FINAL REPORT

BIT MISSION 7060

25 June 1965

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SAFSS SH0194-65

FINAL REPORT
BIT MISSION 7060

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

1.1 ~~(S)~~ Program Objectives.

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 153 to 163 Mc to determine if signals are present 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.

[redacted]

1.3 ~~(S)~~ Flight Summary.

Vehicle Number	1615
Launch Date	18 May 1965

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1.3 ~~(S)~~ -- Continued.

Launch Time	1802Z
Inclination	75 degrees
Apogee	181.4 nautical miles
Perigee	109.8 nautical miles
Period	89.8 minutes

2. ~~(S)~~ MISSION COVERAGE.

2.1 ~~(S)~~ Operational Coverage.

This mission was split into two parts separated by a four-day scheduled "dead" period. The first part lasted 166 orbits and covered the period from launch to 0159Z on 29 May. The vehicle was then deactivated for 64 orbits until 0135Z on 2 June. The remainder of the mission lasted until orbit 264 and was terminated at 0430Z on 4 June.

The BIT system was programmed on during 199 orbits of the 200 active orbits. On 27 of the orbits the unit was programmed on throughout the entire orbit. Data were received from all of the orbits with the exceptions of data from orbits 136 through 141, 161 through 165, 174 through 175, and 242 through 245. These data were lost because the tape recorder which BIT shares with the primary payload failed to read out when commanded.

2.2 ~~(S)~~ System Coverage.

The BIT system shown in Figure 1, monitors the 154 to 162 Mc frequency range with a receiver sensitivity of -55 dbm. With the inclusion of the effects of the antenna pattern with different polarizations and aspect angles, the over-all detection sensitivity of the system ranges from -58 dbm to -46 dbm. Signals intercepted by the receiver are checked by a pulse width qualifier to determine if the pulse width is greater than 25 microseconds. The pulses which qualify are counted in a total pulse counter, PRC, over the commutator read-in interval of 400 milliseconds and are measured to determine their amplitude and RF frequency. On previous systems, the amplitude and frequency measurements also required PRF qualification but on this unit the PRF Qualifier is bypassed. It is, however, still used to accurately check the PRF to determine if it falls within the 94 to 100 pps acceptance band

