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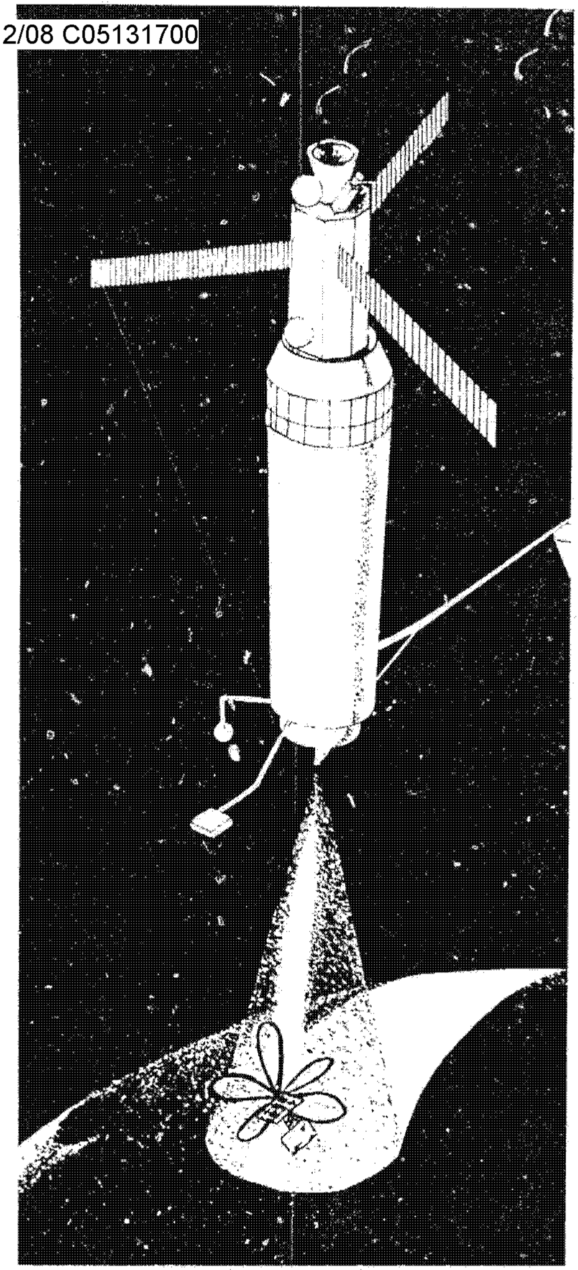

DESCRIPTION OF SIGINT MISSIONS 7167/7236/7240

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Mission Description 7167/7236/7240

1. INTRODUCTION

1.1 General.

Missions 7167, 7236, and 7240 are SIGINT payloads which will be carried aboard a 3-axis stabilized satellite system. These payloads collect electronic signals, store intercepted data in digital and analog form, and later transmit this data to various satellite tracking stations throughout the world. This mission description will discuss the technical and operational considerations applicable to each payload.

1.2 Missions 7167 and 7236.

These missions are identical to Missions 7166 and 7235 except that Mission 7236 has 16 recognizers instead of the eight which are carried by Mission 7235. With this one exception, the mission description for 7166 and 7235 (TCS-37573-70, 12 June 1970) is valid for Missions 7167 and 7236.

1.3 Mission 7240.

Mission 7240 is a directed-search SIGINT payload which was designed to collect signals in the frequency range of 2.0 to 12.0 GHz. The primary purpose of Mission 7240 is to maximize the probability of intercept of signals
emanating from the [redacted] radar, but it can be used as a (b)(1)
directed-search system against any other emitter in the frequency range of (b)(3)
2 to 12 GHz which has known geographical locations as well as a general search system.

The unique feature of this payload is the antenna tracking or steering system which keeps the main beam of the intercept antenna boresighted on the target emitter/area of interest during the satellite pass over the target. In this manner, signals emanating from the target are enhanced because the intercept system always views the target emitter/area with maximum sensitivity and correspondingly reduces the amount of unwanted signals being received from outside the target area.

