FINAL REPORT - BIT MISSION 7051

1. ~~(S)~~ MISSION SUMMARY.

1.1 ~~(S)~~ Program Objectives.

As part of the over-all problem of determining the vulnerability of the Agena satellites to Soviet radar detection and tracking, the objective of the BIT program is to determine if and when the radar system associated with the signal [redacted] acquires and tracks the Agena vehicle. The BIT system, designed to fulfill this objective, covers the frequency range from 150 to 164 Mc and accepts only those signals which have characteristics similar to [redacted] On those signals which qualify, the system will measure frequency, PRF, and signal amplitude along with the time of intercept to enable an analyst to identify the signal characteristics and to estimate a geographical area within which the emitter is located.

1.2 ~~(S)~~ Mission Highlights.

During the mission life of 112 orbits, the BIT system intercepted one signal which passed the system's qualification requirements but which is not the signal of interest, [redacted] The signal, intercepted for six seconds while the vehicle was over Shenyang, China (42.2°N, 123°E), is identified as [redacted] which is deployed in China. It is concluded that the [redacted] emitter did not detect or track the Agena vehicle during the intercept. Although the system functioned properly throughout the duration of the mission, the [redacted] signal intercepted on orbit 77 was the only signal of interest intercepted during the operation.

1.3 ~~(S)~~ Flight Summary.

Vehicle Number	1170
Launch Date	5 October 1964
Launch Time	2150 GMT
Inclination	80 degrees
Apogee	240 nautical miles
Perigee	99 nautical miles
Period	90.7 minutes

SPECIAL HANDLING

2. (S) DATA ANALYSIS.

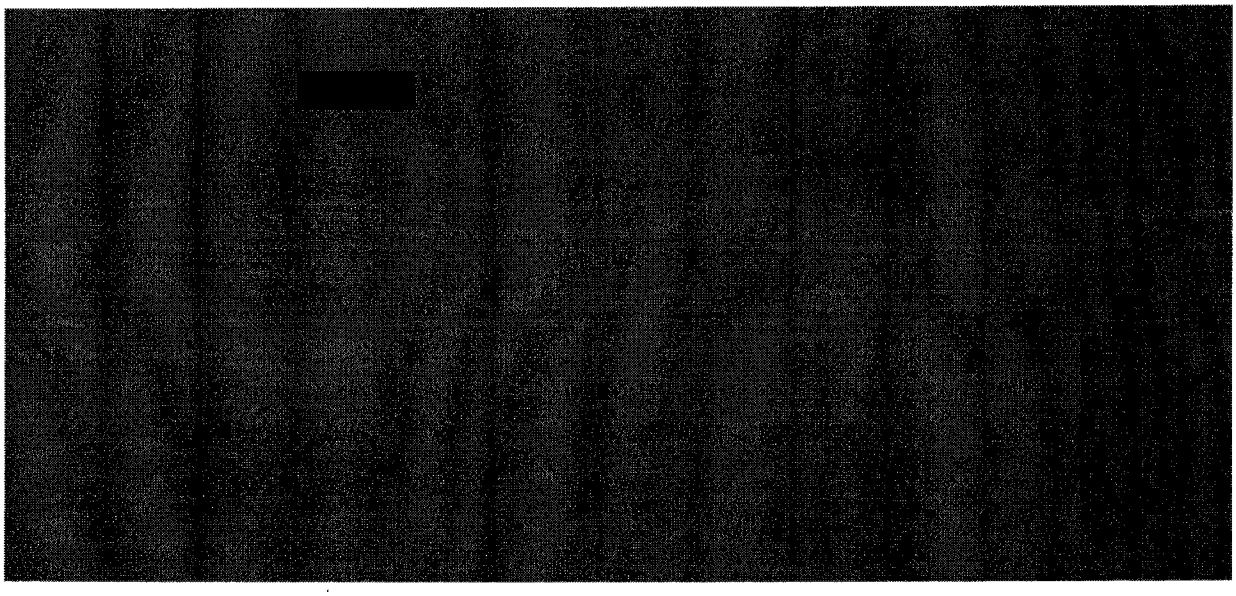
2.1 (S) System Coverage.

The BIT system was programmed on during every orbit throughout the mission life while the vehicle was over the northern hemisphere with an emphasis on the coverage over Europe, the USSR and Asia. On seven occasions, the unit was on throughout the entire orbit to make periodic checks in the southern hemisphere.

