Summary Report on the Viking 1975 DSN Telecommunications Compatibility Test Program

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The Viking 1975/DSN Telecommunications Compatibility Test Program consisted of three phases: subsystem design, system design, and system verification tests which were performed at JPL and at the Air Force Eastern Test Range and Kennedy Space Center complexes. Subsystem design tests were performed with the Viking Orbiter (VO) and the Viking Lander (VL) during 1973. System design compatibility tests were performed with the Viking Proof Test Orbiter, Viking Spacecraft Test Lander, and a multiple Viking spacecraft configuration during the summer of 1974. System verification tests were performed with the Viking Orbiter, Viking Lander and Viking spacecraft during the spring and summer of 1975. This article describes the system design tests and test results that provided the basis for establishment of telecommunications design between the DSN and Viking 1975.

I. Introduction

This report summarizes the DSN/Viking Telecommunications Compatibility Test Program covering the period from April 1973 through August 1975. This test program was the most complex and extensive test program ever undertaken by the Deep Space Network. Equipment resources had to be greatly expanded to meet the challenges and requirements of multiple spacecraft operation. To fulfill the requirements, the Viking Master Integrated Test Plan was developed and agreed to by all major Viking Project systems.

The plan specified that telecommunications design compatibility would be established at the subsystem and system levels and conclude with a final verification at

Cape Canaveral, Florida, prior to launch. Additionally, the DSN and flight project equipment software configurations, requirements, and test objectives in all phases were specified.

Procedures for conducting the tests as well as test design criteria and test parameters for the ground station hardware and software were prepared by network personnel. Spacecraft telecommunications design performance criteria and test parameters to establish flight project nominal and threshold telecommunications conditions were provided by the respective Viking Orbiter and Lander telecommunications teams. The test criteria were included as part of the test procedure to provide real-time assessment of performance. All test procedures were approved by the DSN and flight project representatives.

II. Types of Tests

The test program encompassed three types of tests: (1) DSN/Viking Lander compatibility tests conducted in three phases, (2) DSN/Viking Orbiter compatibility tests conducted in three phases, and (3) DSN/Viking Orbiter and Lander compatibility tests conducted in two phases.

III. Objectives

The objectives of the test program were to demonstrate compatibility between the spacecraft telecommunications subsystems and the Network, to establish system design compatibility between the flight spacecraft and the Network, and to verify continued interface integrity and maintenance of compatibility during prelaunch activities.

IV. Test Results

A. DSN/Viking Lander Compatibility Tests

These three-phase tests were conducted in the major areas of radio frequency acquisition and tracking, command, radio metric data, and telemetry.

1. Phase I: development test model—S-band radio assembly. These tests were conducted at the Compatibility Test Area in Pasadena (CTA 21) with the Lander subsystem components during April 1973. With the exceptions of the Block IV receiver-exciter and the planetary ranging assembly, CTA 21 provided a standard Network configuration for tests with the Lander S-band radio assembly. The simulation conversion assembly provided simulated spacecraft subcarrier data, and command testing utilized the multimission command compatibility software to investigate interference between S-band channels 13 and 16. Channel 16 downlink was simulated by the CTA 21 test transmitter.

The tests established radio frequency compatibility between the Lander direct communications subsystem and the Network. Command, ranging, and telemetry interference tests revealed no problems with the Lander S-band radio assembly operating on channel 13. However, it should be noted that most of these tests were performed with channel 16 modulated by the Mark 1A ranging subsystem. The planetary ranging assembly was simulated by the simulation conversion assembly in the remaining tests. The question of interference between channels 13 and 16 was not resolved during this phase of testing.

2. Phase II: spacecraft test lander. These tests were conducted at CTA 21 with the Viking Lander in July 1974. The test Lander was configured to represent a flight spacecraft telecommunications system, and CTA 21 was configured to represent a 64-meter-diameter antenna station. The Lander was located in the screen room of the Spacecraft Assembly Facility at JPL. An S-band radio frequency link was established between the Lander and the ground station. The tests were performed at nominal and threshold conditions to prove Network/single spacecraft performance prior to multiple spacecraft telecommunications compatibility testing and to provide prerequisite data bases for performing the data compatibility tests which established data flow system interface compatibility from the spacecraft via the Network to the Viking Mission Control and Computing Center. The results of these tests are documented in *DSN Progress Report* 42-24 (Ref. 1).

3. Phase III: Viking Lander capsule. There were two sets of tests in this phase with Viking Lander Capsules 1 and 2. The Network test with Capsule 1 was conducted from January 30 through February 7, 1975, and the test with Capsule 2 from April 7 through April 9, 1975. These tests were conducted with the DSN equipment in the Spacecraft Tracking and Data Network Station (STDN-(MIL 71)) at Merritt Island and the capsules located in the Spacecraft Assembly and Encapsulation Facility at Kennedy Space Center, approximately three miles from MIL 71. Both capsules were configured for mission operations, and MIL 71 was configured to simulate a 64-m-diameter antenna station. S-band radio frequency links

were utilized between the flight articles and the ground station. Tables 1 and 2 provide a listing of the tests performed; on the basis of these results, continued compatibility between the Network and Viking Lander Capsules 1 and 2 was verified.

B. DSN/Viking Orbiter Compatibility Tests

Phases I and II of these tests were conducted at CTA 21; Phase III was conducted at MIL 71 with the spacecraft located at Cape Canaveral Air Force Station, Florida, which is approximately 7 miles from MIL 71.

1. Phase I: Viking Orbiter subsystem design tests. These tests were conducted with the Orbiter radio frequency subsystem prototype on August 28-29, 1973. The prototype was located in the screen room at the Telemetry Development Laboratory; S-band link was utilized between the prototype and CTA 21. The tests performed were uplink threshold, downlink threshold (one-way and two-way), ranging acquisition and polarity verification, downlink spectrum analysis, and radio frequency acquisition and tracking. The objectives—to establish telecommunications subsystem design compatibility for radio frequency and radio metric data—were met.

2. Phase II: DSN/Viking proof test Orbiter tests. These tests were conducted from June 26 through July 24, 1974. The Orbiter was located in the Space Simulator at JPL. S-band and X-band links were utilized between the Orbiter and CTA 21. The Orbiter was configured to represent a flight spacecraft telecommunication system; CTA 21 was configured to simulate a DSN 64-m-diameter antenna station. The Block IV Receiver-Exciter Subsystem was represented by an engineering model prototype. The tests were performed at nominal and threshold conditions to (1) establish compatibility for telemetry, command, tracking and radio metric data, (2) provide baseline criteria for analysis of the multiple carrier interference effects in the multiple spacecraft radio frequency compatibility tests, and (3) provide prerequisite data bases for performing data compatibility tests. The results of the tests are documented in Ref. 1.

3. Phase III: Viking Orbiter flight model. There were two sets of tests in this phase. Both Orbiters were configured for mission operations, and MIL 71 was configured to simulate a 64-m-diameter antenna station. S-band and X-band links were utilized between the flight articles and the ground station. Tables 3 and 4 provide a listing of the tests performed, and continued compatibility between the Network and the two radio frequency subsystems was verified.

C. DSN/Viking Spacecraft Compatibility Testing

1. Multiple spacecraft testing. These tests were conducted at CTA 21 with the test Lander and the proof test Orbiter located in the Spacecraft Assembly Facility at JPL. A test transmitter to simulate the second Orbiter with an S-band downlink capability only was installed in the screen room of CTA 21. S-band and X-band links were established between the Orbiter and CTA 21. Interface with the test Lander was established via an S-band link between CTA 21 and the Spacecraft Assembly Facility. To support these tests, CTA 21 provided two simultaneous S-band uplink signals and received and processed telemetry data from three simultaneous downlinks.

In general, the tests performed were false uplink acquisition with ranging, false command acquisition with ranging, radio metric degradation with ranging, Viking Lander telemetry degradation by the Viking Orbiter high-rate telemetry, and command and telemetry degradation with ranging. The objectives of the tests were to (1) verify the performance and operational capability of the DSN in a multiple downlink carrier environment, (2) ascertain the performance of the VO and VL under predicted RF interference conditions, and (3) provide baseline criteria as a prerequisite to conducting the multiple spacecraft data compatibility tests. The test descriptions and results are documented in Ref. 1. In general, however, the results established telecommunications system design compatibility between the Viking multiple spacecraft and the DSN.

2. Viking spacecraft testing (flight configuration). These tests were conducted at MIL 71 with the two Viking spacecraft located in the Spacecraft Assembly and Encapsulation Facilities 1 and 2. An S-band link of approximately three miles was utilized between the flight articles and the ground station.

The ground station software utilized in performing these tests was supplied by the DSN and was a subset of software officially released to the station for Viking Project support. The software consisted of the Telemetry and Command Data which provides independent control of the command and telemetry functions. Commands may be controlled manually from the station or automatically from the Mission Control and Computing Center (MCCC). Telemetry may be decoded, formated, and transmitted to the MCCC for decommutation and display.

In general, the tests performed consisted of a series of command performance tests to verify in the spacecraft

configuration the capability of the Lander to receive commands and reject Orbiter commands, and verify in the spacecraft configuration the capability of the VL to receive commands and reject VO commands.

During the initial attempt to transmit commands to Orbiter 1 on Side 1, it was noted that the Lander command detector 1 toggled in and out of lock. The test conditions under which this anomaly occurred were uplink signal level (total power) set at −99.85 dBm, Orbiter subcarrier frequency of 512.0 Hz, and bit sync acquisition sequence (Idle 2).

Upon detection of this discrepancy, on-line troubleshooting was initiated in real-time. The Command Modulator Assembly (CMA) was returned to Idle 1 (subcarrier only) and the lock status of Lander command detector 1 monitored. Under this condition, a stable out-of-lock condition was detected. The CMA was reconfigured to offset the Orbiter subcarrier to a frequency of 512.1 Hz. Monitoring of the lock status of the Lander command detector 1 while Idle 1 and Idle 2 were transmitted showed that the detector toggled in and out of lock only with Idle 2 present. Photographs of the signal on the interface wires were taken during this on-line investigation with negative results. With these data for off-line investigation and analysis, it was decided to continue with the test in accordance with the procedure and to document test discrepancies in the Martin Marietta Failure Reporting System.

During the test, Lander 1 command detector 1 lock status at no time indicated an in-lock condition when the command waveform to the Orbiter was Subcarrier ⊕ Bit Sync ⊕ Data. Further, the false in-lock condition of Lander 1 command detector 1 with Idle 2 present occurred at strong uplink signal, as evidenced by the test results at −143 dBm.

The anomalous in-lock conditions identified above were not noted on command detector 2 during the accomplishment of the test. The command detector problem was resolved and documented. The resolution was that the Lander command has four levels of protection and this problem posed no threat to command operations during flight operations.

