOUNTER
MARINER VII ENCOUNTER
DSS OPERATIONAL
PIONEER LAUNCH PERIOD
11, 41 62
11, 41 62
ALT
ALT
DSS 12 & 14
ALL DSS
PRE
FINAL
E=O
E=O
PLAYBACK
PLAYBACK
DSS 41, 51, 62
DSS 11, 12, 14
DSS 42
PRE ENCOUNTER OPERATIONS SCHEDULE
REVISION: 2 5/28/69 PREPARED BY: G. P. Textor
APPROVED BY R. L. Crabtree
R. L. Crabtree
MM69 SFOD

Fig. 20 (contd)

A. Cruise Coverage and Support

With the midcourse maneuvers of Mariners 6 and 7 complete, the DSN supported the cruise mode of each while preparing for the encounter sequences. During the cruise mode and the encounter sequence of both Mariners, the TDS maintained logs of the flight support provided to the project.

These logs, Tables A-1 and A-2 of appendix A, summarize the DSN operations for Mariners 6 and 7, respectively, during cruise, encounter, and postencounter activities for GMT days 098 through 226. The logs present the major events in chronological order.

The values for the high-speed data in these logs are computed on the basis of 7044 processing. The percentage given is derived by dividing the number of frames processed by the sum of the number of frames processed and the number of missing frames. A missing frame is detected when a frame is not printed after a given interval. When this detection occurs, the time tag is listed to indicate the missing frame. Thus, DSIF, GCF, and SFOF effects on the telemetry data stream are included in the percentage.

The numerical values for the total telemetry available (derived by adding the number of available high-speed data frames and the number of missing high-speed data frames present in the raw teletype data) are not computed.

Values for the teletype tracking are based on a count of the data condition code on the teletype printouts. Because metric data samples are normally taken at the rate of one per minute, the data from a complete pass permit a manual count to be taken.

The total available tracking values take into account the data recalled after the pass. These values reflect the upgraded percentage from recalling data from the TCP tape at the station. Recall is initiated when less than 95 % of the available data is processed or when a data outage of at least 15 min occurs.

For days 99 through 125, the HSD performance accountability was done on a 24-h basis at the end of radio days: no accountability was available on a station-pass basis. Because of software problems in the records program, these figures were unreliable. No accountability was done for days 126 through 131. For days 132 through 134, accountability was performed with the validation program; the results of this program were displayed on a station-pass basis.

B. Pre-encounter Flight Test Support

Another type of testing that involved extensive extra support by the DSIF was necessitated by the anomalous performance of both spacecraft radios. This required the frequent running of special tests (RF threshold, auxiliary oscillator stability, best-lock check, etc.), all of which required special instructions to the stations and more support by the DSIF operations control team than would have been required for normal cruise operations. The breakdown, by station, is shown in Table 10, to give an idea of the extent of this testing.

C. Encounter and Playback Support

1. Encounter preparations. The encounter configuration of the Goldstone Deep Space Communications Complex (DSCC) stations was completed in the latter part of June. The configuration was evolved to support the development of the encounter sequence of the Mariner Mars 1969 spacecraft. The original standard mission was then designated as the conservative sequence, and a new standard mission was substituted to utilize the HRT system to undertake an expanded far-encounter sequence. The conservative sequence, retained as a fallback plan, would have obtained eight far-encounter pictures, spaced about 4 h apart, followed by 24 near-encounter pictures. These pictures, recorded on magnetic tape during the encounter, would then be played back after encounter at 270 bits/s.

Successful development of the HRT system permitted playback of 33 pictures from the spacecraft analog tape recorder in about 2-1/2 h at a rate of 16,200 bits/s. The far-encounter sequence was modified, therefore, to permit recording pictures on the days before near encounter and playing them back during each Goldstone DSCC station pass. The last such high-rate playback was completed an hour or so before near encounter. The HRT requires the use of the 64-m antenna at DSS 14 (Fig. 6).

The exact performance margin of the HRT was not determined prior to its pre-encounter calibrations. The 64-m antenna at DSS 14 was equipped with a special feed cone capable of either a listen-only mode or a diplex mode. If the additional sensitivity of the listen-only mode had been required, two-way tracking with command capability was to be provided by the 26-m antenna at DSS 12. For this reason, the station configuration shown in Fig. 6 was implemented. The plan was to have DSS 14 in two-way lock with command capability, performance margin permitting.

Since the prime function of DSS 14 was to obtain HRT, it was equipped with additional subcarrier demodulator assemblies and the high-rate correlators (Fig. 9). DSSs 12 (Fig. 10) and 14 worked in conjunction with each other. For example, when both DSS 14 telemetry and command processors were processing HRT data, engineering telemetry from DSS 14 was microwaved to DSS 12 for processing on one of its TCPs. Those data were then back-fed to DSS 14 for station operations.

A variety of configurations was possible, and the tests and training for encounter preparations included practice in setting up the various configurations and transferring from one to another. Both stations included receiver equipment for the S-band occultation experiment. Data from

this equipment were microwaved to an SDS 930 computer at DSS 13.

A third station of the Goldstone DSCC, DSS 11, tracked the nonencountering spacecraft. Since DSS 11 is not equipped with a TCP, the data were microwaved to the JPL Compatibility Test Area in Pasadena for processing and transmission to the SFOF (Fig. 11).

The CTA, initially used to establish compatibility between the spacecraft telecommunications equipment and the DSIF, also processed HRT data from DSS 14, returned to the CTA via microwave, in the prototype HRC and sent them to the SFOF. In the SFOF, the 1219 computer processed the data and sent them to the scan conversion equipment, from which they were displayed in real time to the Operations and Public Information Office personnel. The DSN provided a TV studio in the SFOF for the Public Information Office, from which the dissemination of pictures to the networks was controlled.

Completion of the configuration and testing of the Goldstone DSCC stations was followed by support of MOS encounter training tests. Preparations culminated in the operational readiness test (ORT) a few days before the initiation of Mariner 6 far-encounter activities.

The Mariner Mars 1969 Project was the first project in which several Goldstone DSCC stations supported each other in the way described. Correct functioning was made possible by proper design and testing of the configuration and operational procedures.

2. Contingency scheduling. The Mariner Mars 1969 encounter preparations overlapped the period of committed DSN Apollo 11 mission support. Several contingency plans were required to accommodate potential slips of the Apollo launch. Had these plans been exercised, the ORT would have been conducted before the Apollo launch instead of immediately after the lunar surface activities and lunar liftoff. Resources allocations, particularly at DSS 14, were determined down to the nearest half-hour many weeks, and even months, in advance and refined as Apollo mission design changed the requirements.

3. Pre-encounter calibrations. In order to conduct the far-encounter sequence with high reliability, it was decided to check the erase function on the spacecraft tape recorder prior to encounter. This coincided with a desire of the DSN to calibrate the HRT performance as well as to measure the telemetry subcarrier oscillator frequencies by turning on the high-rate channel prior to the far-encounter sequence. Therefore, each spacecraft was launched with a prerecorded picture on Track 1 of its tape recorder. In the early part of July, these pictures were played back via the HRT system, erased, and the erasure checked by an additional playback. No anomalies occurred and the telecommunications performance of the high-rate telemetry, which was hitherto unmeasured except in the CTA, was established. The calibrations had the additional benefit of exercising the Goldstone DSCC stations as well as the SFOF-centered mission operations. This exercise provided experience and confidence in conducting the encounter operations.

4. Encounter and playback operations. Encounter operations began on July 28 when DSS 62 sent a command to turn on the HRT system. Although HRT reception is possible only through the DSS 14 64-m antenna, the system was commanded on by DSS 62 and off by DSS 41 in order to preserve valuable coverage time over DSS 14. The roundtrip light time at encounter was in excess of 10 min; correct response to these commands and proper functioning of the spacecraft was, therefore, determined by the 26-m DSSs outside of the DSS 14 view periods.

The encounter of Mariner 6 proceeded according to plan. The far-encounter picture-taking sequence was initiated by command from DSS 14 during the latter part of the pass. A total of 33 pictures was recorded, the last few during the first part of the next DSS 14 pass on the following day. While the picture-taking sequence was observed, the spacecraft was in the Encounter 2 Mode so that the low-resolution pictures, normally recorded on the digital tape recorder in the spacecraft, were being returned in real time via HRT; at the same time, the complete picture was being recorded on the analog tape recorder. When the last picture had been recorded, the spacecraft was commanded to the Playback 2 Mode and all 33 pictures were returned in about 2-1/2 h.

The data rate for HRT is 16,200 bits/s so that one picture is returned in about 5 min. After playback completion, a command from DSS 14 returned the spacecraft to the Encounter 2 Mode and also initiated the next picture-taking sequence (a series of 17 pictures). On the following day, the spacecraft was again commanded to the Playback 2 Mode and the pictures were played back. The spacecraft was then made ready for the near-encounter sequence at about 6 h from encounter.

The spacecraft proceeded through near-encounter in the Encounter 2 Mode, in which the low-resolution pictures were sent via HRT and the real-time link to the SFOF. After near encounter, commands placed the spacecraft in the Playback 1 Mode (270 bits/s) in which the digital tape recorder was read out to obtain the low-resolution TV and the nonvideo science data. All of these data had already been obtained in real time via HRT in the Encounter 2 Mode. The spacecraft entered occultation while in the Playback 1 Mode, and, after emerging from occultation, tracking was resumed. On the next pass over DSS 14 on the following day, the near-encounter pictures were played back using the HRT system. At this point, all of the encounter data obtained by Mariner 6 had been returned to earth via HRT. During the non-DSS 14 view periods, the overseas DSSs continued to receive and return the 270-bits/s data being played back from the digital tape recorder.

The far encounter of Mariner 7 was similar except that three picture-taking sequences of 33, 33, and 25 pictures each were followed.

An additional feature of the Mariner Mars 1969 operations during the passes just described was the use of ground commands to update the spacecraft central computer and sequencer (CC&S). During the encounters of both Mariner 6 and 7, many hundreds of commands were sent to update the memory of the CC&S and to verify the update instructions. Usually, the instructions

were for adjusting both the slewing parameters of the scan platform, in both near and far encounter, and the commands of the picture-taking sequence. In some cases, ground commands were primary on Mariner 7 because of some nonoperative functions in the CC&S.

At approximately 6 h from Mariner 6 encounter, DSS 51 reported the disappearance of the Mariner 7 signal. DSS 62 was commanding Mariner 6 to update the CC&S and turn on the HRT, as described. The Goldstone DSCC stations were waiting for the spacecraft to come into view. DSS 61 broke off a track on Pioneer 8 and commenced to help search for the missing Mariner 7. When the spacecraft came into view of the Goldstone DSCC stations, DSS 11 joined in the search, and, after DSS 62 handed Mariner 6 over to DSS 12, it too joined the search. The spacecraft went below the horizons of DSSs 51, 61, and 62 without the signal reappearing. DSS 51, although not certain that the uplink was still in lock, went through the procedures with DSS 11 of handing over the uplink. When it was later decided to send 10 commands to switch the spacecraft transmitter from the high-gain to the low-gain antenna, the spacecraft responded on the first command and DSSs 11 and 42 both commenced tracking and acquiring telemetry data.

The original requirements on the DSN were to support one spacecraft in a critical phase and the other in a normal cruise phase. However, a small, special team was set up in a separate area to work with the available project personnel in handling Mariner 7 until after the Mariner 6 near encounter when the MOS personnel could turn their attention to the spacecraft with problems. At that point, the special team was disbanded and DSN support of the project was provided through the regular operations organization. Although the problems occurred at a time when the Mariner Mars 1969 Project was unable to devote any but the most minimal resources to the Mariner 7 problem, the operation of the DSN in providing the temporary emergency support and transferring this support back to the regular operations organization was very smooth and without difficulty.

When sufficient telemetry data had been analyzed to determine that the critical reference potentiometer for determining the position of the scan platform in one direction was no longer on an operating telemetry channel, a plan was devised to use the television camera to photograph the planet and thereby obtain a reference. This was done using the Encounter 2 Mode, returning low-resolution pictures in real time via HRT. When the reference was determined, two complete pictures were recorded on the analog tape recorder and played back in real time in the Playback 2 Mode. The HRT system, therefore, permitted rapid solution of the problem.

Time consumed in analyzing the problem and performing these tests delayed start of the first far-encounter sequence of Mariner 7 for about 5 h. The Mariner 7 CC&S was updated by ground commands from DSS 41 to shorten the picture-taking interval, commence the sequence at a later time, and finish it at the originally scheduled time.

The HRT system permitted an additional beneficial change to the Mariner 7 near-encounter sequence. The original plan provided for several TV frames to be recorded on the dark side of the planet after crossing the terminator. Although the video information would provide only a black picture, this was the only way in which UV and IR data could be obtained. Since the HRT system was capable of providing this information in the Encounter 2 Mode, the CC&S was again reprogrammed with a new slewing strategy and picture-taking sequence so that 33 instead of 24 near-encounter pictures were taken on the lighted side of the planet. Since the spacecraft was in the Encounter 2 Mode, the UV and IR data being returned in real time during that sequence were extended on into the dark side.

The Mariner Mars 1969 Project decided to utilize the planetary ranging system on Mariner 7 during the near-encounter phase. The system continued to operate through the near encounter and until the planet occulted the spacecraft.

The total near- and far-encounter pictures of Mariner 6 and 7 returned with and without HRT are listed in Table 11. The Mariner Mars 1969 Project required the near-encounter pictures to be played back six times from each spacecraft. In addition, the Encounter 2 Mode produced about 250 usable low-resolution TV pictures, primarily of interest for calibration of high-resolution pictures and photometric calibrations. This quantity of high-rate playback produced a total of about 2.7×10^9 bits returned during 47 h of transmission during 11 passes over DSS 14. By way of contrast, 14 days of playback of Mariner 4 data returned about 1.0×10^7 bits.

5. Mariner 6 encounter operations. The operations for Mariner 6, from pre-encounter through exit occultation, including the Mariner 7 anomaly at the Mariner 6 encounter, are discussed.

a. Frequency measurements. Frequency measurements in the encounter sequence went smoothly. Some confusion resulted during the initial measurement because personnel outside the DSIF were unaware of DSIF operating procedures.

There were eleven one-way blocks for frequency measurements in the Mariner 6 sequence, which were scheduled at handovers except for four blocks during the DSS 41 and DSS 62 passes just before encounter. The one-way tracking data and acquisition times used by SDA to calculate the current spacecraft auxiliary oscillator and best-lock frequencies were then passed to project telcom. Telcom, in return, provided an update to predictions of spacecraft frequencies at exit occultation based on the current measurement. In this way, changes in spacecraft frequencies were followed through far-encounter sequence.

Spacecraft frequencies, and therefore temperature, appeared to stabilize at about the time of the last handover from DSS 41 to DSS 62 before encounter;* handover occurred at 1600 GMT, Day 211, or E* -13 h. Total change in auxiliary

*Here, encounter is a predefined time of closest approach of 0519 GMT, Day 212, and E minus or plus is the time from encounter.

oscillator frequency seen during the encounter sequence was a minus 773 Hz at S-band. Telcom predicted a further minus 39 Hz would take place from the time of the last frequency measurement, the DSS 62 to DSS 12 handover at E -6 h, to exit occultation.

b. Mariner 7 anomaly at encounter. Just before Goldstone rise for Mariner 6 encounter, all signal from Mariner 7 was lost at DSS 51. Immediately, several stations began searching for Mariner 7. At the same time, Mariner 6 activities were exponentially increasing. To allow proper attention to both spacecraft, SDA personnel in the NAT Area assisted on the Mariner 7 problem and the SDA personnel in FPAC concentrated entirely on the encountering spacecraft. This division of personnel between spacecraft proved both necessary and effective.

c. Pseudoresiduals. A practical problem with tracking more than one spacecraft during a critical period is associated with the merge function of the pseudoresiduals program. Pseudoresiduals use tracking predicts to analyze tracking data quality. Since the program operates off only one magnetic tape, predicts for several spacecraft (Mariner and Pioneer) must be merged onto one tape. The merging process takes a significant amount of time and cannot be considered a real-time function. During encounter, predicts are run after every few orbit determination updates on the encountering spacecraft. It is impractical to remerge each predict run. The solution to the problem was to run pseudoresiduals on the merged tape in the NAT area for all spacecraft being tracked using one 7044 and to run the encountering spacecraft by itself in FPAC on the other 7044. This allowed flexibility in the choice of which predict set to use to analyze the encountering spacecraft data and also allowed the use of two different predicts in pseudoresiduals at the same time for the same spacecraft.

During the far-encounter sequence, noise spikes appeared in the DSS 14 receiver. These noise spikes had been seen previously only when the station was using 20-kW transmitter power; however, for the first time, the noise appeared at the 1-kW level. The decision was then made to fly the rest of the Mariner 6 encounter sequence with DSS 12, the two-way station for the Goldstone passes, with the possible exception of the period from exit occultation to Goldstone set during encounter. This meant that no planetary ranging data could be taken during Mariner 6 encounter.

d. Search for Mariner 7. At Goldstone rise on July 30, 1969, operations in FPAC moved into full swing. Predicts good for tracking purposes were already at the stations; the search for Mariner 7 was now organized so it would not interface with Mariner 6 operations, and the last possible frequency measurement had been completed on Mariner 6. All that remained now was to continually assess data quality and follow changes in the determined orbit for the sake of the occultation. Since all one-way data in the encounter sequence had shown the spacecraft auxiliary oscillator to be stable, the occultation principal investigator elected the standard sequence, which called for exit occultation in one-way mode.

e. Predict strategy. The predict strategy was designed with short occultation predict sets in anticipation of the determined orbit changing during encounter, requiring transmission of several predict sets. Leading up to Mariner 6 occultation, the orbits did move around; however, there were no criteria, as each orbit was generated to indicate that the new predicts would be more accurate than the set already available. A real-time decision was made not to send any additional predict sets and, instead, to monitor predicts that were generated against actual data to determine which orbit was best. The method of comparison was to monitor two predict sets by pseudoresiduals, one set on each computer string, using two-way residuals to determine actual doppler, then make hand comparisons to the other predict sets. The orbits and predict sets involved are shown in Table 12.

Information on the changing orbits was frequently relayed to occultation personnel at the stations over the occultation coordination voice net by the SDA PE. The stations were using predict set 6E2. At about occultation minus 1 h, the uncertainty in frequencies and time were read to the occultation operators. The expected spread was 130 Hz (S-band) at the time of the last open-loop synthesizer frequency change, and about 100 Hz at enter and exit, with a 10-s spread in exit occultation.

Closest approach, which occurred about 1/2 h before occultation, was the point in the trajectory where the doppler was most sensitive to orbit error. Before closest approach, an old predict set, F18, looked better than anything else. As we came upon closest approach, F18 degenerated and a predict set 6E4 began to look the best. At occultation minus 30 min, the occult and emerge times from predict set 6E4 were read to the stations and posted in the SFOF. These times turned out to be within 1 s of the actual. The frequency differences between 6E2 and 6E4 were discussed with the occultation operators, but no action was necessary. Based on the time for entrance to occultation, an expected bias of 40 Hz at DSS 14 and 10 Hz at DSS 12 was determined; however, the stations were instructed to exit using 6E2 without bias to avoid possible confusion since the expected biases were small.

f. Exit occultation. Exit from occultation was completely successful with all receivers locking up fast; in fact the standard DSIF closed-loop receivers actually locked up before the open-loop receivers indicated lock. The open-loop receivers started recording good data several seconds before geometric exit from occultation.

The closed-loop operators were given more latitude than with previous Mariner occultation exits, so that at DSS 12, for example, one receiver was set to predicts while the second receiver was tuned in a station-devised search pattern. However, the receiver that was set to predicts locked up first.

The two-way predicts were off by +38 Hz at entrance to occultation. At exit, the one-way predicts were off by +52 Hz with +13 Hz of it due to orbit error so that the prediction of the auxiliary oscillator frequency of the spacecraft

was in error by +39 Hz, which is equivalent to a -0.2-deg temperature error.

6. Mariner 7 encounter operations. Signal recovery through exit from occultation for the Mariner 7 mission is discussed below.

a. Signal recovery. SDA personnel in NAT assisted in the search for Mariner 7 during Mariner 6 encounter. The main assistance provided was monitoring tracking data for clues and talking directly to the stations on frequency search information. The first indication of the presence of a signal seen in the SFOF was intermittent in-lock indications in the tracking data, which the station was queried on and asked to pursue. The weak signal of Mariner 7 was subsequently acquired.

b. Orbit determination. Entering the far-encounter sequence, the main impact on the operations with which SDA was concerned was the anomaly's effect on the Mariner 7 trajectory. Shortly after the anomaly there was an apparent change in the spacecraft trajectory and a continuing acceleration. The abrupt change in trajectory meant that the orbit determination would have to start a new data arc from shortly after the anomaly. Therefore, there would be only short arc orbits available in the encounter sequence, which greatly enlarged the uncertainties in the encounter parameters. The apparent continuing acceleration made matters even worse because it is very difficult to fit an extra acceleration in an unknown direction, particularly at a time when acceleration due to approaching the target body is becoming important. In addition, any acceleration due to the spacecraft is likely to be a function of time. The task of orbit determination personnel during Mariner 7 encounter was a difficult one indeed.

c. Frequency measurements. Since the amount of tracking data had become critical, and since Mariner 6 frequencies stabilized early, it was decided to give up the two frequency measurements during DSS 62's last pass before encounter if the frequencies had stabilized by the DSS 41 to DSS 62 handover.

All frequency measurements on Mariner 7 went smoothly. The frequencies did appear to stabilize in time so that the two measurements during DSS 62 pass were relinquished to assist the orbit determination problems. The telcom-SDA interface functioned quite well, again providing agreed-upon information when required.

d. Predict strategy. Based on Mariner 6 experience and the known problems with the Mariner 7 orbit, a plan was formulated to run predicts on each new orbit, to provide only one reference predict set to the stations, and to use the two-way doppler at closest approach to assess by voice which orbit was best providing any necessary biases. The predict sets generated during encounter for the above purposes are described in Table 13. The total spreads in predicted occult and emerge times were 2 min. Later in the sequence, the uncertainty closed down to about 40 s in exit occultation. Since the spread in predicted exit frequency appeared to be within the closed-loop receiver bandwidth for each different predicted exit time, the stations were told the latest exit time so that the closed-loop operators would not get anxious, waiting a possible 40 s for a signal.

e. Exit occultation. The total spread in two-way doppler at closest approach was 117 Hz. Predict set 7E1 looked best at closest approach and was off only 24 Hz at entrance to occultation. Based on the enter-occultation information, the stations were briefed during occultation that the spread in expected exit occultation was 20 s, from 05:49:00Z to 05:49:20Z, but that the D1 they had in predicts, biased by -50 Hz, would be a good frequency for exit. During actual exit, the DSS 14 closed loop locked up at 05:49:07Z, the open-loop receivers indicated lock at 05:59:08Z, and DSS 12 closed loop locked up at 05:49:10Z. Again, there was a completely successful occultation.

The one-way doppler residual at exit was a +10 Hz at S-band, although the stations were told to bias by a -50 Hz. The 60-Hz difference was close enough to allow the fast lockup. When two-way doppler was achieved, the two-way residual was a -132 Hz, which meant that, due to orbit, only the one-way residual should have been a -66 Hz (which makes the -50 Hz bias look like a good number). The error of +76 Hz (+10 Hz actual one-way residual + 66 Hz orbit only error) was therefore due to mispredicting the spacecraft auxiliary oscillator frequency by -76 Hz. This corresponds to about a +0.5-deg error in predicted temperature.

D. Postencounter Support

Tracking and Data System support for the Mariner Mars 1969 Project continued through the end of the mission on November 1, 1969. Postencounter activities supported were routine cruise and special tests and experiments. Routine cruise tracking provided metric data for orbit determination and telemetry data. Special tests were performed to investigate anomalies in the spacecraft radio subsystem occurring earlier in the mission. The DSN developed special procedures to reduce the output power of the ground transmitter to very low levels to assist in the investigations.

The project conducted special scientific experiments with the ultraviolet spectrometer by pointing it in various directions and mapping large portions of the celestial sphere. The DSN supported these activities with the 64-m antenna station (DSS 14) at Goldstone, using the high-rate telemetry system. The HRT made it possible for the ultraviolet data to be returned in real time.

Other activities of the project included reprogramming the CC&S by ground command to prepare it for the Mariner extended operations. Experiments were also conducted with the CC&S in support of Mariner Mars 1971 planning. On the Mariner Mars 1969 Project, the CC&S memory was read out in its entirety by ground command. The project experimented with reading out a single word, which represented the sum of all words in the memory, thereby indicating the condition of the memory without a total readout. All of this activity was supported by the DSN within its routine operational capability. More than 3611 commands were sent to Mariners 6 and 7 since launch.

Table 10. DSIF spacecraft in-flight test support

Test Title	Tests Supported					
	DSS 12	DSS 14	DSS 41	DSS 51	DSS 62	Total
Best-lock freq. check	6		3			9
RFS/CMD threshold	3	1	6	2	6	18
SPE check			2			2
Downlink spectrum analysis	1	1				2
Ranging link checkout	1	1		1	1	4
Aux. osc. stability	1		1	1	2	5
Totals	12	3	12	4	9	40

Table 11. Mariner Mars 1969 TV pictures

SEQUENCE	WITHOUT HRT[a]		WITH HRT[b]	
	MARINER 6	MARINER 7	MARINER 6	MARINER 7
NEAR ENCOUNTER	24	24	24	33
FAR ENCOUNTER	8	8	50	95

[a]ORIGINAL MISSION DESIGN RETAINED AS THE FALL-BACK PLAN.
[b]ACTUAL.

