Viking 1975 Analog Recording

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The requirements on the FR1400 analog magnetic tape recorders in the DSN have been increasing in recent years. Viking 1975 requirements appeared particularly stringent. Problems of insufficient tape recording channels or bandwidth were solved by decreasing telemetry requirements and by providing no backup recording for occultation purposes on the standard telemetry recorders.

I. Introduction

An understanding of the potential problems to be faced by the analog telemetry recorders for the Viking 1975 mission may be facilitated by mention of the difficulties involved in the Mariner Venus/Mercury 1973 (MVM'73) mission, particularly at a 64-m antenna site. It was decided by the Deep Space Network (DSN) that since occultation data recorded on the occultation-dedicated analog tape recorders at DSSs 14 and 43 comprised prime radio science data, critical occultation data backup would be provided on the standard telemetry recorders. To this end, two tracks were assigned to occultation, three tracks to telemetry, and two tracks were shared by telemetry and occultation signals. Telemetry recording resources were stressed, particularly by the number of ground signals to be recorded and the large bandwidth which some of them required. Considerable investigation was needed before a workable final recording configuration for MVM'73 was evolved.

II. Viking 1975 Requirements and Changes

Occultation requirements for Viking 1975 will remain approximately the same as for MVM'73, while the number of many of the telemetry requirements will nearly double. It is clear therefore that with the present seven-track recorders, occultation and telemetry cannot share the same tape recorder. All occultation signals are therefore to be recorded on occultation-dedicated FR1400 Analog Magnetic Tape Recorders at DSSs 14 and 43.

At the same time, the DSN has agreed that only four of the 16 possible ground signals must be recorded on the telemetry recorders. In order to obviate interference problems, it is planned to install low-pass (50-Hz) filters in the pre/post detection recording subsystem (PPR) and the analog instrumentation subsystem (AIS), such that the bandwidth of these signals will be limited before they are routed into voltage controlled oscillators (VCOs) and multiplexed with other signals. The bandwidth-restricted

ground signals processed in the PPR are also to be used in the occultation recorder's signal conditioning equipment.

As a result of the above agreements, individual track assignments are relatively uncrowded and are substantially the same as for the Mariner 1971 mission, on a track-for-track basis, with the exception of the necessity for the mixing of speedlock signals with VCO signals containing subcarrier demodulation assembly (SDA) output data. MVM'73 recording successfully made use of speedlock signals mixed with SDA output VCO signals. To ensure success in the playback of data at Compatibility Test Area (CTA) 21, an external bandpass filter was used in MVM'73 and will be used in Viking 1975 to extract speedlock from a multiplex and present it to the servo of the FR2000 analog magnetic tape recorder.

Listed below are the recommended track assignments for a 64-m station:

Cruise Mode, 38.1 cm/s (15 ips)

Track 1. Ground signals, NASA time, commands and voice on VCOs ranging from 1.3 to 93 kHz

Track 2. Baseband Orbiter 1 direct record

Track 3. Orbiter 1 SDA outputs, 13.5-kHz VCO and 108-kHz VCO combined

Track 4. Speedlock 25-kHz direct record

Track 5. Speedlock 25-kHz direct record

Track 6. Baseband Orbiter 2 direct record

Track 7. Orbiter 2 SDA outputs, 13.5/108-kHz VCOs

Planetary Mode, 152.4 cm/s (60 ips)

Track 1. Same as cruise

Track 2. Same as cruise

Track 3. Baseband Lander direct record

Track 4. Speedlock 100-kHz mixed with Orbiter 1 SDA outputs on 13.5/525-kHz VCOs

Track 5. Speedlock 100-kHz mixed with Orbiter 2 SDA outputs on 13.5/525-kHz VCOs

Track 6. Same as cruise

Track 7. Lander SDA outputs, 13.5/108-kHz VCOs

The following are the recommended track assignments for the 26-meter stations, 38.1 cm/s (15 ips), planetary and cruise mode:

Track 1. Vacant

Track 2. Receiver 1 baseband, direct record

Track 3. Ground signal, NASA time, command and voice

Track 4. Speedlock 25-kHz mixed with SDA 1 output, 108-kHz VCO

Track 5. Speedlock 25-kHz mixed with SDA 2 output, 108-kHz VCO

Track 6. Receiver 2 baseband, direct record

Track 7. Vacant

III. Predictions for Data Degradation

Detected data outputs recorded at encounter signal-to-noise ratios should be capable of being reproduced with data degradations of less than 1 dB. Baseband data similarly recorded should be capable of being reproduced with data degradation of less than 1.5 dB. The improvement in the baseband degradation figure from past performance is expected to occur as a result of upgrading the present FR2000s at CTA 21 to FR2000As with improved time base error and skew figures.

IV. Testing Performance

Two tests should be performed in validation of the proposed configuration. One is playback of baseband data using speedlock multiplexed with SDA outputs. This will test interference with speedlock as well as the degradation figure for baseband. The other test is the playback of the track having ground signals, time, and command recorded to check for the efficacy of the low-pass filters. The successful extraction of time would be a good indication of this. Other possible tests may be considered as having already been accomplished by the success experienced in past missions.