Mission 7240 was designed to share certain common components of Mission 7167/7236 such as the Core Storage Units (CSU), Data Storage Units (DSU) and the command programmer. This mission description will discuss the following technical and operational aspects of the payload required for mission planning:

a. Receiver Subsystem

b. Antenna Subsystem

c. Payload Interface Equipment

d. Summary of System Characteristics

2. RECEIVER SUBSYSTEM

2.1 <u>RF Section.</u>

The receiver subsystem is designed to intercept both pulse and CW signals in the frequency range of 2 to 12 GHz. The receiver is divided into 10 frequency bands which are 1000 MHz wide. The bands are divided 2 to 3 GHz, 3 to 4 GHz through 11 to 12 GHz. Each band is downconverted to 1 to 2 GHz where it is further divided into four 250-MHz segments. Each of the four segments are again downconverted to 125 to 375 MHz where separate narrowband (4 MHz) and wideband (250 MHz) receivers are used to process intercepted signals.

The narrowband receiver is a synthesizer-tuned, superheterodyne, VHF receiver which has a 4-MHz bandwidth and tunes the downconverted frequency range of 125 to 375 MHz in 2-MHz steps. The narrowband receiver can be step-tuned in any one of three modes. They are: (1) scan 2 to 12 GHz from the lowest frequency to the highest frequency, (2) scan 4 to 12 GHz from the lowest frequency to the highest frequency, and (3) scan up to five selected frequency segments as defined by sectors of the frequency search memory. Each sector is defined by an upper and lower frequency limit, and each frequency limit can be any 2-MHz step in the 2 to 12 GHz frequency range (in any order). Additionally, the receiver can be fixed-tuned to any 2-MHz step for the entire payload operating time. The narrowband receiver has two selectable dwell periods after stepping. The normal dwell period for each frequency step is 3.125 milliseconds which extends to 128.125 milliseconds for signals which exceed a fixed threshold and are received in the main beam of the intercept antenna. A fixed 125-millisecond dwell period for each frequency step can also be selected. The narrowband receiver is capable of detecting both pulse and CW signals.

The wideband receiver is a fixed-tuned receiver which takes the 250-MHz RF segment (125 to 375 MHz) and passes it through a crystal detector and a low pass filter to output a 250-MHz RF/400-KHz bandwidth detected (stretched) video signal. The wideband channel is used to intercept pulse type frequency jumping emitters.

Tuning of the wideband receiver is accomplished automatically. The wideband receiver is always tuned to the 250-MHz segment in which the narrowband receiver is being step tuned. For example, if the narrowband receiver is being tuned at 8,292 MHz (the second 250-MHz segment of the 8.0 to 9.0 GHz range), the wideband receiver will be tuned between 8.250 to 8.500 GHz (inclusive).

Figure 2.1 is a simplified block diagram which illustrates how intercepted signals are processed by the narrowband and wideband receivers.

2.2 Signal Outputs.

2.2.1 Analog Data.

The narrowband receiver outputs 4-MHz predetected video and the wideband receiver outputs 250-MHz RF/400-KHz video data which together with a 6-MHz reference tone is recorded in the Data Storage Unit (see section 4). Two 48-bit marker words containing system time, receiver frequency, CW recognizer, vehicle attitude, Mission 7240 antenna attitude, and command status are recorded every 125 milliseconds on the digital track of the Data Storage Unit. Analog data outputs from the narrowband and wideband receivers are controlled by selecting any one of three sidelobe inhibit qualification criteria.

2.2.2 Digital Data.

The narrowband receiver has a signal measurement unit and digital encoder which will output digital data to the CSU whenever it intercepts signals which exceed a selectable threshold (normally set at 15 db S/N) and which also meet the sidelobe inhibit criteria. There are two selectable modes for the signal measurement/digital encoder unit operation. The first mode (4-pulse mode) will output the digitized parameters of the first four pulses which meet the threshold and sidelobe inhibit criteria on a given frequency step during the specified dwell period, and likewise, the second mode (16-pulse mode) will output the digitized parameters of the first 16 pulses which meet the qualification criteria. Table 2.1 lists the parameters which are measured, digitized, and output from the narrowband receiver.