FIRE BOX SYSTEM

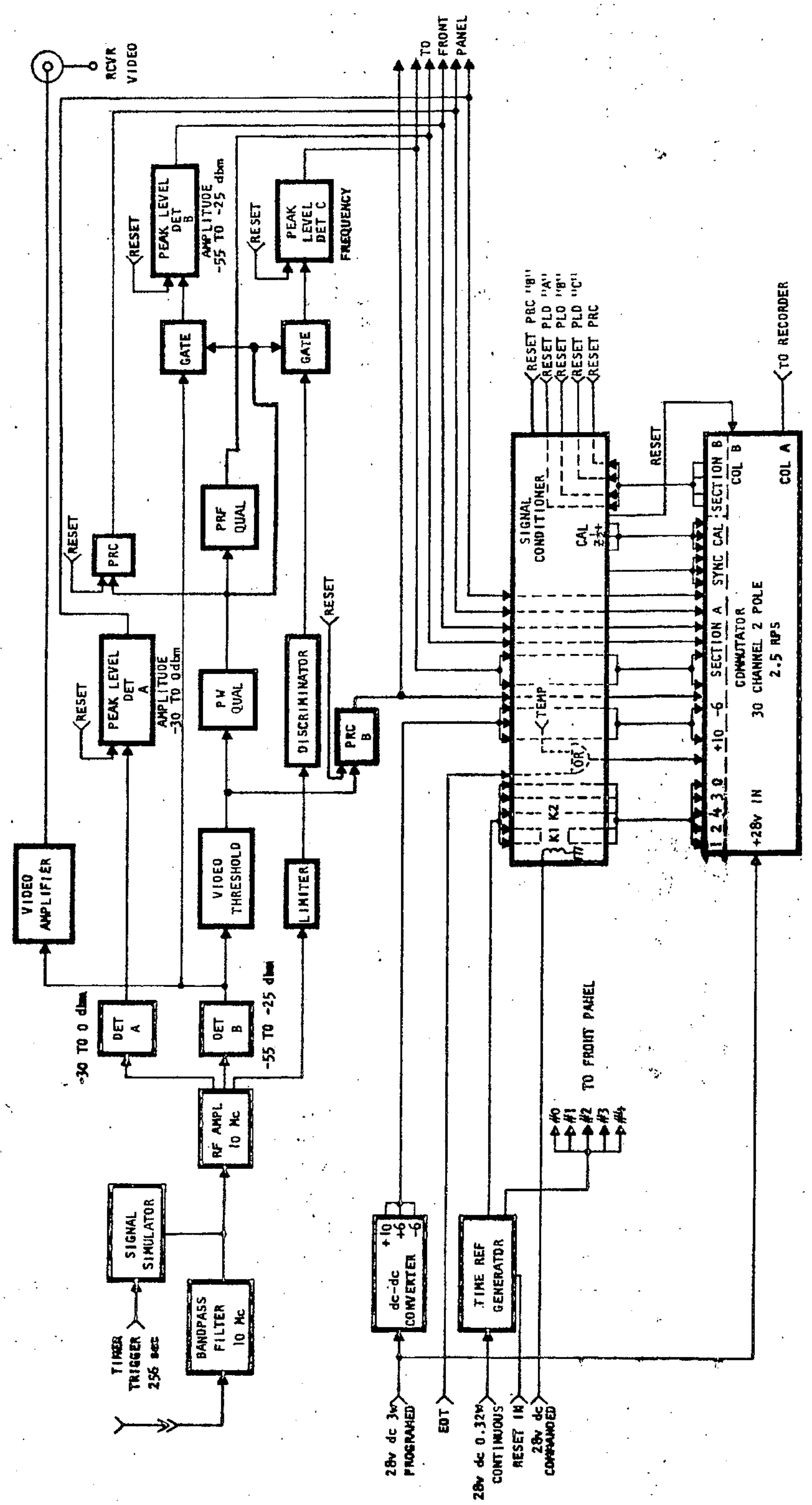

Figure 1

2.2 ~~(S)~~ -- Continued.

or harmonics of this range. If a signal has a power level at the receiver in excess of -30 dbm, its amplitude will be measured in the PLD-A channel regardless of PRF or pulse width. The RF frequency of the high amplitude pulses will not be read unless the signal also satisfies the pulse width criterion.

3. ~~(S)~~ MISSION RESULTS.

3.1 ~~(S)~~ PRF Qualified Intercepts.

[redacted]

3.2 ~~(S)~~ Non Qualified Intercepts.

[redacted]

[redacted]

[redacted]

[redacted]