Table 12. Mariner 6 encounter predicts and orbits

PRDX No.	Orbit No.	Occultation (GMT)	Emerge (GMT)	TCA[1] (at S/C)	B. Tc[2] (km)	B. Rc[2] (km)	$\gamma\beta$ [3] (unitless)
F-18	3 Post 7	05:39:54	05:59:20	05:19:10.9	7532	-476	34423
6-E0	3 Post 92	05:39:45	05:59:27	05:19:01.5	7562	-407	28629
6-E1	3 Post 100	05:39:41	05:59:33	05:19:02.2	7563	-377	28629
6-E4	ENC 31	05:39:52	05:59:43	05:19:07.5	7579	-371	28629
6-E5	3 Post 7	05:39:47	05:59:34	05:19:28.8	7483	-441	28629
Actual	As of 1 Sep 69	05:39:52	05:59:42	05:19:06.9	7595	-336	---

[1] Time of closest approach

[2] Ecliptic target plane

[3] Solved for solar pressure constant

Table 13. Mariner 7 encounter predicts and orbits

PRDX No.	Orbit No.	Occultation (GMT)	Emerge (GMT)	TCP[1] (at S/C)	B. Tc[2] (km)	B. Rc[2] (km)	$\gamma\beta$ [3] (unitless)
6-15	2 Post 24	05:18:58	05:48:30	05:00:48.4	6677	3461	34423
7-01	3 Post 25	05:20:20	05:49:48	05:00:52.3	6683	3896	31925
7-02	3 Post 23	05:19:41	05:49:01	05:00:45.6	6592	3845	31925
7-03	3 Post 24	95:21:02	05:50:50	04:59:56.6	6943	4070	31925
7-E0	ENC 5	05:19:43	05:48:59	05:00:45.1	6558	3902	28774
7-E1	ENC 9	05:19:47	05:49:01	05:00:45.3	6553	3929	28774
7-E2	ENC 18	05:20:15	05:49:40	05:00:50.8	6656	3915	28774
7-E3	ENC 23	05:19:59	05:49:30	05:00:49.8	6698	3769	28774
7-E4	ENC 29	05:19:34	05:49:18	05:00:48.7	6809	3450	18756
Actual	As of 1 Sep	05:19:41	05:49:07	05:00:50.0	6712	3630	---

[1] Time of closest approach

[2] Ecliptic target plane

[3] Solved for solar pressure constant

VI. PERFORMANCE EVALUATION

The TDS system performance is monitored daily by the Network Analysis Team. The results of the analysis are provided to the operations control team to allow corrective action to be initiated when performance falls below predicted or committed levels. Results of the analysis indicate that the performance of the TDS has been excellent.

A. Tracking System Performance

The NAT metric data group has provided, since launch, an analysis of the tracking system performance. Results of Mariners 6 and 7 deep space phase for GMT days 99 through 167 are shown in Figs. 21-24 for two-way doppler data only. The figures include only the usable two-way data, which was flagged with a good data-condition code, transmitted by the DSS and actually processed by the tracking data processor (TDP) and contained on the master data record (MDR). The percentage shown on the figures is the ratio between the usable data transmitted and the usable data received. Recall was initiated when less than 95 % of the available data were processed or when a data outage of at least 15 min occurred.

To provide a more complete analysis of processed tracking, the entire MDF tape content was profiled for GMT days 176/7 through 226. Thus, in-house duplication was eliminated and DSN/project was provided a more useful tool. The metric data recovery percentages by doppler type for Mariners 6 and 7 are shown in Figs. 25-31.

B. Telemetry System Performance

The NAT telemetry group has, since shortly after launch, provided analysis of telemetry system performance. Results of the analysis of the data by the DSS for GMT days 101 through 220 of the Mariner 6 and 7 flights are shown in Figs. 32 and 33, respectively.

The statistical summary of the telemetry system operations during the Mariner 6 and 7 encounters is shown in Figs. 34-40. The encounter data are expressed in the figures as percentage of usable data by DSS and bit rate used. The usable data reflect the total of the fully synchronized frames with all the indicators in lock status, divided by the total possible frames. Some of the values in the illustrations can be found elsewhere in this report; in some cases, discrepancies will occur because the numbers in these illustrations include recall of data, when available, in order to provide the maximum possible for future use.

C. Command System Performance

Anomalous behavior of both spacecraft during the mission resulted in much more spacecraft commanding activity than was anticipated. The number of commands transmitted as of September 30, 1969 is given in Table 14. Following encounter, commanding activity continued to be heavy, with a total of 683 commands transmitted between August 15 and September 30, 1969.

Command operational performance by the DSIF throughout the mission has been excellent. Errors or equipment problems that affected a command transmission sequence are tabulated in Table 15. A description of each error is given in Table 16. In no instance did a command error occur at a critical time or have an adverse effect on the mission. In every instance a rapid recovery was made in accordance with the DSIF command procedures.

D. Operational Support

All operational support functions were provided in a timely and satisfactory manner to the TDS and project. A few specific areas of the DSN monitor, simulation, and GCF performance are briefly discussed.

1. Data validation program. The DSN monitor program for validation of the TCP tape data included the development of the TCP telemetry science program. This development was completed and tested on schedule. The results of the validation efforts on Mariner 6 and 7 science data have been satisfactory to date.

2. Phase II simulation program. After the midcourse maneuver of Mariner 6 was completed, the Phase II program was begun, duplicating the flight data as closely as possible. Comparisons were made between the simulated data and the flight data on a point-by-point and channel-by-channel basis. The results of this comparison showed that some subsystem models performed simulations very satisfactorily (e.g., CC&S computer and power distribution), while others will need improvement for future simulation (e.g., solar panels and launch transients in attitude control).

3. Communications processor operation. The overall performance of the communications processors within the NASCOM teletype network, including the GCF processor at the SFOF, was average. The detrimental effects of processor faults and equipment failures on teletype data inbound to the SFOF from the DSS were negated by alert operator actions and the availability of non-processor-routed backup teletype circuits. However, problems appeared within the 490 central processor and 7044 interface during operational testing before encounter.

The most perplexing problem, experienced with a high load on the on-line communications processor, was the display of apparently old or garbled teletype-formatted data on selectable teleprinters in the mission support area. A formal meeting was convened in early July 1969 for problem analysis. As a result of this meeting, a controlled test was conducted on July 8, 1969 to duplicate the problem under controlled conditions. The major conclusions reached were:

(1) The communications processor accesses were the critical parameter that tended to degrade the processor-7044 performance.

(2) The number of entries in the processor timer queue is a more accurate measurement of processor loading than the indicated busy rate (%).

(3) The processor drum reread timer entry must remain at a value of 5 s for a highly loaded system.

4. Overseas DSS voice circuits. Premission planning included a requirement for a quantity of one operational voice circuit to each DSS supporting the Mariner Mars 1969 project. This requirement was provided during prelaunch testing through the immediate post launch cruise phase.

However, before encounter testing, representatives of NASCOM contacted DSN representatives regarding the operational side effects of decreasing the number of voice circuits to the major overseas NASCOM switching centers. The reason for decreasing the quantity of communications circuits within the NASCOM network was clear: reduction of costs associated with the procurement and lease of long-haul communications service from commercial carriers.

Interfacility planning, which was followed within the DSN and was coordinated with NASCOM, resulted in the following agreement after a successful 30-day trial of operation with the decreased voice capability:

(1) One active voice circuit from the SFOF was provided to each of the two major overseas NASCOM switching centers.

(2) The active voice circuit of each DSS served by the respective switching center was conferenced (bridged) to the singular active voice circuit to the SFOF.

(3) Each switching center--SFOF voice circuit entered into an internal SFOF VOCA network as before. It was further agreed upon by NASCOM and the DSN that a discrete voice circuit would be available (in real time) to any affected DSS during critical support periods or time of spacecraft emergency.

This change in GCF-NASCOM voice circuit and its governing criteria of operation was not peculiar to DSN support of MM69, but extended to all flight projects being supported by the DSN. Further, use of voice circuits to the DSS in this manner (with the exception of the Goldstone Complex) has become standard within the DSN and is expected to remain in effect for future flight projects supported by the DSN.

5. DSIF network configuration operations. Although employed with success, the Goldstone/CTA 21 configuration for support of the Goldstone encounter operations and the high-rate telemetry passes was a complex structure that presented a few operational problems. This configuration involved the DSSs 11, 12, and 14 at Goldstone (plus DSS 13 for occultation) and CTA 21, and included microwave and teletype transmissions between stations in addition to the normal transmission of telemetry and tracking data to the SFOF.

The major problems occurring during the operation of the Goldstone/CTA 21 configuration were as follows:

(1) A common, integrated countdown for the stations was not available until just before the final ORT. This late insertion of the countdown made the preceding encounter tests difficult for the stations to support, since each one had to accomplish intersite equipment calibrations separately.

(2) Although different configuration modes were established to cope with anticipated failures, no mode was available for the one failure that created the most difficulty: both TCPs were inoperative at DSS 12. This failure occurred once during pre-encounter testing and again during Mariner 7 encounter. Thus, failure-mode planning must be carried beyond the single component failure level.

(3) The hydrostatic bearing at DSS 14 was a major source of trouble, particularly during pre-encounter testing. If an alarm occurred (because of low oil-film height or foreign particle on the bearing), it was necessary to place the antenna in brake position to stop it immediately and clear the problem before resuming track. This action resulted in loss of lock with the spacecraft; this loss was a situation that could not be tolerated on an encounter pass.

Two steps were taken to minimize the effects of an alarm on the hydrostatic bearing. One was the positioning of a qualified individual at each of the three pads on the bearing to advise the station operations supervisor whether the alarm was an instrumentation error or a dangerous situation. This was done for the critical passes (encounter and high rate TLM playback), and although alarms did occur, it was never necessary to stop the antenna.

The other step was to establish a procedure when the antenna would have to be stopped. This entailed a rapid transfer of two-way lock from DSS 14 to DSS 12. The procedure was tested successfully before its publication.

Table 14. DSIF summary of transmitted commands (as of September 30, 1969)

DSS	Commands Transmitted (Number)		
	Mariner 6	Mariner 7	Total
11	0	23	23
12	89	89	178
14	92	584	676
41	392	169	561
51	35	76	111
62	1002	374	1376
Totals	1610	1315	2925

Table 15. DSIF summary of command errors (as of September 30, 1969)

Spacecraft Number	Number of Commands	Number of Operator Errors	Number of Eqpt. Failures
6	1610	2	2
7	1315	3	1
Total	2925	5	3

Table 16. Description of DSIF command errors

Date 1969	Error		Remarks
	No.	Type	
20 April	1	Operator	Failed to backspace DC-17; recycled and transmitted 5 minutes late.
13 May	2	Eqpt.	Error light on as CC-1 read into "B" register; transmitted 3 minutes late.
16 June	3	Eqpt.	Error light on as CC-1 read into "A" register; transmitted 3 minutes late.
14 July	4	Operator	Lost S/C command loop lock for 2 minutes when TCD patch panel pulled inadvertently; retransmitted last 9 CCs of interrupted block.
2 August	5	Operator	Fourth CC in block of eight aborted when TC erroneously interpreted octal value readback from DSS; picked up transmission 3 minutes later.
11 August	6	Operator	QC-4-18 transmitted 10 seconds late because of error in thumbwheel settings for timed start.
10 Sept.	7	Operator	DC-16 initiated with RWV in Mode I Verify. Mode II XMT selected and CMD transmitted 1 minute, 16 seconds late.
11 Sept.	8	Eqpt.	RWV glitched on initiation of DC-18. Transmitted 1 minute, 26 seconds late.