During the initial attempt to transmit commands to Viking spacecraft no. 2, commands were rejected. It was determined that the cause of this problem was an incorrect spacecraft identifier in the command bit structure. A new set of commands was then transmitted which contained the proper spacecraft identifier. All commands were successfully accepted and executed by the spacecraft. However, two commands (DC-2A, Ranging Channel ON and DC-2AR, Ranging Channel OFF) gave indications of each command containing one bit error, which was corrected by the on-board computer. The octal structures for these two commands were

DC-2A	652050264210257261604
DC-2AR	652050264220257275604

Subsequently, it was learned that these octals were in error and should have been

DC-2A	652050264210257261605
DC-2AR	652050264220257275605

In order for the Command Modulator Assembly (CMA) to function correctly, the command word must contain 63 bits, although only 62 bits are transmitted. Additionally, the 63rd bit of the command structure must always be high. This bit serves as a marker bit to flag the command software that the previous bit (62nd bit of the spacecraft command) is the final bit to be transmitted. To verify that this was a true condition, the proper octals for DC-2A and DC-2AR were successfully transmitted to the spacecraft, accepted and executed and gave no indication of bit errors or corrections.

Detailed results of testing with Viking Spacecraft 1 and 2 are contained in Tables 5 and 6, respectively. Table 7 defines terminology; Table 8 presents RF channels and center frequencies for special RF interference tests.

V. Conclusion

The successful completion of the DSN/Viking Project Telecommunications Compatibility Test Program on schedule and within anticipated cost figures enabled the establishment of telecommunications compatibility as evidenced by the successful launch of the Viking '75 spacecraft on August 21 and September 9, 1975.

The importance of a formal compatibility test program was clearly demonstrated by the problem areas uncovered, verified, and resolved during the testing. Prominent problem areas resolved during the test program were:

(1) Verification of DSN capability to receive simultaneous multiple downlinks, process and transmit data to the Mission Control and Computing Center.

(2) Verification of false uplink acquisition by the Viking Orbiter and Lander with S-band rf channels 13 and 20 modulated with command and ranging.

(3) Ranging modulation polarity inversion by the Block IV exciter.

(4) Inverted pulse polarity of the Frequency and Timing Subsystem 1 k pulse per second to the Telemetry and Command Processor, which resulted in command symbol period alarm/aborts.

(5) The Orbiter 1 radio frequency subsystem 202 auxiliary oscillator no. 2 was found to be 800 HZ below design center frequency.

(6) A transitory increase in spacecraft receiver automatic gain control when discrete ranging modulation is turned on and during a ranging acquisition sequence.

(7) Viking Orbiter 2 automatic gain control remaining positive during a sweep acquisition until the uplink frequency ramp function is terminated.

These and other problems, undetected and unresolved prior to launch, would have presented serious operational problems to the DSN and Viking Project during the mission.

References

1. Bryan, A. I., "Summary Report On The Deep Space Network/Viking Flight Project Telecommunications Compatibility," in *The Deep Space Network Progress Report 42-24*, pp. 9–34, Jet Propulsion Laboratory, Pasadena, Calif., Dec. 15, 1974.

Test date, 1975	Test title	Test	Deep Space Network									
			BLK IV RCV, dBm	BLK IV EXC, dBm	PRA RNG	CMD	Uplink doppler	Uplink offset	CMA SUBC offset	SDA SUBC offset	Mode	RM
2/3	DL threshold one-way	1A	−145.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5B	
2/5		1B	−145.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6B	
1/30	UL threshold	2A	−100.0	−140.2	N/A	On	None	None	N/A	N/A	3B	
1/30		2B	−100.0	−140.5	Off	Off	None	None	N/A	N/A	3B	
			−100.0	−140.7	Off	On	None	None	N/A	N/A	3B	
			−100.0	−141.0	On	Off	None	None	N/A	N/A	3B	
			−100.0	−141.5	On	On	None	None	N/A	N/A	3B	
1/30	DL threshold two-way	3A	−145.0	−142.5	On	On	None	None	N/A	N/A	3B	
2/5		3B	−145.0	−120.0	Off	On	None	None	N/A	N/A	6B	
2/4	DL threshold two-way	3C	−145.0	−120.0	On	Off	None	None	N/A	N/A	5AR	
1/30	SC RCV pull-in range and rate RCVR ACQ/ TRK rate	4A	−100.0	−120.0	Off	Off	N/A	−480 Hz	N/A	N/A	3B	
			−100.0	−120.5	Off	Off	N/A	+480 Hz	N/A	N/A	3B	
			−100.0	−142.7	Off	Off	45 Hz/s	+63 kHz	N/A	N/A	3B	
			−100.0	−142.0	Off	Off	45 Hz/s	−63 kHz	N/A	N/A	3B	
			−100.0	−143.2	Off	Off	45 Hz/s	+63 kHz	N/A	N/A	3B	
1/30	SC RCVR pull in range and rate RCVR ACQ/ TRK rate	4A	−100.0	−142.0	Off	Off	45 Hz/s	−63 kHz	N/A	N/A	3B	
		4B	−100.0	−120.9	Off	Off	N/A	−480 Hz	N/A	N/A	5B	
			−100.0	−119.9	Off	Off	N/A	+480 Hz	N/A	N/A	5B	
			−100.0	−141.7	Off	Off	45 Hz/s	+63 kHz	N/A	N/A	5B	
			−100.0	−141.6	Off	Off	45 Hz/s	−63 kHz	N/A	N/A	5B	
			−100.0	−142.0	Off	Off	45 Hz/s	+63 kHz	N/A	N/A	5B	
			−100.0	−141.3	Off	Off	45 Hz/s	−63 kHz	N/A	N/A	5B	
1/30	Carrier residual phase jitter	5A	−100.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3B	
			−100.0	−100.0	N/A	N/A	N/A	N/A	N/A	N/A	3B	
2/5		5B	−100.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6B	
			−100.0	−100.8	N/A	N/A	N/A	N/A	N/A	N/A	6B	

Table 1. Deep Space Network/Viking Lander Capsule 1 Telecommunications Compatibility Test

Spacecraft								Test data		Test time	Comments
EXC	RCV	PWR	ANT	TWT	RNG	TMU	CDU	Performance	Criteria		
1	2	High		1	Off	A	2	−157.2 dBm	−159.0 ±3 dBm	20 min	DSN RCV signal levels are starting P_c levels.
2	2	High		2	Off	A	2	−157.8 dBm	−159.0 ±3 dBm	21 min	
1	1	High		1	Off	A	1	−149.1 dBm	−150.3 ±2.5 dBm	2 h 32 min	DSN RCV signal levels are starting P_c levels.
1	1	High		1	Off	A	1	−149.2 dBm	−149.2 ±2.5 dBm	2 h 44 min	
1	1	High		1	Off	A	1	−149.0 dBm	−149.2 ±2.5 dBm		
1	1	High		1	Off	A	1	−150.2 dBm	−149.2 ±2.5 dBm		
1	1	High		1	Off	A	1	−151.0 dBm	−149.2 ±2.5 dBm		
1	1	High		1	Off	A	1	−157.2 dBm	−159.0 ±3 dBm	38 min	DSN RCV signal levels are starting P_c levels.
2	2	High		2	Off	A	2	−157.0 dBm	−159.0 ±3 dBm	28 min	
1	2	High		1	On	A	2	−157.3 dBm	−159.0 ±3 dBm	33 min	DSN RCV signal levels are starting P_c levels.
1	1	High		1	Off	A	1	2 sec	SC RCV must lock to UL	5 hr 54 min	
1	1	High		1	Off	A	1	2 sec			
1	1	High		1	Off	A	1	+63.0 kHz	+63.0 kHz		
1	1	High		1	Off	A	1	−63.0 kHz	−63.0 kHz		
1	1	High		1	Off	A	1	ACQ/TRK to +63.0 kHz	ACQ/TRK to +63 kHz		
1	1	High		1	Off	A	1	ACQ/TRK to −61.33 kHz	ACQ/TRK to −63.0 kHz		UL 1 dB weaker than other side. No software problems.
1	2	High		1	Off	A	2	5 s	SC RCV must lock to UL	5 h 01 min	No problems noted.
1	2	High		1	Off	A	2	2 s			
1	2	High		1	Off	A	2	+63.0 kHz	+63.0 kHz		
1	2	High		1	Off	A	2	−63.0 kHz	−63.0 kHz		
1	2	High		1	Off	A	2	ACQ/TRK to +63.0 kHz	ACQ/TRK to +63.0 kHz		
1	2	High		1	Off	A	2	ACQ/TRK to −63.0 kHz	ACQ/TRK to −63.0 kHz		
1	1	High		1	Off	A	1	1.65 deg rms	5.0 deg rms	1 h 27 min	No problems noted.
1	1	High		1	Off	A	1	1.43 deg rms	5.0 deg rms		
2	2	High		2	Off	A	2	4.17 deg rms	5.0 deg rms	1 h 35 min	No problems noted.
2	2	High		2	Off	A	2	1.08 deg rms	5.0 deg rms		

Test date, 1975	Test title	Test	Deep Space Network									
			BLK IV RCV, dBm	BLK IV EXC, dBm	PRA RNG	CMD	Uplink doppler	Uplink offset	CMA SUBC offset	SDA SUBC offset	Mode	RM
1/31	DL spectrum analysis	6A	−85.0	N/A	Off	Off	N/A	N/A	N/A	N/A	3B	
			−85.0	−140.0	Off	Off	N/A	N/A	N/A	N/A	3B	
2/4	DL spectrum analysis	6B	−85.0	N/A	Off	On	N/A	N/A	N/A	N/A	6B	
			−85.0	−120.5	Off	Off	N/A	N/A	N/A	N/A	6B	
			−85.0	−123.0	Off	On	N/A	N/A	N/A	N/A	6B	
2/4	DL spectrum analysis	6C	−85.5	−111.2	On	Off	N/A	N/A	N/A	N/A	5AR	
1/31	Transponder rest frequency	7A	−100.0	−100.0	Off	Off	N/A	N/A	N/A	N/A	3B	
			−100.0	−100.0	Off	Off	N/A	N/A	N/A	N/A	3B	
2/5		7B	−100.0	−120.5	Off	Off	N/A	N/A	N/A	N/A	6B	
			−100.0	−120.5	Off	Off	N/A	N/A	N/A	N/A	6B	
1/4	Auxiliary oscillator frequency	8A	−100.0	N/A	Off	Off	N/A	N/A	N/A	N/A	5B	
2/5		8B	−100.0	N/A	Off	Off	N/A	N/A	N/A	N/A	6B	
1/31	Command capability under doppler conditions	9A	−100.0	−142.5 2.6 db car. sup.	N/A	On	None	+20 kHz	None	N/A	3B	
			−100.0	−142.3 2.3 db car. sup.	N/A	On	None	−20 kHz	None	N/A	3B	
			−100.0	−143.0 2.8 db car. sup.	N/A	On	None	None	384.1 Hz	N/A	3B	
			−100.0	−142.9 2.5 db car. sup.	N/A	On	None	None	383.9 Hz	N/A	3B	
1/4	Command capability under doppler conditions	9B	−100.0	−119.9 2.0 db car. sup.	N/A	On	None	+20 kHz	None	N/A	5B	
			−100.0	−119.9 2.0 db car. sup.	N/A	On	None	−20 kHz	None	N/A	5B	

Table 1 (contd)