The system monitors the 150- to 164-Mc frequency range with a receiver sensitivity of -54 dbm. With the inclusion of the antenna pattern, the over-all system sensitivity varies from approximately -44 dbm at the horizon to -52 dbm looking straight down. Signals intercepted by the system are rejected by qualification circuitry if the pulse widths are less than approximately 18 microseconds and if the PRFs do not fall within the 95- to 101-pps PRF acceptance band or harmonics of this band. The system measures amplitude, frequency, and PRF on those signals which qualify. If a signal has a power level at the receiver of -28 dbm or greater, it will also be fed into a high level channel which requires no qualification other than amplitude and which measures only the signal amplitude.

2.2 (S) Mission Results.

2.2.1 (S) Qualified Intercept.



2.2.1 ~~(S)~~ -- Continued.

[redacted]

2.2.1 (S) -- Continued.

[redacted]

2.2.2 (S) Non-Qualified Intercept.

[redacted]

2.2.2 (S) -- Continued.

[redacted]

[redacted]

3. (S) SYSTEM PERFORMANCE EVALUATION.

3.1 (S) System Description.

A block diagram of the BIT system is shown in Figure 1 although it is labeled by its in-house name of FIRE BOX. It is basically a TRF (tuned radio frequency) receiver with video logic for signal recognition and circuits for parameter measurement. An intercepted signal which exceeds the Detector B threshold of -54 dbm is amplitude standardized in the video threshold circuit and then qualified. If the pulse width is greater than 18 microseconds, the signal will be passed to the Pulse Rate Counter (PRC) and the PRF Qualifier. The PRC counts the total number of pulses received during one commutator read-in cycle (400 milliseconds) and the PRF Qualifier examines the pulse train for a PRF of 95 to 101 pps or harmonics of this PRF range. If the PRF qualifies, a pulse-by-pulse gate pulse is generated which opens the two gates to permit the Peak Level Detectors (PLD) to read amplitude and frequency. The PLD's store the lowest frequency and the highest pulse amplitude intercepted during the 400-millisecond read-in period. If the signal level exceeds -30 dbm at the receiver, the signal amplitude will be read in the Detector A channel without qualification. A Time Reference Generator provides a parallel orbital time code reference for the system. It is also used to trigger the Signal Simulator on for four seconds every 256 seconds. The Simulator generates a 98-pps signal at a frequency of 160 Mc and a power level of -35 dbm which is used to test the entire system for proper operation plus providing a one-point calibration check of the system.