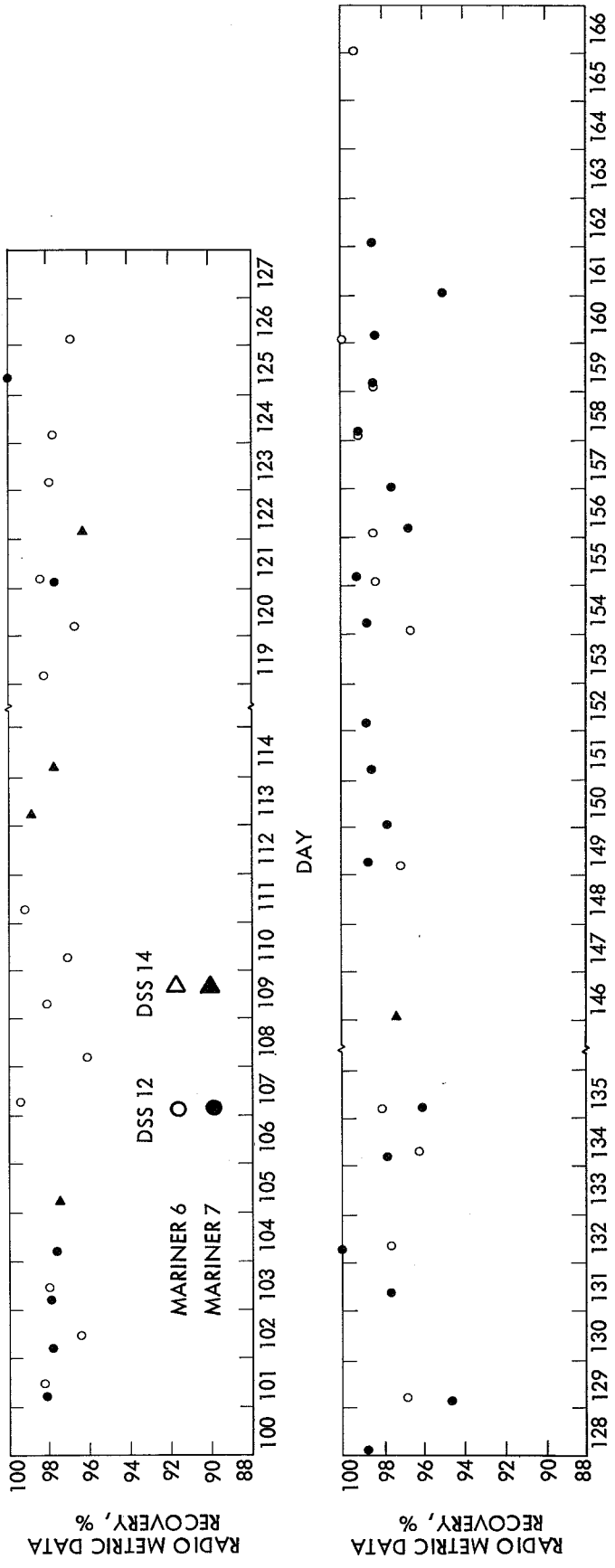


Fig. 21. DSS 12 and DSS 14 radio metric data recovery

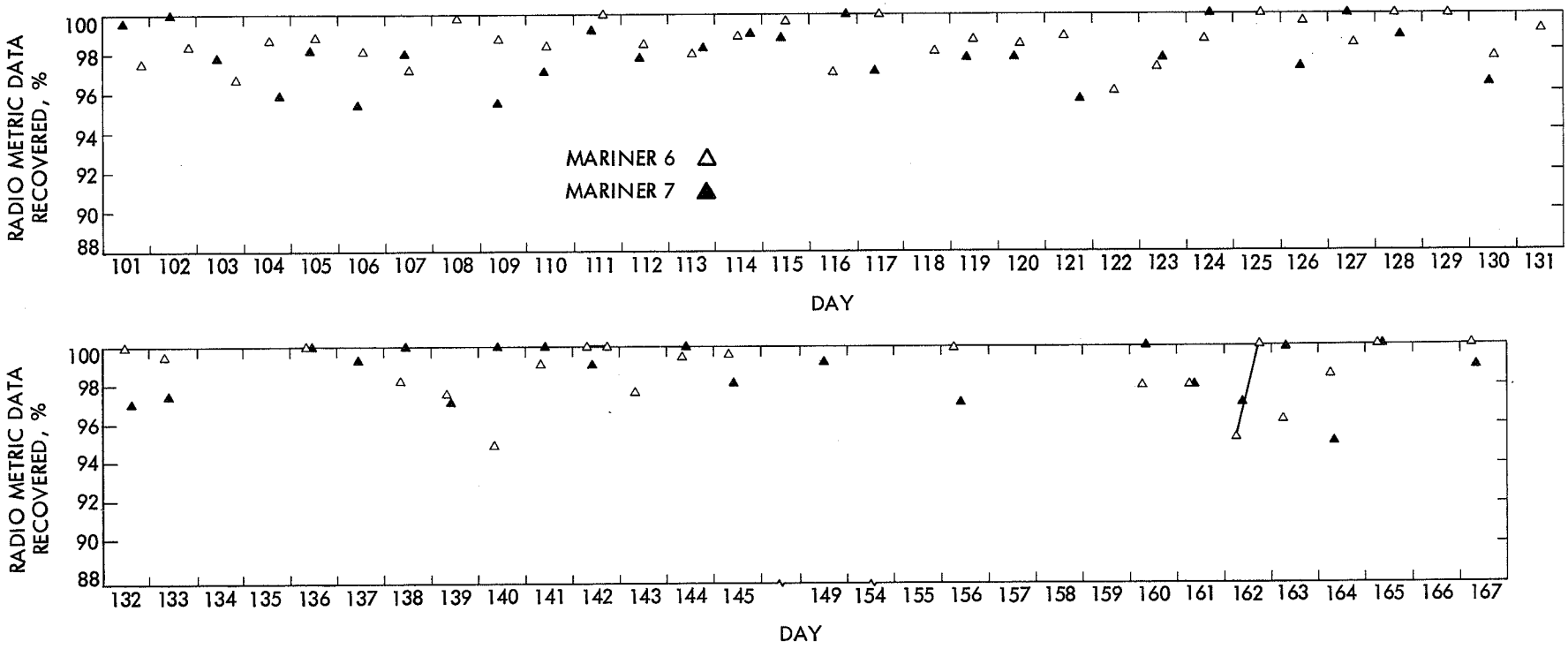


Fig. 22. DSS 41 radio metric data recovery

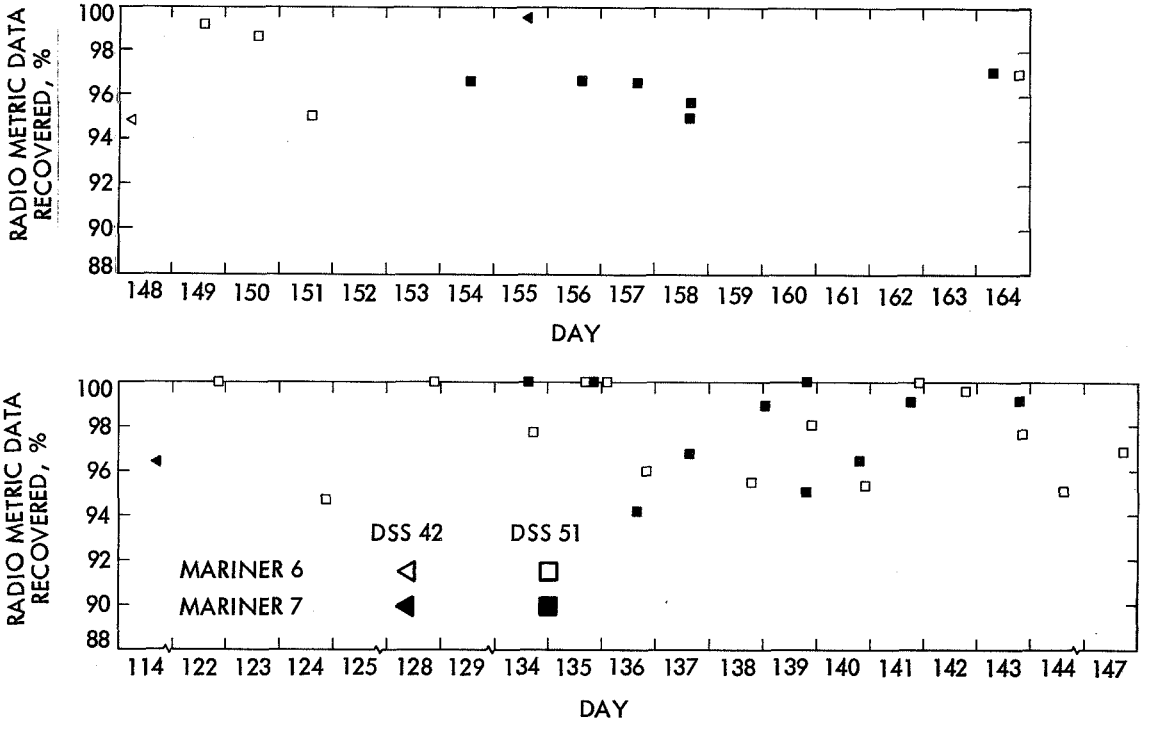


Fig. 23. DSS 42 and DSS 51 radio metric data recovery

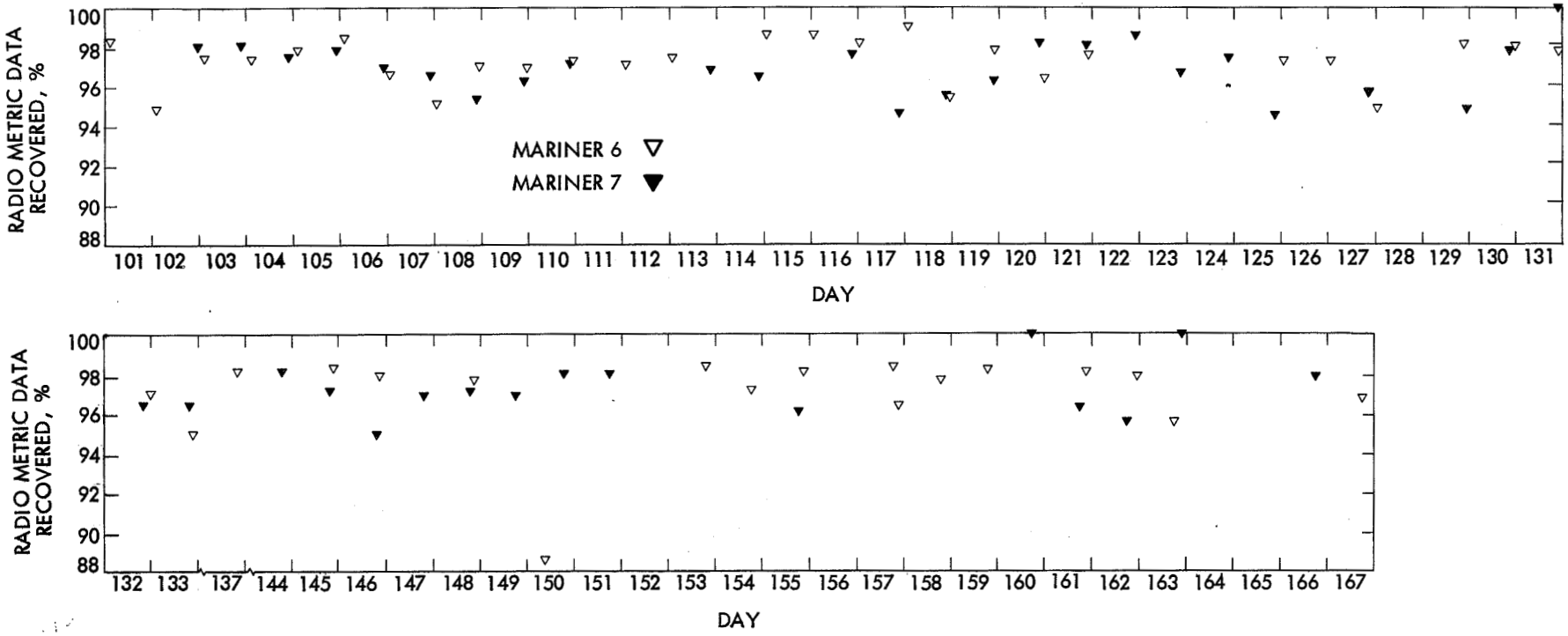


Fig. 24. DSS 62 radio metric data recovery

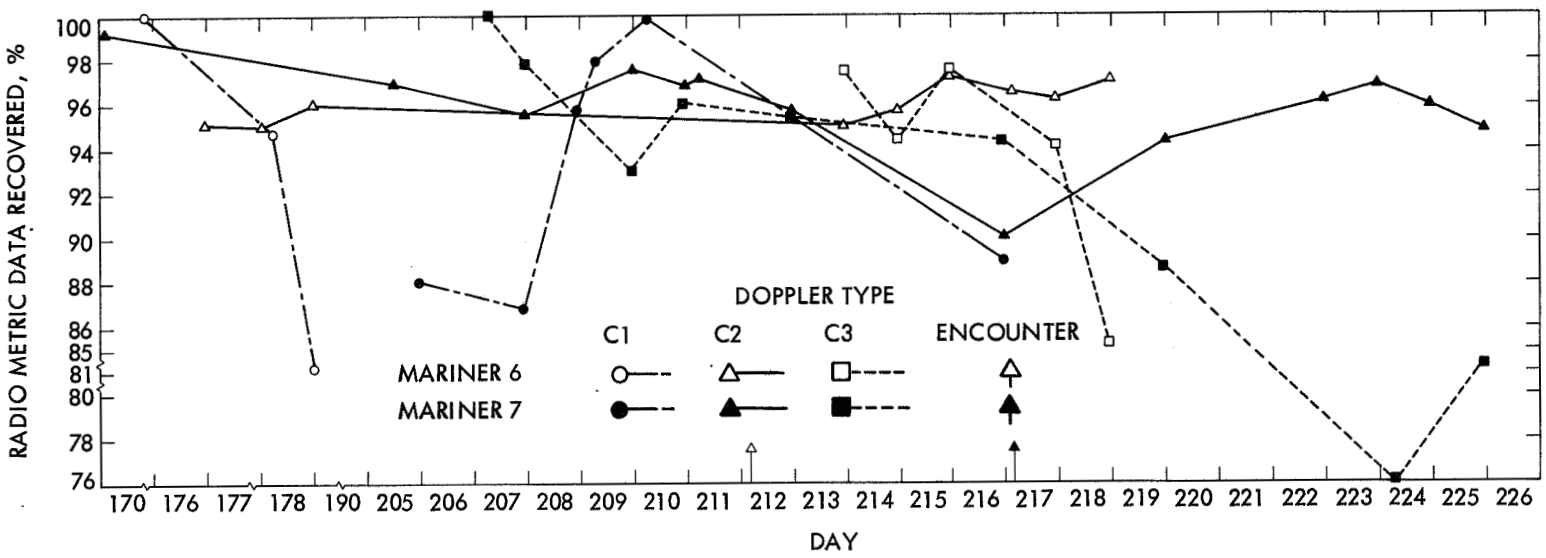


Fig. 25. DSS 11 radio metric data recovery by doppler type

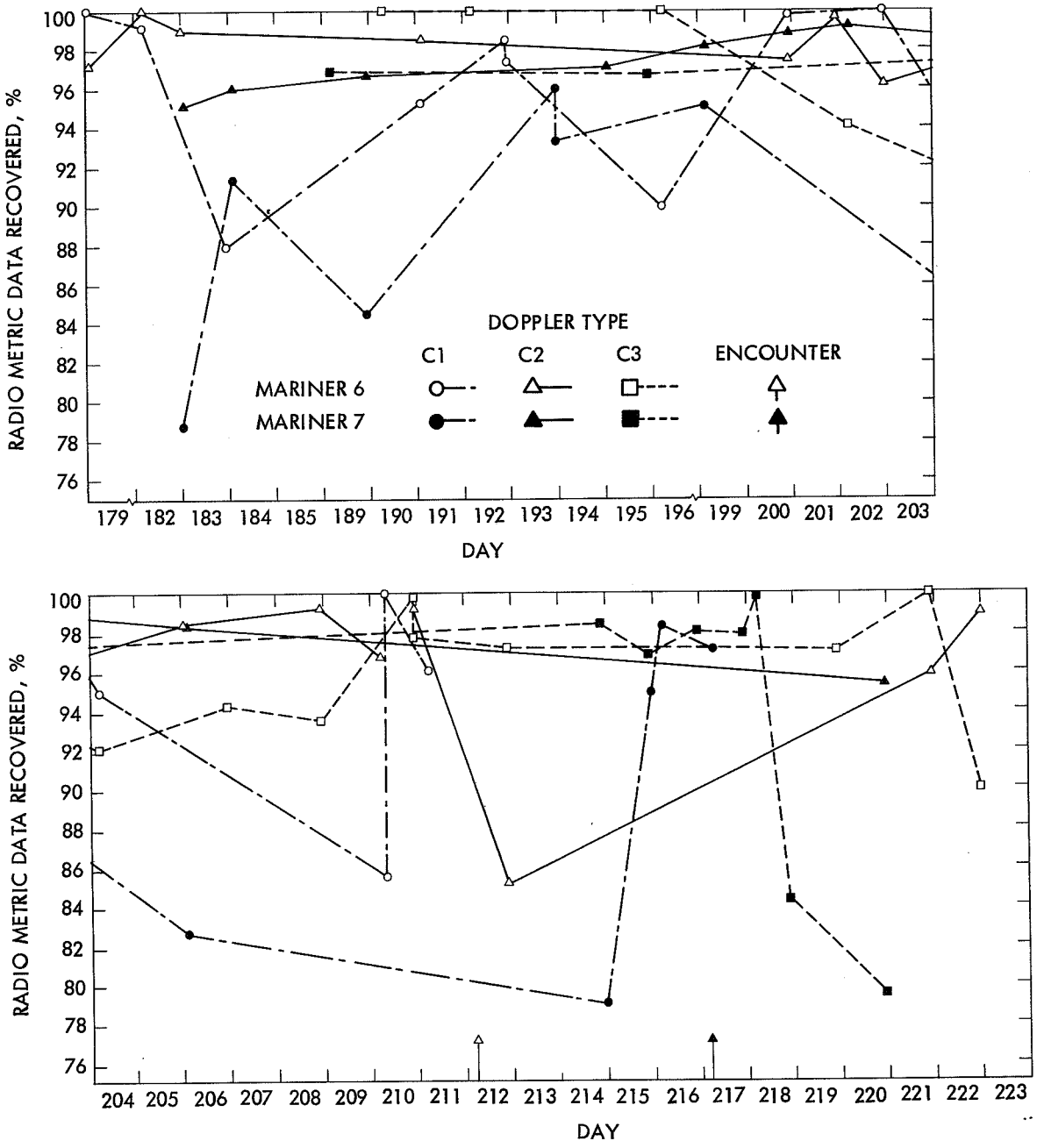


Fig. 26. DSS 12 radio metric data recovery by doppler type

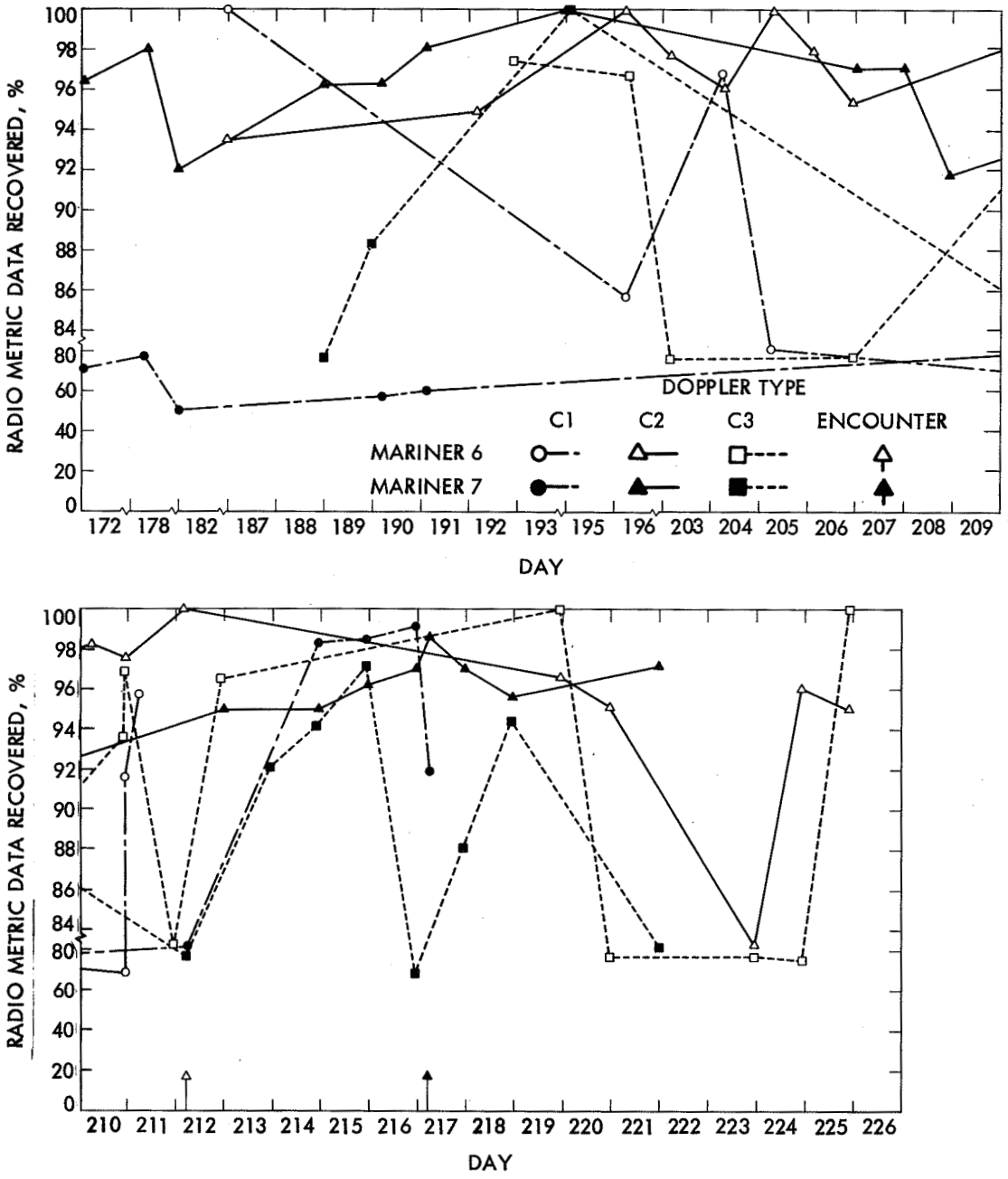


Fig. 27. DSS 14 radio metric data recovery by doppler type

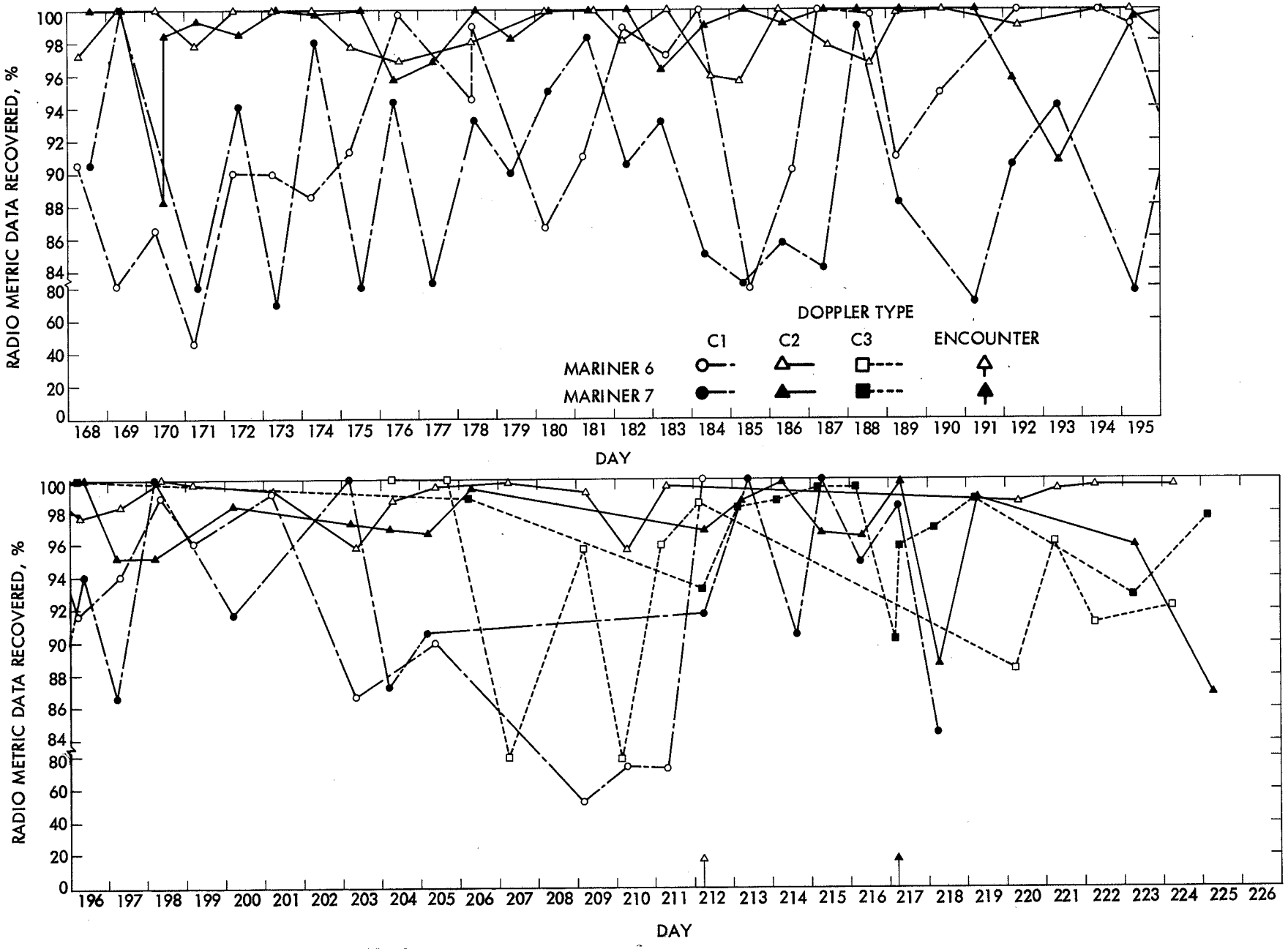


Fig. 28. DSS 41 radio metric data recovery by doppler type

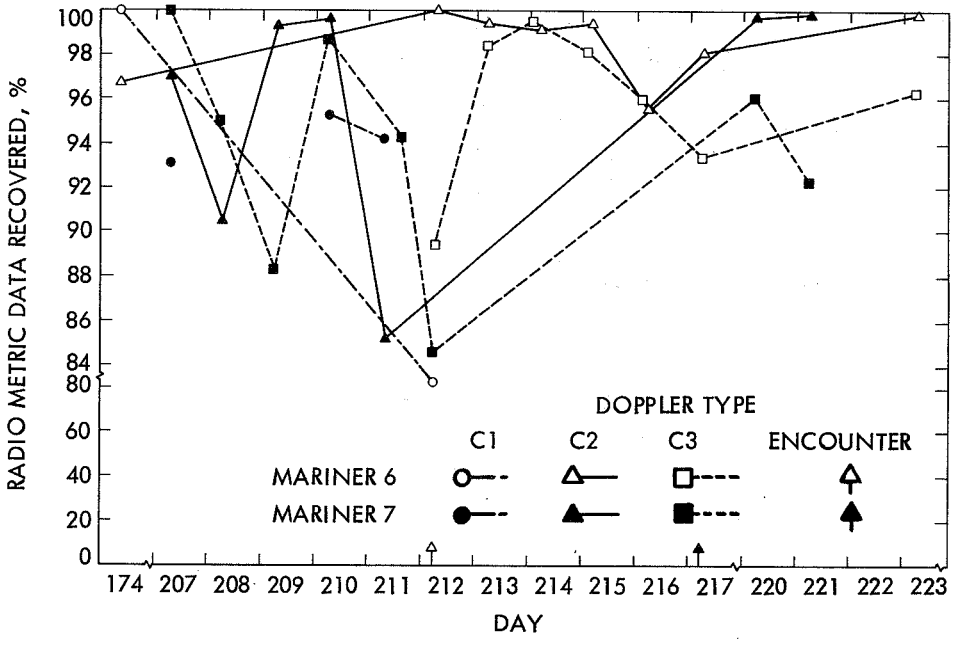


Fig. 29. DSS 42 radio metric data recovery by doppler type

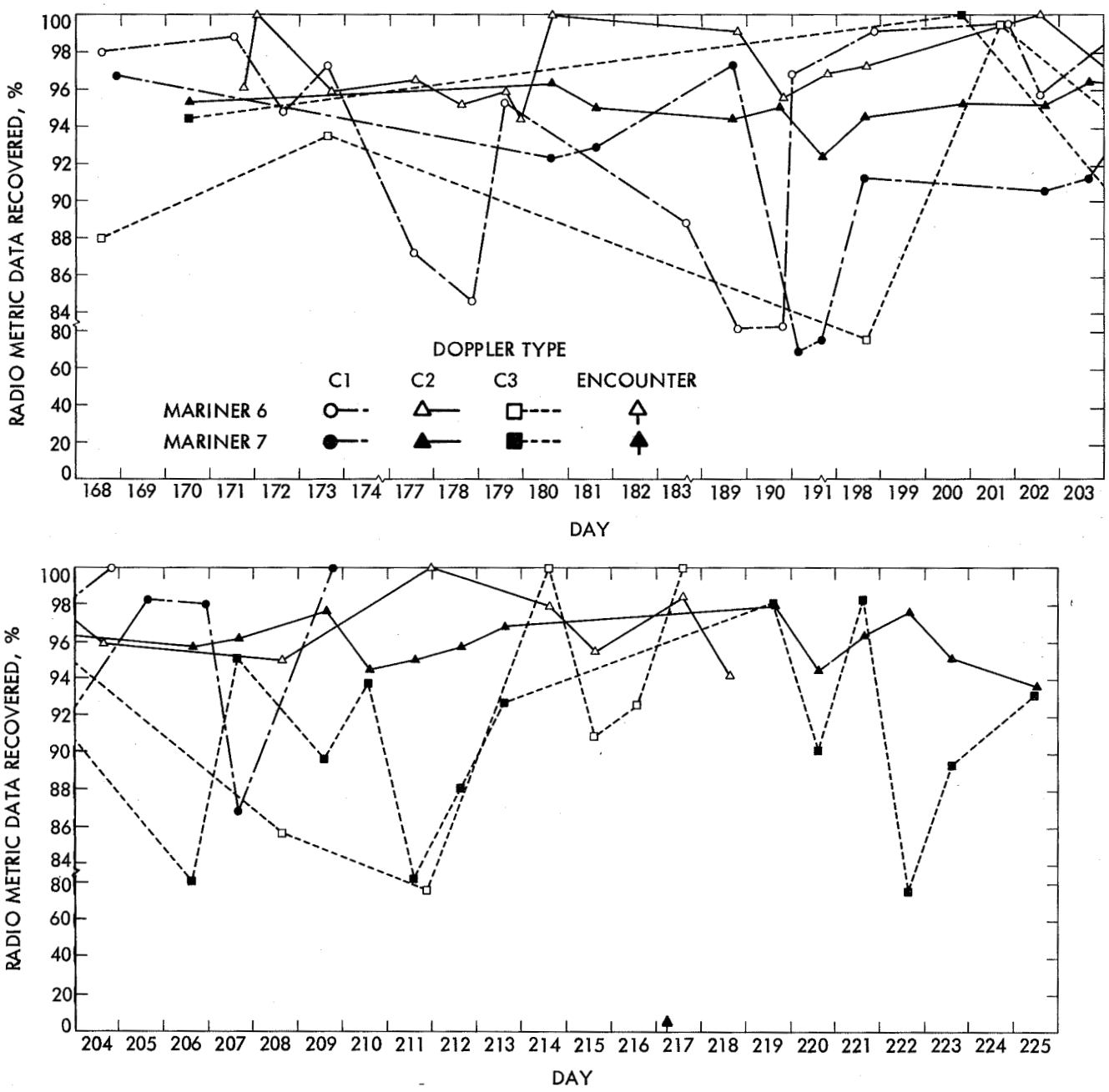


Fig. 30. DSS 51 radio metric data recovery by doppler type

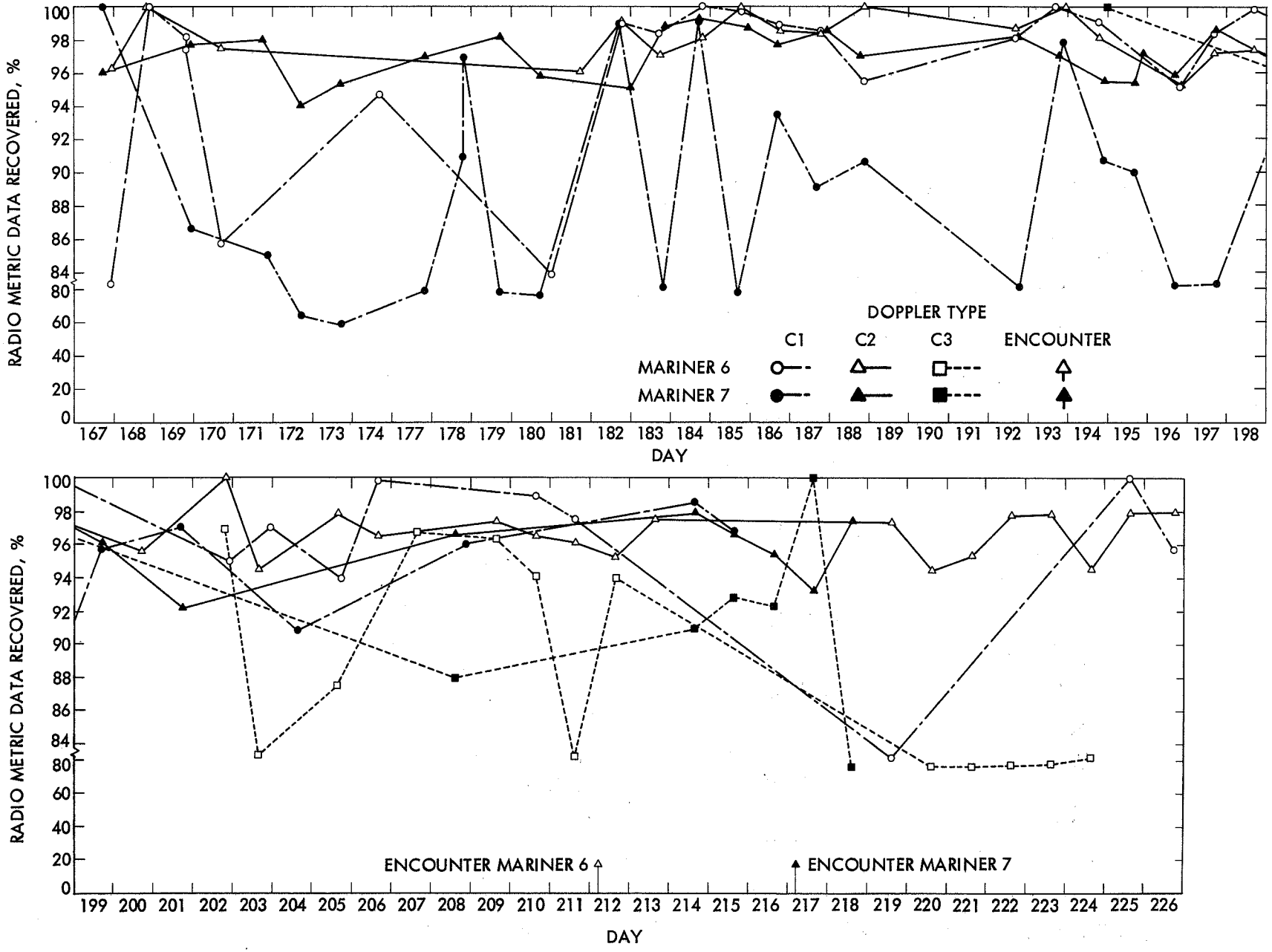


Fig. 31. DSS 62 radio metric data recovery by doppler type

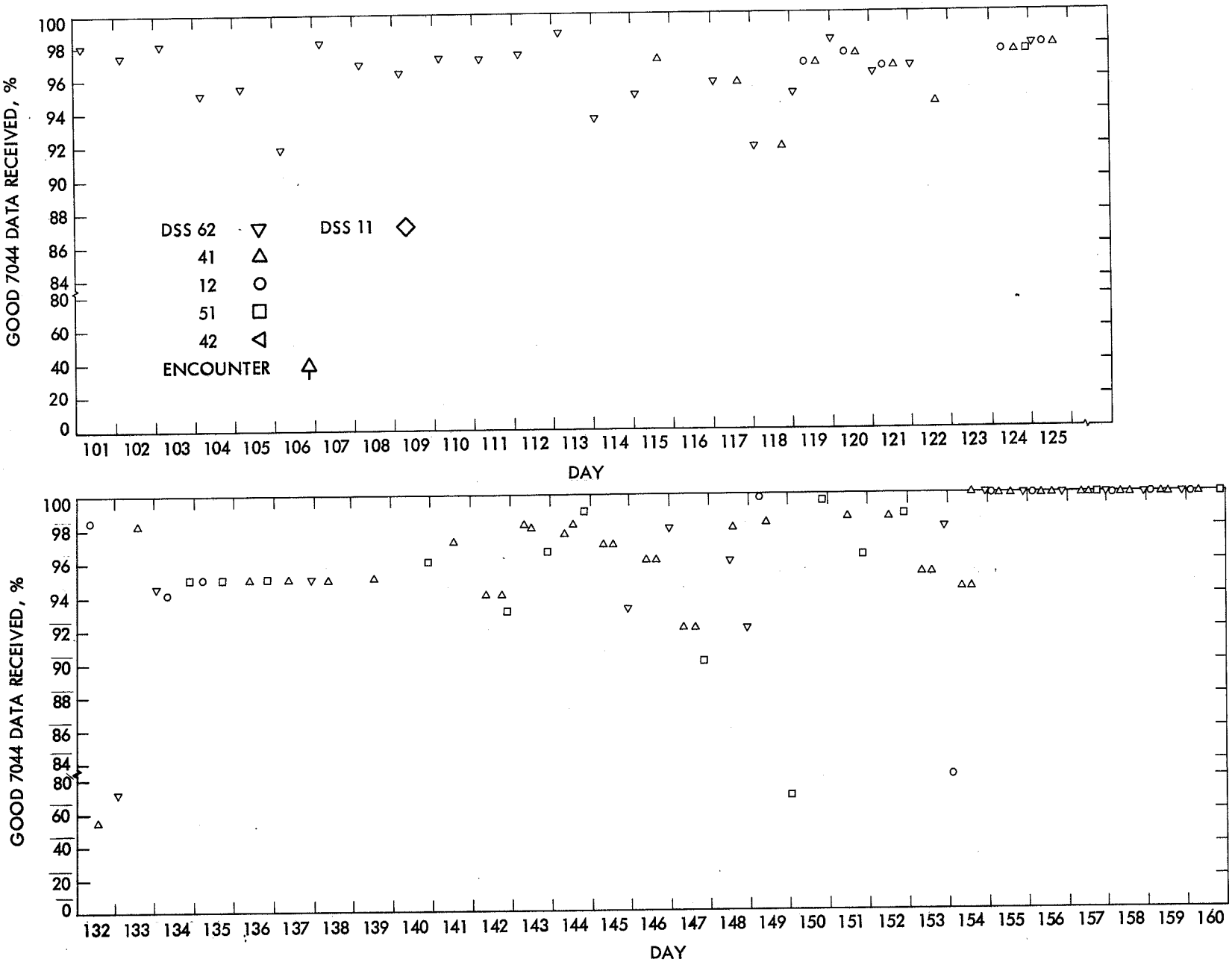
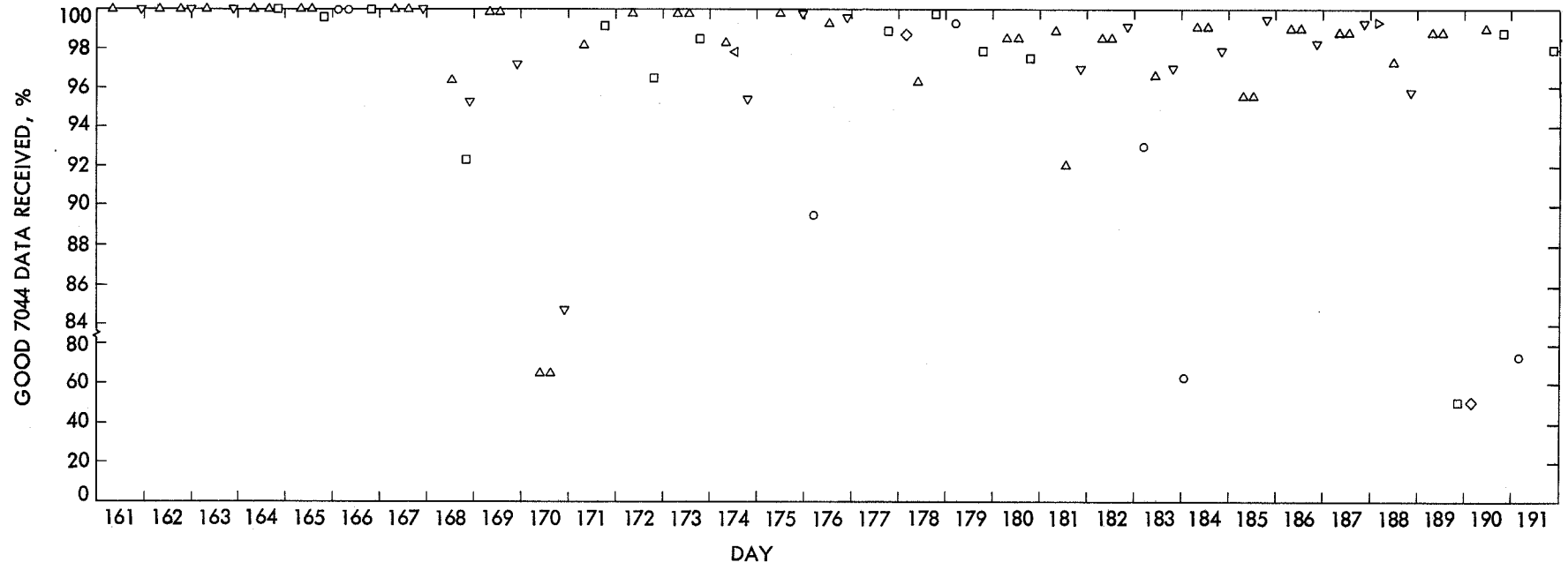