Spacecraft								Test data		Test time	Comments
EXC	RCV	PWR	ANT	TWT	RNG	TMU	CDU	Performance	Criteria		
1	1	High		1	Off	A	1	TBD	No spurious components	49 min	Photos taken; no spurs seen. DFT will be performed later.
1	1	High		1	Off	A	1	TBD			
2	2	High		2	Off	A	2	TBD	No spurious components	27 min	Photos taken; no spurs seen. DFT to be performed later.
2	2	High		2	Off	A	2	TBD			
2	2	High		2	Off	A	2	TBD			
1	2	High		1	On	A	2	TBD	No spurious components	17 min	Photos taken; no spurs seen. DFT to be performed later.
1	1	High		1	Off	A	1	VCO freq = 2112.969891 MHz	2112971.451 ±30 kHz	36 min	SC VCO temp = 30.33° C at start,
1	1	High		1	Off	A	1	SC locked to UL	SC locked to UL		31.18°C at end.
2	2	High		2	Off	A	2	VCO freq = 2112.970760 MHz	2112971.451 ±30 kHz	39 min	SC VCO temp = 28.94°C at start,
2	2	High		2	Off	A	2	SC locked to UL	SC locked to UL		28.94°C at end.
1	2	High		1	Off	A	2	D/L freq = 2294.634509	2294629.630 ±30 kHz	50 min	AUX. OSC. temp = 20.21°C at start, 22.26°C at end.
2	2	High		2	Off	A	2	D/L freq = 2294.605568	2294629.630 ±30 kHz	44 min	AUX. OSC. temp = 28.94°C at start, 28.55°C at end.
1	1	High		1	Off	A	1	All commands successfully detected and executed by SC; 3 aborts with command subcarrier offset ±0.1 Hz. All CMDS transmitted were successfully detected and executed by SC.	3 segments of 32-word command messages successfully detected and executed by SC for each test condition.	5 h	Uplink varied −141.4 to −142.5 dBm by SC AGC readouts. Internal station check indicated command modulation was stable. 3 command aborts, symbol period 1250 ms instead of 250 ms (see Note 1).
1	1	High		1	Off	A	1				
1	1	High		1	Off	A	1				
1	1	High		1	Off	A	1				
1	2	High		1	Off	A	2	All commands successfully detected and executed by SC.	3 segments of 32 word command messages successfully detected and executed by SC for each test condition.	1 h 17 min	CMA offsets (±0.1 Hz) not performed because of equipment problems.
1	2	High		1	Off	A	2				

Test date, 1975	Test title	Test	Deep Space Network									
			BLK IV RCV, dBm	BLK IV EXC, dBm	PRA RNG	CMD	Uplink doppler	Uplink offset	CMA SUBC offset	SDA SUBC offset	Mode	RM
2/5	Ranging channel delay threshold and polarity verification	10A	−100.0	−100.8	On	Off	None	None	N/A	N/A	5AR	
			−134.5	−119.9	On	Off	None	None	N/A	N/A	5AR	
2/5	Ranging channel delay threshold and polarity verification	10B	−100.0	−100.8	On	Off	None	None	N/A	N/A	6AR	
			−135.0	−119.9	On	Off	None	None	N/A	N/A	6AR	
1/31	Telemetry performance test	12A	YF = 12.59 −136.0	−140.2	Off	Off	N/A	N/A	N/A	−2.125 Hz −0.350 Hz	3B	
			YF = 12.59 −136.0	−139.6	Off	Off	N/A	+20 kHz	N/A	−2.125 Hz −0.350 Hz	3B	
			YF = 12.59 −136.0	−139.6	Off	Off	N/A	−20 kHz	N/A	−2.125 Hz −0.350 Hz	3B	
2/4	Telemetry performance test	12B	YF = 12.59 −136.0	−120.5	Off	On	N/A	N/A	N/A	−2.125 Hz −0.350 Hz	6B	
			YF = 12.59 −136.0	−120.5	Off	On	N/A	+20 kHz	N/A	−2.125 Hz −0.350 Hz	6B	
			YF = 12.59 −136.0	−121.2	Off	On	N/A	−20 kHz	N/A	−2.125 Hz −0.350 Hz	6B	
2/4		12C	YF = 12.62 −135.5	−120.5	On	Off	N/A	N/A	N/A	−0.35 Hz	5AR	
			YF = 12.62 −135.5	−120.5	On	Off	N/A	+20 kHz	N/A	−0.35 Hz	5AR	
			YF = 12.62 −135.5	−120.5	On	Off	N/A	−20 kHz	N/A	−0.35 Hz	5AR	
2/1	Subcarrier residual phase jitter	13A	−100.0	−101.0	Off	Off	N/A	N/A	N/A	N/A	3B	
			−100.0	−142.2	Off	Off	N/A	N/A	N/A	N/A	3B	
2/5		13B	−100.0	−100.8	Off	Off	N/A	N/A	N/A	N/A	6B	
			−100.0		Off	Off	N/A	N/A	N/A	N/A	6B	

Notes:

1. Corrective action of reversing polarity of 1 K pps in the frequency and time subsystem resolved the command abort problem. Retest of the system at offsets of ±0.1 Hz and ±0.2 Hz was successful.
2. Test 10A data not reliable because of ranging inversion problem. Not retested because of time constraint.

Table 1 (contd)

Spacecraft								Test data		Test time	Comments
EXC	RCV	PWR	ANT	TWT	RNG	TMU	CDU	Performance	Criteria		
1	2	High		1	On	A	2	Inconclusive	Range delay	95 min	Discrete spectrum with 15 components, clock acq. time 30, code acq. time 5, DRVID avg. time 30. 2 bad acquisitions (see Note 2).
1	2	High		1	On	A	2		710 ±75 ns		
2	2	High		2	On	A	2	675.2 ns	Range delay	66 min	Discrete spectrum with 15 components, clock acq. time 30, code acq. time 5, DRVID avg. time 30. 4 bad acquisitions (see Note 3).
2	2	High		2	On	A	2		710 ±75 ns		
1	1	High		1	Off	A	1	8.05 dB HR 15.83 dB LR	7.9 ±1.5 dB 14.7 ±1.5 dB	3 h 49 min	40-s lockup time.
1	1	High		1	Off	A	1	8.05 dB HR 14.95 dB LR	7.9 ±1.5 dB 14.7 ±1.5 dB		40-s lockup time.
1	1	High		1	Off	A	1	7.88 dB HR 14.78 dB LR	7.9 ±1.5 dB 14.7 ±1.5 dB		40-s lockup time.
2	2	High		2	Off	A	2	7.73 dB HR 15.71 dB LR	7.9 ±1.5 dB 14.7 ±1.5 dB	1 h 50 min	40-s lockup time.
2	2	High		2	Off	A	2	8.09 dB HR 15.68 dB LR	7.9 ±1.5 dB 14.7 ±1.5 dB		40-s lockup time.
2	2	High		2	Off	A	2	7.54 dB HR 15.65 dB LR	7.9 ±1.5 dB 14.7 ±1.5 dB		40-s lockup time.
1	2	High		1	On	A	2	21.01 dB	20.8 ±1.5 dB	2 h 2 min	40-s lockup time.
1	2	High		1	On	A	2	21.37 dB	20.8 ±1.5 dB		40-s lockup time.
1	2	High		1	On	A	2	21.07 dB	20.8 ±1.5 dB		40-s lockup time.
1	1	High		1	Off	A		0.38 deg rms	5.8 deg rms	1 h 11 min	
1	1	High		1	Off	A		0.275 deg rms	5.8 deg rms		
2	2	High		2	Off	A		0.45 deg rms	5.8 deg rms	45 min	
2	2	High		2	Off	A		0.46 deg rms	5.8 deg rms		

3. Original test 10B data not reliable because of ranging code inversion problem. Retest and post-test calibration provided correct data. The block IV exciter inverts the ranging code.

Test date, 1975	Test title	Test	Deep Space Network									
			BLK IV RCV	BLK IV EXC	PRA RNG	CMD	Uplink doppler	Uplink offset	CMA SUBC offset	SDA SUBC offset	Mode	RM
4/8	DL threshold one-way	1A	2294.633680 MHz, RCVR 4	N/A	Off	Off	None	None	None	None	5B	
		1B	2294.649800 MHz, RCVR 4	N/A	Off	Off	None	None	None	None	6B	
4/7	UL threshold	2A	2294.621040 MHz, −100.0 dBm, RCVR 4	2112.963541 MHz, EXC 2	N/A	Off	None	None	N/A	N/A	3B	
					N/A	On	None	None	N/A	N/A	3B	
4/8		2B	2294.630020 MHz, RCVR 4	2112.971810 MHz, EXC 2	Off	Off	None	None	N/A	N/A	5B	
					Off	On	None	None	N/A	N/A	5B	
					On	Off	None	None	N/A	N/A	5B	
					On	On	None	None	None	N/A	5B	
4/7	DL threshold two-way	3A	2294.621040 MHz, RCVR 4	2112.963541 MHz, EXC 2	Off	On	None	None	N/A	N/A	3B	
4/9	DL threshold two-way	3B	2294.628880 MHz, RCVR 4	2112.970704 MHz, EXC 2	Off	On	None	None	N/A	N/A	6B	
4/8		3C	2294.630740 MHz, RCVR 3	2112.972384 MHz, EXC 2	On	Off	None	None	N/A	N/A	5AR	
4/7	SC RCVR pull in range and rate and false lock	4A	−100.0 dBm, RCVR 4	2113.027536 MHz at Offset, EXC 2	Off	Off	250 Hz/s	+63 kHz	N/A	N/A	3B	
				2112.906336 MHz at Offset, EXC 2	Off	Off	250 Hz/s	−63 kHz	N/A	N/A	3B	
		4B	−100.0 dBm, RCVR 4	2113.034736 MHz at Offset, EXC 2	Off	Off	250 Hz/s	+63 kHz	N/A	N/A	5B	
				2112.908736 MHz at Offset, EXC 2	Off	Off	250 Hz/s	−63 kHz	N/A	N/A	5B	
4/8	Carrier residual phase jitter	5A	2294.620660 MHz, −100.0 dBm, RCVR 3 and 4	N/A	Off	Off	None	None	None	None	3B	
4/8	Carrier residual phase jitter		2294.616700 MHz, −100.0 dBm, RCVR 3 and 4	2112.959545 MHz, EXC 2	Off	Off	None	None	None	None	3B	

Table 2. Deep Space Network/Viking Lander Capsule 2 telecommunications compatibility tests