FIRE BOX SYSTEM

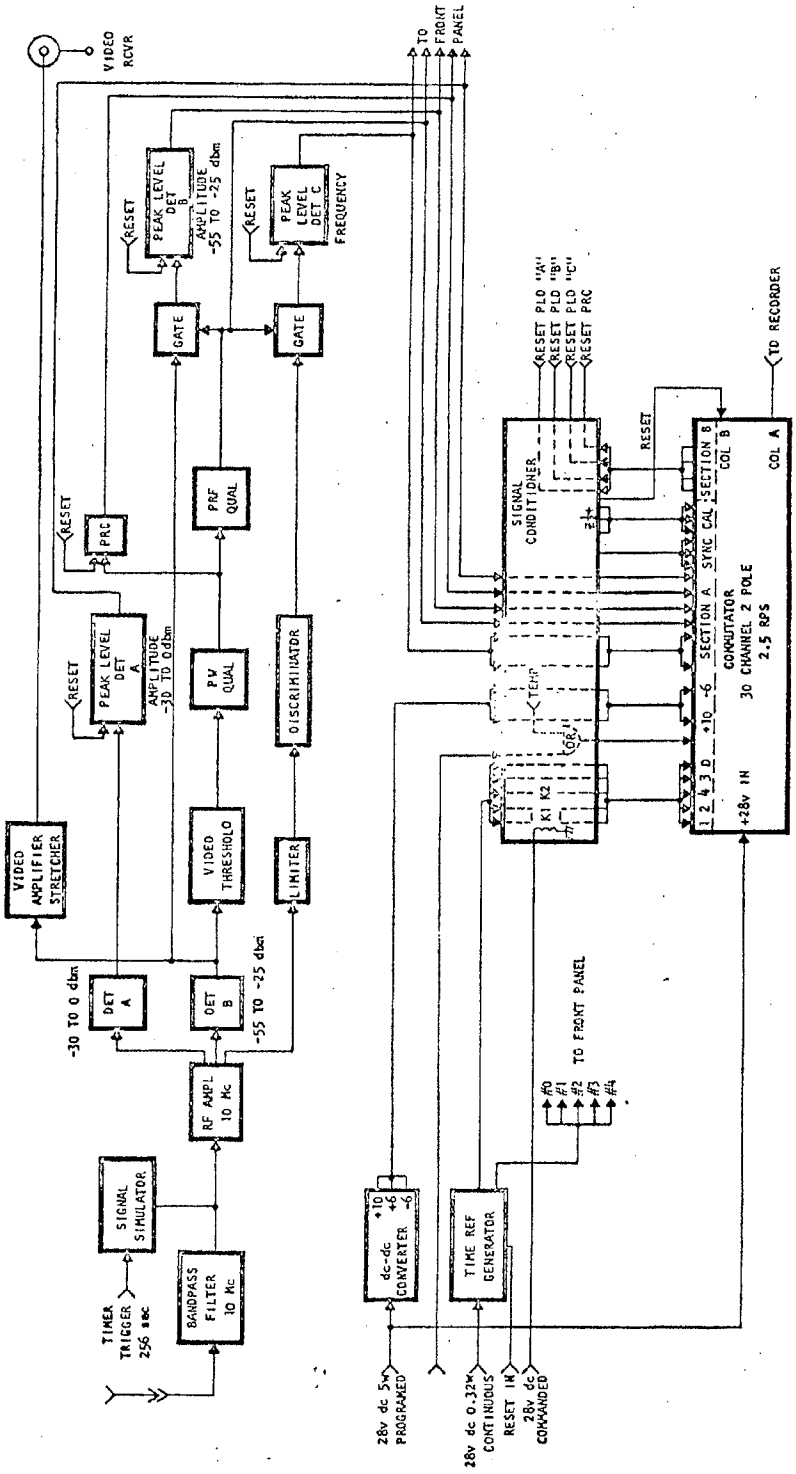


Figure 1

3.1 ~~(S)~~ -- Continued.

A summary of the system specifications for the BIT system used in this mission is given below and a plot of the system's detection sensitivity is shown in Figure 2.

Minimum Detectable Signal	-54 dbm (PLD-B) -28 dbm (PLD-A)
PRC Minimum Acceptable Pulse Width	18 microseconds
Frequency/Amplitude PLD Minimum Pulse Width	24 microseconds
PRF Qualifier Acceptance Range	95-101 pps (fundamental) 193-202 pps (2nd harmonic)
RF Passband at -51 dbm	150.2 to 164.3 Mc

3.2 ~~(S)~~ System Performance.

The BIT system performed as designed for the duration of the mission. Comparison of the system's response to the Signal Simulator during the mission with its response prior to launch showed that the detection sensitivity and the calibrations for frequency and PRF maintained their original levels. The system's operating temperature was 110 degrees Fahrenheit initially and gradually cooled to 80 degrees Fahrenheit on orbit 16 and to 66 degrees Fahrenheit during the final day of the mission.

The only problem noted was a fluctuating level of the frequency measuring Peak Level Detector (PLD-C) during the signal simulator calibration checks. During a four-second check, the PLD would show the correct Simulator frequency with the exception that two to four of the twenty commutator samples would show a lower frequency (higher peak voltage). This condition was not noted during the prelaunch check and it did not occur on every Simulator check. It may have been due to occasional pulses from the external signal environment getting into the frequency channel during the 700-microsecond acceptance gate which is generated for each of the 98 pps of the simulated signal.

4. ~~(S)~~ COMMENTS AND RECOMMENDATIONS.

4.1 ~~(S)~~ Data Analysis.

The data for this mission were received at a relatively slow rate from the processing group at Lockheed. The initial data indicating that the system was working was received one day after launch but the receipt of the remainder of the data was sporadic. Approximately seventy per cent of the data were received by 22 October. The remainder,