Fig. 32. Mariner 6 telemetry performance


GOOD 7044 DATA RECEIVED, %
100
98
96
94
92
90
88
86
84
80
60
40
20
0
161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191
DAY

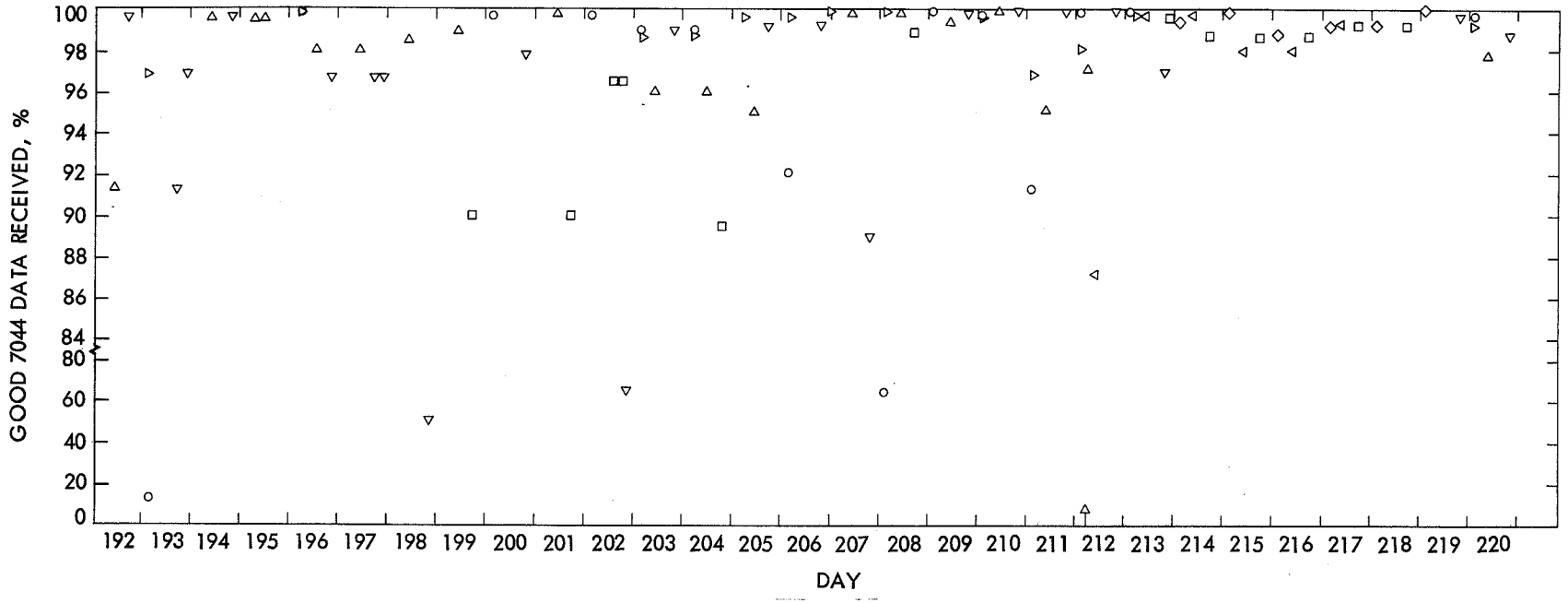

GOOD 7044 DATA RECEIVED, %
100
98
96
94
92
90
88
86
84
80
60
40
20
0
192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220
DAY

Fig. 32 (contd)

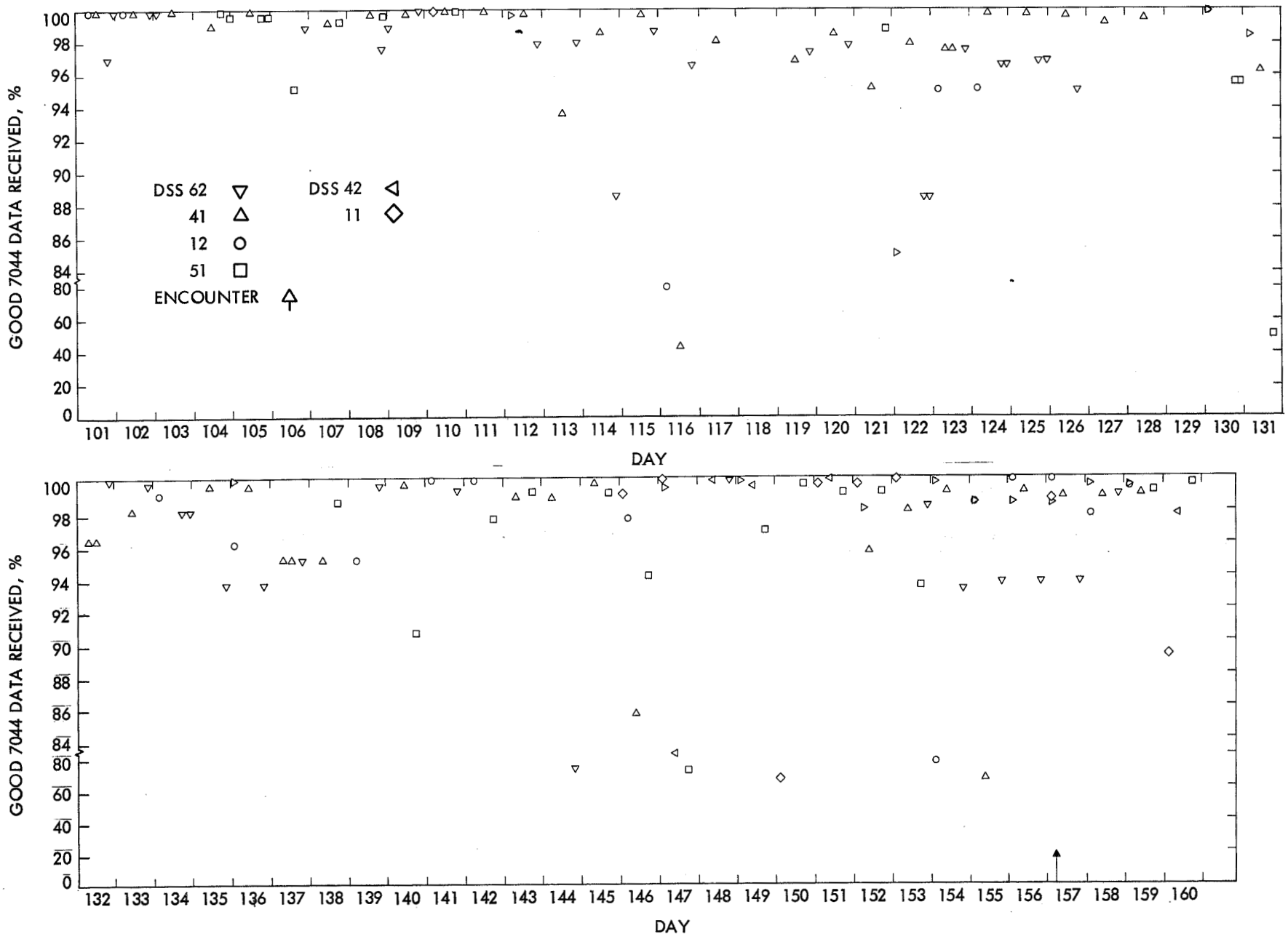


Fig. 33. Mariner 7 telemetry performance

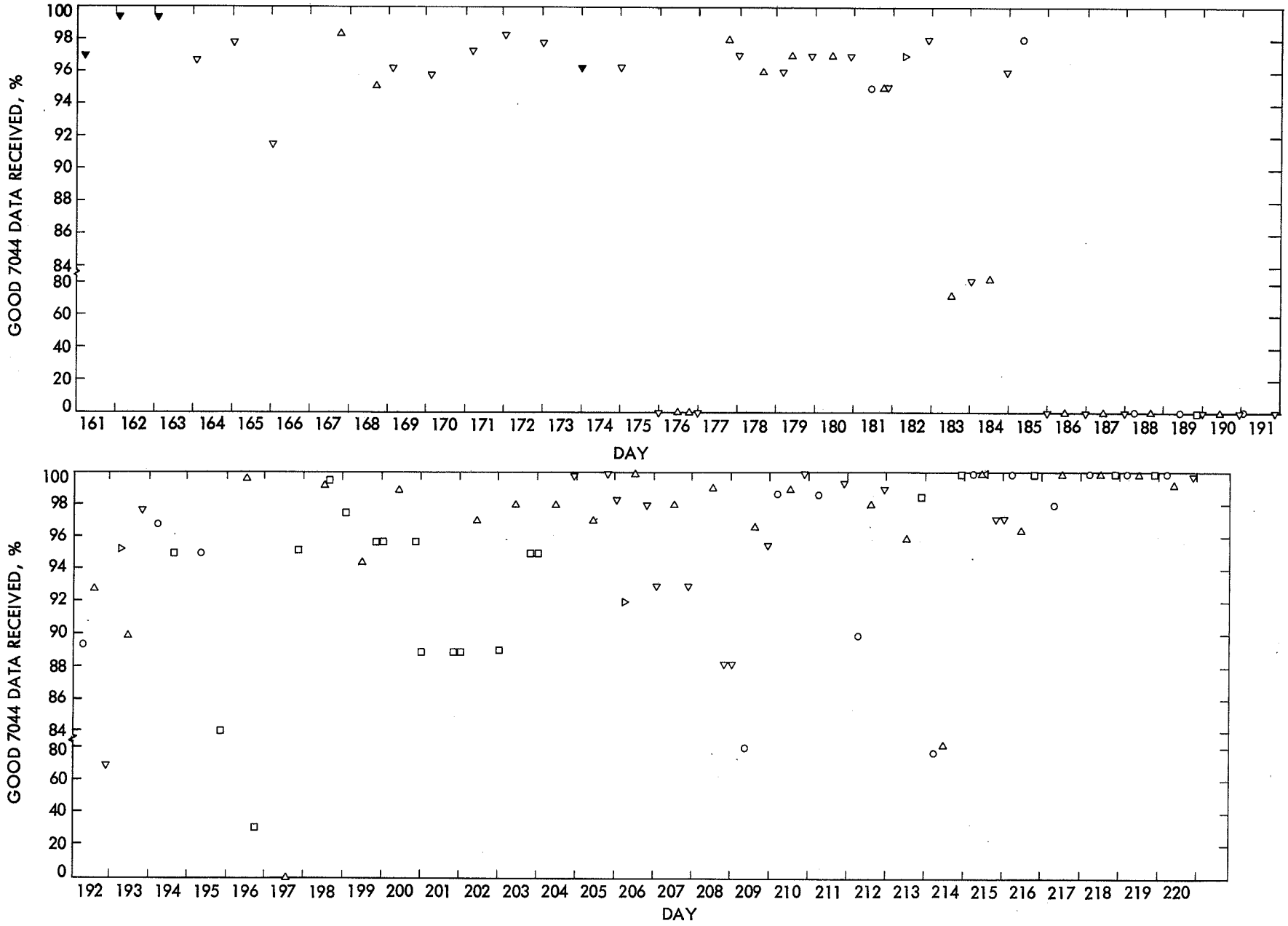

GOOD 7044 DATA RECEIVED, %
100
98
96
94
92
90
88
86
84
80
60
40
20
0
161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191
DAY
GOOD 7044 DATA RECEIVED, %
100
98
96
94
92
90
88
86
84
80
60
40
20
0
192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220
DAY

Fig. 33 (contd)

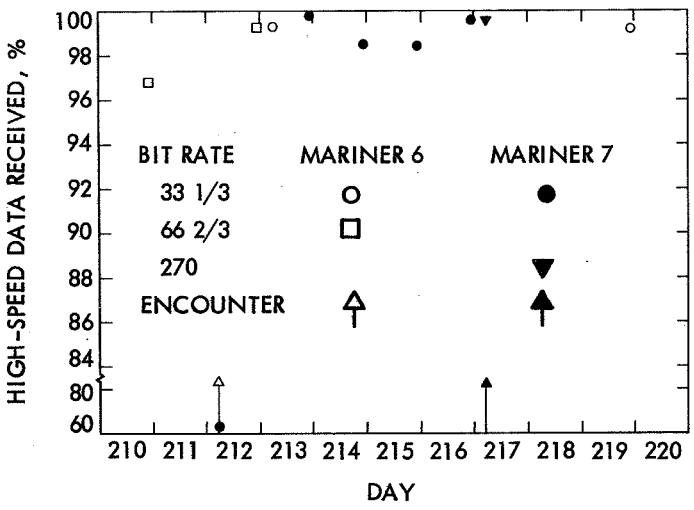


Fig. 34. Encounter statistics, DSS 14

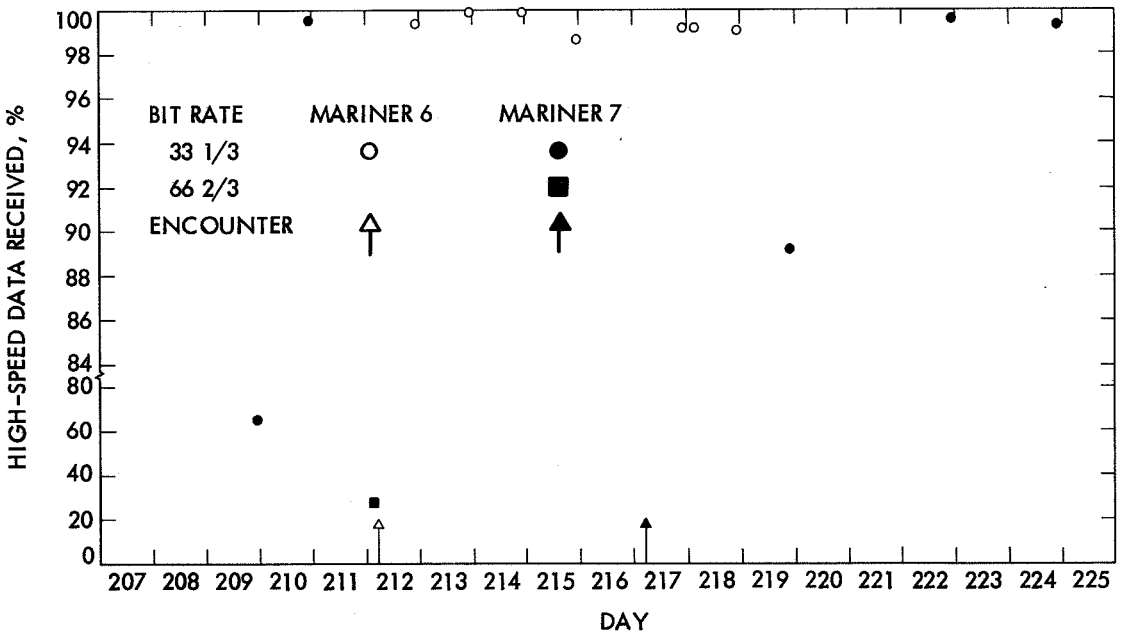


Fig. 35. Encounter statistics, DSS 11 and DSS 21

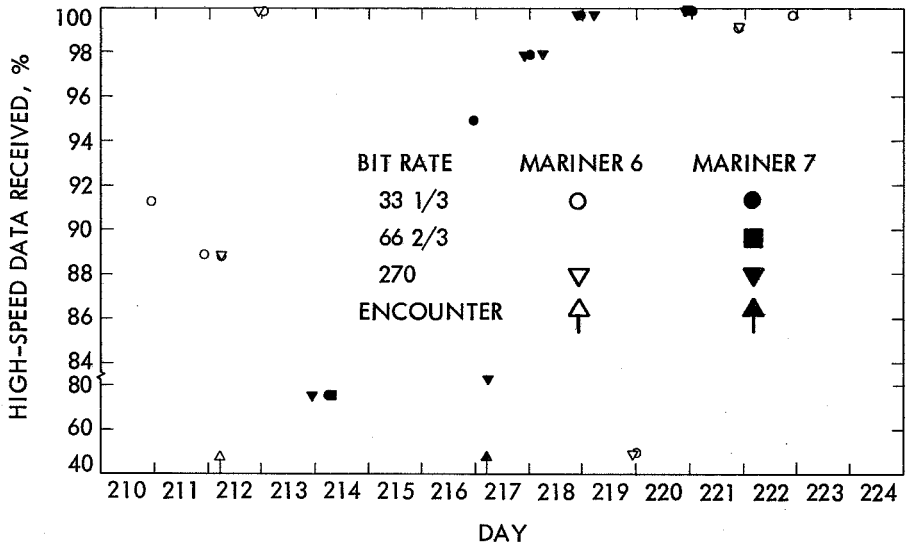


Fig. 36. Encounter statistics, DSS 12

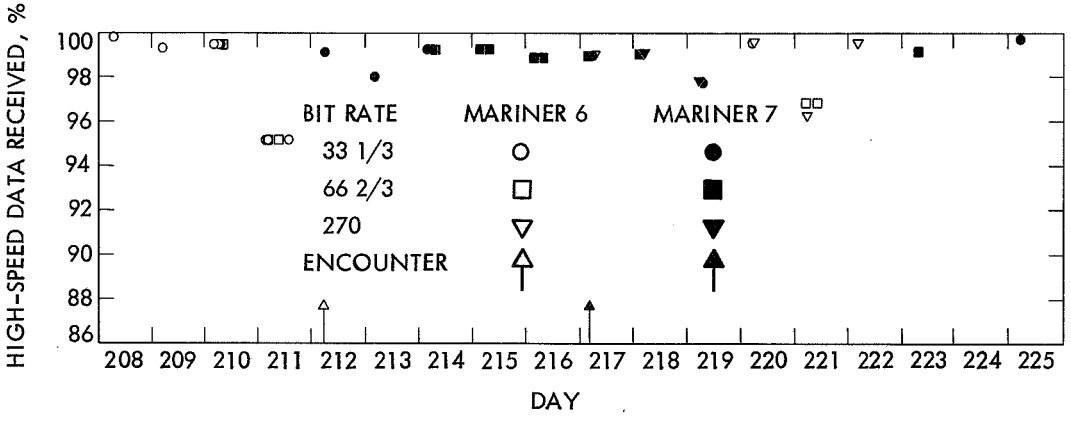


Fig. 37. Encounter statistics, DSS 41

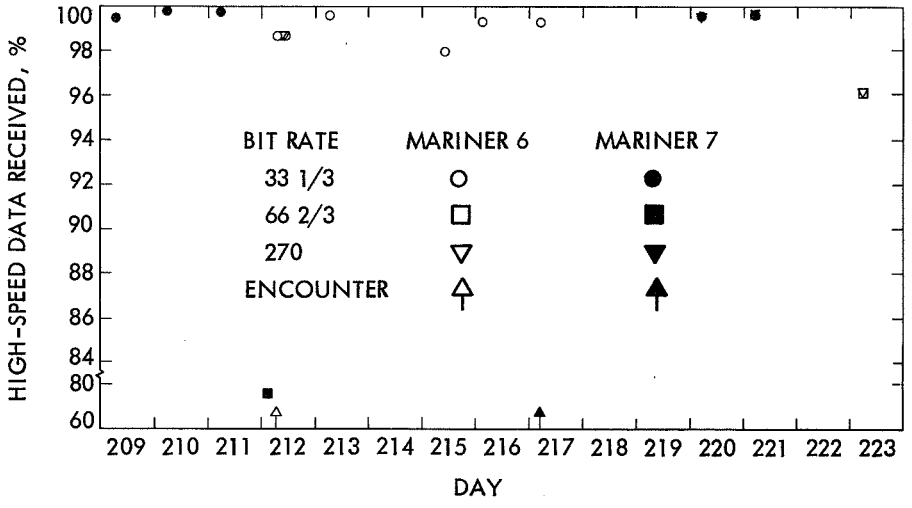


Fig. 38. Encounter statistics, DSS 42

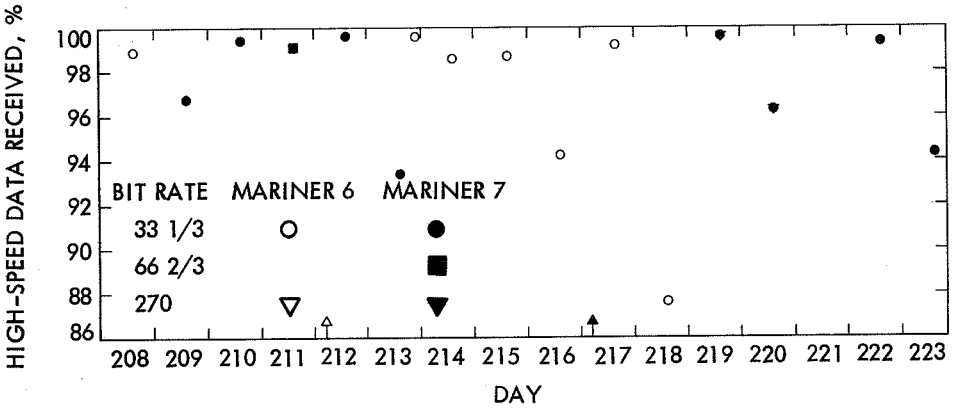


Fig. 39. Encounter statistics, DSS 51

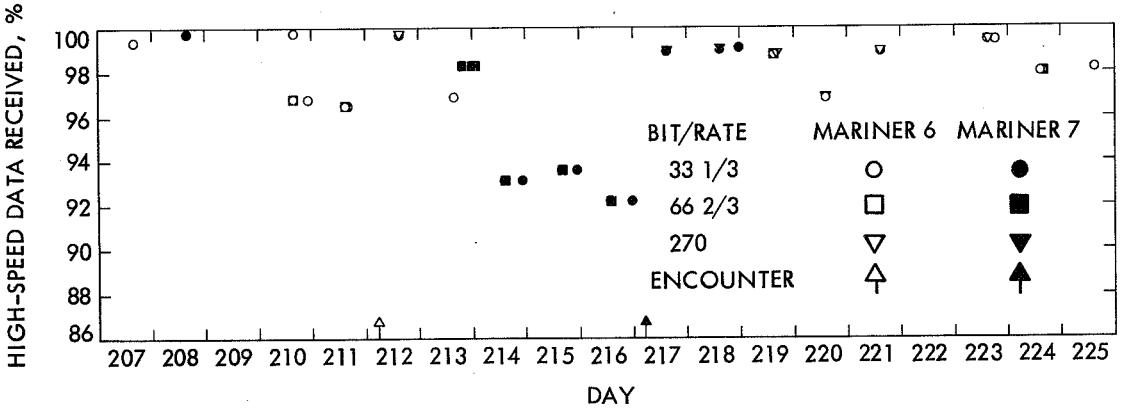


Fig. 40. Encounter statistics, DSS 62

ACQ	acquisition
A/D	analog-to-digital
ADC	analog-to-digital converter
ADSS	automatic data switching system
AFETR	Air Force Eastern Test Range
AGC	automatic gain control
AIS	analog instrumentation subsystem
ANT	antenna
AOS	acquisition of signal
APP	antenna pointing program
APS	antenna pointing subsystem
ATR	analog tape recorder
CAL	calibration
CAT	complementary analysis team
CC	coded command
CC&S	central computer and sequencer
CDE	cognizant development engineer
CEC	Consolidated Electrodynamics Corporation
CJM	comm junction module
CMD	command
comm	communications
CP	communications processor
CTA	Compatibility Test Area
CVR	command verification
CVT	configuration verification test
DACON	data controller
dc	direct current
DC	direct command
D. C.	duty cycle
DCC	data communication channel
DGI	DSIF/GCF interface
DIS	digital instrumentation subsystem
DPODP	double precision orbit determination program
DPS	data processing system
DQM	data quality monitor
DRS	discrepancy reporting system
DSCC	Deep Space Communications Complex
DSIF	Deep Space Instrumentation Facility
DSN	Deep Space Network
DSS	Deep Space Station
DSS 11	Pioneer Deep Space Station, Goldstone, California
DSS 12	Echo Deep Space Station, Goldstone, California
DSS 13	Venus Deep Space Station, Goldstone, California
DSS 14	Mars Deep Space Station, Goldstone, California
DSS 41	Woomera Deep Space Station, Island Lagoon, Australia
DSS 42	Tidbinbilla Deep Space Station, Canberra, Australia
DSS 51	Johannesburg Deep Space Station, Johannesburg, South Africa
DSS 61	Robledo Deep Space Station, Madrid, Spain
DSS 62	Cebreros Deep Space Station, Madrid, Spain
DSS 72	Ascension Deep Space Station, Ascension Island
DTR	digital tape recorder
DTU	data transmission unit
E	encounter
EDED	error-detector-encoder-decoder
EFR	equipment failure report
EI	engineering instructions
ENC	encounter
EOF	end of file
ETO	estimated time operational
FDX	full-duplex, two way
FEPS	far-encounter planet sensor
FMT	format
FOL	frame out of lock
FR-1400	Ampex tape recorder
F. SS	position F subsystem