Spacecraft								Test data		Test time	Test Comments
EXC	RCV	PWR	ANT	TWT	RNG	TMU	CDU	Performance	Criteria		
1	2	High	HGA	1	Off	A	2	−157.0 dBm	−159.0 ± 3 dBm	51 min	Avg. of three thresholds.
2	2	High	HGA	2	Off	A	2	−158.7 dBm	−159.0 ± 3 dBm	31 min	Avg. of three thresholds.
1	1	High	LGA	1	Off	A	1	−150.8 dBm	−150.3 ± 2.5 dBm	50 min	Avg. of three thresholds, VCO temp = 26.75°C.
1	1	High	LGA	1	Off	A	1	−150.5 dBm	−150.3 ± 2.5 dBm		Avg. of three thresholds, VCO temp = 27.62°C.
1	2	High	HGA	1	Off	A	2	−150.2 dBm	−149.2 ± 2.5 dBm	1 h 59 min	Avg. of three thresholds, VCO temp = 29.33°C.
1	2	High	HGA	1	Off	A	2	−150.2 dBm	−149.2 ± 2.5 dBm		Avg. of three thresholds, VCO temp = 29.66°C.
1	2	High	HGA	1	Off	A	2	−151.2 dBm	−149.2 ± 2.5 dBm		Avg. of three thresholds, VCO temp = 29.66°C.
1	2	High	HGA	1	Off	A	2	−152.0 dBm	−149.2 ± 2.5 dBm		Avg. of three thresholds, VCO temp = 30.00°C.
1, −147.7 dBm	1	High	LGA	1	Off	A	1	−157.8 dBm	−159.0 ± 3.0 dBm dBm	24 min	Avg. of three thresholds.
2	2, −119.4 dBm	High	HGA	2	Off	A	2	−156.8 dBm	−159.0 ± 3.0 dBm	39 min	Avg. of three thresholds.
1	2, −120.9 dBm	High	HGA	1	Off	A	1	−158.7 dBm	−159.0 ± 3.0 dBm	32 min	Avg. of three thresholds.
1	1, −120.6 dBm	High	LGA	1	Off	A	1	Acquired U/L at 2112.963552 MHz and 5 MHz biased doppler	Acquire/biased doppler = 5 MHz	28 min	DL at acquisition 2294.621100 MHz.
1	1, −120.6 dBm	High	LGA	1	Off	A	1	Acquired U/L at 2112.963120 MHz and 5 MHz biased doppler	Acquire/biased doppler = 5 MHz		DL at acquisition 2294.620660 MHz.
1	2, −119.4 dBm	High	LGA	1	Off	A	2	Acquired U/L at 2112.971904 MHz and 5 MHz biased doppler	Acquire/biased doppler = 5 MHz	40 min	DL at acquisition 2294.630200 MHz.
1	2, −119.4 dBm	High	LGA	1	Off	A	2	Acquired U/L at 2112.971664 MHz and 5 MHz biased doppler	Acquire/biased doppler = 5 MHz		DL at acquisition 2294.630440 MHz.
1	1	High	HGA	1	Off	A	1	1.73 deg rms	5.0 deg rms	59 min	Test performed in one-way.
1	1, −100.1 dBm	High	HGA	1	Off	A	1	0.65 deg rms	5.0 deg rms		Test performed in two-way.

Test date, 1975	Test title	Test	Deep Space Network									
			BLK IV RCV	BLK IV EXC	PRA RNG	CMD	Uplink doppler	Uplink offset	CMA SUBC offset	SDA SUBC offset	Mode	RM
4/9		5B	2294.648180 MHz, −100.0 dBm, RCVR 3 and 4	N/A	Off	Off	None	None	None	None	6B	
			2294.623740 MHz, −100.0 dBm, RCVR 3 and 4	2112.966000 MHz, EXC 2	Off	Off	None	None	None	None	6B	
4/8	DL spectrum analysis	6A	2294.630180 MHz, −85.0 dBm, RCVR 3	N/A	Off	Off	None	None	None	None	3B	
			2294.616460 MHz, −85.0 dBm, RCVR 3	2112.959232 MHz, EXC 2	Off	Off	None	None	None	None	3B	
			2294.616460 MHz, −85.0 dBm, RCVR 3	2112.959232 MHz, EXC 2	Off	On	None	None	None	None	3B	
4/9		6B	2294.643680 MHz, −85.0 dBm, RCVR 4	N/A	Off	Off	None	None	None	None	6B	
			2294.624240 MHz, −85.0 dBm, RCVR 4	2112.966480 MHz, EXC 2	Off	Off	None	None	None	None	6B	
			2294.624240 MHz, −85.0 dBm, RCVR 4	2112.966480 MHz, EXC 2	Off	On	None	None	None	None	6B	
4/8		6C	2294.630740 MHz, −85.0 dBm, RCVR 3	2112.972384 MHz, EXC 2	On	Off	None	None	None	None	5AR	
4/8	Transponder rest frequency	7A	2294.616460 MHz, −100.0 dBm, BLK III, RCVR 1	N/A	Off	Off	N/A	N/A	N/A	N/A	3B	
			2294.615264 MHz, RCVR 4	2112.958222 MHz, EXC 2	Off	Off	N/A	N/A	N/A	N/A	3B	
4/9		7B	2294.624480 MHz, −100.0 dBm, BLK III, RCVR 1	N/A	Off	Off	N/A	N/A	N/A	N/A	6B	
			2294.625824 MHz, −100.0 dBm, RCVR 4	2112.967968 MHz, EXC 2	Off	Off	N/A	N/A	N/A	N/A	6B	

Table 2 (contd)

Spacecraft								Test data		Test time	Test Comments
EXC	RCV	PWR	ANT	TWT	RNG	TMU	CDU	Performance	Criteria		
2	2	High	HGA	2	Off	A	2	1.99 deg rms	5.0 deg rms	48 min	Test performed in one-way.
2	2	High	HGA	2	Off	A	2	1.09 deg rms	5.0 deg rms		Test performed in one-way.
1	1	High	HGA	1	Off	A	1	No spurious components	No spurious components	32 min	Photos taken, no spurs seen; DFT performed off-line.
1	1, −140.8 dBm	High	HGA	1	Off	A	1	No spurious components	No spurious components		Photos taken, no spurs seen; DFT performed off-line.
1	1, −143.3 dBm	High	HGA	1	Off	A	1	No spurious components	No spurious components		Photos taken, no spurs seen; DFT performed off-line.
2	2	High	HGA	2	Off	A	2	No spurious components	No spurious components	54 min	Photos taken, no spurs seen, DFT performed off-line.
2	2, −121.6 dBm	High	HGA	2	Off	A	2	No spurious components	No spurious components		Photos taken, no spurs seen; DFT performed off-line.
2	2, −123.8 dBm	High	HGA	2	Off	A	2	No spurious components	No spurious components		Photos taken, no spurs seen; DFT performed off-line.
1	2, −120.9 dBm	High	HGA	1	On	A	2	No spurious components	No spurious components	14 min	Photos taken, no spurs seen; DFT performed off-line.
1	1	High	HGA	1	Off	A	1	VCO freq = 2112.958222 MHz	2112971.451 ± 30 kHz	35 min	SC VCO temp = 30.25°C at start, 30.54°C at end, 15 min run.
1	1, −120.0 dBm	High	HGA	1	Off	A	1	SC locked to UL	SC locked to UL		SC locked in 1 s.
2	2	High	HGA	2	Off	A	2	VCO freq = 2112.967968 MHz	2112971.451 ± 30 kHz	32 min	SC VCO temp = +32.33°C at start, 15 min run.
2	2, −119.4 dBm	High	HGA	2	Off	A	2	SC locked to UL	SC locked to UL		SC locked in 1 s.

Test date, 1975	Test title	Test	Deep Space Network									
			BLK IV RCV	BLK IV EXC	PRA RNG	CMD	Uplink doppler	Uplink offset	CMA SUBC offset	SDA SUBC offset	Mode	RM
4/8	Auxiliary oscillator frequency	8A	−100.0 dBm, BLK III, RCVR 1	N/A	Off	Off	N/A	N/A	N/A	N/A	5B	
4/9		8B	−100.0 dBm, BLK III, RCVR 1	N/A	Off	Off	N/A	N/A	N/A	N/A	6B	
4/8	Command capability	9A	2294.642474 MHz, −99.5 dBm, RCVR 4	2112.983232 MHz, EXC 2	Off	On	None	+20 kHz	None	None	3B	
			2294.599002 MHz, −99.5 dBm, RCVR 4	2112.943248 MHz, EXC 2	Off	On	None	−20 kHz	None	None	3B	
4/8		9B	2294.652380 MHz, −100.0 dBm, RCVR 4	2112.992400 MHz, EXC 2	Off	On	None	+20 kHz	None	None	5B	
			2294.608906 MHz, −100.0 dBm, RCVR 4	2112.952368 MHz, EXC 2	Off	On	None	−20 kHz	None	None	5B	
4/8	Ranging channel delay, threshold and polarity verification	10A	2294.630740 MHz, −100.0 dBm, RCVR 4	2112.972384 MHz, EXC 2	On	Off	None	None	N/A	N/A	5AR	
4/8			2294.630740 MHz, −135.0 dBm, RCVR 4	2112.972384 MHz, EXC 2	On	Off	None	None	N/A	N/A	5AR	
4/9		10B	2294.631040 MHz, −100.0 dBm, RCVR 4	2112.972672 MHz, EXC 2	On	Off	None	None	N/A	N/A	6AR	
			2294.631040 MHz, −135.0 dBm, RCVR 4	2112.972672 MHz, EXC 2	On	Off	None	None	N/A	N/A	6AR	
4/8	Telemetry performance test	12A	2294.620800 MHz, STb/No 9.0 dB, −135.0 dBm, RCVR 4	2112.963320 MHz, EXC 2	Off	On	None	None	None	−2.125 Hz −0.35 Hz	3B	
			2294.642424 MHz, STb/No 9.0 dB, −135.0 dBm, RCVR 4	2112.983232 MHz, EXC 2	Off	On	None	+20 kHz	None	−2.125 Hz −0.35 Hz	3B	
			2294.599002 MHz, STb/No 9.0 dB, −135.0 dBm, RCVR 4	2112.943248 MHz, EXC 2	Off	On	None	−20 kHz	None	−2.125 Hz −0.35 Hz	3B	

Table 2 (contd)

Spacecraft								Test data		Test time	Test Comments
EXC	RCV	PWR	ANT	TWT	RNG	TMU	CDU	Performance	Criteria		
1	2	High	HGA	1	Off	A	2	Aux. osc. freq = 2294.630672 MHz	2294629.630 ± 30 kHz	46 min	Aux. osc. temp = 30.33°C at start, 30.66°C at end, 30-min run.
2	2	High	HGA	1	Off	A	2	Aux. osc. freq = 2294.647424 MHz	2294629.630 ± 30 kHz	38 min	Aux. osc. temp = 32.33°C at start, 30-min run.
1	1, −142.1 dBm	High	LGA	1	Off	A	1	All commands successfully detected and executed by SC with no errors	3 segments of 32-word command messages successfully detected and executed by SC for each test condition	1 h 38 min	Center frequencies, UL 2112.963320 DL 2294.620800
1	1, −142.7 dBm	High	LGA	1	Off	A	1				
1	1, −119.4 dBm	High	HGA	1	Off	A	2	All commands successfully detected and executed by SC with no errors	3 segments of 32-word command messages successfully detected and executed by SC for each test condition	1 h 31 min	Center frequencies, UL 2112.972384 DL 2294.630680
1	1, −120.2 dBm	High	HGA	1	Off	A	2				
1	2, −101.1 dBm	High	HGA	1	On	A	2	683.9 ns	Range delay: 710 ± 75 ns	23 min	No problems noted.
1	2, −120.9 dBm	High	HGA	1	On	A	2	670.3 ns	Range delay: 710 ±75 ns		
2	2, −99.73 dBm	High	HGA	2	On	A	2	666.8 ns	Range delay: 710 ±75 ns polarity	44 min	No problems noted.
2	2, −120.2 dBm	High	HGA	2	On	A	2	663.4 ns	Range delay: 710 ±75 ns		
1	1, −140.5 dBm	High	HGA	1	Off	A	1	8.56 dB HR 15.98 dB LR	7.9 ±1.5 dB 14.7 ±1.5 dB	2 h 19 min	LR subcarrier = 11999.725 Hz; HR subcarrier = 71998.325 Hz.
1	1, −140.5 dBm	High	HGA	1	Off	A	1	8.3 dB HR 15.9 dB LR	7.9 ±1.5 dB 14.7 ±1.5 dB		
1	1, −140.1 dBm	High	HGA	1	Off	A	1	7.98 dB HR 14.77 dB LR	7.9 ±1.5 db 14.7 ±1.5 dB		