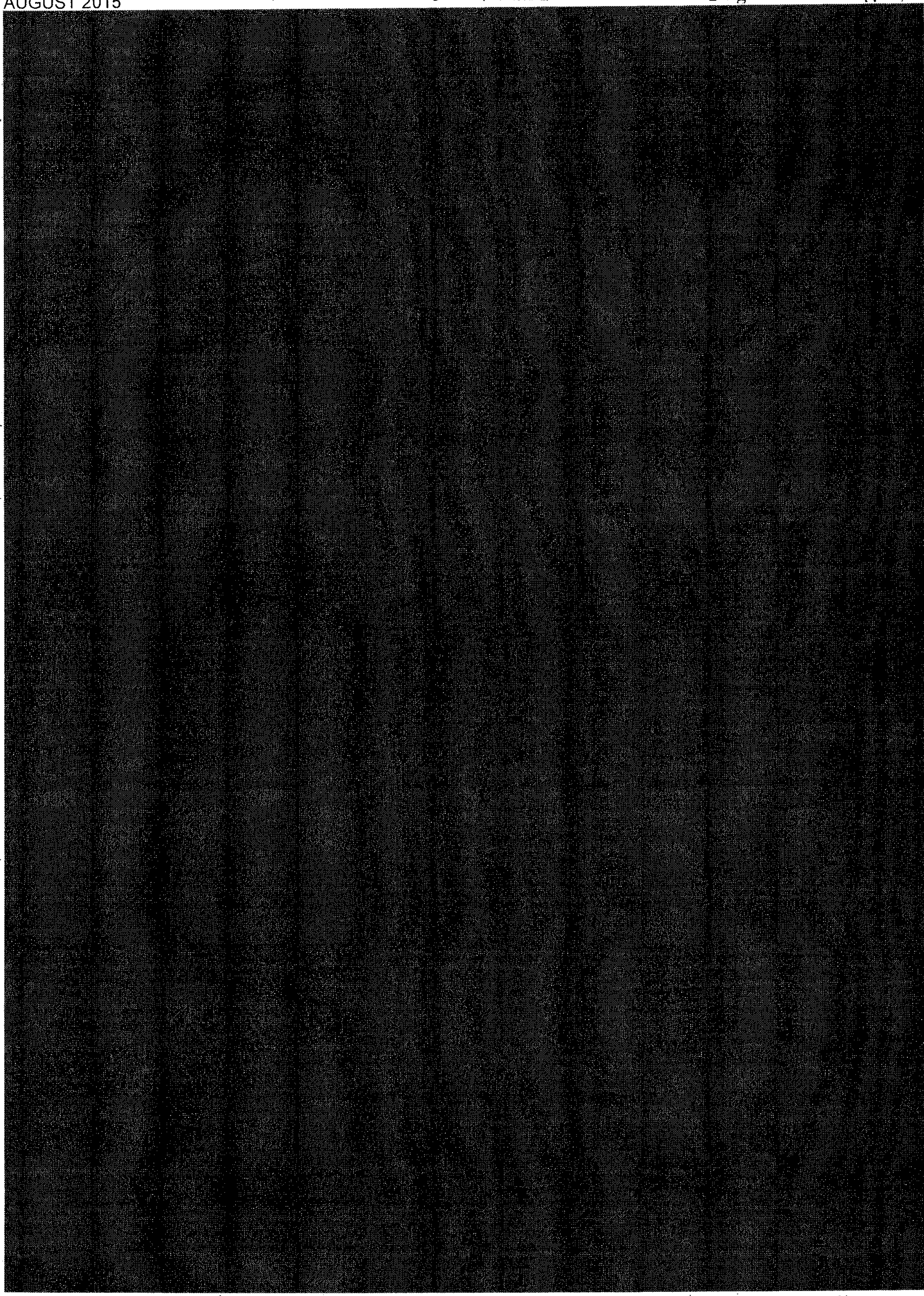

Figure 3

3.2 ~~(S)~~ -- Continued.

[redacted]

3.2 (S) -- Continued.

[redacted]

[redacted]

4. (S) SYSTEM PERFORMANCE.

4.1 (S) System Specifications.

A summary of the system specifications for the BIT system used on this mission is given below. The block diagram of the system is shown in Figure 1.

Minimum Detectable Signal	-55 dbm PLD-B -30 dbm PLD-A
Minimum Acceptable Pulse Width	25 microseconds
PRF Qualifier Range	94-100 pps 188-198 pps (2nd Harmonic)
RF Passband	
-52 dbm	154.4 to 161.4 Mc
-25 dbm	147.0 to 170.3 Mc

4.2 (S) System Operation.

The BIT system appeared to function normally throughout the mission with the exception of a failure in the Time Reference Generator (TRG) which occurred approximately 30 minutes after launch. This unit, built by the Adcole Corporation, apparently sufferred a failure in the binary countdown chain which resulted in an erratic doubling of the counting rate just prior to complete failure. As a result of this failure, the BIT

4.2 ~~(S)~~ -- Continued.

Signal Simulator was disabled because it requires a start trigger from the TRG. Thus, the operation of the BIT circuits could not be checked after the failure. The system response to the Simulator prior to the TRG failure showed that all of the circuits were functioning properly.

The primary function of the TRG is to provide a time base from which event times can be established. Because of the failure, the event times for the orbit 23 intercept had to be determined by interpolation between the turn on and turn off times of the system and recorder on that orbit. These times are determined by the primary program organization and are accurate to within one second. Thus, the accuracy of the intercept times depend only on the magnitude of tape recorder speed variations during the tape recorder read in and read out periods. Comparing the time required to read out the data from orbit 23 with the programmed duration of the read in shows that the recorder operated at its specified 26 to 1 playback to record ratio. This ratio was also observed in the data prior to the TRG failure. It is therefore concluded that any speed variations were minor and averaged out to zero. The interpolation process should then enable determining event times to within approximately five seconds.