FTS	frequency and timing subsystem
GCF	Ground Communications Facility
GMT	Greenwich Mean Time
GRTS	Goddard real-time system
GSFC	Goddard Space Flight Center
HA	hour angle
HRC	high-rate correlator
HRT	high-rate telemetry
HSD	high-speed data
HSDL	high-speed data line
HVAC	high-voltage alternating current
I/O	input/output
I/P	input
IR	infrared
IRS	infrared spectrometer
IRV	inter-range vector
JPL	Jet Propulsion Laboratory
KSR	keyboard send-receive
LOS	loss of signal
MCD	monitor criteria data
MDE	mission-dependent equipment
MDR	master data record
MGR	manager
MMTS	multiple-mission telemetry system
MM69	Mariner Mars 1969
MOD	Model or Modification or MODEM
MODEM	Modulator-Demodulator
MOS	mission operations system
MSA	mission support area
MSFN	Manned Space Flight Network
MTBF	mean time between failures
MUX	multiplexer
MW	microwave
NASCOM	NASA Communications system
NAMG	narrow-angle Mars gate
NAT	network analysis team
NBR	number
N/E	near-encounter
NON-ENC	non-encounter
NOP	network operations plan
NRZ	Non-Return-to-Zero
OCCUL	occultation
OD	orbit determination
ODG	orbit data generator
ODP	orbit determination program
ODR	original data record
O/L	out of lock
O/P	output
OPS	operations
ORT	operational readiness test
OVCS	operational voice communications subsystem
OVT	operational verification test
PCM	pulse code modulated
PCS	peripheral communications system
PE	project engineer
PN	pseudonoise
PRDX	prediction program
PSA	printer selecting assembly
PS%L	power sequencer and logic
PT&T	Pacific Telephone and Telegraph Company
QC	quantitative command
RCV	receiver
RCVR	receiver
R&D	research and development
RDSP	remote site data processor
RF	radio frequency
RFS	radio frequency subsystem
RIL	receiver in lock
RNG	ranging
RO	receive-only
ROL	receiver out of lock
ROPP	receive-only page printer
ROTR	receive-only teletype reperforator

RTCS	real-time computer system
RTLT	round-trip light time
RWV	read-write-verify
SAF	Spacecraft Assembly Facility
S/C	spacecraft
SCCG	station communications control group
SCI	science
SDA	subcarrier demodulator assembly
SDCC	Simulation data conversion center
SFOD	Space Flight Operations Director
SFOF	Space Flight Operations Facility
SIM	simulation system
SIRD	support instrumentation requirements document
SNR	signal-to-noise ratio
SOE	sequence of events
SOP	standard operating procedure
SOPM	standard orbital parameter message
SPE	static phase error
SPKR	speaker
SPX	simplex
S/S	signal strength
SSAC	spacecraft science analysis and command
STC	system test complex
STCDS	system test complex data set
TAG	technical analysis group
TCD	telemetry and command data handling subsystem
TCFM	temperature control flux monitor
TCP	telemetry and command processor
TCS	telemetry and command system
TDH	tracking data handling subsystem
TDM	technical direction memo
TDP	tracking data processor
TDS	tracking and data system
TECH	technician
TFR	trouble/failure report
TLM	telemetry
TRAKAD	track advisor
TRK	tracking
TTY	teletype
TV	television
TVCS	Television Communication Subsystem
TWM	traveling wave maser
TWT	traveling wave tube
UNDA	undecipherable
USB	unified S-band
UV	ultraviolet
UVS	ultraviolet spectrometer
UWV	antenna microwave subsystem
VCO	voltage-controlled oscillator
VFTG	voice frequency telegraph gear
VHF	very high frequency
WB	wideband
XFR	transfer
XMTR	transmitter

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APPENDIX

DSN OPERATIONS LOGS FOR MARINER MARS 1969

Table A-1. DSN operations log for Mariner 6

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
044	51	098/9	2238	0500	-147.3	98.10		958	95.4	2345: DIS not outputting on HSD, program reloaded, effect on operations not reported by DSS.	219/223/224	2
044	12	099	1120	1330	-146.7	97.83		93.1	98.2		219/220/223	N/A
044	41	099	1023	2000	-148.5	97.83		87.9	95.0		219/220/222/223/224	N/A
045	62	100	0304	0537	-147.5	95.33		91.6	98.4		219/223	N/A
045	12	100	1120	1330	N/A	95.33		93.1	99.0		219	N/A
045	41	100	2000	2230	-148.8	95.33		93.3	96.7		219/220/223	2
046	62	101	0301	0533	-148.0	98.07		94.1	98.4		219/223	N/A
046	12	101	1118	1330	-146.9	98.07		91.6	98.2		219/220	N/A
046	41	101	2000	2230	-149.0	98.07		93.3	97.5		219/223	N/A
047	62	102	0301	0530	-147.9	97.39		92.6	94.9		219/223	N/A
047	12	102	1115	1330	-148.8	97.39		91.0	96.4		219	N/A
047	41	102	2001	2230	-149.0	97.39		94.0	98.4		219/223	N/A
048	62	103	0301	0521	-148.5	99.42		97.2	97.5		219/223	N/A
048	12	103	1110	1320	-147.3	99.42		90.8	98.0		219/223	N/A
048	41	103	2002	2230	-148.8	98.13		93.2	96.7		219/223	N/A
049	62	104	0300	0525	-148.4	96.77		93.8	97.4	4 minutes 43 seconds DIS monitor data lost as operator used S/C ID 72 in place of 71.	219/223	N/A
049	41	104	1259	1830	-148.4	96.77		96.7	98.7		219/223	N/A
050	62	105	0230	0521	-148.4	95.22		94.7	97.9		219/223	N/A
050	41	105	1230	1830	-148.2	95.22		94.7	98.8		219/223	N/A
051	62	106	0233	0517	-148.3	91.81		93.9	98.5		219/223	N/A
051	41	106	1240	1830	-148.6	91.81		95.7	91.1*	*Recall in progress.	219/223	N/A
052	62	107	0146	0513	-148.4	98.18		92.3	96.7		219/223	N/A

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
052	12	107	0631	1304	-147.0	98.18		95.2	99.4		219	N/A
052	41	107	1240	1830	-148.0	98.18		95.4	97.2	DSS utilizing paramp as maser is down.	219/223/224	N/A
053	62	108	0130	0531	-146.3	96.86		94.2	95.2	1) Transmitter VCO at DSS-62 giving false readings. 2) S/C VCO began varying at 0442, definite S/C anomaly under investigation.	219/223	N/A
053	12	108	0624	1120	-148.6	96.86		94.9	82.0*	Emergency track to investigate S/C anomaly. *TDH recall in progress.	219	N/A
053	41	108	1047& 1755	1700& 2327	-148.1	96.86		97.2	99.8	DSS tracked S/C 72 from 1700-55 DSS utilizing paramp as maser is down.	219/221/223	N/A
053	42	108	1355	1436	N/A	N/A		89.3	0*	Emergency track, 3-way, HSD not processed, though received. *3-way pass, No 2-way TDH sent.		
054	62	108/9	2332& 0331	0230 0501	-146.9	96.68		92.9	97.1	0230-0330, DSS tracked S/C 72.	219/223	N/A
054	12	109	0630	0930	-146.2	96.38		91.7	98.1		219	N/A
054	41	109	1004& 1731	1630& 2320	-148.3	96.38		96.8	90.7	DSS tracked S/C 72 from 1631-1730.	219/223	N/A
055	62	109/ 10	2341& 0305	0230& 0459	-147.1	97.05		91.5	97.0	DSS tracked S/C 72 from 0231-0304.	219/223	N/A
055	12	110	0630	0900	-147.2	97.30		93.4	97.1		219	X3
055	41	110	1037& 1735	1632 2314	-148.0	97.30		94.7	98.4	DSS tracked S/C 72 from 1633-1734.	219/221/223	N/A
056	62	110/ 11	2316& 0200	0055 0450	-147.0	97.25		92.3	97.4	1) DC-17 aborted then sent 5 minutes later due operator error. 2) DSS tracked S/C 72 0056-0159.	219/221/223	N/A

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
056	12	111	0604	1246	-147.4	97.23		95.3	99.2		219	N/A
056	41	111	1209	1700	-147.6	97.23		91.8	100.0		219/223	N/A
057	62	112	0131	0445	-147.0	97.46		87.6	97.2		219/223	N/A
057	41	112	1201	1800	-147.1	97.46		96.1	97.8		219/223	N/A
058	62	113	0131	0442	-147.0	98.82		91.3	97.5		219/223	N/A
058	41	113	1226	2000	-147.9	98.82		96.7	98.3		219/223	N/A
059	62	114	0130	0438	-147.0	93.61	96.42	94.7	84.9*	*Recall in progress.	219/223	X3
059	41	114	1215	1800	-148.1	93.61	96.42	95.9	99.0		219/223	X3
060	62	115	0130	0434	-147.2	N/A*		95.1	98.7	*Playback in progress.	219/223	X3
060	41	115	1201	1800	-147.9	N/A*		97.2	98.8	*Playback in progress.	219/223	N/A
061	62	116	0130	0430	-146.6	0*		94.4	98.7	*115/2028-117/0000, No TLM logged by DPS, reason unknown. TCP tapes will be processed.	219/223	X3
061	41	116	1201	1800	-147.7	0*		95.3	100	*115/2028-117/0000, No TLM logged by DPS, reason unknown. TCP tapes will be processed.	219/223	N/A
062	62	117	0100	0427	-147.1	95.81		94.7	98.3		219/223	Y3
062	41	117	1200	1800	-147.6	95.81		97.2	97.1		219/223	N/A
063	62	118	0130	0400	-146.8	91.89	96.17	93.3	99.1		219/223	Y3
063	41	118	1600	2228	-147.7	91.89	96.17	96.4	93.2*	*Recall in progress.	219/221/223	N/A
064	62	118/19	2238	0330	-147.5	95.12		42.1*	95.5	*DSS performed S/C receiver best lock frequency test, accounting for many DCC changes.	219/223	N/A
064	12	119	0504	1208	-147.6	96.87		59.2*	98.2	*DSS conducted S/C receiver best lock frequency test accounting for many DCC changes.	223	Y2

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
064	41	119	1146	2223	-147.8	96.87		66.1*	97.8	1) 1238-42 transmitter VCO frequency output from DIS lost, DIS reinitialization solved problem. 2) 1950-2015-DIS stopped outputting, 25 minutes DIS monitor data lost, program reinitialized. *3) DSS conducted S/C receiver best lock frequency test, causing many TDH samples to be bad DCC.	219/223/224	N/A
065	62	119/20	2210	0420	-149.5**	98.32		66.6*	97.9	**1) Paramp prime, maser in cool down. *2) DSS conducted S/C receiver best lock frequency test, causing many TDH samples to be bad DCC.	219/223	Y2
065	12	120	0456	1210	-147.2	97.54		67.1*	96.7	*1) DSS conducted S/C receiver best lock frequency test, causing many TDH samples to be bad DCC.	223	X2
065	41	120	1146	2210	-148.4	97.54		98.2	97.8		219/221/223	X2, X3
066	62	120/1	2321	0400	-150.0*	96.25		96.1	96.5	*1) Paramp prime, maser in cool down.	219/221/223	X2, X3
066	12	121	0449	1021	-147.4	96.65		95.2	98.4		219/223	X2, X3
066	41	121	0955	1800	-148.2	96.65		95.7	95.7		219/224	X3
067	62	121/2	2152	0400	-148.6	96.65		97.3	97.7	1) Maser in cool down, paramp prime.	219/223	X2
067	41	122	1129	2200	-151.5	94.51		94.3	0		219/221/223	N/A
068	51	122/3	2107	0500	-147.8	N/A*		91.1	79.4**	1) 123/0000-0123, day did not cycle from 122-123 on TDH printout-datex clock fault, manual reset neces.		

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
068	51	122/3	2107	0500	-147.8	N/A*		91.1	79.4**	1) 123/0000-0123, day did not cycle from 122-123 on TDH printout-datex clock fault, manual reset necessary. 2) TCP beta (prime) down 2233:43-2324:50. Constant 100 PPS interrupts stopped program. 51 minutes of TLM lost as DSS did not switch to back up TCP. 3) Maser in cool down, par-amp prime, AOS delayed 7 minutes. 4) No doppler monitoring from DIS as TDH system was not sending data to DIS. Cause undetermined. *Playback (analog). **Recall in process.	219/221/224	N/A
068	62	122/3	2249	0400	148.5	N/A*		97.1	0**	*SFOF software problem (records) in error. **No 2-way data.	224	X
068	12	123	0436	0900	-147.9	N/A*		88.3	52.4**	*SFOF software problem (records) in error. **Recall in progress.	219/221	X
068	41	123	0923 1300	1200 2130	-148.1	N/A*		84.7	58.6**	1) Frequency dist. amp failed in FTS system, causing loss of 71 minutes of coherent doppler and 4 minutes of TLM. 2) DSS tracked MM-7, 1200-1300. *SFOF software problem (records) in error. **Recall in progress.	219/223	N/A

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
069	51	123/4	2112	0400	-148.1	N/A*		88.0	56.7**	1) CEC recorder switched off during comm. and sequence. 2) Datex clock didn't sequence from day 123 to 124, manually reset. 3) DIS recorder 'B' hanging. *Software at SFOF records program. in error. **Recall in progress.	219	X
069	12	124	0430	0950	-147.4	97.55		91.6	65.2*	*Recall in progress.	221	N/A
069	41	124	0917 1300	1200 2131	-148.4	97.55		94.5	89.9*	1) DSS tracked MMT 1200-1300. 2) Frequency dist. amp. of FTS system still down. *Recall in progress.	219/223/224	Y
070	51	124	2102	2330	-147.8	97.55		74.7*	94.7	*2103-2132, VCO counter inoperative.	219/224	Y
070	62	125	0130	0400	-147.8	98.01		75.3	57.4*	*Recall in progress.	219/223	Y
070	12	125	0422 0904	0800 1150	-147.8	98.01		94.0	81.7*	DSS tracked MM-7, 0800-0900. *Recall in progress.	219	N/A
070	41	125	1425	1730	-147.8	98.01		99.5	100		219/223	N/A
071	62	126	0101	0330	-148.0			93.3	97.4		219/223	N/A
071	41	126	1200	1630	-148.0			96.7	83.5*	*Recall in progress.	219/223	N/A
072	62	127	0100	0330	-148.1			94.0	97.4		219/223	N/A
072	41	127	1230	1630	-148.1			98.2	98.5		219/223	N/A

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
073	62	128	0100	0330	-148.2			90.0	81.0*	*Recall in progress.	219/223	X2
073	41	128	0956	1300	-148.2			94.6	100		219/223	Y3
074	51	128	1920	2136	-148.2			84.7	91.8*	*Recall in progress.	219/221	X2
074	12	129	0538	0900	-148.4			95.0	75.1*	*Recall in progress.	219/223	X3
074	41	129	1325	1630	-148.4			89.2	93.9		219/223	Y3
075	62	129/30	2104 0100	2230 0330	-148.5			87.7	98.2	DSIF tracked MM-7, 2230-0100	219/223	Y3
075	41	130	1218	1630	-148.5			95.6	97.8		219/223	N/A
076	62	130/1	2330	0330	-148.7			95.4	98.1	2353-0113, mon. HSD off line to check line printer.	219/223	X3
076	41	131	1219	1500	-148.7			93.2	99.2		219/223	Y3
077	62	131/2	2132	0330	-148.6			97.2	97.9		219/223	N/A
077	12	132	0835	1100	-149.2	98.50		87.0	97.6		219	N/A
077	41	132	1230	1432	-149.0	56.80*		89.3	100	*Playback in progress.	218/219/223	N/A
078	62	132/3	2330	0300	-149.8	73.49*		95.2	97.1	*Playback in progress.	219/223	Y2, Y3
078	41	133	0830 1301	1030 1530	-149.9	98.16		93.0		1) DSS tracked MM-7, 1030-1300.	219/223	Y3
079	62	133/4	2100	0300	-149.2	94.88*		96.9		1) 2215, error light indication during transmitting of first CC comm. and command resent at 2218. Cause undetermined by DSS. *Playback in progress.	219/223	Y2
079	12	134	0718	0930	-148.0	94.11		91.0		*Playback in progress.	219/223	Y3

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
080	51	134	1734	2400	-148.5	91.84	*	88.1	97.8	1832-1901, paramp used as maser down due momentary loss of helium pressure. TFR 135142. TCP A still down. *Relay in progress.	217/219/221	2
080	12	135	0500	0800	-149.8	99.21		92.3	98.0		219/223	N/A
081	51	135/6	1657 0229	1800 0350	-148.1	71.61	*	65.5	100.0	TCP A still down. *Replay in progress. 1) At 1840 prob. with antenna, can get on 4db carrier supp., up at 2046.	217/224/223	3
081	41	136	0824	1100	-150.5	98.25		87.8	100.0		219/223	3
082	51	136/7	1929 0108	2400 0230	-149.9	84.04	*	87.0	100.0	Working on DSS51 HS circuits. 1) Maser down, paramp utilized no report on this in post track. 2) Recorder B1 down 2228-31, TFR 135161. 3) TCP tape playback bad TFR 135162. *Replay in progress.	291	2

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
082	41	137	0825 1401	1100 1630	-151.1	92.35	*	92.5	88.9**	1) 1438-40, DIS mag stopped, cause unknown, dislog tape data lost for 2 minutes. 2) 1617:18, TCP memory failure due air conditioning failure. TFP 41/TCP/137391. 3) Air conditioning main belts failed causing 10P , 1 minute 47 seconds. HSD, TTY lost TFR 41/UTL/131600. *Replay in progress. **Recalled, day 137/pass 82.	219/223	3
083	62	137/8	2019	0319	-150.0	99.75		97.1	98.2	1) Rubidium 2 prime.	219/223	3
083	41	138	0824	1100	-151.3	96.86		91.7	98.3		219/223	3
084	51	138	1910	2400	-148.8	97.23		87.9	95.5	1) SDA-2 inoperative, 150 amp bad TFR 135163. 2) CEC recorder down, power supply out, TFR 135162. 3) A/D converter, TCP 'B' unstable, TFR 135164. DSS did not explain how they output HSO TTY TLM with both TCP's down. 4) 1935 DSS dropped uplink on first attempt.	219/223	2

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
084	41	139	0801 1231	1000 1500	-151.1	98.29		90.7	97.6	1) 0800-1136, SDA 2 down with 10μs pulse missing from phase shifter back up data missing for period TFR SDA/41/137603.	219/223	3
085	51	139	2200	2400	-149.6	64.41	*	90.5	98.1	*Replay requested, in progress. DSS config. R-1, demod-2, TCP-2.	219/223	2
085	41	140	0756 1231	1000 1500	-151.5	88.68	*	88.5	95.0	1) 0800-1000 DIS indicated receiver OOL, TCP input disabled TFR 41/TCP/137610. *Replay for entire pass has been requested.	219/223	3
086	51	140	2135	2400	-149.3	96.01		91.8	95.4	1) TCP 'A' remains down Ref. is TFR 135137. 2) 2207-2243, wrong dec-angle TDH under invest., as fault cleared itself.	219/223	2
086	41	141	0751 1231	1000 1445	-151.8 -151.4	97.22		90.5	99.1	1) 1001-1231 DSS TFR MM-7.	219/223	3
087	51	141	2150	2400	-150.3	78.68	*	88.5	100.0	1) Wrong acq. time on post trl 1921 in place of 2150. 2) No DIS, entire pass as system wouldn't accept prog. no monitor data available. TFR 135173. 3) TCP 'A' still down TFR 135137. *Replay in progress.	N/A	2
087A	41	142	0756	1000	-152.6	94.24	*	86.8	100.0	1) 1001→1800 DSS trkd. MM-7.	219/221/223	3
087B	41	142	1801	1949	-152.6	94.24	*	86.8	100.0	2) Bad bearing during trk. no data lost. TFR-41-REC-137613		3

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
088	51	142	1900	2400	-150.8	93.51	*	87.3	99.6	1) DSS acq. 3-way but DCC on TDH reflects 1-way 1900→1913. 2) DSS unable to match proper DCC with actual config. during tuning. 3) DIS still down. Ref., TFR 135173. 4) CEC still down. TFR 135172, TCP 'A' still down TFR-13517.	N/A	3
088A B	41	143	0759 1230	1000 1500	-152.2 -152.1	98.24		94.8	97.7	No major anomalies - paramp down for maintenance TFR 137621.	223/219	3
089	51	143	2133	2400	-150.4	96.67		86.4	97.7	1) TCP 'A' and DIS still down. TFR's Ref. 135037, 135173. 2) Sanborn still in use TFR 135162 refers. 3) TCD bypass cable in.	223/219	2
089A B	41	144	0758 1230	1000 1500	-151.9 -151.9	97.68		97.7	99.5	Paramp still down for maint. TFR-137621.	223/219	3
090	51	144/5	1510	0308	-150.6	99.93		93.3	95.1	1) DIS still down. 2) TCP 'A' still down. 3) CEC overheating TFR 15172. 4) TCD bypass cable still in.	223/219	X3
090A B	41	145	0756 1230	1000 1500	-152.2 -152.3	97.01		95.0	99.6	NIL.	223/219	Y3

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
091	62	145	2100	2330	-151.6	93.19	*	91.9	98.4	1) TCP 'B' failed to recog. EOF unknown reason. 2103→2120. Prog. reloaded, no recorded on TCP 'B' for ≈17 minutes. 2) Klystron to CHN. 14 for MM-69 and PN support. MM-7 M output = 9kw rubidium 2 prime. 3) On TCP 'B' 3 write errors 1 record lost.	223/219	Y3
091A B	41	146	0729 1500	1030 1700	-152.5 -152.6	96.06		99.1		DSS 1-way entire pass. 1) 0730→0815 TFR 4-1/ANT/137630 Tacho belt broken, then replaced on hour angle east motor. At 14302 transferred from MM-7, used 30 minutes clear backlog of TDH, 1 second data.	223	Y3
092	62	146/7	2031	0100	-151.8	98.35		95.5	98.0	Rubidium 2 prime Klystron tuned to CHN. 14 for MM-69 and PN support MM-6 M output = 9 kw.	221/219	Y2
092A B	41 41	147 147	0725 1430	0930 1700	-152.5 -152.6	92.44	*	97.0		1) TFR 41/FTS/137554 refers. 2) 1-way only pass. *Replay in progress.	223	Y3

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
093	51	147/8	1757	0230	-151.2	90.37	*	57.8	96.9	1) DSS showed bad DCC 1842z→1850z when data was in fact good. 2) VCO on TDH on wrong TS frequency. 3) TFR 135183 refers. 4) DSS-51 advises VCO counter faulty. 5) TCP 'A' still down. TFR 135037. 6) No AEC or SPE from TCP TDR 135186. 7) Replaced Hi RPM solenoid on HA antenna. TFR 135187.		Y2, Y3
093	41	148	1430	1700	-152.9	98.03		98.6		1) 1-way only pass. 2) TFR 41/FTS/137554. 3) GSFC CP problems caused excessive data replays all data recovered.	223	Y2
093	42	148	0727	1400	-154.3	96.4		97.8	94.9	1) T/REC 'A' problems at 07302. TFR 108235- T/REC 'B' started. 2) Patching error (T/R) TFR 108237 refers.	219/223	Y3
094	62	148	2030	2400	-152.1	92.39	*	91.9	97.8	1) Klystron tuned to CHN. 14 for MM-69 and PN support MM-6 M output = 9kw. 2) Rubidium 2 prime. *Replay in progress.	223/219	Y2, Y3

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
094	12	149	0525	0730	-150.3	99.83		89.7	**	**1-way only pass.	223	Y3
094	41	149	0727	1200	-152.9	98.31		99.7	**	**1-way data only. 1) TFR 41/FTS/137554 Awaiting spares.	224/223	Y3
095	51	149/50	1504	0248	-151.2	69.9	*	97.0		1) DSS comm. lines out, No TDH received for pass. All TDH will be transmitted on day 151 at 0300z. 2) TCP 'A' still down. TFR 135037 refs. 3) CEC still down. TFR 135162 refs. (no etro on items #2, #3). 4) Config. used 2-2-BETA. 5) Switched to "RECORD ONLY" at 1521. 6) At 0030 data rec from DSS51 up to 0117z.	223/219/217	N/A
096	51	150/51	1445	0240	-151.6	99.59		96.0*		*165825z→170202, DCC undecipherable, all samples considered ng. 1) TCP 'A' still down. 2) TCD by-pass cable still in.	219/223	Y3
096	41	151	0954	1300	-153.5	98.65		99.9		1-way track only.	223	3

*Replay in progress.