Test date, 1975	Test title	Test	Deep Space Network									
			BLK IV RCV	BLK IV EXC	PRA RNG	CMD	Uplink doppler	Uplink offset	CMA SUBC offset	SDA SUBC offset	Mode	RM
4/9		12B	2294.628640 MHz, STb/ No 9.0 dB, −135.0 dBm, RCVR 4	2112.970512 MHz, EXC 2	Off	On	None	None	None	−2.125 Hz −0.35 Hz	6B	
4/9	DL threshold one-way	12B	2294.650295 MHz, STb/ No 9.0 dB, −135.0 dBm, RCVR 4	2112.990480 MHz, EXC 2	Off	On	None	+20 kHz	None	−2.125 Hz −0.35 Hz	6B	
			2294.606873 MHz, STb/ No 9.0 dB, −135.0 dBm, RCVR 4	2112.950496 MHz, EXC 2	Off	On	None	−20 kHz	None	−2.125 Hz −0.35 Hz	6B	
4/8		12C	2294.630740 MHz, STb/ No 23.8 dB, −134.0 dBm, RCVR 4	2112.972384 MHz, EXC 2	On	Off	None	None	None	−0.35 Hz	5AR	
			2294.652380 MHz, STb/ No 23.8 dB, −134.0 dBm, RCVR 4	2112.992 MHz, EXC 2	On	Off	None	+20 kHz	None	−0.35 Hz	5AR	
			2294.608906 MHz, STb/ No 23.8 dB, −134.0 dBm, RCVR 4	2112.952368 MHz, EXC 2	On	Off	None	−20 kHz	None	−0.35 Hz	5AR	
4/8	Subcarrier residual phase jitter	13A	2294.630400 MHz, −100.0 dBm, RCVR 3 and 4	N/A	Off	Off	None	None	None	None SDA 1 and 2	3B	
4/8		13A	2294.616740 MHz, −100.0 dBm, RCVR 3 and 4	2112.959520 MHz, EXC 2	Off	On	None	None	None	None SDA 1 and 2	3B	
4/9		13B	2294.647800 MHz, −100.0 dBm, RCVR 3 and 4	N/A	Off	On	None	None	None	None SDA 1 and 2	6B	
			2294.620280 MHz, −100.0 dBm, RCVR 3 and 4	2112.962784 MHz, EXC 2	Off	On	None	None	None	None SDA 1 and 2	6B	

Table 2 (contd)

Spacecraft								Test data		Test time	Test Comments
EXC	RCV	PWR	ANT	TWT	RNG	TMU	CDU	Performance	Criteria		
2	2, −120.9 dBm	High	HGA	2	Off	A	2	8.65 dB HR 15.37 dB LR	7.9 ±1.5 dB 14.7 ± 1.5 dB	1 h 20 min	LR subcarrier = 11999.925 Hz; HR subcarrier = 71999.85 Hz.
2	2, −120.2 dBm	High	HGA	2	Off	A	2	8.51 dB HR 15.66 dB LR	7.9± 1.5 dB 14.7 ±1.5 dB		
2	2, −120.2 dBm	High	HGA	2	Off	A	2	8.52 dB HR 15.59 dB LR	7.9 ±1.5 dB 14.7 ±1.5 dB		
1	2, −120.9 dBm	High	HGA	1	Off	A	2	21.06 dB LR	20.8 ±1.5 dB	1 h	LR subcarrier = 12000.0 Hz.
1	2, −120.9 dBm	High	HGA	1	Off	A	2	20.7 dB LR	20.8 ±1.5 dB		
1	2, −120.9 dBm	High	HGA	1	Off	A	2	20.95 dB LR	20.8 ±1.5 dB		
1	1	High	HGA	1	Off	A	1	0.31 deg rms	5.8 deg rms	43 min	Test performed in one-way.
1	1, −142.7 dBm	High	HGA	1	Off	A	1	0.31 deg rms	5.8 deg rms		Test performed in two-way.
2	2	High	HGA	2	Off	A	2	0.33 deg rms	5.8 deg rms	39 min	Test performed in one-way.
2	2, −120.9 dBm	High	HGA	2	Off	A	2	0.34 deg rms	5.8 deg rms		Test performed in two-way.

Test date, 1975	Test title	Test	Deep Space Network									
			RCV	EXC	PRA RNG	CMD	Uplink doppler	Uplink offset	CMA SUBC offset	SDA SUBC offset	Mode	RM
2/27	DL threshold one-way	1A	Blk III, RCV 1	N/A	Off	Off	N/A	N/A	N/A	N/A	1	204
2/28		1B	Blk IV, RCV 4	N/A	Off	Off	N/A	N/A	N/A	N/A	1	304
2/27	UL threshold	2A	Blk IV, RCV 4, −114.5 dBm, 23.408637 MHz	Blk IV, 22.035054 MHz	Off	Off	N/A	N/A	N/A	N/A	1	304
					On	On	N/A	N/A	N/A	N/A	1	304
2/27	DL threshold two-way	3A	Blk III, RCV 1, 2297.232032 MHz	Blk III, 2115.367872 MHz	Off	Off	N/A	N/A	N/A	N/A	1A	304
					On	On	N/A	N/A	N/A	N/A	1AR/ CMD	305
2/28	DL threshold two-way	3B	Blk IV, RCV 4, 8423.166325 MHz	Blk IV, 2115.363456 MHz	On	On	N/A	N/A	N/A	N/A	1FR	305
2/27	SC RCVR pull-in	4A	Blk III, RCV 1, 2297.232032 MHz	Blk IV, 2115.367872 MHz	Off	Off	N/A	−700 Hz	N/A	N/A	1	304
	SC RCVR range and rate				Off	Off	500 Hz/s	+40 kHz	N/A	N/A	1	304
	SC RCVR pull-in		−115 dBm		Off	Off	N/A	+700 Hz	N/A	N/A	1	304
	SC RCVR range and rate				Off	Off	500 Hz/s	−40 kHz	N/A	N/A	1	304
	SC RCVR false lock	4A			Off	Off	500 Hz/s	−10 kHz to +7 kHz	N/A	N/A	1	304
					Off	Off	500 Hz/s	+10 kHz to −7 kHz	N/A	N/A	1	304

Table 3. Deep Space Network/Viking Orbiter 1 Telecommunications Compatibility Tests (Radio Frequency Subsystem 203)

Spacecraft								Test data		Test time	Test comments
EXC	RCV	PWR	ANT	TWT	RNG	TMU	CDU	Performance	Criteria		
1	1	High	High	1	Off	A	A	−156.6 dBm	−157.0 ±3 dBm	31 min	DL variations ±0.25 dB.
1	1	High	High	1	Off	A	A	−151.0 dBm	−153.0 ±3 dBm	1 h 8 min	SC in 2-way instead of 1-way mode.
1	1	High	High	1	Off	A	A	−152.5 dBm	−151.5 ±2 dBm	47 min	DL variations ±0.25 dB. VCO temp = 78.68°F.
1	1	High	High	1	Off	A	A	−153.0 dBm	−151.5 ±2 dBm		
1	1, −130.0 dBm	High	High	1	Off	A	A	−157.2 dBm	−157.0 ±3 dBm	37 min	±3 dB DL variation.
1	1, −133.7 dBm	High	High	1	On	A	A	−157.7 dBm	−157.0 ±3 dBm		
1	1, −129.4 dBm	High	High	1	On	A	A	−155.3 dBm	−153 ±3 dBm	47 min	Test run in mode 1 FR not 1 AR, DL variations ±1 dB.
1	1, −120.8 dBm	High	High	1	Off	A	A	11-s acquisition time	≤60-s acquisition time	2 h 19 min	1st attempt unsuccessful because of ramp cable.
1	1, −120.8 dBm	High	High	1	Off	A	A	Tracked to +40 kHz, no loss of lock	Track to +40 kHz, no loss of lock		During test, DL variations increased from ±0.1 dB to ±3 dB at 162400Z.
1	1, −120.8 dBm	High	High	1	Off	A	A	31-s acquisition time	≤60-s acquisition time		
1	1, −120.8 dBm	High	High	1	Off	A	A	Tracked to −40 kHz, no loss of lock	Track to −40 kHz, no loss of lock		
1	1, −120.8 dBm	High	High	1	Off	A	A	Acquired and tracked to +7 kHz	Acquire near BL and track to +7 kHz		
1	1, −120.8 dBm	High	High	1	Off	A	A	Acquired and tracked to −7 kHz	Acquire near BL and track to −7 kHz		

Test date, 1975	Test title	Test	Deep Space Network									
			RCV	EXC	PRA RNG	CMD	Uplink doppler	Uplink offset	CMA SUBC offset	SDA SUBC offset	Mode	RM
2/27	SC RCVR pull-in	4B	Blk III, RCV 1, 2297.222720 MHz,	Blk III, 2115.359232 MHz	Off	Off	N/A	−700 Hz	N/A	N/A	2	376
	SC RCVR range and rate		−121 dBm		Off	Off	500 Hz/s	+40 kHz	N/A	N/A	2	376
	SC RCVR pull-in				Off	Off	N/A	+700 Hz	N/A	N/A	2	376
	SC RCVR range and rate				Off	Off	500 Hz/s	−40 kHz	N/A	N/A	2	376
	SC RCVR false lock				Off	Off	500 Hz/s	−10 kHz to +7 kHz	N/A	N/A	2	376
	SC RCVR false lock				Off	Off	500 Hz/s	+10 kHz to −7 kHz	N/A	N/A	2	376
2/27	Carrier residual phase jitter	5	Blk IV, RCV 3 and 4, 2297.232032 MHz, −106 dBm	N/A	Off	Off	N/A	N/A	N/A	N/A	1A	204
			Blk IV, RCV 3 and 4, −106 dBm	Blk IV, 2115.367872 MHz	Off	Off	N/A	N/A	N/A	N/A	1A	304
2/27	Transponder rest frequency best lock and acquisition time	7A	Blk III, RCV 1, 2297.229152 MHz, −114.5 dBm	Blk III, 22.035055 MHz	Off	Off	N/A	N/A	N/A	N/A	1	204
2/27	Transponder rest frequency best lock and acquisition time	7B	Blk III, RCV 1, 2297.222624 MHz, −120.0 dBm	Blk III, 2115.359232 MHz	Off	Off	N/A	N/A	N/A	N/A	2	376
2/27	Aux. osc. frequency	8A	Blk III, RCV 1, −114.5 dBm	N/A	Off	Off	N/A	N/A	N/A	N/A	1	204

Table 3 (contd)

Spacecraft								Test data		Test time	Test comments
EXC	RCV	PWR	ANT	TWT	RNG	TMU	CDU	Performance	Criteria		
2	2, −121.0 dBm	High	Low	2	On	B	B	14-s acquisition time	≤60-s acquisition time	87 min	Ranging channel left on in the spacecraft.
2	2, −121.0 dBm	High	Low	2	On	B	B	Tracked to +40 kHz, no loss of lock	Track to +40 kHz, no loss of lock		
2	2, −121.0 dBm	High	Low	2	On	B	B	23-s acquisition time	≤60-s acquisition time		
2	2, −121.0 dBm	High	Low	2	On	B	B	Tracked to −40 kHz, no loss of lock	Track to −40 kHz, no loss of lock		
2	2, −121.0 dBm	High	Low	2	On	B	B	Acquired and tracked to +7 kHz	Acquire near BL and track to +7 kHz		
2	2, −121.0 dBm	High	Low	2	On	B	B	Acquired and tracked to −7 kHz	Acquire near BL and track to −7 kHz		
1	1	High	High	1	Off	A	A	2.2 rms	≤3.6 rms	46 min	One-way.
1	1, −121.0 dBm	High	High	1	Off	A	A	TBD	≤2.8 rms		UL −121 dBm instead of −70 dBm; criteria will be recomputed.
1	1, −120.6 dBm	High	High	1	Off	A	A	31-s acquisition time	60 s max. to regain 2-way lock	34 min	VCO temp = 78.68–79.67°F. During −15 min run DL variations ±0.1 dB.
2	2, −121.0 dBm	High	Low	2	Off	B	B	1-s acquisition time	60 s max. to regain 2-way lock	40 min	DL variations ±1.0 dB. VCO temp = 82.5°F.
1	1	High	High	1	Off	A	A	Avg. DL 2297.222374 MHz	Avg. DL 2297.222400 MHz ±500 Hz	13 min	DL variations ±0.25 dB. Aux. osc. temp = 79.53–80.52°F.