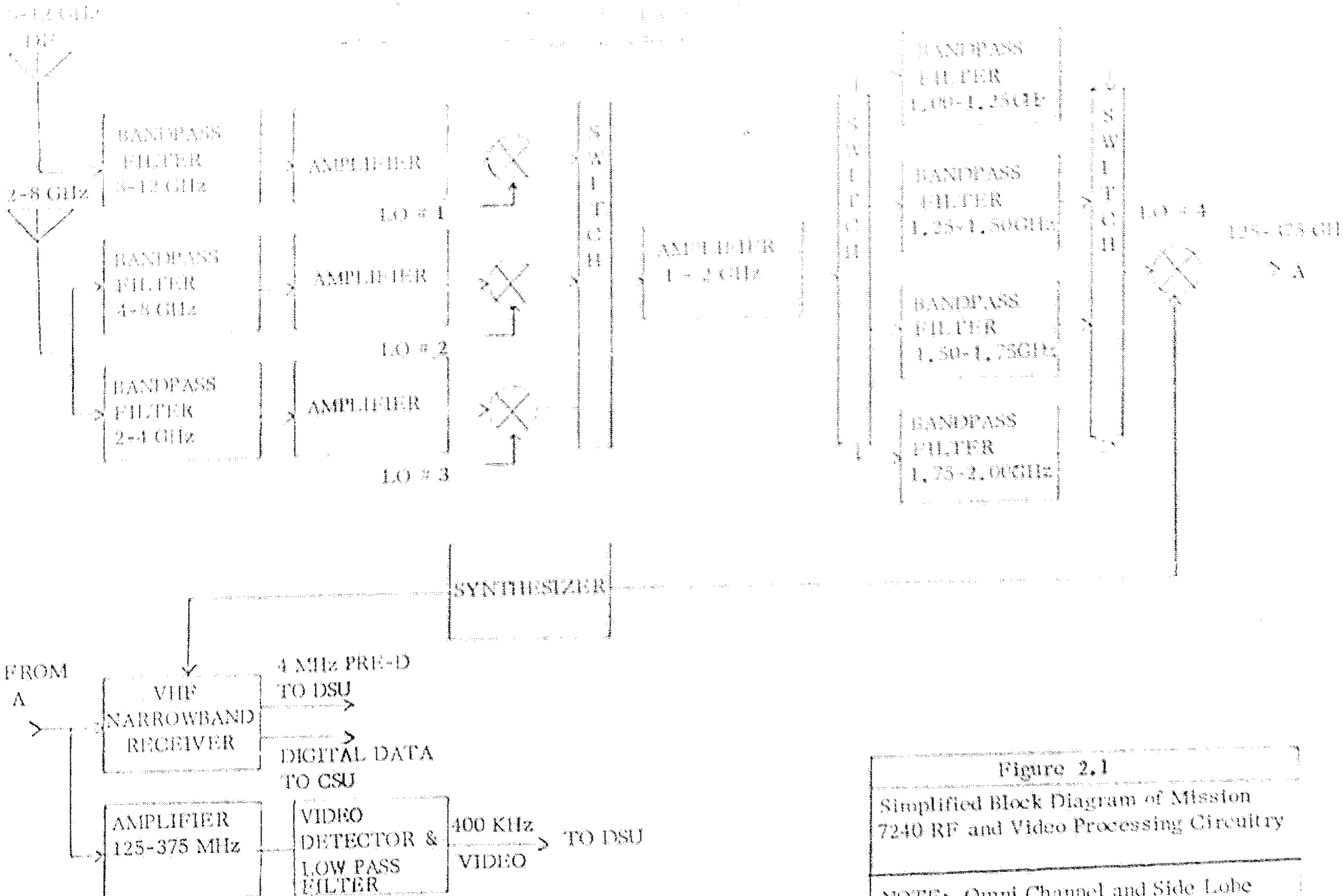

Figure 2.1

Simplified Block Diagram of Mission 7240 RF and Video Processing Circuitry

NOTE: Omni Channel and Side Lobe Inhibit Circuitry is not shown.

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Table 2.1

Parameter	Measurement Range; Resolution
Frequency	$\pm$2 MHz
PRI	30 to 131,071 msec; 1 microsecond
PW	0.167 to 42.5 msec; 0.167 microsecond
Pulse Amplitude	40 db dynamic range; 3 db

3. ANTENNA SUBSYSTEM

3.1 Antennas.

The Mission 7240 antenna system consists of two high gain intercept antennas and two low gain omnidirectional antennas mounted on a common platform. The platform is gimbaled for preprogrammed rotation in both pitch and roll.

The intercept antenna covering 2 to 8 GHz (low band) is a 36-inch unfurlable dish which has a gain of 22 to 31 db and a beamwidth of 3.3 to 10 degrees--both gain and beamwidth are a function of frequency. The intercept antenna covering 8 to 12 GHz (high band) is a 20-inch solid dish which has a gain of 31 to 35 db and a beamwidth of 3.3 to 5 degrees. The footprint of the low band intercept antenna at nadir varies from a circle of 48 miles in diameter at 2 GHz to about 16 miles in diameter at 8 GHz. The footprint of the high band intercept antenna at nadir varies from 24 miles (diameter) at 8 GHz to about 16 miles (diameter) at 12 GHz.