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
097	51	151/2	1441	0239	-152.5	96.38		80.3		1) DSS mislabeling DCC. 2) TCP 'A' still down. 3) STD. config. deviation: the DSS PT report states they used receiver 2 SDAZ TCP 'B', but in the PT measures, they stated loop B/W and thresh. for receiver 1 only. 4) Assumed TCD by-pass still in.	219/223	N/A
097	41	152	0955	1300	-153.9	96.78		100.0		1) 1-way track only.	223	Y3
098	51	152/3	1437	0236	-152.2	98.82		96.4		1) APS down TFR 135181 refs. 2) TCP 'A' still down TFR 135037 refs. 3) Receiver 1 as prime. 4) Config. used = 1-2-B	219/223	Y3
098	41	153	0700 1331	0930 1630	-154.3 -154.6	95.29		99.8		1) 1-way trk only. 2) DSS transfer to MM-7 at 0930.	223	Y3
099	62	153/54	1900	0200	-153.0	98.2		96.7	98.5	1) Rubidium 2 prime.	223/219	Y2
099	12	154	0147	0515	-153.1	86.70	*	10.1*	96.6	*Threshold test; no data available.	219	Y3
099A B	41	154	0659 1330	0930 1630	-153.6 -154.0	99.84		98.4	1-way		223	Y3
100	62	154/55	1843	0228	-152.3	98.28		96.3	97.3	1) Rubidium 2 prime. 2) Frequency converter problems any affect to data flow doubtful.	223/219	Y2

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
100	12	155	0200	0430	-153.4	10.01	99.0	90.7	98.3		223/219	N/A
100A B	41	155	0656 1256	0900 1630	-154.4 -153.9	97.25		99.3	1-way	1) (Receiver-1, SDA-1, TCP 'A') = prime.	223	Y3
101	62	155	2051	2330	-153.3	98.4		83.6	98.2	1) Rubidium 2 prime. 2) Transmitter problems. TFR 142344.	223/219	N/A
101	12	156	0150	0430	-151.9	94.97		91.9	98.5		N/A	N/A
101A B	41	156	0656 1501	1015 1730	N/A N/A	95.65		51.7*	99.9	*Threshold checks on pass 101A.	223/219	Y3
102	62	156/57	1855	0200	-152.9	98.9		95.3	88.6*	*Recall in progress. 1) Rubidium 2 prime.	223/219/221	Y3
102A B	41	157	0656 1330	0930 1630	N/A -154.6	100.0		99.9	1-way		223	Y3
103A B	62	157/58	1900	0200	-154.0	86.37	91.34*	93.6	97.5	1) Rubidium 2 prime. 2) TCP 'A' prime. *Recall percent. Present outages are: 1900-1936, 2214-2318.	223/219	Y2, Y3
103	12	158	0150	0430	N/A	99.7		88.2	99.2	1) No PTR in folder.	N/A	N/A
103A B	41	158	0656 1330	0930 1630	-153.6 -153.5	100.0		99.9	1-way only		223	X3
104	62	158/59	1900	0200	-153.6	99.7		96.4	97.8	1) Rubidium 2 prime.	223/219	X3
104	12	159	0150	0430	-153.4	99.1		82.6	98.5	1) (TCP 'A', SDA-2, RCV-2) = prime.	219	Y3
104A B	41	159	0655 1331	0930 1630	-154.7 -154.9	99.4		95.9	1-way		223	Y3

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
105	62	159/60	1900	0200	-154.3	97.46		96.4	98.3	1) Rubidium 2 prime.	223/219	Y2, Y3
105	12	160	0200	0400	-153.8	98.4		81.8	100.0	1) No PTR in folder.	N/A	Y3
105	41	160	0634	0830	-155.2	99.3		89.9	98.0		223/219	N/A
106	51	160/61	1407	0205	-153.3	94.6	94.50	97.3	1-way only	1) TFR 135037. 2) TFR 135162. 3) TFR 135242. 4) (TCP-B, SDA-2, RCV-2) = prime. *Recall percent. Present outages are 2134-2149, 0049-0054.	223	Y2
106	41	161	0630	0822	-155.1	99.4		86.7	98.0		223/219	N/A
107	62	161	2050	2330	-155.3	98.7		83.6	98.2	1) Excessive noise in the TDH dopp. data. TFR 142281 refers. 2) Rubidium 2 prime.	223/219	N/A
107A B	41	162	0630 1801	0950 1900	-156.1 -156.3	98.9		73.5	95.3 100.0		223/219	Y3
108	62	162/63	2304	0200	-156.2	95.0*		89.8	98.0	1) Rubidium 2 prime. *Receiver OOL for 5 minutes, increased % from 93.5 to 95.0.	223/219	
108	41	163	0627	0800	-151.9	98.9		83.0	96.2		223/219	Y2
109	62	163	1800	2200	-155.7	96.1		90.7	95.6	1) Rubidium 2 prime.	219/223	N/A
109A B	41	164	0626 1535	0830 1900	-158.1	98.8		88.5	98.5		223/219	Y2, Y3
110	51	164	1918	2230	-154.8	98.7		74.2	97.0	1) TFR 135037 refers.	219	Y3

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
110A B	41	165	0625 1230	0830 1530	-158.1 -157.1	98.7		89.5	100.0		223/219	X3
111	51	165	*	*	-154.6	99.6		99.5	1-way only	*No ACQ. and EOT times on PTR.	223	X3
111A B	12	166	0130 0700	0400 0930	-154.4 -153.6	98.5		87.4	99.4		219 223/219	Y2 X3
112	51	166/67	1600	0144	-154.8	96.7		99.2	1-way only	1) First 14 minutes, at 10 second rate, of TDH shows S/C ID as 72 in place of 71. 2) (RCV-2, SDA-2, TCP 'B') = prime.	223	X3, Y3
112A B	41	167	0609 1230	0830 1530	-156.5 -156.6	99.0		91.0	100.0		223/219	Y3
113	62	167/68	1746	0150	-152.9	97.6		60.9*	96.9	1) Aux. OSC test this pass. 2) Rubidium 2 prime. 3) First CC command delayed 3 minutes. (TFR 142286 refs.)	219/221/223	Y2
113	41	168	0607	1345	-156.1	96.4		97.3	97.2		223/219	Y3
114	62	168/69	2147	0130	-154.5	95.3		71.4	96.3	1) Carrier supp. test last part this pass. 2) Rubidium 2 prime.	223/219/221	Y2
114	51	168	1342	2145	-152.6	92.3	97.5	98.9	1-way 3-way only	1) TFR 135037 refers.	223	Y3
114A B	41	169	0602 1236	0830 1630	-154.8 -155.3	94.03	*	85.8 94.8	100.0	1) Receiver probs. TFR 137689 refers. *Time regressions in recall several outages remain.	223/219	N/A

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
115	62	169	2006	2300	-154.0	97.2		94.9	100.0	1) Rubidium 2 prime.	223/219	X2
115A B	41	170	0559 1342	1100 1630	-156.6 -155.8	98.11	*	93.6	100.0	*Recall percent, outage at present is 0748-0916.	223/219	Y3
116	62	170/71	1737	0146	-153.8	91.0	98.2	94.1	97.4	1) Rubidium 2 prime.	223/219	Y2, Y3
116	41	171	0557	0830	-156.7	98.2		89.6	97.8		223/219	Y2, Y3
117	51	171	1326	1934	-153.9	99.2		95.9	96.1	1) TFR 135037 refers.	223/219	Y3
117	41	172	0549	0931	-155.4	99.8		91.0	100.0	1) TFR 137693 (minor data loss).	223/219	Y3
118	51	172/73	1535	0128	-153.4	96.5		98.5	100.0	1) TFR 135037. 2) TFR 135277.	223	X3
118A B	41	173	0550 1233	0830 1530	-155.4	99.0		91.3 93.3	100.0		223/219	Y3
119	51	173/74	1525	0123	-154.5	98.5		95.4	95.9	1) TFR 135037.	223/219	Y3
119	42	174	0857	1530	-155.0	97.8		97.5	96.6		223/219	X3
119	41	174	0555	0833	-156.4	98.3		95.8	100.0		219	X3
120	62	174	1713	1900	-155.1	95.4		79.7	94.7	1) Rubidium 2 prime.	223/219	X2
120	41	175	0555	1233	-155.5	98.86		94.2	99.7		219	X2
121A	62	175/76	1710	1900	-154.9	98.0		84.4	*	1) Rubidium 2 prime.	223/219/221	X2
B			2236	0100						*Recall in progress.		
121	12	176	0431	0900	-156.8	89.5	*	0.0**	N/A	*Replay in progress. **SPE and CMD tests throughout pass, no good DCC's on TTY print.	219	X2, X3
121	41	176	1204	1532	-155.5	99.3		92.9	96.8	1) 43 minutes late acq, due to polarizer left on ant.	219/223	X3
122	62	176/77	2054	0000	-155.8	99.6		96.4	*	1) Rubidium 2 prime. *Recall in progress.	223/219	X2

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
122	11	177	0048	0900	-158.2	87.3	*	94.5	53.5	*Recall in progress. (0330-0419Z outage) 1) Special CMD test this pass.	N/A	N/A
123	51	177	1350	0100	-154.7	96.4		93.4	96.5	1) TFR-135037. 2) TCP 'A', receiver-1, SDA-1; prime. 3) Goddard CP probs.	219/221	X3
123	11	177/178	0100	0600	-157.5	92.75	*	94.5	95.0	1) μω drop probs. *Recall in progress. Outage 0100-0127Z 0240-0251Z	N/A	N/A
123	41	178	0850	1030	-156.4	98.9		94.1	98.0		223/219	X2
125	51	179/180	1400	0100	-155.0	97.9		80.4	95.9	1) TFR-135037.	223/219	X3
124	51	178/179	1400	0100	-155.0	90.6*		58.4	**	*Recall in progress. 1830-1930. **1-way only.	223/221/219	X3
124	12	179	0100	0600	-155.5	99.3		93.0	97.1		N/A	X2
125A 125B	41	180	0527 1206	0803 1503	-156.4	98.5		76.7	*	*1-way only.	223/219	Y2
126	51	180/181	1500	0100	-155.2	99.0		89.5	100.0	1) TCP a deficient part of one memory. 2) Deviations: RCV 1, SDA 1, TCP A.	223/219	Y2
126A 126B	41	181	0526 1204	0802 1502	-156.4	92.0		73.6	100.0	1) DIS mag tape stopped. 0620-0623. 2) DIS program hung up. 1250-1253.	223/219	Y2, Y3
127	62	181/182	1700	0030	-156.5	97.0		97.0	96.1	1) Deviations: NBR 2 prime.	223/219	N/A

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
127A 127B	41	182	0523 1205	0802 1502	-157.5	93.95	*	70.0	98.9	*Not recalled/OCC's.	223/219	X2, X3
128	62	182	1910	2130	-157.2	99.1		52.5	99.1	1) Deviations: Rubidium NBR 2 prime.	223/219	X2
128	41	183	0910	1201	-157.2	96.6		82.5	100.0		223/219	X2
128	12	183	0429	0854	-156.2	92.95*		59.7	100.0	1) Deviations: TCP BETA config. for receiver NBR 1, SDA NBR 1. *No recall /OCC.	221/220	X2
129	62	183	1700	2001	-157.0	97.0		94.4	97.1	1) Deviations: Rubidium NBR 2 prime.	223/219	X3
129	51	183	1512	1800	-155.6	N/A		44.3		1) Maser maintenance extended, pass abandoned at 1800. 2) Deviations: Started with 2-2-A but tried several different config. in attempt to improve TCP frame lock stability. 3) 1-way only.	223/219	N/A
129	12	183/184	2347	0230	-156.5	62.5[1]		81.8	99.0	1) TCP will not lock to SDA 2 0140. 2) Deviations: TCP 'B' initialized to receiver NBR 2 SDA NBR 1 from 0140-0230.	219	N/A
129A 129B	41	184	0519 1206	0801 1501	-158.5	99.1		87.7	95.9		219/223	X2, Y3
130	62	184	1904	2130	-157.6	97.9		95.0	*	*1-way only.	219/223	Y3
130A 130B	41	185	0526 1208	0802 1502	-158.4 -158.2	95.5		94.5	95.6		223/219	Y3
131	62	185	1830	2230	-157.2	99.5		94.4	100.0	1) No PTR in folder.	223/219	Y3

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
131A 131B	41	186	0525 1206	0802 1502	-158.2 -157.9	98.95		97.1	95.6	1) Incorrect doppler performance. 2) Deviations: RCV 1, SDA 1, TCP A prime. RCV 2, SDA 2, TCP B backup.	223/219	X3
132	62	186	1834	0100	-157.5	98.3		97.9	98.4	1) Deviations: Rubidium NBR 2 prime.	223/219	N/A
132A 132B	41	187	0525 1207	0902 1502	-158.1 -158.2	98.8		96.4	100.0	1) DIS program hung up 1218-27. 2) Deviations: 1, 1, A.	223/219	Y2
133	62	187	1831	2230	-157.3	99.3		95.8	100.0	1) Deviations: Rubidum NBR 2 prime.	223/219	Y2
133	14	187/ 188	0014	0829	-150.5	99.3		97.1	93.5	1) TCP B would not give correct header or lock up. 2) Deviations: TCP A replaced TCP B due to failure.	221/219	Y3
133	41	188	1136	1502	-159.0	97.3		94.3	97.8	1) APS drive would not read in correctly.	223/219	Y3
134	62	188	2107	2200	-157.8	95.8		96.2	100.0		223/219	Y2
134A 134B	41	189	0524 1207	0802 1502	-158.3 -158.0	98.8		93.7	99.8	1) Bad AGC calibration.	223/219	Y2, Y3
135	51	189	1930	2200	-156.5	93.48		76.3	99.1	1) No PTR in folder. 2) Comm. outage.	223/219	Y2
135	12	190	0803	0831	-158.0	73.0*		92.8	**	1) A non-scheduled TRK. 2) TCP B will not write. 3) TCP A excessive write errors and records lost. *Recall was not required due to their being only 350 frames available and 92 missing. **3-way only.	224	N/A

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
135	11	190	0006	0824	-158.6	49.88*		94.8	96.0	1) DIS failed to read doppler predict tape 0402-0446. *Recall in process.	N/A	X3
135	41	190	0924	1202	-157.8	99.0		94.1	100.0	1) DIS mag tape stopped 1120-23.	223/219	Y3
136	51	190	1908	2115	-156.4	89.8*		73.0	95.5	*Recall in process.	223/219	Y2
136	12	191	0315	0601	-158.8	98.3		80.5	98.5		219	N/A
137	51	191/192	1854	0030	-153.1	98.0		94.8	96.8	1) Deviations: RCV 2, SDA 2, TCP A.	223/219/221	Y2
137	41	192	0804	1202	-149.8	98.95*		90.4	99.0	1) Deviations: No angle calibration or boresights taken during pre cals. due to maser not cool. *Recall Percent.	223/219	N/A
138	62	192	1628	1830	-148.6	99.6		90.3	98.7	1) TCP A would not accept program. 2) Deviations: Rubidium NBR 2 prime.	223/219	N/A
138	12	192/193	2321	0550	-150.0	93.58		86.4	100.0	1) Deviations: HRT track-non STD.	223/221	N/A
138	14	192/193	2357	0816	-142.0	96.9		96.4	94.9		202/224/220/206	Y2
139A 139B	62	193	1631 2203	1830 0030	-148.6 -148.1	97.84*		87.9	100.0	1) Deviations: Rubidium NRR 2 prime. *Recall percent.	223/219	X3
139	41	194	0920	1132	-147.4	99.6		80.0	100.0		223/219	Y3
140	62	194	1833	2200	-148.0	98.0		90.9	98.2		223/219	Y3
140	12	196	0622	0824	-149.9	N/A		33.3	*	1) Deviations: DSN mode I this pass. *3-way only.	224	Y2

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
140A 140B	41	195	0525 1204	0802 1502	-147.1 -147.3	99.5		92.4	*	*1-way only.	223/219	A=Y3 B=N/A
141	14	195/ 196	0600	0809	-139.2	98.2		76.1	100.0		214	Y2
141A 141B	41	196	0554 1314	0932 1702	-148.2 -146.5	98.0		92.8	97.7	1) Deviations: TCP A prime from 0957.	223/219	A=Y2 B=Y0 @EOA
[illegible]2	62	196/ 197	2011	0039	-145.5	96.7		51.3	95.3	1) Deviations: Rubidium NBR 2 prime, 1-1-A stream used.	219/221/222/ 223	Y2
142	41	197	0805	1202	-146.3	98.67*		95.5	98.4	1) Deviations: Prime RCV 1, SDA 1, TCP A. *Recall percent.	223/219	Y2
143A 143B	62	197/ 198	1630 2131	1830 0030	-145.2 -145.3	95.0		97.0	97.2	1) Deviations: Rubidium NBR 2 prime.	223/219	Y2
143	41	198	0834	1702	-145.5	96.16*		98.9	100.0	*Recall percent. (present outage 1550-1604-2)	223/219	Y2
144	62	198	1700	2300	-145.6	99.2*		92.2**	97.4	1) Deviations: Rubidium NBR 2 prime. 2) CP problems at 62. *Recall percent. **First 2 hours and 25 minutes mission from TDH printout.	223/219	Y2
144	41	199	0457	1700	-144.8	98.9		94.5	99.7		223/219	Y3, Y2
145	51	199	1628	2132	-143.2	99.56		95.8	97.2		223/219	Y2
145	12	199/ 200	2301	0800	-143.2	99.7		89.9	98.2		223/219	Y2, Y3
146	62	200	1700	0030	-144.3	97.8		96.2	95.6	1) Deviations: Rubidium NBR 2 prime.	219	X2
147	12	201/ 202	2300	0500	-143.5	99.7		90.3	99.7		223/219	N/A

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
146	41	201	0458	1700	-144.4	98.8		97.3	99.3		223/219	Y2
147	51	201	1626	2132	-142.2	99.59		90.0	99.5		219	Y2
148	62	202	2000	2400	-142.9	96.3		89.6	100.0	1) Deviations: Rubidium NBR 2 prime.	219/221/223	Y2
148A 148B	51	202	1359 1841	1537 2031	-143.3 -143.2	96.5		90.8	100.0		223	Y2
148	12	202/203	2300	0730	-142.5	99.7		96.0	100.0	1) Deviations: RCV 1, SDA 1, TCP B, from 2300-0122.		
148	14	203	0425	0753	-136.0	98.7		91.3	97.7	1) Deviations: RCV 1, SDA 1, TCP A, used as prime.	219/206	Y2
148	41	203	0835	1631	-144.0	96.0		96.2	95.8		223/219	Y2
149	62	203	1600	2400	-143.4	99.0		97.0	94.5	1) Deviations: Rubidium NBR 2 prime.	224/219/221/223	Y2
149	12	204	0554	0740	-142.5	N/A		55.0	*	*One ψ 3-way only.	N/A	N/A
149	14	204	0553	0712	-133.0	0.0*		88.6	96.1	*Tapes sent in data pkg. not yet recalled.	202/208/212	N/A
149	41	204	0708	1631	-144.5	99.15*		96.7	98.7	*Recall percent.	224/219	Y2
150	51	204	1556	2100	-141.8	93.0*		91.6	95.9	*Partial minute outages throughout.	219/221/223	Y2
150	14	205	0644	0748	-136.0	99.6		75.3	100.0		202/204	X2
150	41	205	0908	1631	-143.0	99.71		95.2	99.5		223/219	X2, Y2
151	62	205	1600	1830	-142.5	99.2		96.5	97.8	1) Deviations: Rubidium NBR 2 prime.	219/223	Y2
151	14	206	0312	0730	-133.9	99.9		93.7	97.9		210/208/200	X2
151	12	206/207	2322	0633	-141.2	99.44*		93.7	98.4	1) Deviations: TCP B used to check microwave between DSS 12 and 14. *All data outages covered by DSS 14 have been excluded.	221/223/213	Y2

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
151	14	206/207	2324	0114	-135.2	94.34*		75.6	94.7	*All data outages covered by DSS 12 have been excluded.	212/202	Y2
152	62	206	1600	2400	-143.4	99.2		88.7	96.5	Deviations: Rubidium NBR 2 prime.	221/219/224	Y3, Y2
152	41	207	0622	1632	-143.3	99.8		98.1	99.8		219	Y2, X2
153	62	207	1600	2400	-142.3	99.47		81.0	96.7	Deviations: Rubidium NBR 2 prime.	219/224	N/A
153	12	207/208	2300	0738	-143.0	99.90		97.4	N/A		224	X2
153	14	207/208	2321	0741	-134.9	N/A		95.6	95.4		212/204/210/208/206	N/A
153	41	208	0619	1632	-143.2	99.8		95.2	98.0		223/219	Y2
154	51	208	1528	2330	-141.2	98.9		91.7	95.0		224/219	Y2
154	12	209	2300	0530	-141.6	99.9		95.1	99.2		219	Y2
154	41	209	0427	1632	-143.3	99.3		92.6	99.2		224/219	X2, Y2
155	62	209	1600	2400	-142.2	99.8		93.5	97.4	1) Deviations: Rubidium NBR prime.	219/223/224	Y2
155	12	209	2239	0750	-146.5	99.7		95.5	96.7		224/236/221	X2
155	14	209/210	2317	0736	-137.0	99.6		92.5	97.5		226/214/224	X2
155	41	210	0415	1655	-147.5	99.5 99.8*		95.5	95.7	*Data type 41.	223/224/221/234/233/231/235/236	X2
156	62	210	1544	0007	-146.5	96.8 98.5*		80.0	96.5	1) Deviations: Rubidium NBR 2 prime. *Data type 41.	221/219/223/224	X2
156	12	210	2237	0750	-146.3	91.3		85.2	99.2	DSS 12 data processed for 8 minutes only. Majority of data processed from DSS 14.	221/224	X2
156	14	210	2315	0734	-138.2	96.8		95.7	98.2		224	X2

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
156	41	211	0413	1655	-147.8	95.1 95.4*		93.4	99.6	*Data type 41.	223/221/233/235/236	X2
157	62	211	1542	2300	-146.4	96.5 97.0*		89.1	96.1	1) Deviations: Rubidium NBR 2 prime. *Data type 41.	231/233/235	X2
157	12	211/212	2235	0745	-146.9	88.9* 42.0**		76.1	98.3	*Data type 22: (partial minute outages) 211/2300-211/2316 required to increase percent. **Data type 42, outage: 0624-0647.	224/223/221/259	X2
157	14	211/212	2314	0615	-138.0	98.1		93.0	95.7		224/234	X2
157	41	212	0410	0613	-148.1	N/A		79.5	*	*3-way only.	224/252/254	N/A
157	42	212	0618	1600	-144.2	98.7 87.2*		92.9	100.0	1) Deviations: RCV 1, SDA 1, TCP B, 33-1/2 eng., RCV 2, SDA 2, TCP A, 270 science. *Data type 42, partial minute outages throughout 212/1230-212/1400 required to increase percentage.	N/A	N/A
158	62	212	1540	0002	-143.8	98.8 99.4*		92.8	95.2	1) Deviations: Rubidium NBR 2 prime. *Data type 42.	200/255/257	X2
158	12	212/213	2233	0745	-145.0	99.9*		94.9	85.1	*Data type 42.	224/221/257	X2, Y2
158	14	212/213	2311	0131	-137.0	99.3		97.6	100.0		224/220/234/200	Y2
158	42	213	0626	1600	-142.3	99.6		96.1	99.4		N/A	N/A
159	62	213	1539	2050	-141.0	96.9		94.8	97.5	1) Deviations: Rubidium NBR 2 prime. 2) C/P fault at 1905.	224/219	X3

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
159	51	213	2135	2330	-140.5	99.6		24.1	100.0		223/219	X2
159	11	213/214	2304	0730	-142.2	99.9		92.3	95.0		N/A	N/A
159	42	214	0304	1600	-142.8	99.5		95.4	99.1		N/A	X2
160	51	214	1458	2332	-140.5	98.6		95.5	97.9		224/219	X2
160	11	214/215	2301	0730	-143.0	99.9		91.5	95.7	1) Deviations: Transmitter NBR 2 used in place of NBR 1 TFR 138725.	N/A	N/A
160	42	215	0303	1600	-142.3	98.0		95.3	99.4	1) Deviations: at 1056 config. change to RX 1 SDN 1 TCP A.	N/A	N/A
161	51	215	1456	2330	-140.4	98.7		91.0	95.5	1) Deviations: RCV 2, SDA 2, TCP B.	224/219	Y2
161	11	215/216	2300	0730	-143.1	98.7		91.3	97.2	1) Deviations: Transmitter NBR 2 used in place of transmitter NBR 1.	N/A	N/A
161	42	216	0303	1600	-142.2	99.3		95.5	95.6		N/A	N/A
162	51	216	1454	2338	-140.5	94.2*		92.0	96.2	*Outage: 216/1816-216/1844.	224/219	X2
162	11	216	0403	0630	-142.5	100.0*		73.8	97.2	1) Deviations: Transmitter No. 2 used in place of transmitter No. 1 TFR 130827. *217/0414-217/0630 - HSD not transmitted due to MM7 encounter.	N/A	N/A
162	42	217	0524	1600	-143.0	99.3*		94.0	98.1	1) Deviations: RCV 2, SDA 2, TCP A. *217/0524-217/0704 - HSD not transmitted due to MM7 encounter. Note period overlaps with previous station.	N/A	N/A

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
163	51	217	1444	2332	-141.0	99.2		88.6	98.4	1) DSS had communication problems.	224/219	X3, X2
163	11	217	2256	0630	-145.3	99.2		93.6	96.2	1) Deviations: Transmitter NBR 2 used in place of transmitter NBR 1.	N/A	N/A
165	62	219	1534	2330	-144.0	98.8 89.7*		97.2	97.3	1) Deviations: Rubidium NBR 2 prime. *Data type 42, partial minute outages throughout 219/1621-219/2329z.	223/221/257/255	X3, X2
165	12	219/220	2230	0700	-146.8	49.4*		97.0	97.1	*Data type 42, partial minute outages throughout 220/0512-220/0700z.	224	X2
165	14	219/220	2300	0701	-138.8	99.2		93.1	96.6		224/220/216/218	X2
165	41	[illegible]	0554	1600	-145.5	99.6 86.3*		97.1	98.6	*Data type 42, partial minute outages throughout 220/0700-220/1200z.	260/255	N/A
164	51	218	1405	2330	-141.0	87.6*		84.1	94.2	1) Deviations: RCV 2, SDA 2, TCP B. *Outage: 218/1547-218/1645.	219	X2
164	11	218/219	2255	0630	-142.3	99.1		93.6	97.0	1) Deviations: Transmitter NBR 2 used in place of NBR 1.	N/A	N/A
166	62	220	1530	2330	-146.1	96.8 97.3*		96.4	96.4	1) Deviations: Rubidium NBR 2 prime. *Data type 42.	260/255/257/223	X2
166	14	220/221	2257	0701	-138.0	99.0		95.8	95.1		N/A	X3
166	41	221	0554	1600	-145.5	96.8 72.8*		97.1	99.4	*Data type 42, partial minute outages throughout 221/0735-221/1500z.	260/255	X3

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
167	62	221	1530	2330	-144.6	99.0 42.2* 99.8**		92.7	97.3	1) Deviations: Rubidium NBR 2 prime. *Data type 47, partial minute outages throughout 221/1605-221/1636z. **Data type 44.	254/255/260	X3
167	12	222	2217	0700	-149.0	99.2* 100.0*		94.6	95.9	*Data type 44, outage: 222/0000-222/0336z. (Both data type 44 and 22*) caused by broken D-5 log tape, not yet replaced.	224/219	X3
167	41	222	0553	1600	-144.2	99.6 3.7*		97.5	99.6	*Data type 42, suspect S/C recorder probs.	260/255	Y3
168	62	222	1530	2330	-144.7	99.5 3.25*		96.0	97.7	1) Deviations: Rubidium NBR 2 prime. *Data type 42, suspect S/C recorder probs.	254/255	Y3
168	12	222/223	2215	0700	-145.4	99.7 .030*		88.5	99.0	*Data type 42, suspect S/C recorder probs.	N/A	N/A
168	42	223	0545	1600	-144.4	96.3 2.7*		96.1	99.8	*Data type 42, suspect S/C recorder probs.	N/A	N/A
169	62	223	1530	2341	-144.5	99.5 100.0*		96.1	97.8	1) Deviations: Rubidium NBR 2 prime. *Data type 44.	260/257/221/219	X3
169	14	223/224	2253	0701	-138.0	99.2		91.8	82.0		N/A	X2
169	41	224	0546	1600	-144.2	89.0*		97.5	99.6	*Outage: 224/0906-224/1001z.	224/219	X2, X3
170	62	224	1530	2330	-143.5	98.0		93.7	94.5		201/224/219/221	X3, X2
170	14	224/225	2251	0703	-138.0	96.0*		95.9	96.0	*Outage: 225/0534-225/0550z.	N/A	X2