Test date, 1975	Test title	Test	Deep Space Network									
			RCV	EXC	PRA RNG	CMD	Uplink doppler	Uplink offset	CMA SUBC offset	SDA SUBC offset	Mode	RM
2/27	Command capability under doppler conditions	9A	Blk IV, RCV 3, 2297.275517 MHz, −120.0 dBm	Blk IV, 2115.407872 MHz	On	On	N/A	+40.0 kHz	+0.1 Hz	N/A	1R	305
			2297.188639 MHz, −120.0 dBm	2115.327872 MHz	On	On	N/A	−40.0 kHz	−0.1 Hz	N/A	1R	305
		9B	Blk IV, RCV 3, 2297.266112 MHz, −121.0 dBm	Blk IV, 2115.399216 MHz	On	On	N/A	+40.0 kHz	+0.1 Hz	N/A	2R	377
			2297.179328 MHz, −121.0 dBm	2115.319248 MHz	On	On	N/A	−40.0 kHz	−0.1 Hz	N/A	2R	377
2/27	Ranging channel delay, threshold and polarity verification	10A	Blk IV, RCV 3, 2297.232032 MHz, −109.0 dBm	Blk IV, 2115.367872 MHz	On	On	N/A	−40.0 kHz	N/A	N/A	1FR	305
			−132.0 dBm		On	On	N/A	−40.0 kHz	N/A	N/A	1FR	305
		10B	Blk IV, RCV 3, 8423.174145 MHz, −125 dBm	Blk IV, 2115.365280 MHz	On	Off	N/A	N/A	N/A	N/A	1FR	305
2/1	Ranging channel delay, threshold and polarity verification	10C	Blk IV, RCV 3, 2297.222340 MHz, −109.0 dBm	Blk IV, 2115.358848 MHz	On	On	N/A	N/A	N/A	N/A	16FR	375
			−132.0 dBm		On	On	N/A	N/A	N/A	N/A	16FR	375
2/28	Mod. index and spectrum analysis	13A	Blk IV, RCV 4, 2297.229800 MHz, −113 dBm	N/A	Off	Off	N/A	N/A	N/A	N/A	1F	304
			−113 dBm	Blk IV, 2115.365760 MHz	On	On	N/A	N/A	N/A	N/A	1FR	305

Table 3 (contd)

Spacecraft								Test data		Test time	Test comments
EXC	RCV	PWR	ANT	TWT	RNG	TMU	CDU	Performance	Criteria		
1	1, −131.0 dBm	High	High	1	On	A	A	All commands confirmed by SC	SC confirms all commands	1 h 36 min	None
1	1, −131.0 dBm	High	High	1	On	A	A	All commands confirmed by SC	SC confirms all commands		
2	2, −130.0 dBm	High	Low	2	On	B	B	All commands confirmed by SC	SC confirms all commands	34 min	None
2	2, −130.0 dBm	High	Low	2	On	B	B	All commands confirmed by SC	SC confirms all commands		
1	1, −133.0 dBm	High	High	1	On	A	A	942.8 ns	976 ns ±100 ns	1 h 38 min	Test run without UL command, mode to increase UL P_c.
1	1, −133.0 dBm	High	High	1	On	A	A	965.4 ns	976 ns ±100 ns		
1	1, −129.5 dBm	High	High	1	On	A	A	778.7 ns	844 ns ±100 ns	1 h 21 min	DL variations ±3 dB. VCO temp = 80.67°F.
2	2, −130.0 dBm	High	High	2	On	B	B	967.6 ns	1012 ns ±100 ns	2 h 37 min	60-min DRVID run spread of 4 ns.
2	2, −130.0 dBm	High	High	2	On	B	B	968.6 ns	1012 ns ±100 ns		
1	1	High	High	1	Off	A	A	TBS	No spurious components, verify mod. index	56 min	HR 4k coded, LR 8⅓ uncoded, no photos taken.
1	1, −120.0 dBm	High	High	1	On	A	A	TBS	No spurious components, verify mod. index		

Test date, 1975	Test title	Test	Deep Space Network									
			RCV	EXC	PRA RNG	CMD	Uplink doppler	Uplink offset	CMA SUBC offset	SDA SUBC offset	Mode	RM
2/28	Telemetry performance	14A	Blk IV, RCV 3, 2297.229800 MHz, −131 dBm	Blk IV, 44.886517 MHz	On	Off	N/A	N/A	N/A	N/A	1FR	305
2/28	Telemetry performance	14B	Blk IV, RCV 3, 2297.222300 MHz, −147 dBm	Blk IV, 2115.358848 MHz	On	Off	N/A	N/A	N/A	N/A	2AR	377

Table 3 (contd)

Spacecraft								Test data		Test time	Test comments
EXC	RCV	PWR	ANT	TWT	RNG	TMU	CDU	Performance	Criteria		
1	1, −130.0 dBm	High	High	1	On	A	A	LR = 12.29 dB, HR = 7.09 dB	TBD	52 min	DL variance ±3 dB, 8⅓, 4k coded, no Y-factor.
2	2, −135.0 dBm	High	Low	2	On	B	B	LR = 8.24 dB	TBD	2 h 15 min	No Y-factor; rest of test scrubbed due to link variations.

Test date, 1975	Test title	Test	Deep Space Network									
			RCV	EXC	PRA RNG	CMD	Uplink doppler	Uplink offset	CMA SUBC offset	SDA SUBC offset	Mode	RM
5/27	DL threshold one-way	1A	BLK 3, RCV 1, 2293.148192 MHz	N/A	Off	Off	N/A	N/A	N/A	N/A	1A	204
		1B	BLK 4, RCV 3, 8408.210320 MHz	N/A	Off	Off	N/A	N/A	N/A	N/A	1A	204
		1C	BLK 4, RCV 4, 2293.148140 MHz	N/A	Off	Off	N/A	N/A	N/A	N/A	16A	374
5/27	UL threshold	2A	BLK 4, RCV 4, 2293.149240 MHz, −120 dBm	BLK 4, 2111.608224 MHz	Off	Off	N/A	N/A	N/A	N/A	1	304
					On	On	N/A	N/A	N/A	N/A	1	304
5/30		2B	BLK 4, RCV 4, 2293.145820 MHz −120.0 dBm	BLK 4, 2111.605056 MHz	Off	Off	N/A	N/A	N/A	N/A	16A	374
					On	On	N/A	N/A	N/A	N/A	16A	374
5/27	DL threshold two-way	3A	BLK 4, RCV 4, 2293.149220 MHz	BLK 4, 2111.608224 MHz	Off	Off	N/A	N/A	N/A	N/A	1A	304
					On	On	N/A	N/A	N/A	N/A	1AR	305
5/27		3B	BLK 4, RCV 4, 8408.213805 MHz	BLK 4, 2111.608224 MHz	Off	Off	N/A	N/A	N/A	N/A	1A	304
					On	On	N/A	N/A	N/A	N/A	1AR	305
5/30		3C	BLK 4, RCV 4, 2293.149240 MHz	BLK 4, 2111.605056 MHz	Off	Off	N/A	N/A	N/A	N/A	16A	374
					On	On	N/A	N/A	N/A	N/A	16AR	375
5/27	SC RCVR pull-in	4A	BLK 4, RCV 4, 2293.149240 MHz	BLK 4, 2111.608128 MHz	Off	Off	N/A	−700 Hz	N/A	N/A	1	304
	SC RCVR range and rate		−120.0 dBm		Off	Off	500 Hz/s	+40 kHz	N/A	N/A	1	304
	SC RCVR pull-in				Off	Off	N/A	+700 Hz	N/A	N/A	1	304
	SC RCVR range and rate				On	Off	500 Hz/s	−40 kHz	N/A	N/A	1	304

Table 4. Deep Space Network/Viking Orbiter 1 Telecommunications Compatibility Tests (Radio Frequency Subsystem 202)

Spacecraft								Test data		Test time	Test comments
EXC	RCV	PWR	ANT	TWT	RNG	TMU	CDU	Performance	Criteria		
1	1	High	High	1	Off	A	A	−158.5 dBm	−157.0 ±3 dBm	22 min	DL variations ±0.75 dB.
1	1	High	High	1	Off	A	A	−155.7 dBm	−153.0 ±3 dBm	41 min	Avg. of three thresholds.
2	2	High	High	2	Off	B	B	−157.5 dBm	−157.0 ±3 dBm	20 min	Avg. of three thresholds.
1	1	High	High	1	Off	A	A	−153.0 dBm	−152.0 ±2 dBm	19 min	VCO temp = 79.3°F.
1	1	High	High	1	Off	A	A	−152.5 dBm	−152.0 ±2 dBm		
2	2	High	High	2	Off	B	B	−154.0 dBm	−152.0 ±2 dBm	23 min	VCO temp = 80.36°F.
2	2	High	High	2	Off	B	B	−153.5 dBm	−152.0 ±2 dBm		Avg. of three thresholds.
1	1	High	High	1	Off	A	A	−157.7 dBm	−157.0 ±3 dBm	1 h 43 min	Avg. of three thresholds.
1	1	High	High	1	On	A	A	−157.5 dBm	−157.0 ±3 dBm		
1	1	High	High	1	Off	A	A	−155 dBm	−153.0 ±3 dBm	52 min	Avg. of three thresholds.
1	1	High	High	1	On	A	A	−155.2 dBm	−153.0 ±3 dBm		Spacecraft ranging channel was on during both thresholds.
2	2, −130.0 dBm	High	High	2	Off	B	B	−157.2 dBm	−157.0 ±3 dBm	33 min	Avg. of three thresholds.
2	2	High	High	2	On	B	B	−156.8 dBm	−157.0 ±3 dBm		
1	1 −120.0 dBm	High	High	1	Off	A	A	5-s acquisition time	≤60-s acquisition time	54 min	No problems noted.
1	1	High	High	1	Off	A	A	Tracked to +40 kHz, no loss of lock	Track to +40 kHz, no loss of lock		
1	1	High	High	1	Off	A	A	44-s acquisition time	≤60-s acquisition time		
1	1	High	High	1	Off	A	A	Tracked to −40 kHz, no loss of lock	Track to −40 kHz, no loss of lock		