4.3 ~~(S)~~ System Testing.

Because of the interference observed during this intercept, it was decided to perform a series of laboratory tests on one of the unused BIT systems to determine the conditions which would produce the effects noted in the data. It was found that the amplitude and frequency measurements are only affected when a narrow interfering pulse is received simultaneously with a wide qualifying pulse. Under this condition, the amplitude measurement will increase by an amount which is a function of the relative amplitudes of the two pulses and the frequency measurement will correspond to the frequency of the narrow pulse only if its frequency is lower and its amplitude is greater than those parameters of the wide pulse. See Figure 4.

Based on the results of the test it can be stated that the frequency measurements are valid; however, the measurements of the interfering signal must be identified and separated from the desired measurements on the [redacted] This was no problem during the scanning mode of Part I because the interference did not completely mask the measurements on the [redacted] scan. It was, however, a problem in Part II since only the 155 Mc frequency measurements are present. In the latter case, either

CONDITIONS PRODUCING FALSE MEASUREMENT IN BIT

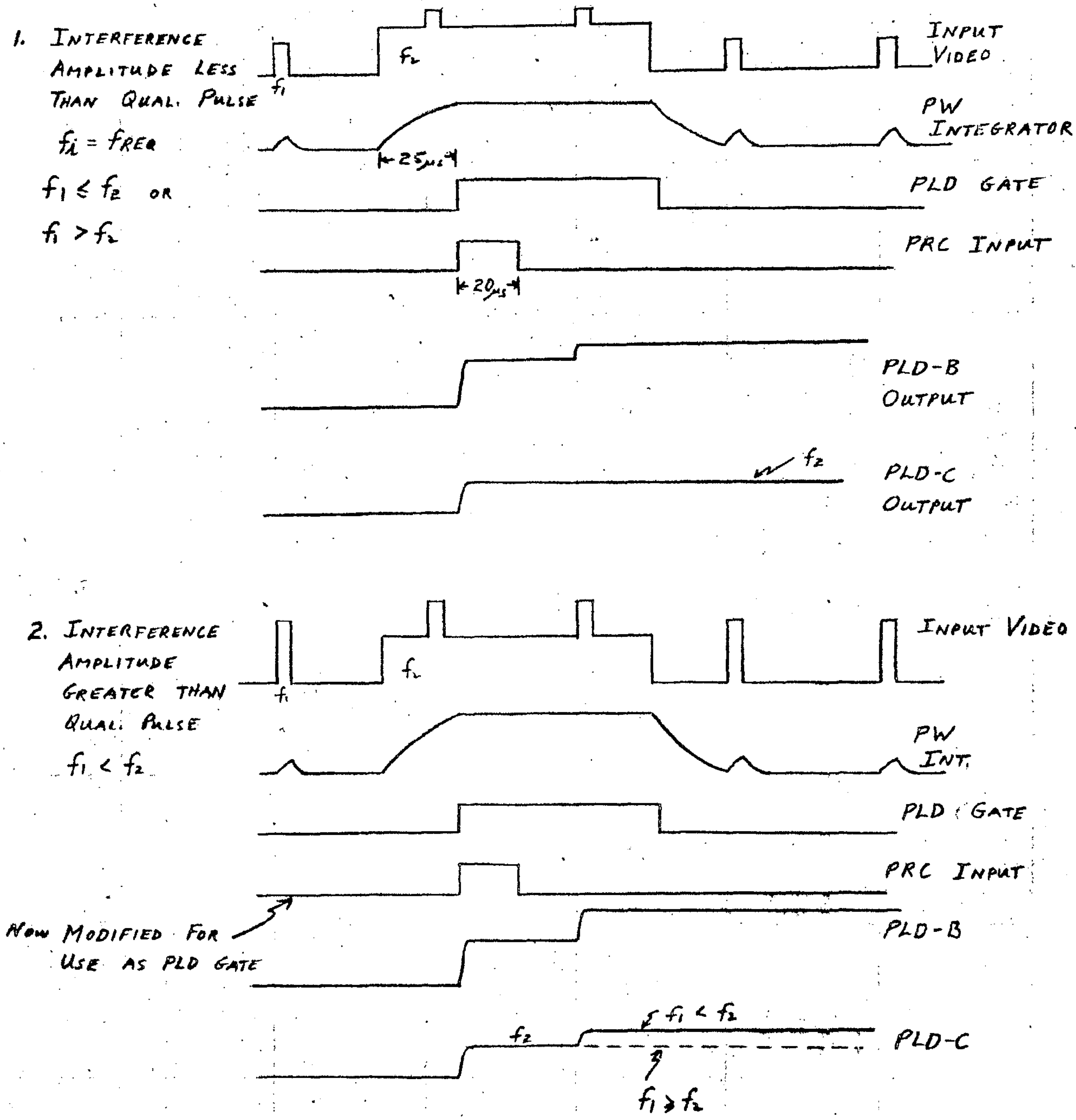

Figure 4

4.3 ~~(S)~~ -- Continued.

the interference completely masked the [redacted] measurements because it always had a greater amplitude and the [redacted] frequency always remained above 156 Mc or, more probably, the [redacted] stopped its scan at 155 Mc making the separation of the two impossible.

The tests also showed that the amplitude of the [redacted] signal cannot exceed the measured levels and it is probable that the actual amplitude of the [redacted] is 3 to 9 db below the measured values. This is because the interference amplitude adds to the [redacted] amplitude to produce a resultant measurement which is greater than either of the components. For example, when the two amplitudes are equal, the measured value of signal level is 6 dbm higher than the level of the qualified signal without the simultaneous pulse interference.