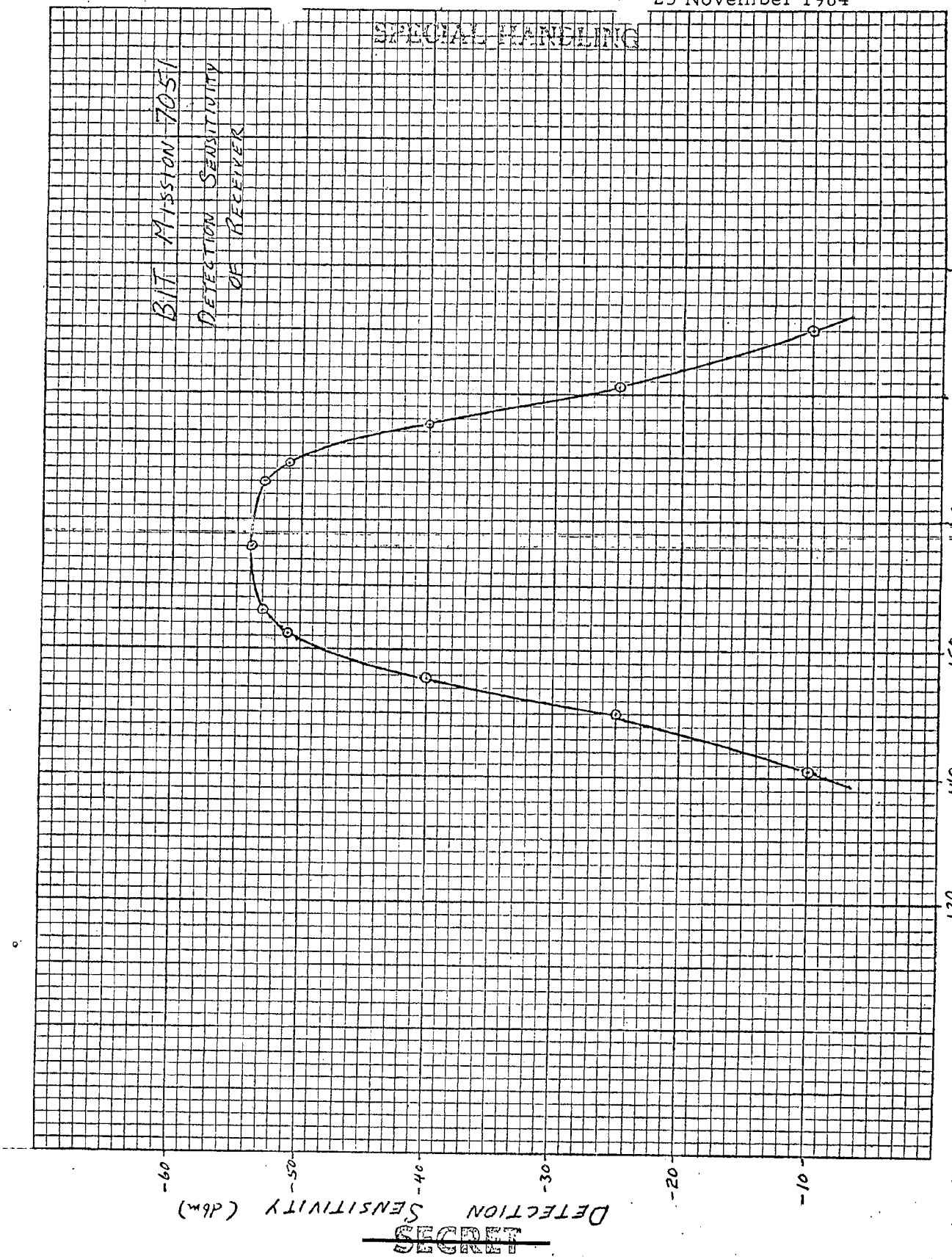


Figure 2

4.1 (S) -- Continued.

with the exception of two orbits, was received by 29 October and the last two orbits were received on 3 November. Part of the problem was in setting up the procedures for the generation and flow of the data for this new program and a second cause of delay was some higher priority, interfering work which had to be performed by the data processing group. It is expected that the data flow will be more rapid and timely on following missions.

Additional information which will be required on a more timely basis is a post launch ephemeris and a post launch tabulation of the actual event times of the vehicle programmer. Fortunately, the orbit of this vehicle followed the predicted orbit very closely and the prelaunch information was sufficient for determining event times and vehicle locations. This, however, may not be the case in later missions.

4.2 (S) System Modifications.

The data from this mission demonstrated the need for an activity indicator in the system which would show that signals of any type are being received by BIT. The Signal Simulator shows that the system is working and it provides a one-point calibration check but it does not provide a check of the antenna or antenna lead in. Because of the system's qualification circuitry, intercepts are relatively scarce and in order to determine that a lack of intercepts is due to the lack of qualifying signals rather than to a damaged antenna or broken lead-in line, an activity indicator is needed. All units for the following missions will be equipped with a crude pulse rate counter which will respond to received pulses of any width or rate to show that the antenna input is good.

As an aid to data analysis, the 256-second step output of the Time Reference Generator will be connected directly to the commutator so that it will appear on the stored data as well as on the real time data. This will enable determining the actual time an event occurred without having to rely on the post launch tabulation of event times for the vehicle programmer.