Test date, 1975	Test title	Test	Deep Space Network									
			RCV	EXC	PRA RNG	CMD	Uplink doppler	Uplink offset	CMA SUBC offset	SDA SUBC offset	Mode	RM
	SC RCVR false lock				Off	Off	500 Hz/s	−10 kHz to +7 kHz	N/A	N/A	1	304
	SC RCVR false lock				Off	Off	500 Hz/s	+10 kHz to −7 kHz	N/A	N/A	1	304
5/29	SC RCVR pull-in	4B	BLK 4, RCV 4, 2293.149240 MHz,	BLK 4, 2111.608224 MHz	Off	Off	N/A	−700 Hz	N/A	N/A	2F	376
	SC RCVR range and rate		−120.0 dBm		Off	Off	500 Hz/s	+40 kHz	N/A	N/A	2F	376
	SC RCVR pull-in				Off	Off	N/A	+700 Hz	N/A	N/A	2F	376
	SC RCVR range and rate				Off	Off	500 Hz/s	−40 kHz	N/A	N/A	2F	376
	SC RCVR false lock				Off	Off	500 Hz/s	−10 kHz to +7 kHz	N/A	N/A	2F	376
	SC RCVR false lock				Off	Off	500 Hz/s	+10 kHz to −7 kHz	N/A	N/A	2F	376
5/28	Carrier residual phase jitter	5A	BLK 4, RCV 3 and 4, 2293.148192 MHz, −110 dBm	N/A	Off	Off	N/A	N/A	N/A	N/A	1A	304
5/30			BLK 4, RCV 3 and 4, 2293.148768 MHz, −110 dBm	BLK 4, 2111.607840 MHz	Off	Off	N/A	N/A	N/A	N/A	1A	304
5/30	Carrier residual phase jitter	5B	BLK 3, RCV 1 and 2, 2293.147328 MHz, −110.0 dBm	N/A	Off	Off	N/A	N/A	N/A	N/A	16A	374
			2293.145888 MHz, −110 dBm	BLK 3, 2111.605152 MHz	Off	Off	N/A	N/A	N/A	N/A	16A	374
5/27	Transponder rest frequency best lock and acquisition time	7A	BLK 3, RCV 1, 2293.149248 MHz, −120 dBm	BLK 3, 2111.608224 MHz	Off	Off	N/A	N/A	N/A	N/A	1	304

Table 4 (contd)

Spacecraft								Test data		Test time	Test comments
EXC	RCV	PWR	ANT	TWT	RNG	TMU	CDU	Performance	Criteria		
1	1	High	High	1	Off	A	A	Acquired and tracked to +7 kHz	Acquire near BL and track to +7 kHz		
1	1	High	High	1	Off	A	A	Acquired and tracked to −7 kHz	Acquire near BL and track to −7 kHz		
2	2, −120.0 dBm	High	Low	2	On	B	B	14-s acquisition time	≤60-s acquisition time		No problems noted.
2	2	High	Low	2	On	B	B	Tracked to +40 kHz, no loss of lock	Track to +40 kHz. no loss of lock	32 min	
2	2	High	Low	2	On	B	B	23.5-s acquisition time	≤60-s acquisition time		
2	2	High	Low	2	On	B	B	Track to −40 kHz, no loss of lock	Track to −40 kHz, no loss of lock		
2	2	High	Low	2	On	B	B	Acquired and tracked to +7 kHz	Acquire near BL and track to +7 kHz		
2	2	High	Low	2	On	B	B	Acquired and tracked to −7 kHz	Acquire near BL and track to −7 kHz		
1	1	High	High	1	Off	A	A	3.66 deg rms	≤3.6 deg rms	21 min	Avg. of three measurements.
1	1, −110 dBm	High	High	1	Off	A	A	2.68 deg rms	≤2.8 deg rms		
2	2	High	High	2	Off	B	B	4.56 deg rms	≤3.6 deg rms	33 min	Avg. of three measurements.
2	2, −108 dBm	High	High	2	Off	B	B	2.84 deg rms	≤2.8 deg rms		
1	1, −119.0 dBm	High	High	1	Off	A	A	1 s acquisition time	60 s max to regain 2-way lock	25 min	VCO temp = 79.3°F.

Test date, 1975	Test title	Test	Deep Space Network									
			RCV	EXC	PRA RNG	CMD	Uplink doppler	Uplink offset	CMA SUBC offset	SDA SUBC offset	Mode	RM
5/29		7B	BLK 3, RCV 1, 2293.149152 MHz, −120.0 dBm	BLK 3, 2111.608224 MHz	Off	Off	N/A	N/A	N/A	N/A	2	376
5/27	Aux. osc. frequency	8A	BLK 3, RCV 1, −120.0 dBm	N/A	Off	Off	N/A	N/A	N/A	N/A	1	304
5/29 5/30	Aux. osc. frequency	8B	BLK 3, RCV 1, −120.0 dBm	N/A	Off	Off	N/A	N/A	N/A	N/A	16	274
5/28	Command capability under doppler conditions	9A	BLK 4, RCV 4, 2293.193354 MHz, −120.0 dBm	BLK 4, 2111.648880 MHz	On	On	N/A	+40.0 kHz	+0.1 Hz	N/A	1R	305
			2293.106459 MHz, −120.0 dBm	2111.568864 MHz	On	On	N/A	−40.0 kHz	−0.1 Hz	N/A	1R	305
5/29		9B	BLK 4, RCV 4, 2293.193354 MHz. −120.0 dBm	BLK 4, 21110.64880 MHz	On	On	N/A	+40.0 kHz	+0.1 Hz	N/A	2R	377
			2293.106459 MHz, −120.0 dBm	2111.568864 MHz	On	On	N/A	−40.0 kHz	−0.1 Hz	N/A	2R	377
5/28	Ranging channel delay, threshold and polarity verification	10A	BLK 4, RCV 4, 2293.106459 MHz, −109.0 dBm	BLK 4, 2111.568864 MHz	On	On	N/A	−40.0 kHz	N/A	N/A	1FR	305
			−132.0 dBm		On	On	N/A	−40.0 kHz	N/A	N/A	1FR	305
5/28		10B	BLK 4, RCV 3, 8408.213975 MHz, −139 dBm	BLK 4, 2111.608128 MHz	On	Off	N/A	N/A	N/A	N/A	1FR	305
5/30	Ranging channel delay, threshold and polarity verification	10C	BLK 4, RCV 4, 2293.145800 MHz, −109.0 dBm	BLK 4, 2111.605056 MHz	On	On	N/A	N/A	N/A	N/A	1FR	375
					On	On	N/A	N/A	N/A	N/A	1FR	375

Table 4 (contd)

Spacecraft								Test data		Test time	Test comments
EXC	RCV	PWR	ANT	TWT	RNG	TMU	CDU	Performance	Criteria		
2	2, −120.0 dBm	High	Low	2	Off	B	B	1 s acquisition time	60 s max to regain 2-way lock	29 min	VCO temp = 78.4°F.
1	1	High	High	1	Off	A	A	Avg DL 2293.148192 MHz	Avg. DL 2293.148148 MHz ±500 MHz	16 min	Aux. osc. temp = 81.9–82.9°F.
2	2	High	High	2	Off	B	B	Avg DL 2293.147328 MHz	Avg. DL 2293.148148 MHz ±500 MHz	14 min	Aux. osc. temp = 87.65–87.6°F.
1	1, −118.0 dBm	High	High	1	On	A	A	All commands confirmed by SC	SC confirms all commands	1 h 12 min	No problems noted.
1	1, −118.0 dBm	High	High	1	On	A	A	All commands confirmed by SC	SC confirms all commands		
2	2, −119.5 dBm	High	Low	2	On	B	B	All commands confirmed by SC	SC confirms all commands	29 min	No problems noted.
2	2, −119.5 dBm	High	Low	2	On	B	B	All commands confirmed by SC	SC confirms all commands		
1	1, −129.0 dBm	High	High	1	On	A	A	1018, ns	976 ±100 ns	1 h 29 min	Exciter freq at −40.0 kHz offset, 43.991018 MHz.
1	1, −129.0 dBm	High	High	1	On	A	A	1017, ns	976 ±100 ns		
1	1, −129.0 dBm	High	High	1	On	A	A	834 ns	844 ±100 ns		
2	2. −129.0 dBm	High	High	2	On	B	B	1001 ns	1012 ±100 ns	1 h 55 min	
2	2, −129.0 dBm	High	High	2	On	B	B	1002 ns	1012 ±100 ns		80.36°F VCO temp.

Test date, 1975	Test title	Test	Deep Space Network									
			RCV	EXC	PRA RNG	CMD	Uplink doppler	Uplink offset	CMA SUBC offset	SDA SUBC offset	Mode	RM
5/30	Ranging channel delay, simultaneous S/X-band	10D	BLK 4, RCV 3. 8408.212445 MHz, −130.4 dBm, BLK 4, RCV 4, 2293.148820 MHz, −113.5 dBm	BLK 4, 2111.607840 MHz	On	On	N/A	N/A	N/A	N/A	1FR	305
5/28	Mod. index and spectrum analysis	13A	BLK 4, RCV 4, 2293.148260 MHz, −96.5 dBm	N/A	Off	Off	N/A	N/A	N/A	N/A	1FR	304
			2293.149980 MHz, −96.5 dBm	BLK 4, 2111.608896 MHz	On	On	N/A	N/A	N/A	N/A	1FR	305
5/29		13B	BLK 4, RCV 4, 2293.147380 MHz, −91.0 dBm	N/A	Off	Off	N/A	N/A	N/A	N/A	2A	376
			2293.148300 MHz, −91.0 dBm	BLK 4, 2111.607360 MHz	On	On	N/A	N/A	N/A	N/A	2AR	377
5/28	Telemetry performance	14A	BLK 4, RCV 4, 2293.149980 MHz, −133.5 dBm, 5 dB STB/No	BLK 4, 2111.608896 MHz	On	Off	N/A	N/A	N/A	N/A	1FR	304/ 305
5/28-29		14B	BLK 4, RCV 4, 2293.149160 MHz, −150.0 dBm 8.6 dB STB/No	BLK 4, 2111.608224 MHz	On	Off	N/A	N/A	N/A	N/A	2AR	376/ 377
			2293.189132 MHz, −139.5 dBm, 18.8 dBm, STB/No	2111.644992 MHz	On	Off	26 Hz/s	+36.8 kHz	N/A	−0.22 Hz	2AR	377
			2293.189132 MHz, −139.5 dBm, 18.8 dB, STB/No	2111.644992 MHz	On	Off	N/A	+36.8	N/A	−0.22 Hz	2AR	377

Table 4 (contd)