Two conical spiral antennas (one for 2 to 8 GHz, the other for 8 to 12 GHz) are used as sidelobe inhibit antennas.

3.2 Antenna Tracking System.

The unique feature of Mission 7240 is the antenna tracking or steering system. The two intercept antennas and the two sidelobe inhibit antennas are mounted on a common platform which is gimbaled to rotate in both pitch and roll (in-track and cross-track, respectively).

The purpose of the antenna tracking system is to keep the intercept antenna systems boresighted with the target emitter of interest during the entire pass of the satellite over the target area. This technique maximizes the probability of intercept of the target emitter by always keeping the main beam (high gain portion) of the intercept antennas pointing at the target emitter, and it also helps to reduce interference (extraneous signals) from nontarget emitters.

Preprogrammed antenna steering commands are stored in the command programmer utilized by Missions 7167/7236. The antennas can be steered in-track (pitch) from nadir (0 degrees) to the horizon (68 degrees), and the antennas can be steered cross-track (roll) plus or minus 30 degrees from nadir. The platform drive system utilizes a four pole stepper motor for both pitch and roll and has a total of seven different pitch rates available.

4. PAYLOAD INTERFACE EQUIPMENT

4.1 General.

The operation of Mission 7240 depends upon the utilization of certain components which are shared with Missions 7167 and 7236. These components are the Digital Command Programmer (DCP), the Data Storage Units (DSU), and the Core Storage Units (CSU).

4.2 Hardware.

4.2.1 Digital Command Programmer.

The DCP is a mini-computer which controls the operation of each of the payloads. The DCP is loaded generally only once per day, and it allows each of the payload configurations to be altered many times on any pass.

4.2.2 Data Storage Unit.

The DSU is a 6-MHz tape recorder which has approximately 40 minutes of readin capacity. There are two recorders (one for redundancy) and each can be operated in several different modes. Only one DSU may be operated at any one time. The DSU can be exclusively assigned to any one/or two of the payloads, or it can be shared by all three. In the latter mode, the DSU would be assigned to Mission 7240, and it would record Mission 7240 data until one of the Mission 7167/7236 signal recognizers identified a signal of interest. When a valid signal recognition occurs, the Mission 7240 analog output data would be interrupted and the DSU would be switched to the other payload for the period of time required to record the signal of interest.

4.3.2 Core Storage Unit.

The CSU's are standard computer core memory devices which have been especially adapted for spacecraft operations. Mission 7240 will share with the vehicle health status telemetry system one of the three CSU's. It is estimated that the digital data generated during one full intercept pass, in which the target is tracked from nadir to horizon, will load the CSU to about 40 percent of its total capacity. Therefore, a maximum of two emitters can be fully tracked, between CSU readouts, before the capacity of the CSU is exceeded.

5. SUMMARY OF SYSTEM CHARACTERISTICS

5.1 Receiver.

Type:	Superheterodyne
Frequency Range:	2 to 12 GHz
Bandwidths:	4 MHz, 250 MHz
Tuning:	
Narrowband:	2 MHz steps, synthesizer controlled
Wideband:	Channel is tuned to the 250-MHz segment in which the narrowband channel is tuned.
Outputs:	
Narrowband:	4 MHz predetection; digital word containing measured PRI, PW, PA, and frequency step.
Wideband:	Detected video (250-MHz RF/400 KHz video bandwidth).
Noise Figure:	12.3 db for 2 to 8 GHz (except 16.0 db at 3.8 to 4.2 GHz) 13.3 db for 8 to 12 GHz

5.2 Antennas.

Intercept Antenna (2 to 8 GHz)	
Gain:	22 to 31 db
Beamwidth (3 db):	3.3 to 10 degrees
Intercept Antenna (8 to 12 GHz):	
Gain:	31 to 35 db
Beamwidth (3 db):	3.3 to 5 degrees

Steering Capabilities:

Pitch (in-track):	Nadir (0 degrees) to horizon (68 degrees)
Roll (cross-track):	Plus or minus 30 degrees from nadir.

There are seven pitch rates available.