Table A-1 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
171	62	225	1530	2314	-143.4	98.2		95.6	97.9	1) Deviations: Rubidium NBR 2 prime.	201/223/219/221	X3, X2
171	14	225	2249	0703	-146.0	98.1		82.4	95.0		N/A	X2
172	62	226	1759	2000	-142.8	96.7		94.2	97.9	1) Deviations: Rubidium NBR 2 prime.	223/219	X2

Table A-2. DSN operations log for Mariner 7

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
013	62	098/9	2228	0530	-137.3	98.05		95.9	97.9	TCP Alpha down throughout pass for trouble-shooting, no effect on operations since TCP Beta utilized.	220/224	X2
013	12	099	0519	1110	-137.1	97.95		96.0	97.2		220/223	N/A
013	41	099	1023	2000	-138.0	97.95		94.5	96.2	DIS Mag tape failure, 3 minutes data lost.	219/220/222/223/224	Y2
014	62	099/100	2223	0300	-138.3	98.02		96.4	94.9	TCP Alpha inoperative 2310-57, SDA 150 amp feed defective, backup TCP log tape lost.	219/220/223	N/A
014	12	100	0514	1110	-139.1	98.11		95.2	99.1		220/224	N/A
014	41	100	1026	2000	-138.4*	98.11		97.9	96.2	*Receiver AGC Calibration curve incorrect, making downlink S/S unreliable.	219/220/222/224	N/A
015	62	100/1	2223	0300	-138.8	97.82		96.8	96.7		219/220/223	X2
015	12	101	0509	1110	-137.5	97.04		96.4	98.1		220	X3
015	41	101	1028	2000	-137.5	97.04		98.1	99.6	1) Transmitter failed 1255, beam HV ac O/L, 6 seconds data lost. 2) 6 mins HSD lost due to faulty patch at GSFC.	220/222/223/224	N/A
016	62	101/2	2214	0300	-138.9	98.30		88.2	88.4*	TDH recall in progress.	219/220/223	N/A
016	12	102	0505	1110	-138.3	99.4		96.4	97.8		220	N/A
016	41	102	1028	2000	-138.3	99.4		98.1	100.0	Combat failure resulted in 2 minute HSD lost, 1524-26.	220/223/224	N/A
017	62	102/3	2218	0300	-139.8	99.41		94.0	98.1	DSS reported down-link S/S varying 3 db on both receivers apparent S/C problem uplink acquisition delayed 30 minutes.	219/220/223	N/A
017	12	103	0500	1105	-138.7	99.42		94.0	97.9	None. Apparently varying down-link S/S was DSS-62 problem.	220/224	N/A
017	41	103	1028	2000	-140.2	99.42		98.3	97.8		219/220/222/223/224	N/A

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
018	62	103/4	2213	0300	-140.2	98.10		96.9	98.1	DIS monitor program hung, reloaded, 2 minutes, 25 seconds data lost.	219/220/223	N/A
018	12	104	0505	1310	-138.8	96.77		96.9	97.6	Receiver 1 locked from AOS-0606 on side-band.	219/220	Y3
018	41	104	1834	2100	-140.6	96.77		93.2	95.9		219/220/221/223	N/A
019	62	104/5	2208	0230	-140.6	97.30		96.6	97.5		219/220/223	N/A
019	14	105	0525	1253	-132.1	97.78		97.8	97.4	1) Recorder A inoperative from AOS-0831, head magnetized during maintenance. 2) Antenna to brake at 0729, cause unknown.	220/223	Y2
019	41	105	1002 1833	1230 2100	-140.8	97.78		96.7	98.2	DSS tracked S/C H71 from 1231-1832.	219/221/223/224	N/A
020	62	105/6	2203	0230	-141.0	N/A		97.0	97.9		219/220/223	Y2
020	41	106	0959 1833	1232 2100	-141.4	91.49	96.80	93.3	95.4	1) DIS mag tape stopped, 9 minutes data lost, cause unknown. 2) DSS tracked S/C-71 from 1233-1832.	219/220/223	N/A
021	62	106/7	2157	0145	-142.0	95.12		94.2	97.0	1) 2 ranging samples lost.	219/220/223	N/A
021	41	107	0958 1830	1230 2100	-141.2	98.29		93.7	98.0	1) DSS switched to S/C 71 from 1231-1829. 2) Maser failed prior to AOS paramp utilized. 3) Wrong XA punched up. Operator error, 2-way delayed 3 minutes.	219/220/221/223	N/A
022	62	107/8	2152	0130	-140.1	97.01		89.5	96.4	DSS unable to range during pass, cause undetermined.	219/220/223	N/A

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
022	41	108	1000	1755	-140.9	95.06		96.7	0*	1) Excessive write errors on backup TCP beta, back-up TCP tape lost for 3 hours. 2) DIS mag tape stopped by operator error, 5 minutes. Data lost. *All 1-way TDH.	223	N/A
023	62	108/9	2125* 0230	2315 0330	-140.4	95.60		92.5	95.4	*1) Initial AOS to close to horizon, causing S/S fluctuations, uplink AOS delayed 15 minutes. 2) DSS tracked S/C-71 2316-0229.	219/223	N/A
023	41	109	0941 1631	1043 1730	-141.8	96.21		85.8	95.5	1) DSS tracked S/C 71 1044-1630.	219/223	N/A
024	62	109/10	2120 0230	2340 0330	-140.7	96.01		85.5	96.3	1) DSS tracked S/C 71 2341-0229. 2) Exc VCO anomaly caused momentary OOL during second track.	219/223	N/A
024	41	110	0934 1632	1037 1730	-142.2	95.80		86.3	97.1	DSS tracked S/C 71, 1038-1631.	219/223	N/A
025	62	110/11	2116 0058	2314 0200	-142.7	96.51		90.6	97.2	1) DSS unable to range during pass, cause unknown.	219/220/221/223	N/A
025	41	111	0929	1200	-143.5	97.31		95.6	72.5*	1) DSS unable to acquire ranging, possible S/C problem. *TDH recall in progress.	219/221/223	N/A
026	62	111/12	2115	0130	-142.5	98.11		92.6	97.3	1) Unable to lock ranging receiver, probably S/C problem.	219/220	N/A

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
026	41	112	0926 1800	1200 2030	-141.9	98.71		90.8	97.8	1) 0940Z:0 Seal broke in HA hydraulics, antenna was driven ahead of S/C and repair effected without losing lock. 2) AOS-0945, HSD lost due bad HSD line.	219/220/223	N/A
027	62	112/3	2106	0130	-142.0	98.20		92.0	86.0	1) First attempt to acquire uplink failed, reason unknown, uplink AOS delayed 10 minutes. 2) TDH recall in progress.	219/223	N/A
027	14	113	0536	1224	-135.4	97.78		98.6	98.8	Acquisition delayed 1 hour, 16 minutes due faulty test translator.	223	Y2
027	41	113	1800	2030	-142.9	97.78		96.0	98.3		219/220/221/223	X2
028	62	113/4	2101	0130	-142.8	97.01		95.2	96.9	Several receiver glitches shortly after AOS due early close to horizon mask.	219/220/223	X2
028	14	114	0410	1210	-134.2	96.31		97.4	97.7		220/223	X3
028	42	114	1731	1930	N/A	96.31		75.6	96.4	1) DSS failed to record TLM on both analogs TFR 42/REC/108181. 2) Paramp utilized due insufficient turnaround time.	221	X3
028	41	114	1802	2030	-143.4	96.31		84.6	99.0	1) DSS dropped uplink at 1913, DSS unable to determine cause.	219/221/223/224	X3
029	62	114/15	2130	0130	-143.7	96.31		92.9	96.6	DSS transmitter failed 0051, focus magnet current tripped, reacquired uplink 0101.	219/223	X3

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
029	41	115	0926 1800	1200 2030	-144.4	0*		85.9	98.8	DSS tracked MM-6 1200-1800 *DPS failed to log TLM, TCP tapes will be played back.	219/220/223	X2, X3
030	62	115/6	2130	0130	-142.4	0*		93.4	66.3**	215353, DSS dropped uplink due tuning back to TSF too quickly, reacquired 2157. **TDH recall in progress, not all TDH logged by 44. *DPS failed to log TLM, TCP tapes will be replayed.	219/223	X2
030	41	116	0928 1800	1200 2030	-143.1	0*		93.7	100.0	DSS tracked MM-6 1200-1800. *DPS failed to log TLM, TCP tapes being replayed.	219/223	X3
031	62	116/7	2116	0100	-143.1	0*		96.3	97.7	*DPS failed to log TLM, causes unknown. TCP tapes being replayed.	219/223	X3
031	41	117	0926 1800	1200 2030	-143.8	97.93		93.8	97.1		219/223	Y3
032	62	117/8	2100	0130	-143.2	97.13		95.9	94.7		219/223	Y3
032	41	118	0900	1600	-143.8	95.61		98.1	93.2*	*TDH recall in progress.	219/223	N/A
033	62	118/9	2055 0333	2235 0428	-143.5	96.25		85.1	95.6	DSS tracked MM-6, 2236-0330.	219/223	N/A
033	41	119	0857	1145	-144.0	96.98		95.3	97.8		219/223	N/A
034	62	119	2050	2205	-144.8	96.98		85.5	96.4		219/223	Y2
034	41	120	0854	1145	-144.5	97.57		95.3	97.8		219/223	N/A

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
035	62	120	2100	2317	-144.6	97.51		95.7	98.5	DSS utilized paramp as maser in cool down.	219/223	X2
035	12	121	0324 1028	0445 1200	-143.6	93.46	95.46	82.2	97.7	0446-1027, DSS tracked MM-6.	219/223	X3
035	41	121	1801	2101	-145.2	93.46	95.46	89.5	95.7		219/221/223/224	X2
036	62	121	2040	2150	-144.4	93.46	95.46	83.1	98.2	Paramp prime, maser in cool down.	219/223/224	X2
036	14	122	0405	1149	-136.0	97.61		94.2	96.3	DIS inoperative throughout pass. Cause unknown.		N/A
037	62	122	2100	2247	-145.6	97.61		94.6	78.9		219/223/224	X
037	41	123	1200	1300	-145.8	71.83*		75.0	91.8	*Playback in progress.	219/223	N/A
038	62	123/4	2100	0400	-145.4	81.21*		97.4	88.4	*Playback in progress.	219/223	X
038	41	124	1200	1300	-145.9	95.30		81.7	100.0		219/223	Y
039	62	124/5	2100	0100	-145.7	95.72		93.8	97.5		219/223	Y
039	12	125	0805	0900	-145.9	98.46		83.9	100.0		219/221	N/A
040	62	125/6	2030	0100	-146.2			91.5	93.7		219/223	Y2
040	41	126	0958	1200	-146.6			92.7	97.3		219/223	N/A
041	62	126/7	2030	0100	-147.3			90.0	86.2		219/223	N/A
041	41	127	1000	1200	-147.2			88.3	100.0	1001-04: Antenna drove off in HA interrogator, DSS retained lock.	219/223	N/A
042	62	127/8	2030	0100	-148.0			91.9	94.0	2157:56-2205, uplink lost as transmitter failed, uplink reacquired 2208:57.	219/223	X2
042	12	128	0254	1135	-146.4			98.5	98.8		219	Y3
042	41	128	1301	2050	-147.4			98.6	98.9		219/221/222/223	X3

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
043	12	129	0330 0909	0530 1130	-146.7			92.1	93.3	0531-0907-DSS tracked MM-7.	219	X3
044	51	129	1547	2200	-146.3			97.8	81.2	1) HSD cross-patch caused erroneous TCP outputs, 1849-1905. 2) Spurious voltages between TCP "B" and SDA 2, utilized by pass cable to resolve.	219/221/223	Y3
044	62	129/30	2230	0100	-146.5			92.0	94.9		219/223	Y2
044	41	130	1002	1200	-147.7			86.6	93.3		219/223	N/A
045	62	130	2030	2330	-148.5			93.9	97.9		219/223	X3
045	12	131	0839	1127	-145.9			87.5	97.6		219/223	N/A
046	62	131	2030	2130	-147.7			83.3	100.0	Antenna to aided track, vice auto track, as HA low speed tach failed.	219	
046	12	132	0630	0830	-147.1	89.41*		72.7	90.2	1) DIS line printer inoperative throughout pass. 2) 0704, 0730 - Generators failed twice, dropping transmitter, at 0731, switched to commercial power. 3) AOS 0630, TCP did not TIL 0648, no explanation from DSS. * Playback.	219/224	Y3
046	41	132	1432	2039	-147.7	92.79 **		46.6*	90.8	* DSS conducted RFS and ranging test, accounting for poor TTY TDH percent. **Playback in progress.	219/223	Y2

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
047	62	132	1940	2330	-148.6	69.29*		64.5	96.5	1) 1940-2111, both TCD's unable to sync properly on PN, TLM bad 1 hour, 31 minutes. * Playback in progress.	219/223/224	Y2
047	14	133	0310	0900	-139.2	95.26		96.0	0.0	1) 0327-0352, TCP would not eliminate sub-comm word 56 until allowable bit errors set to 0. 2) TDH total available low because of aided track.	219/221/223	Y2
047	41	133	1034	1300	-148.5	89.89*		89.8		* Playback in process.	221/223	Y2
048	62	133	1936	2100	-148.4	97.70		88.2			219/223	Y2
048	12	134	0500	0700	-147.0	96.79		90.1			219/223	N/A
049	12	135	0801	0950	-149.1	85.67	*	85.4	96.0		217/223	X3
050	51	135/6	2037[2)]	0200	-147.2	84.11	*	0.0[1)]	100.0	1) DSS conducted S/C receiver best lock frequency test. However DSS consistently showed erroneous DCC readings on TDM printout. In addition SDA suspects validity of all angle and doppler readings taken during pass. Therefore, percentage of good TDM samples received is considered '0'. 2) Acquisition delayed 2 hours 8 minutes due misunderstanding by DSS personnel of scheduling TDX. 3) CEC timing flash faulty, TFR 135158. 4) No power 2 lock indication at AIS TFR 135157.	219	Y3
050	41	136	1101	1400	-149.4	99.64		92.7	100.0		219/223	Y3

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
051	51	136	1525	1900	-148.2	31.39	*	79.1	94.2	1) Punch 1 faulty, changed to punch 2, TFR 135159. 2) TCD hatch panel defective, necessary to cable directly between SDA 2 and TCP, TFR 135160. 3) DSS utilized paramp deviation from configuration not noted on post track report. 4) 1526-1530 and 1851-55, DSS indicated 2-way on TDH printout while actually 1-way. 5) TDH indicates receiver OOL 1713-14. No mention of this on post track report. * Replay in progress.	291	Y2
051	41	137	1101	1400	-149.8	N/A	N/A	93.9	99.3		219/223	Y3
052	51	137/8	1515	0312	-148.3	95.20		90.4	96.8	1) Paramp utilized as maser is still down. 2) TCP "A" down, "B" used as prime TFR 135037. 3) CEC galvo lamp inoperative TFR 135162.	291	X3
052	41	138	1102	1400	-147.5	99.21		93.9	100.0		219/223	X3
053	51	138/9	1521	0230	-147.5	97.52		74.5	99.0	1) Wrong S/C ID on TDM printout, 71 in place of 72, 139/0023-0044. 2) Erronous DCC on TDH, 0039-46 and 0043-46. 3) DSS unable to acquire uplink on first attempt due too rapid tuning rate. 4) TCP 'B' down due unstable AID converter TFR 135164.	219/223	Y3

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
										5) SDA-2 150 amp down, TFR 135163. 6) CEC recorder still down with power supply problem. 7) DSS tracked MM-7, 1901-0115. 8) DSS continues to give incomplete descriptions of anomalies on post track reports, i. e., no description of corrective action taken or of effect on mission support.		
053	41	139	1006	1230	-148.7	94.09	*	93.1	97.2	1) 1006-1136: SDA 2 unserviceable due missing -15V from 10 MC/5 phase shifter. No backup path stream for period. TFR 41 SDA 137603.	219/223	X3
054	51	139/40	1929 0029	2130 0230	-148.8 -148.4	90.01	*	83.1	100.0	1) DSS tracked MM-6, 2131-0025. 2) Psuedo-residuals in Apollo format. 3) HSD out from 0106→01118 due to line trouble.	219/223/225	X2
054	41	140	1002	1030	-150.1	99.6		98.6	100.0		219/223	X3
055	51	140/1	1918 0100	2130 0230	-148.2 -148.1	95.69		79.9	96.5	1) 141/0010-0023, wrong S/C ID on TDH printout, 71 in place of 72. 2) DSS tracked M-6, 2131-0109. 3) TCP 'A' still down, missing memory stack. 4) Excessive heavy hits on HSD line.	219/223	X3, X2

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
055	41	141	1002	1230	-150.4	98.94		91.4	100.0		219/223	Y3
056	51	141/2	1923	0230	-149.4	88.96	*	79.0	99.1	1) DIS difficulties precluded output of monitor data. This anomaly not mentioned on post track report. 2) DSS tracked M-6, 2131-3009. 3) Uplink dropped 19-12, faulty tuning pot. TFR 135174. 4) TDH DCC consistently erroneous from AOS throughout good 2-way for both tracks. * Replay in progress.		Y2
056	41	142	1000	1800	-151.2	96.94		79.0	99.1	1) DSIF conducted S/C command threshold test. 2) DSIF displayed wrong DCC: AOS-1013, 2-way in place of 1-way.	219/221/223	Y3
057	51	143	0015	0230	-149.7	95.19		62.5	69.0**	1) DSIF performed S/C receiver degradation investigation. 2) DSIF displayed erroneous DCC during tuning and after acquiring uplink, duration 36 minutes. 3) DIS inoperative, no monitor data available. TFR 135173. 4) CEC still down, TFR 135172. 5) TCP 'A' still down, no ETO available. ** Recalled.		Y2

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
057	41	143	1004	1230	-150.8	98.09		98.0		1) 1-way track. 2) Paramp down for maintenance. TFR 41/uwv/ 137621.	223	Y3
058	51	143/4	1922 0005	2130 0230	-149.8	94.69	*	89.1	99.2	1) 2131-0004, DSIF tracked MM-6. 2) CEC, TCP 'A' and DIS all still down, ETO's not available, no monitor data available.		Y2
058	41	144	1000	1230	-151.1	98.76		99.0	100.0	1) Paramp still down for maintenance.	219/223	Y2
059	62	144/5	1850	0230	-150.6	99.83		97.2	98.2	1) Rubidium #2 prime.	219/223	X3
059	41	145	1001	1230	-151.3	96.93		98.2	98.2		219/223	Y3
060	62	145/6	1900 2331	2100 0200	-150.9	98.28		77.8	97.2	1) 2005-2100, both TDS bad, DSS pulled TDH off line at 2040 to rectify problem. 55 minutes of TDH lost of garbled TFR 1-12305. 2) 0116-0120, DIS computer stopped due mag tape vacuum motor failure. TFR 1-12306. 3) Rubidium #2 prime.	219/223	Y3
060	14	146	0221	1075	-142.6	92.02	*	96.1	97.3	*Replay in progress.	219/223	Y3
060	41	146	1032	1430	-151.3	99.9		99.2	*	* 1-way only.	223	Y3
061A 061B	62	146 147	1832 0100	2030 0230	-151.0	98.3		91.4	97.0	1) Rubidium #2 prime. 2) MM-7 transmitter M = 9kw. 3) TCP'B" probs, to TCP 'A' ≈10 minutes data lost.	223/219	Y2
061	41	147	0931	1430	-151.6	98.49		99.8	*	* 1-way only.	223	Y3

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
062	62	147/ 148	1830	0230	-151.0	97.4		96.2	97.0	1) Rubidium #2 prime. 2) MM-7 transmitter M = 9kw.	219/221/223	Y3
062	41	148	0728	1430	-152.2	99.7		99.1	*	* 1-way only. 1) TFR 41/FTS/137554.	223	Y3
063A 063B	62	148/ 149	1830 0001	2030 0230	-151.4 -151.3	97.3		90.7	97.2	1) Rubidium #2 prime. 2) MM-7 transmitter M = 9 kw. 3) MO prog. probs. 53 minutes back-up data lost.	219/223	Y3
063	12	149	0758	1000	-152.5	98.92		84.6	95.7	1) Receiver-1 SDA-1 TCP'A' used as prime from 0822 → EOP. Not recalled project TCP 0/0/L 0800-0822.	217/219	
063	41	149	1200	1937	-152.1	96.6		86.0	99.2	1) Special frequency test this pass. 2) TFR 41/TDH/137641 broken TDH tape, 15 minutes data lost.	221/222/223	Y3
064	62	149/ 150	1852	0245	-152.1	95.55		84.2	97.0	1) Frequency test this pass. 2) Rudibium #2 prime.	219/221/ 223/224	N/A
064	12	150	0230	1025	-151.2	98.71		97.2	97.8	1) TFR-12-1100-142681 bad disc mag tape unit TCP 'B'. 2) TFR-12-1100-142683. 3) Receiver-1, SDA-1, TCP 'A'.	219	Y3
064	41	150	0954	1830	-152.4	98.9		96.8	*	* 1-way only pass. 1) TFR/41/receiver/137642. 2) Goddard CP recovery from 1533 → 1539.	223/224	Y3
065	62	150/ 151	1817	0240	-152.2	99.89		97.2	98.1	1) Rubidium #2 prime.	219/223	Y2

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
065	12	151	0516	1000	-150.8	98.65		93.3	98.5		219/223	Y3
065	41	151	1301	1700	-153.2	91.62	99.0**	99.3	*	* 1-way only. ** 99 percent with recall.	223	Y3
066	62	151/152	1815	0239	-152.3	99.33		97.2	98.1	1) Transmitter VCO FCY missing in DIS data. DIS comp. software prob.	219/223	Y3
066	12	152	0530	1000	-149.3	91.95	*	95.5	98.8	* Not recalled (project). TCP tape bad. 1) TFR-12/1100/142685. 2) TFR-12/0100/142684. 3) TFR-12/1100/142686. 4) (TCP 'A', SDA-2, receiver-2) = prime. TCP 'B' prime from 0726→ EOP.	219	Y3
066	41	152	1300	1700	-153.2	98.02		99.6	*	* 1-way only.	223	Y3
067	62	152/153	1811	0236	-152.2	99.0		95.8	94.1	1) Rubidium #2 prime. 2) Minor anomalies with no minor outages.	223/219	Y3
067	41	153	0930	1330	-153.3	95.92		99.7	*	* 1-way only.	223	Y3
068	51	153/154	1627	0200	-151.8	98.5		83.0	85.2*	* Recall in process. 1) TCP 'A' still down. 2) (TCP 'B', receiver-2, SDA-2) = prime.	219	Y3
068	12	154	0536	0845	-151.7	77.56*	*	**	98.8	* Special threshold test this pass. ** Data ignored from: 0534→ 0842 due to special tests.	223	Y3

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
068	41	154	0930	1330	-153.9	82.82*		99.8	**	** 1-way pass only. * Recall percent. Present outage 1013-1057.	223	Y3
069	51	154/155	1414	0210	-151.7	96.73		89.4*	96.7	* Comm. line probs. and Goddard CP probs. 1) TCP 'A' still down (old TFR). 2) CEC still down (old TFR). 3) Tape prob. on B recorder TFR-135-238.	219	Y3
069	12	155	0437	0700	-152.7	92.9	99.8*	90.1	99.2	* Recalled percentage.	219	Y3
069	41	155	0900	1230	-153.3	94.32	*	98.0	**	* Not recalled (project). ** 1-way pass only. 1) Receiver probs. TFR-137659 refs.	223	Y3
069	42	155	1205	1630	-153.0	97.87		92.1	99.5	1) TWM-2 down for maint. 2) Ant. probs., ant. to slave at 1404Z → E.O.P.	N/A	N/A
070A 070B	62	155/156	1830 2340	2030 0200	-152.8 -153.1	97.26		83.8	96.2	1) Rubidium 2 prime.	223/219	Y2 Y3
070	12	156	0435	0700	-152.3	97.97		89.0	96.8		N/A	Y2
070	41	156	1016	1500	-153.4	96.38		46.5*	97.1	* S/C SPE test from: 1030 → 1335Z.	223/219	Y3
071	51	156/157	1627	0200	-152.5	98.53*	*	90.4	96.6	* Not recalled (project). TCP out 0108-0200. 1) TCP 'A' still down TFR-135037. 2) CEC down TFR-135162. 3) Frequency conv. probs. TFR-135241.	219	Y3

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking			DSIF/MCD	DPS Mode
						HSD	Total Available	TTY TRK	Total Available			
										4) TDH punch probs. TFR-135243. 5) APS memory probs. TFR-135242. 6) TCP 'A' mag. tape prob. TFR-135244.		
071	41	157	0930	1330	-153.9	98.99*		99.8	1-way	*After recall.	223/224	Y3
071	12	157	0103	0954	N/A	95.8	98.0	89.3	97.6	1) Special tests this pass.	219	Y3
072	51	157	1625	0200	N/A	98.5		93.7	95.0	1) TFR-135037 (TCP 'A' prob.). 2) TFR-135162 (CEC prob.). 3) TCP tape valid. N/G TFR-135244. 4) Due to date line probs. throughout pass many data loss. Recalled and sent at 1600z day 158. Out 1649-2236. TCP did not log.	219	Y3
072	41	158	0930	1330	-153.3	100.0		99.5	1-way		223	X3
072	12	158	0430	0700	-154.4	88.9	98.0	89.2	99.2	1) Changed to: Receiver-2, SDA-2, TCP 'A' at 0511z. 2) Test: TWX 06/2112z June refers.	N/A	N/A
073	51	158/159	1625	0159	-153.1	98.2		94.4	95.7	1) TFR-135037. 2) TFR-135162. 3) TFR-135242. 4) TFR-135244.	219	X3
073	12	159	0431	0700	-154.4	99.5		91.3	98.5	1) (TCP 'A', RCV-2, SDA-2) = prime.	223/219	Y3

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
073	41	159	0930	1330	-154.8	99.5	-	99.89	1-way		223	Y3
074	51	159/60	1627	0155	-153.4	100.0	-	97.5	1-way	1) See Pass-73 DSS-51 on previous sheet. 2) Rev. 2, SDA-2, TCP 'B' (thru TCD).	223	Y3
074	12	160	0403	0630	-153.7	99.5	-	91.2	98.4		219	N/A
074	41	160	0830	1230	-153.4	99.5	-	91.7	100.0		223/219	Y3
075	62	160/61	1744	0118	-151.8	98.4	-	45.0	100.0	1) Rubidium 2 prime TCP 'A' prime. 2) Special CMD and thresh. test this pass.	223/219/221	Y2
075	12	161	0100	0952	-151.5	90.7	99.0	25.0	95.0	1) S/C threshold test this pass.	219/218	Y2
075	41	161	0829	1801	-151.4	87.65	90.67*	55.3	98.0	1) Threshold testing this pass. *Recall percent.	223/219	Y3
076A	62	161/62	1800	2048	-152.1	97.1	-	59.7	96.4	1) Threshold test this pass.	224/223/219	Y3
076B			2348	0200	-152.5			84.7				
076	12	162	0200	0950	-152.8	97.6	-	69.1	98.5	1) Carrier suppression test this pass.	219	Y2
076	41	162	0951	1800	-152.6	92.9	96.5	68.3	97.1		223/219	Y3
077	62	162	1800	2300	-152.4	98.0	-	95.0	95.7	1) Threshold test this pass.	219/224/223	Y3
077	41	163	0803	1806	-154.0	98.8	-	61.6	99.9	1) Threshold testing this pass and suppression testing.	223/219/221	Y3
078	62	163/64	2204	0200	-152.4	99.1	-	78.9*	99.9	*CP Failure at Madrid near end of pass. 1) Carrier supression test this pass.	223/219	N/A
078	41	164	0834	1530	-154.5	99.9	-	78.6	95.1		223/219/221/222	Y2

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
079A	51	164/65	1520	1902	-151.9	98.64	*	59.7	97.1	1) Thresh. test on pass 79A.	223/219	Y2
079B			2240	0130						*No data for 79A, TCP tape sent to JPL, unable to recall at present.		
										2) TFR-135037.		
										3) TFR-135272 (computerized DTR probs.)		
079	41	165	0830	1230	-154.5	99.9	-	92.9	100.0		223/219	X3
080A	51	165/66	1524	1900	-151.9	99.6	-	99.6	1-way only	1) TFR-135037	223	X3
080B			2240	0136								
080	12	166	0400	0701	0.0	95.0	-	86.8	84.3*	*Recall in progress.	223/219	Y2/X3
081	62	166/67	1800	0155	-153.2	98.9	-	96.2	98.0	1) DIS sporadically stops TFR-130357.	223/219	Y3
										2) Rubidium 2 prime.		
081	51	166	1335	1530	-153.6	95.2	-	93.7	-		223	X3
081	41	167	0831	1230	-153.7	99.2	-	69.1	98.9		223/219	Y3
082	51	167/68	1331	0131	-152.5	99.3	-	96.1	N/A	1) TFR-135037.	223	Y2
										2) TFR-135276.		
										3) TFR-135277.		
										4) TFR-135272.		
										5) PTR shows erroneous Julian Day.		
082	41	168	1345	1530	-156.5	97.43	*	84.4	90.5		223/219	N/A
083	62	168	1731	2145	-153.6	92.71	*	42.1	96.0	*Recall in progress 1913 - 1957.	223/219/221/222	Y2/Y3
										1) Tests conducted this pass.		