Tests on the Pulse Width Qualifier and the total pulse counter (PRC) showed that it would not respond to the narrow pulse interference except under two conditions. One condition requires that two or more narrow pulses each have sufficiently wide widths and occur close enough together so that the resulting group of pulses has sufficient energy to charge up the PW integrator until it exceeds the qualification threshold. This condition rarely occurs for it generally requires three pulses with 8 to 10 microsecond widths occurring at 3 microsecond spacings before it appears to the PW Qualifier as a single 25 microsecond pulse. The second condition requires a PW qualified pulse train having widths greater than 40 microseconds and narrow, interfering pulses. If a narrow pulse of sufficient width occurs just after the trailing edge of the wide pulse an additional pulse count will result. To produce this effect, a pulse width of at least 4 microseconds is required. The spacing is 3 ±0.5 microseconds for the minimum 4 microsecond pulse width and increases as the pulse width of the interference increases. Since the requirements for the width and position of the narrow pulse with respect to the wide pulse are rather critical, the requirements will be only occasionally satisfied in the general signal environment. Even under the worst case, where the narrow pulses are synchronized with the wide pulses, the measured pulse count would only be twice the count of the wide pulses. During this intercept, something more complex than noise or narrow pulse interference occurred to cause the PRC to register values between 30 and 130 pps.

The tests on the BIT system also revealed that PLD-A could be influenced by noise spikes passing through the receiver. A condition, similar to that noted during this intercept, was observed when a noisy commutator was used with the system. As soon as a signal was present in the receiver, the noise spikes drove PLD-A to a level corresponding to approximately -20 dbm regardless of the input signal level. This level remained constant until the signal level exceeded the -20 dbm level at

