# Network Command System Performance Test Report for Mariner Venus/Mercury 1973

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*This article presents a description of Network Command System Performance Tests that were executed throughout the DSN in support of the MVM'73 project.*

## I. Introduction

The purpose of this article is to describe the Network Command System Performance Test (SPT) conducted at each DSN station in preparation for the MVM'73 mission, and to report the status of each station at the time of launch. The objectives of the performance tests will be discussed, along with a description of the various sections of the test procedure. Problems uncovered and their solutions will also be discussed. The SPT is contained in Section II of Ref. 1.

## II. Objectives

The overall objective of the Network Command SPT is to verify that the Network Command System can support MVM'73 operational capabilities. These capabilities are defined in various documents, such as Refs. 2 and 3. A more general statement would be to verify each station's capability to provide the correct modulation mode, phase-shift keyed (PSK) with pseudo-noise (PN) synchronization (sync). More specific objectives are:

(1) To perform integration testing on telemetry and command processor (TCP) operational software.

(2) To verify station capabilities after hardware or software changes.

(3) To verify command capability while processing telemetry in the same TCP computer.

(4) To train station personnel with TCP operational software.

(5) To provide the stations with a prepass readiness test.

During the SPT, the telemetry and command data handling subsystem (TCD) operational program DOI-5050-OP Model A, was exclusively used in the TCP.

## III. Test Procedure Format

In this section, the format of the SPT, which will provide a description of the tests that were performed, will be presented. The SPT is divided into four main sections: Countdown, Manual Mode, Automatic Mode, and Reliability. The complete testing can be performed in approximately six hours per TCD.

### A. Countdown

The Countdown section is used as a prepass readiness test that is performed prior to the data transfer test with Network Operations. Using the appropriate TCP operational software, command capability is verified in the manual and remote mode of operations. The modulation index is adjusted and measured. Monitor interface is verified. Both timed and nontimed commands are transmitted.

### B. Manual Mode Tests

In this section, the same type of testing is performed as in the Countdown section. Additional tests are performed on Command Modulator Assembly (CMA) configurations and TCP program manipulation. The ability to record and recover command data from an analog tape is performed.

### C. Automatic Mode Tests

The automatic test uses the digital instrumentation subsystem (DIS) computer to simulate remote command operations. Special test software is used in the DIS to process certain programmed test sequences that can be independently selected by an operator. Each test sequence generates the command data, predicts results and verifies command data from the TCP, by utilizing high-speed data (HSD) interface to the TCP. These test sequences are processed automatically, and the results are output to the operator. All HSD blocks are automatically checked against Ref. 2. The programmed test sequences are:

(1) CMA mode changes.

(2) Monitor interface.

(3) CMA operational alarms and aborts.

(a) Symbol rate.

(b) Subcarrier frequency.

(c) Command register and marker bit failure detection.

(d) PN sync quality.

(e) Data quality.

(f) PSK data to PN sync ratio.

(4) Exciter interface alarms and aborts.

(5) Time command accuracy.

(6) Stack warnings.

(7) PN generator failure detection.

### D. Reliability Tests

In the reliability tests, the capability to command and to process telemetry in the same computer is demonstrated. Continuous commanding is exercised while processing telemetry at bit rates of 33⅓, 2450, and 117.6 kilobits/s. Commanding consists of priority commands on 26-s centers and timed commands on 30-s centers. The DIS computer is used to generate the command data, to process the command data from the TCP, and to process the telemetry data for errors. This type of testing is performed continuously for four hours per TCD.

An appendix has been added to the reliability section giving the stations the capability to test the PN generators used to generate the PN sync signal. This was developed after detecting bit rate alarms at some stations during the first SPTs. In this peculiar test, the 511-bit PN sequences generated by the CMA are processed as a 511-bit/s telemetry channel. The processed telemetry is checked at the DIS for bit errors in the PN sequence. PN sequences containing bit errors are dumped on a line printer.

## IV. Problems

In the following paragraph, the problems uncovered and the solutions to them will be discussed.

### A. PSK Data to PN Sync Ratio

The majority of the stations did not have the correct ratio. Analog adjustments within the CMA were made to obtain the correct ratio. The repair depot procedures were changed to reflect the correct ratio adjustments on the CMA analog drawers.

### B. Subcarrier Frequency Alarms and Aborts

Two stations experienced this problem only during reliability testing while processing 2450-bit/s telemetry.

Engineering change order (ECO) 73-023 was installed in the CMA clock counter interface to eliminate the noise problem on TCP pin/pot lines.

### C. Bit Rate Alarms and Watch Dog Time Failures

DSSs 12, 14, and 42 experienced this problem. This condition was corrected at DSSs 12 and 42 by analog adjustments. However, at Station 14, an emergency ECO was installed as a temporary solution. The final solution for all DSSs is currently being implemented by the Cognizant Operating Engineer (COE). During operations, the bit rate warning limits are narrow to enable detection of bit rate errors caused by PN generator failures.

### D. Exciter Confirmation Phase Detector

Most stations reported excessive dc drifting on the output of the exciter's confirmation phase detector. The drift was more pronounced at some stations. As a result, command confirmation was changed to use the local confirmation within the CMA. During the investigation, a wrong value capacitor that had been installed at the factory was discovered. Installing a capacitor of the correct value enabled the 26-m DSSs to meet specifications. However, a different problem exists at the 64-m DSS with Programmed Oscillator Control Assembly (POCA) installation. The development section is still working on a solution to this problem.

## V. Status at Launch

DSSs 12, 14, 62, 63, and 71 had successfully completed and passed all command system tests. DSS 42/43 completed and passed approximately 80% of the command system test. DSSs 11 and 51 were not required to perform the tests.

## References


1. *DSIF Standard Test Procedure No. 853-62; 2A-08, Command System Test for MVM'73*, Document No. 853. Jet Propulsion Laboratory, Pasadena, Calif. (JPL internal document in preparation.)
2. *Deep Space Network System Requirements—Detailed Interface Design*, Document No. 820–13. Jet Propulsion Laboratory, Pasadena, Calif., Feb. 1, 1971. (JPL internal document.)
3. *Deep Space Network Support Requirements for MVM'73 Project*, Document No. 615–15–Rev. A. Jet Propulsion Laboratory, Pasadena, Calif., Jan. 15, 1973. (JPL internal document.)