Spacecraft								Test data		Test time	Test comments
EXC	RCV	PWR	ANT	TWT	RNG	TMU	CDU	Performance	Criteria		
1	1, −128.8 dBm	High	High	1	On	A	A	848 ns 1015 ns	844 ±100 × delay 976 ±100 S delay	47 min	79.3°F VCO temp.
1	1	High	High	1	Off	A	A	TBS	No spurious components, verify mod. index	51 min	No problems noted.
1	1, −113.0 dBm	High	High	1	On	A	A	TBS			
2	2	High	Low	2	Off	B	B	TBS	No spurious components, verify mod. index	29 min	No problems noted.
2	2, −111.0 dBm	High	Low	2	On	B	B	TBS			
1	1, −127.0 dBm	High	High	1	On	A	A	LR = 8.26 dB HR = 3.07 dB	10.3 ±1.9 dB 3.1 ±1.1 dB	1 h 10 min	
2	2, −128.2 dBm	High	Low	2	On	B	B	LR = 5.1 dB	4.8 ±1.4 dB	2 h 13 min	
2	2, −137.0 dBm	High	Low	2	On	B	B	LR = 16.9 dB	16.2 ±1.7 dB		
2	2, −137.5 dBm	High	Low	2	On	B	B	LR = 17.32 dB	17.5 ±1.7 dB		

Test date, 1975	Test title	Test	Deep Space Network									
			RCV	EXC	PRA RNG	CMD	Uplink doppler	Uplink offset	CMA SUBC offset	SDA SUBC offset	Mode	RM
3/22	Orbiter/ Lander command discrimination	3A	BLK IV, RCV 4, 2295.739338 MHz, −100.0 dBm	BLK IV, 2113.993344 MHz	Off	CMA 1 on, CMA 2 off	N/A	N/A	CMA 1 = VL 0.0 Hz, CMA 2 = VO 0.0 Hz	N/A	N/A	306 VO
					Off	CMA 1 off, CMA 2 on						
					On	CMA 1 on, CMA 2 off	N/A	+40.0 kHz	CMA 1 = VL +0.1 Hz, CMA 2 = VO +0.1 Hz	N/A	N/A	307 VO
					On	CMA 1 off, CMA 2 on						
					Off	CMA 1 on, CMA 2 off	N/A	+40.0 kHz	CMA 1 = VL +0.1 Hz, CMA 2 = VO +0.1 Hz	N/A	N/A	306 VO
					Off	CMA 1 off, CMA 2 on						
					Off	CMA 1 on, CMA 2 off	N/A	−40.0 kHz	CMA 1 = VL −0.1 Hz, CMA 2 = VO −0.1 Hz	N/A	N/A	307 VO
					Off	CMA 1 off, CMA 2 on						
		3B	BLK IV, RCV 4, 2295.743780 MHz, −100.0 dBm	BLK IV, 2113.997376 MHz	Off	CMA 1 on, CMA 2 off	N/A	N/A	CMA 1 = VL 0.0 Hz, CMA 2 = VO 0.0 Hz	N/A	N/A	316
					Off	CMA 1 off, CMA 2 on,						
					On	CMA 1 on, CMA 2 off	N/A	+40.0 kHz	CMA 1 = VL +0.1 Hz, CMA 2 = VO +0.1 Hz	N/A	N/A	317
					On	CMA 1 off, CMA 2 on						
					Off	CMA 1 on, CMA 2 off	N/A	+40.0 kHz	CMA 1 = VL +0.1 Hz, CMA 2 = VO +0.1 Hz	N/A	N/A	316
					Off	CMA 1 off, CMA 2 on						

Table 5. Deep Space Network/Viking Spacecraft 1 Telecommunications Compatibility Test

Spacecraft								Test data		Test time	Test comments
EXC	RCV	PWR	ANT	TWT	RNG	TMU	CDU	Performance	Criteria		
N/A	1 −99.85 dBm	N/A	N/A	N/A	Off	N/A	1	Met criteria	All commands successfully detected by Lander (step 7)	3 h 39 min	None.
								Met criteria	All commands successfully detected by Orbiter (step 11)		VL indicated sporadic in/out-of-lock with VO subcarrier plus bit sync present.
N/A	1 −112.0 dBm	N/A	N/A	N/A	On	N/A	1	Met criteria	All commands successfully detected by Lander (step 18)		None.
								Met criteria	All commands successfully detected by Orbiter (step 23)		VL indicated sporadic in/out-of-lock with VO subcarrier plus bit sync present.
N/A	1 −143.2 dBm	N/A	N/A	N/A	Off	N/A	1	Met criteria	All commands successfully detected by Lander (step 29)		None.
								Met criteria	All commands successfully detected by Orbiter (step 34)		VL indicated no lock at −143.2 dBm UL P_c.
N/A	1 −111.0 dBm	N/A	N/A	N/A	On	N/A	1	Met criteria	All commands successfully detected by Lander (step 42)		None.
								Met criteria	All commands successfully detected by Orbiter (step 48)		VL indicated sporadic in/out-of-lock with VO subcarrier plus bit sync present.
N/A	2 −98.5 dBm	N/A	N/A	N/A	Off	N/A	2	Met criteria	All commands successfully detected by Lander (step 7)	1 h 40 min	None.
								Met criteria	All commands successfully detected by Orbiter (step 11)		None.
N/A	2 −113.6 dBm	N/A	N/A	N/A	On	N/A	2	Met criteria	All commands successfully detected by Lander (step 18)		None.
								Met criteria	All commands successfully detected by Orbiter (step 23)		None.
N/A	2 −142.9 dBm	N/A	N/A	N/A	Off	N/A	2	Met criteria	All commands successfully detected by Lander (step 29)		None.
								Met criteria	All commands successfully detected by Orbiter (step 34)		None.

Test date, 1975	Test title	Test	Deep Space Network									
			RCV	EXC	PRA RNG	CMD	Uplink doppler	Uplink offset	CMA SUBC offset	SDA SUBC offset	Mode	RM
7/7	Orbiter/ Lander command discrimination	3A	BLK IV, RCV 4, 2297.225380 MHz, −99.5 dBm	BLK IV, 2115.366912 MHz	Off	CMA 1 on, CMA 2 off	N/A	N/A	CMA 1 = VL 0.0 Hz, CMA 2 = VO 0.0 Hz	N/A	N/A	306 VO
					Off	CMA 1 off, CMA 2 on						
					On	CMA 1 on, CMA 2 off	N/A	+40.0 kHz	CMA 1 = VL +0.1 Hz, CMA 2 = VO +0.1 Hz	N/A	N/A	307 VO
					On	CMA 1 off, CMA 2 on						
					Off	CMA 1 on, CMA 2 off	N/A	+40.0 kHz	CMA 1 = VL +0.1 Hz, CMA 2 = VO +0.1 Hz	N/A	N/A	306 VO
					Off	CMA 1 off, CMA 2 on						
					Off	CMA 1 on, CMA 2 off	N/A	−40.0 kHz	CMA 1 = VL −0.1 Hz, CMA 2 = VO −0.1 Hz	N/A	N/A	307 VO
					Off	CMA 1 off, CMA 2 on						
		3B	BLK IV, RCV 4, 2297.223040 MHz, −100.0 dBm	BLK IV, 2115.359520 MHz	Off	CMA 1 on, CMA 2 off	N/A	N/A	CMA 1 = VL 0.0 Hz, CMA 2 = VO 0.0 Hz	N/A	N/A	316
					Off	CMA 1 off, CMA 2 on						
					On	CMA 1 on, CMA 2 off	N/A	+40.0 kHz	CMA 1 = VL +0.1 Hz, CMA 2 = VO +0.1 Hz	N/A	N/A	317
					On	CMA 1 off, CMA 2 on						
					Off	CMA 1 on, CMA 2 off	N/A	+40.0 kHz	CMA 1 = VL +0.1 Hz, CMA 2 = VO +0.1 Hz	N/A	N/A	316
					Off	CMA 1 off, CMA 2 on						

Table 6. Deep Space Network/Viking Spacecraft 2 Telecommunications Compatibility Test

Spacecraft								Test data		Test time	Test comments
EXC	RCV	PWR	ANT	TWT	RNG	TMU	CDU	Performance	Criteria		
N/A	1 −101.0 dBm	N/A	N/A	N/A	Off	N/A	1	Met criteria	All commands successfully detected by Lander (step 7)	6 h 33 min	See paragraph 3.1.2.1 of test report.
								Met criteria	All commands successfully detected by Orbiter (step 11)		
N/A	1 −112.7 dBm	N/A	N/A	N/A	On	N/A	1	Met criteria	All commands successfully detected by Lander (step 18)		
								Met criteria	All commands successfully detected by Orbiter (step 23)		
N/A	1 −143.0 dBm	N/A	N/A	N/A	Off	N/A	1	Met criteria	All commands successfully detected by Lander (step 28)		
								Met criteria	All commands successfully detected by Orbiter (step 33)		
N/A	1 −112.0 dBm	N/A	N/A	N/A	On	N/A	1	Met criteria	All commands successfully detected by Lander (step 41)		
								Met criteria	All commands successfully detected by Orbiter (step 46)		
N/A	2 −99.6 dBm	N/A	N/A	N/A	Off	N/A	2	Met criteria	All commands successfully detected by Lander (step 7)	1 h 40 min	See paragraph 3.1.2.1 of test report.
								Met criteria	All commands successfully detected by Orbiter (step 11)		
N/A	2 −113.0 dBm	N/A	N/A	N/A	On	N/A	2	Met criteria	All commands successfully detected by Lander (step 18)		
								Met criteria	All commands successfully detected by Orbiter (step 23)		
N/A	2 −143.0 dBm	N/A	N/A	N/A	Off	N/A	2	Met criteria	All commands successfully detected by Lander (step 28)		
								Met criteria	All commands successfully detected by Orbiter (step 33)		

Table 7. Definition of terms

Term	Definition
Bit rate	clock frequency of the telemetry bit information
Car. sup.	downlink carrier suppression due to telemetry modulation
CMA SUBC offset	command modulation assembly subcarrier frequency offset relative to nominal
DL	S-band RF downlink
DSN CMD	telemetry and command data handling command modulation
DRVID	differenced range vs integrated doppler
DSN EXC	the standard DSN Block III/Block IV exciter equipment
DSN RCVR	the standard DSN Block III/Block IV receiving equipment
HR	high rate
LR	low rate
P_c	power in carrier
DSN RNG	planetary ranging assembly modulation
SC ant	spacecraft antenna
SC CDU	spacecraft command detector unit
SC EXC	spacecraft S-band exciter equipment
SC mode	spacecraft telemetry mode
SC PWR	spacecraft transmitter power mode
SC RCV	spacecraft S-band receiving equipment
SC RNG	spacecraft ranging channel—ON/OFF
SC RM	spacecraft radio mode
SC TMU	spacecraft telemetry modulation unit
SC TWT	spacecraft traveling wave tube amplifier
SDA SUBC offset	subcarrier demodulator assembly subcarrier frequency offset relative to nominal
TBD	to be determined
TLM	telemetry
UL	S-band RF uplink
Uplink doppler	ramp rate of the uplink carrier frequency
Uplink offset	uplink carrier frequency offset relative to the spacecraft receiver rest frequency

Table 8. RF channels and center frequencies for special RF interference tests

	Orbiter Channel 9, MHz	Lander Channel 13, MHz	Test transmitter Channel 20, MHz
DSN receive	2293.148148	2294.629630	2297.222222
DSN transmit	2111.607253	2112.971451	Not Applicable