CONDITIONS PRODUCING FALSE PRC COUNTS IN BIT

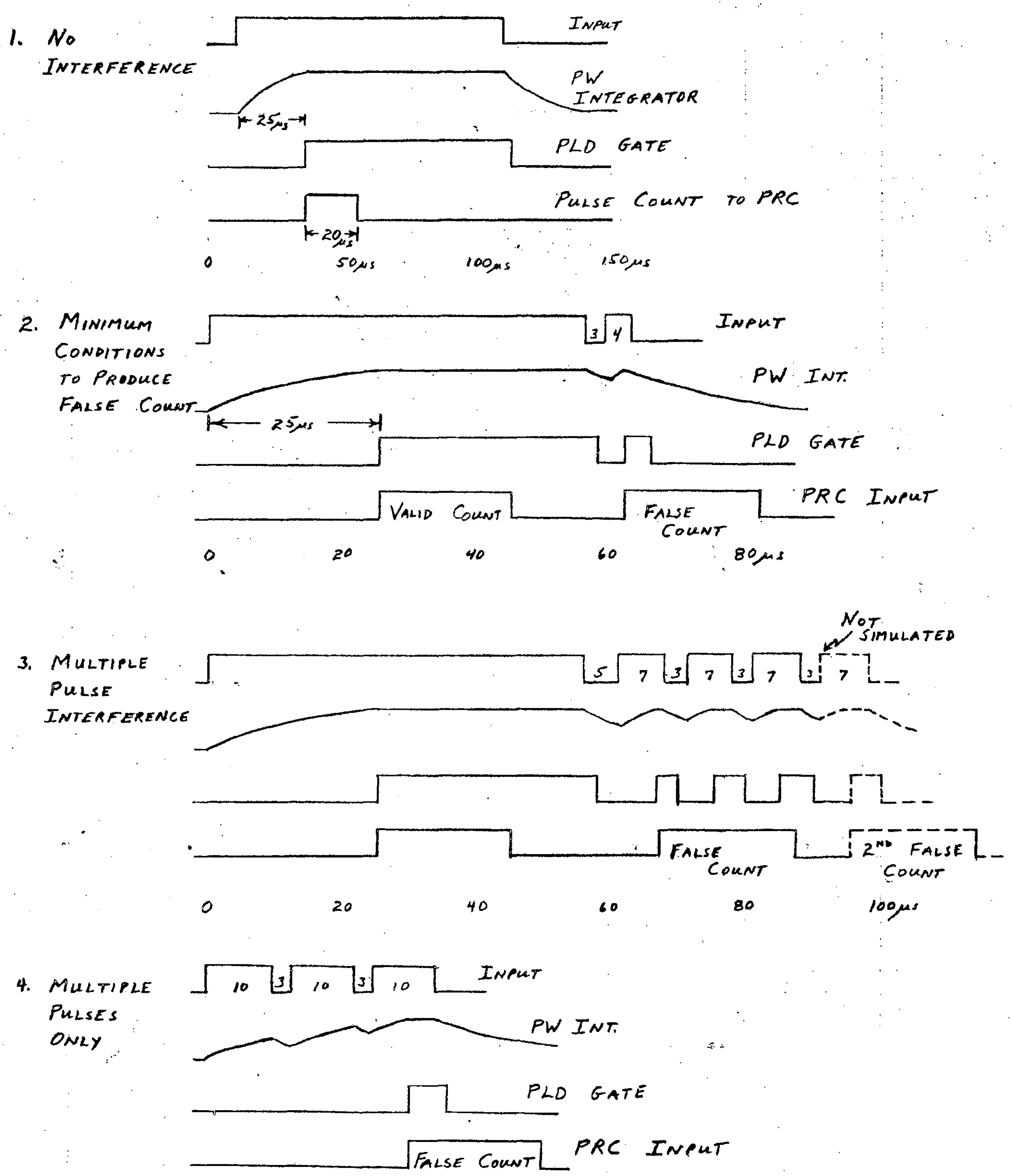

 Figure 5

4.3 ~~(S)~~ -- Continued.

which point PLD-A then responded to the higher amplitude signal. Apparently, during this intercept, noise spikes were being generated at approximately two second intervals by something on the vehicle. This caused PLD-A to indicate a constant signal level of -19 dbm during the entire 250 second intercept.

4.4 ~~(S)~~ System Modifications.

Corrective action has been taken to significantly reduce the susceptibility of the two remaining BIT systems to the interference generated by simultaneously receiving a non-qualified pulse with a qualified pulse. The Recognition Logic was modified such that the amplitude and frequency Peak Level Detectors would open for only 20 microseconds rather than for the entire pulse duration. The 20 microsecond monostable multivibrator in the PRC is now used to control the gates. This modification was readily accomplished because the PRF Qualification requirement had been previously eliminated on an earlier modification. Tests show that this change virtually eliminates the type of interference observed during this mission since PLD-B and PLD-C are now open for only 20 microseconds rather than for the pulse duration. Thus, interference can only occur if a narrow pulse falls within the 20 microsecond gate.

The response of PLD-A to noise spikes was also greatly reduced by decreasing the rise time of the circuits from approximately 0.5 microseconds to approximately 2 microseconds. This eliminated the simulated interference and will, presumably, reduce or eliminate actual interference on future vehicles.