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
083	41	169	0836	1230	-154.0	99.7	-	90.6	100.0		223/219	Y3
083	51	169/70	2155	0127	-152.5	97.8	-	98.0	1-way	1) TFR-135037.	223	Y2
084A	62	169	1728	2000	-153.5			87.6	97.7	Pass 84A not logged. First. Recall tape blank. Second. Recall in progress.	219	N/A
084B	62	169/170	2304	0130	-153.6	98.67		79.1	97.7	1) Rubidium #2 prime.	223/219	X2
084	41	170	1113	1335	-154.8	98.2	-	91.5	98.4		223/219	N/A
085	51	170/71	1330	0120	-127.6	97.8	-	93.7	N/A	1) TFR-135037. 2) TFR-135277.	219	Y2/Y3
085	41	171	0835	1530	-154.5	98.7	-	97.1	99.3		223/219	N/A
086	62	171/72	1725	0044	-154.5	97.5	-	85.7*	98.0	1) Rubidium #2 prime. *DSS-62 varied transmitter power from 2014 to 2341.	223/219/221	N/A
086	14	172	0048	0900	-145.2	99.78	-	93.4	96.4	1) S/S low due to cone alignment.	221/219	Y3
086	41	172	0933	1531	-155.4	99.8	-	95.8	98.5	1) TFR-137694 faulty TCP 'A' ring tape unit.	223/219	Y3
087	62	172/73	1730	0130	-154.2	99.3	-	91.7	94.0	1) Rubidium 2 prime.	223/219	X3
087	41	173	0837	1230	-155.1	93.6	*	94.4	100.0	*Not recalled: OCC.	219	Y3
088	62	173/74	1729	0131	-154.0	98.0	-	94.4	95.3	1) Rubidium #2 prime. 2) TFR-142327 TCP "A" A to D converter unit prob.	223/219	Y3
088	41	174	0836	1530	-155.3	98.6	-	97.2	99.7		219/223	X3

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
089	62	174/75	1900	0100	-155.0	88.6	**	80.3*	***	1) Rubidium 2 prime. *2) Carrier suppression test this pass. *3) Data noisy throughout pass. **Unrecoverable due to receiver being OOL. ***Recall in progress.	229/219/221/223	X2
089	41	175	1234	1532	-156.4	99.7	-	90.5	100.0		219	X2
090	62	175	1905	2230	-154.4	98.7	-	86.4	*	*Recall in progress. 1) Rubidium 2 prime.	223/219	X2
090	41	176	0858**	1232	-155.6	96.34	*	92.7	95.7	*Recall in progress for outage 1200-1232Z. **This time conflicts with PTR Acq. time i.e. (05558).	219	X3
090	12	175/76	0043	0410	-157.0	79.5	*	44.0	**	1) SPE test throughout pass. *Unable to recall; OCC. 2) No PTR in folder. **Recall in progress.	223/219	N/A
091	62	176	1700	2030	-155.5	96.5	-	94.3	*	*Recall in progress. 1) Rubidium 2 prime. 2) Receiver glitching TFR-142348.	223/219	X2
091	41	177	0848	1302	-155.6	98.1	-	92.3	96.8		219	X3
092	62	177/78	1910	0100	-157.0	86.2*	-	96.8	97.0	*First recall percent present outage 2318-2400Z. 1) Rubidium 2 prime.	223/219	N/A

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
092	14	178	0728	0854	-149.0	99.0	-	95.1	98.0		222	X2
092	41	178	1034	1300	-157.3	98.7	-	69.6		1) 1-way only.	223/219	X2
093	62	178/179	1909	0100	-157.2	85.1*	-	97.4		1) Rubidium NBR 2 prime. *2) First recall percent. *3) 1-way only.	223/219	N/A
093	41	179	0857	1451	-156.3	96.8	-	88.7	98.2		223/219	X3
094	62	179/180	1700	0100	-156.2	97.4	-	95.0	*	Rubudium NBR 2 prime. *1-way only.	223/219	X3
094	41	180	0807	1203	-156.9	96.8	-	90.7	*	From 1042 to 1500 the prime telemetry path was receiver 1 - SDA 1, TCP alpha. *1-way only.	223/219	Y2
095	62	180/181	1700	0100	-156.3	97.8	-	95.2	95.8	Rubidium NBR 2 prime.	223/219	N/A
095	41	181	0804	1202	-156.7	98.4	-	95.9	100.0		223/219	Y3
096	51	181/182	1500	0030	-155.8	96.8	-	75.1	95.0	Deviations from standard config. Receiver 1 SDA 1 TCP A.	223/219	Y3
096	14	182	0017	0200	-148.3	85.0	99.0*	75.4	92.0	*D-5 8576 increased percentage.	219	X2
096	41	182	0804	1202	-157.3	95.1	-	91.4	100.0		223/219	X3
097A	62	182/183	1703	1900	-157.1	98.2	-	90.1	95.1	1) Rubidium NBR 2 prime.	223/219	X2
097B			2138	0000	-157.3							
097	12	183	0051	0423	-156.2	95.0	-	4.4	95.1	Ran spacecraft threshold test this pass. Deviation from standard config.: TCP beta configured for receiver NBR 1, SDA NBR 1.	221	X2

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
097A	41	183	0527	0901	-157.6	97.9	-	91.9	96.3	1) CP problems.	219/223	X2
097B			1206	1501	-157.2					2) Loss of TDH samples 055902-060602 TFR/41/ TDH/137719. Operator error.		
										3) Deviations: Antenna in slave mode from 0900-1500.		
098	62	183/4	2011	0030	-157.2	97.5	-	91.5	98.8	1) Failures: TCP a direct locate 2 EOF, effect: lost 19 minutes of backup data.	223/219	N/A
										2) Deviations: Rubidium NBR 2 prime.		
098	12	184	0239	0531	-155.4	95.1	-	61.3	96.0	1) Deviation: at 0240 TCP 'B' initialized for receiver 2 SDA 1 at 0458 TCP 'B' back to normal configuration, receiver 2 SDA 2.	223/221	X2
098	41	184	0806	1201	-157.5	97.5	-	95.7	99.0		223/219	Y3
099A	62	184/185	1700	1900	-157.0	96.6	-	92.2	99.3	1) Deviations: Rubidium NBR 2 prime.	223/219	Y3
099B			2135	0000	-157.1							
099	41	185	0804	1202	-157.5	99.7	-	93.3	100.0	1) No PTR in folder.	223/219	Y3
100A	62	185/6	1633	1830	-157.6	96.8	-	85.4	98.7	1) Failures: APS giving errors while program being loaded.	223/219	Y3/X3
100B			2231	0100	-157.2					2) TCP B mag tape keeps giving errors.		
										3) Deviations: Rubidium NBR 2 prime.		

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
100	41	186	0804	1202	-157.7	99.7	-	93.7	99.1		223/219	X3
101	62	186	1630	1830	-157.8	95.0	-	76.6	97.7	1) Rubidium NBR 2 prime.	223/219	X3
101	41	187	0910	1202	-157.85	99.6	-	92.4	100.0		223/219	Y2
102A	62	187/88	1628	1830	-157.8	90.65	-	82.1	98.5	1) No PTR in folder.	223/219	Y2
102B			2231	0055	-158.4					*2) Recall in process; outage 2235-2246Z.		
102	41	188	0522	1132	-158.5	99.2	-	96.1	100.0		223/219	Y3
103A	62	188/9	1630	2100	-157.5	95.0	-	86.1	97.0		219/221	Y3/Y2
103B			2204	0030	-147.0							
103	41	189	0809	1202	-147.6	99.4	-	96.5	100.0		223/219	Y3
104	51	189	1626	1901	-141.5	95.0	-	90.9	95.4	Deviation from standard configuration: Receiver 1, SDA 1, TCP A.	223/219	Y2
104	12	189/90	2320	0755	-147.5	95.82*	-	90.2	96.7	1) 2320-E/T/O TCP B mag tape will not write. 2) 2320-E/T/O TCP A has excessive write errors ψ and records lost. *Percentage adjusted to exclude outages filled by DSS 14, same type.	221/223/224	Y2
103	14	189	0000	0700	-139.2	98.6	-	91.2	96.2	1) Failures: 0200 transmitter off with beam A.V. ac overcurrent interlock. TRR No 136368.	212/208	Y2
104	14	189/190	2357	0821	-140.0	94.09*	-	91.8	96.3	*Percentage adjusted to exclude outages filled by DSS 12, same tape.	224/220/208	Y2
105A	51	190/191	1633	1900	-146.3	97.5	-	62.5	95.0	1) Wrong S/C ID on type 30 HSD rectified at 2204.	223/219	Y2, X2
105B	51		2230	0030	-146.5							
105	14	191	0305	0600	-148.0	98.39	-	90.3	98.1		210/202	Y2

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
105	41	191	0655	1202	-147.5	96.2	-	95.1	100.0	1) Deviations: LNA is paramp for entire pass. maser down because of helium line failure. TFR 41/UWV/137750.	223/219	Y3
106	51	191	1630	1832	-145.9	87.2	-	66.6	92.4	1) Deviations: RCV 2 SDA 2 TCP A. *2) Recall percents present outage 1630-1707A.	223/219	N/A
106A	41	192	0536	0802	-145.5	98.4	-	86.8	95.7	1) Failures: no transfer of 24 bit data. From TCP beta to DIS from 1206-1500. 2) Deviations: No angle calibrations or boresights taken during pre cals due to maser not cool.	223/219	Y3
106B			1204	1502	-145.8							
107	62	192	1831	0030	-144.6	99.9	-	93.3	98.2	1) Deviations: Rubidium NBR 2 prime.	223/219	Y2
107	41	193	0923	1132	-144.9	98.0	-	71.5	90.7		223/219	N/A
108	62	193	1833	2200	-145.2	99.6	-	94.8	97.0		223/219	X3
108	12	193/194	2310	0821	-143.8	99.0	-	83.2	93.3		223/219	X2, X3
109A	62	194/5	1637	1830	-143.5	98.0	-	82.8	95.5	1) Failures: DIS would not output headers on type 30 data. 2) Deviations: Rubidium NBR 2 prime. TCP A down for troubleshooting.	223/219	N/A
109B			2203	0030	-144.6							
109	41	195	0804	1202	-144.0	99.5	-	93.7	99.5		223/219	Y3
110	62	195/6	1630	0030	-142.9	93.5	-	94.3	95.4	1) Deviations: Rubidium NBR 2 prime. TCP A down till 2251 (DIS disable) no recall/project.	223/219	Y3

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
110	12	195/6	2307	0550	-144.0	0.0*	-	66.5	97.1	1) 0046-0508 unable to output.HSD from alpha computer. 2) 0047-0506 not able to output HSD from beta computer. 3) 0506-0508 CMD loop out of lock. 4) Deviation: DSN Mode I. 5) TCP's sent in data package not recalled as yet.	224/221	Y0
110	14	195/6	2344	0548	-137.0	0.0*	-	90.4	100.0	1) 0158 Sta. E boss power off bad gen. TFR 136370. 2) 0219 E buss on commercial power. *3) TCP's sent in data package not yet recalled.	224/202/214/220	Y0
110A	41	196	0537	0551	-143.3	95.0	-	91.3	100.0	1) Failures: memory parity error on TCP beta 0948-0957. 2) Lost control of DIS 1034-1039. 3) Deviations: TCP alpha prime from 0957.	223/219	Y2
110B			0935	1312	-143.6							
111	62	196	1610	2010	-143.2	95.0	-	18.6	95.6		219/221/222	Y2
111A	41	197	0529	0802	-144.2	99.4	-	91.3	95.2	1) Deviations: RCV 1, SDA 1, TCP A, prime.	223/219	Y2
111B			1204	1502	-143.5							
112	62	197	1830	2130	-142.2	99.3	-	94.4	98.7	1) Deviation: Rubidium NBR 2 prime.	223/219	Y2

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
112	41	198	0456	0832	-143.5	99.7	-	88.0	95.2		223/219	Y2
113	51	198	1537	2100	-141.3	98.5	-	88.8	94.5		223/219	X2, Y2
113	12	199	0355	0800	-142.5	95.0	-	97.9	98.2		223/220/219	Y3
114	62	199/200	1700	0030	-142.0	99.6	-	93.1	96.1	1) Deviations.	219/223	Y2
114	41	200	0458	1700	-143.0	99.6	-	96.4	98.4		223/219	Y2
115	51	200	1627	2130	-140.6	99.69	-	96.0	95.2	1) Deviations: RCV 2, SDA 2, TCP B.	224/219	X2
115	12	200/201	2300	0800	-142.4	99.9	-	94.2	98.8		223/219	N/A
116	62	201	1700	2300	-148.9	99.2	-	96.6	92.2	1) Deviations: Rubidium NBR 2 prime.	223/219	Y2
116	12	202	0501	0730	-141.5	99.8	-	83.3	99.2		223/219	Y2
117	51	202	1558	1823	-141.5	97.5	-	76.7	95.1		223/219	Y2, Y3
117	41	203	0428	0831	-141.3	98.8	-	95.0	97.3		219/223	Y2
118	51	203	1555	2100	-140.7	99.2	-	89.8	96.4		223/219	Y2
118	41	204	0427	0701	-142.2	97.39*	-	81.2	96.9	*1) Recall percent.	223/219	Y2
119	62	204	1600	2400	-141.3	99.4*	-	86.2	98.5	1) APS would not admit program 1500-2000. 2) Deviations: Rubidium NBR 2 prime. *3) Recall, percent.	219/223	N/A
119	41	205	0426	0901	-142.1	99.7	-	72.1	96.7		223/219	X2, Y2
120	51	205	1558	1830	-140.9	99.1	-	79.7	*	*1) 1-way only.	223/219	Y2
120	12	206	0306	0730	-141.3	97.5	-	91.6	98.3		221/219	X2
120	11	205	2346	0300	-143.9	99.0	-	81.5	96.9		N/A	N/A

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
120	41	206	0611	1638	-141.8	99.01	-	92.1	99.4		219	X2, Y3
121	51	206	1527	2330	-140.3	98.81	-	93.7	95.7	1) Deviations: Receiver 2, SDA 2, TCP B.	219/223	Y3
121	14	207	0119	0740	-133.3	99.4	-	93.7	97.0		202/208/206	Y2
121	42	207	0620	1630	-141.0	99.73	-	82.8	97.0		N/A	N/A
122	51	207	1526	2330	-140.3	99.64	-	87.5	96.2	*1) Recall in progress. Outage 1702-1944.	224/219/221	Y2, X2
122	11	207/8	2314	0730	-142.5	99.9	-	87.7	95.5		N/A	N/A
122	42	208	0622	1630	-141.5	99.8	-	93.2	90.5		N/A	N/A
123	62	208	1600	2400	-141.6	99.8	-	90.0	96.5	Deviations: Rubidium NBR 2 prime.	219/221/223	Y2
123	11	209	2313	0730	-144.3	N/A	-	95.9	*	*1) 1-and 3-way only.	N/A	Y2
123	14	208/9	2316	0730	-135.8	99.8	-	95.4	97.1		210/206	Y2
123	42	209	0621	1600	-141.5	99.5	-	94.6	99.3		N/A	N/A
124	51	209	1453	2330	-140.4	96.8	-	70.4	97.7	1) Deviations: Receiver 2 SDA 2, TCP B.	224/219/220	Y2
124	11	209/10	2310	0730	-142.1	65.0	-	94.9	97.5	*Out 0423-0709Z.	N/A	N/A
124	42	210	0621	1600	-141.5	99.8	-	94.4	99.6		N/A	N/A
125	51	210	1453	2338	-140.3	99.4	-	92.7	94.5		219/223	X2
125	11	210	2307	0730	-142.3	99.5	-	92.0	96.8		N/A	X2
125	42	211	0621	1600	-142.0	99.8	-	95.3	85.2		N/A	N/A
126	51	211	1500	2330	-140.3	99.1	-	73.9	95.0		219	X2
126	71	212	0521	0736	N/A	27.9	-	48.3	97.1		N/A	N/A
126	14	212	0615	0729	-153.4	60.8*	-	62.6	*	*1) Data not recoverable. *2) 1-and 3-way only.	212	X2

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
126	41	212	0615	1651	-142.5	92.1	-	88.4	96.9		219/224/223/221	X2
126	42	212	0521	0615	-161.5	75.7*	-	32.9	84.6	1) TDH stopped at 054202 *Partial minute outages 0525-0609Z.	N/A	Y2
127	51	211	1500	2330	-140.1	99.6	-	57.9	95.7	1) No PTR in folder. 2) CP problems.	224/219	X2
127	11	212/13	2305	0730	-142.8	99.4	-	79.2	95.7		N/A	N/A
127	41	213	0403	1648	-142.5	98.0	-	95.3	98.7		224/219/221/223	N/A
128	62	213	2051	0000	-146.0	98.3 100.0*	-	73.5	98.0	1) No PTR in folder. *2) Data type 42.	221/223	X2
128	51	213	1457	2123	-140.1	93.4*	-	90.6	96.8	1) C/P fault at 1905. *Outage 1646-1656Z.	224/219	X3
128	12	213/14	2228	0739	-146.8	75.1*	-	94.5	*	*Outage 0641-0656Z. *1) 1-and 3-way only.	224	X2
128	14	213/14	2306	0725	-138.0	99.7	-	82.3	95.0		224/214/220	X2
128	41	214	0403	1644	-148.0	99.2	-	95.9	99.8		224/236/233	X2
129	62	214	1528	2355	-146.5	93.1*	-	90.8	97.9	1) Deviations: Rubidium NBR 2 prime. *Outage 2155-2223Z.	235/233/221/223	X2
129	12	214/15	2226	0733	-147.6	N/A	-	91.5	*	1) No PTR in folder. *2) 1-and 3-way only.	224	Y2
129	14	214/15	2305	0723	-139.2	98.5	-	79.1	95.0		224/220	Y2
129	41	215	0402	1642	-148.0	99.2 64.9	-	93.4	96.7	*1) Data type 41, outage 0423-0733Z.	236/224/223/221/233/235/231	Y2

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
130	62	215	1526	2353	-147.0	93.6* 93.2***	-	91.6	97.6	*Outage 2054-2114Z. **1) Data type 41.	236/233	Y2
130	12	215/16	2225	0734	-147.4	N/A	-	93.6	*	*1) 1- and 3-way only.	224	X2
130	14	215/16	2303	0721	-139.5	98.4	-	91.5	96.2		224/220	X2
130	41	216	0400	1640	-147.2	98.8 99.5*	-	84.4	96.5	*Data type 41.	224/223/221/233/231/236	X2
131	62	216	1523	2351	-147.1	92.2* 93.5**	-	89.1	98.3	*Outage 1816-1845Z. **1) Data type 41.	233/231/223/224	X2
131	12	216	2222	0730	-145.6	94.9**	-	76.2*	***	1) Sta had TCP complication could not come up. *1) TDH start time 2330. **2) Data type 42. ***3) 1- and 3-way only.	224/259/254	X2
131	11	216	2258	0402	-148.5	N/A	-	88.6	90.0	1) Deviations: Transmitter Number 2 used in place of Transmitter Number 1, TFR 135827.	N/A	N/A
131	14	216/17	2302	0718	-137.5	99.6	-	89.6	97.0		224/222/220/268	X2
131	41	217	0358	1638	-144.5	98.9 99.3*	-	80.7	99.8	*Data type 42.	224/254/257	X3,Y2
132	62	217	1522	2349	-144.4	99.0 99.8*	-	88.2	93.2	1) Deviations: Rubidium NBR 2 prime. *2) Data type 42.	255/257	X3,X2
132	12	217/18	2221	0730	-147.4	97.9*	-	95.2	**	*1) Data type 42. **2) 1- and 3-way only.	224/260	X2

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
132	14	217/18	2300	0717	-137.2	N/A	-	95.3	97.0		224/220	X2
132	41	218	0356	1636	-146.0	99.0 99.3*	-	95.7	88.7	*1) Data type 42.	224/255/260	X2
133	62	218	1520	2347	-143.8	99.1 99.8*	-	93.8	97.4	*1) Deviations: Rubidium NBR 2 prime. *2) Data type 42.	260/258/257/223	X2
133	12	218	2218	0726	-146.0	99.7*	-	94.7	99.8	*1) Data type 42.	224/260/221	X2
133	14	218/19	2258	0715	-138.0	99.5	-	93.9	95.6		224/220	X2
133	41	219	0554	1600	-145.2	97.8 98.9*	-	96.4	98.9	*1) Data type 42.	260/255	X2, X3
134	51	219	1458	2329	-143.0	99.6 99.6*	-	93.5	97.9	*1) Data type 42	219/221	X3
134	11	219/20	2300	0700	-143.2	89.2*	N/A	88.9	94.3	1) Deviations: Transmitter NBR 2 used in place of transmitter. *Partial minute outages observed 0300-0538Z.	N/A	N/A
134	42	220	0526	1600	-143.7	99.6 100.0*	-	94.0	99.7	*1) Data type 42.	N/A	N/A
135	51	220	1442	2328	-143.0	96.3 97.4*	-	92.2	94.5	1) Configuration: 1-1-A science, 2-2-B eng. *2) Data type 42.	264/219/255	X2
135	12	221	2330	0700	-141.3	99.9 100.0*	-	95.3	95.3	*1) Data type 44.	224/219	N/A
135	42	221	0545	1600	-141.5	99.7	-	93.6	99.6		N/A	N/A

Table A-2 (contd)

Pass No.	Station (DSS)	Day of Year (GMT)	Acquisition (GMT)	End of Track (GMT)	Average Received Signal Level (dbm)	DSN Real-Time Performance (%)				Failures and Anomalies	Configuration	
						Telemetry		Tracking				
						HSD	Total Available	TTY TRK	Total Available		DSIF/MCD	DPS Mode
136	51	221	1455	2330	-140.9	95.4	-	93.0	96.4	1) Deviations: Receiver 2 SDA 2 TCP B.	224/219/255	X3
136	14	221/222	2253	0700	-138.0	100.0	-	94.2	97.2	Outage 0000-0336Z D-5 broken, not yet replaced.	N/A	Y3
136	42	222	0545	1600	-142.5	98.4	-	94.9	99.8	1) Deviations: TCP A data prime.	N/A	N/A
137	51	222	1452	2328	-141.2	99.3	-	88.7	97.6		224/219	Y3
137	11	222/23	2250	0700	-143.5	99.6	-	91.6	96.1		N/A	N/A
137	41	223	0546	1600	-142.5	99.2	-	95.2	95.9		224/221/219	X2
138	51	223	1458	2300	-140.9	94.3*	-	88.6	95.1	*Outage 1650-1700Z.	224/219	X2, X3, X2
138	11	223/24	2245	0700	-143.7	N/A*	-	92.3	96.8	1) No PTP in folder. *2) Record only.	N/A	N/A
139	11	224/25	2243	0700	-143.7	99.3	-	92.1	95.9	1) Deviations: Changed SDA SDA-2 input from Receiver-2 to Receiver-1 at 0147.	N/A	N/A
139	41	225	0353	1600	-143.2	99.7	-	97.9	86.9		224/219	X2, X3
140	51	225	1134	2300	-143.2	84.1*	-	94.3	93.6	*Outage 1935-2035Z.	224/219	X2
140	11	226	2241	0700	-143.8	N/A*	-	93.2	94.8	*1) Deviations: Record only mode.	N/A	N/A