~~TOP SECRET~~

HANDLE VIA
BYEMAN
CONTROL SYSTEM

~~TSL~~ NATIONAL RECONNAISSANCE OFFICE
WASHINGTON, D.C.

E NRO STAFF

ATTACHMENT
7 August 1969
SORS 11./46

MEMORANDUM FOR CHAIRMAN, SIGINT OVERHEAD RECONNAISSANCE SUBCOMMITTEE

SUBJECT: Mission Description of SIGINT Mission 7336 (SAVANT II)

The mission description for Mission 7336 is forwarded as an attachment to this memorandum. This SIGINT Reconnaissance System is designed to meet the requirements of USIB-S-10.9/5 and USIB-S-10.9/11.

Mission 7336 is contained in a spin-stabilized P-11 sub-satellite which is scheduled to be launched into a nominal 275-mile circular orbit by and Atlas-Agena booster. SAVANT II is generally similar in design to SAVANT I with the major exceptions that there are 10 individual receivers preset on Soviet telemetry frequencies, three tape recorders, and a variable time read-in capability.

The planned launch date, predicated on launch of the primary payload, is 17 September 1969. Mission life is expected to be in excess of nine months. A nominal 10 to 12 collection revs per day should be available for mission accomplishment.

Collection guidance in the form of target areas related to telemetry usage and signal recognition criteria is requested.

Edwin F. Sweeney
EDWIN F. SWEENEY
Colonel, USAF
Deputy Director for
Satellite Operations

Attachment
Mission Description SAVANT II

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CONTROL NO. BYE-12924-69
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SAVANT II - MISSION DESCRIPTION

1.1 GENERAL

The orbital intercept system (Diagrams 1 and 2) comprises one payload system containing 10 individual receivers, receiving antennas, three dual-channel tape recorders, two UHF and one VHF telemetry transmitters, command system, and necessary vehicle auxiliary equipment.

The intercept system will receive and copy Soviet telemetry data through the planar spiral and single monopole antenna system. The data will in turn be recorded upon a 1-MHz tape recorder for later transmission through the UHF telemetry links. Inputs to the tape recorders can be transferred (upon external command) to any one of three recorders. The UHF telemetry links will consist of two conical spiral antennas to provide optimum signal strength. The point in time for switching from one to the other is performed by a ground command. The vehicle command system provides flexibility for positioning the payload in various read-in configurations and read-in times.

1.2 SYSTEM PARAMETERS

Altitude	275 nm
Direction of Spin	CCW when viewed from -Y axis
Spin Rate	Initial spin rate as high as possible without exceeding deployment limit of the antennas or spacecraft qualification
Inclination Angle	85^{o} $+7^{o}$
Operations/Day	Minimum of 10 per day and 3 consecutive orbit taskings for a minimum of 9 months in orbit.
Frequencies (MHz)	247.8, 240.2, 192.4, 181.1, 165.8, 163.8, 76.0, 71.0, 66.0, 61.0 (in priority order)

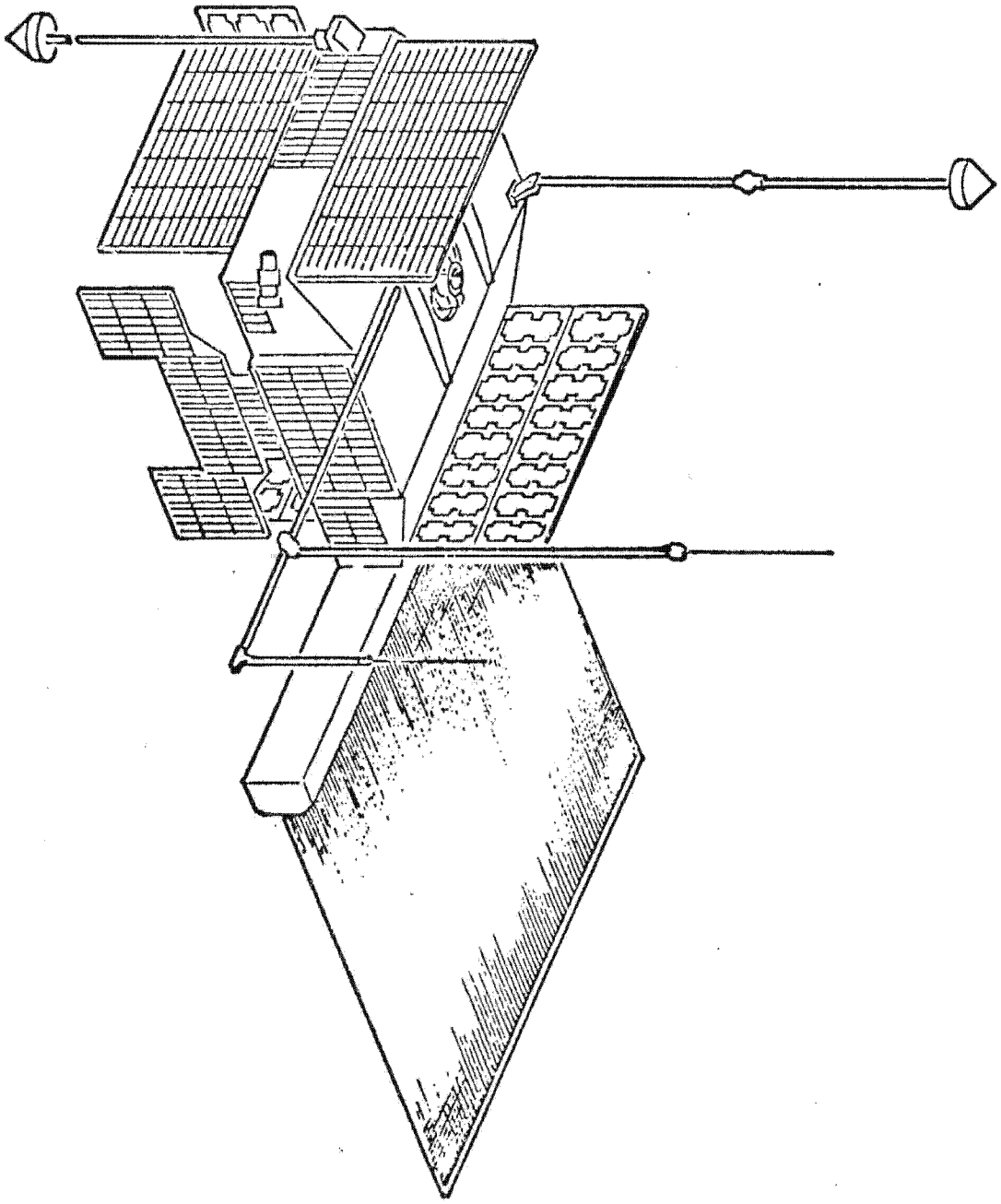


Diagram 1. Mission 7336 Configuration

RPOP

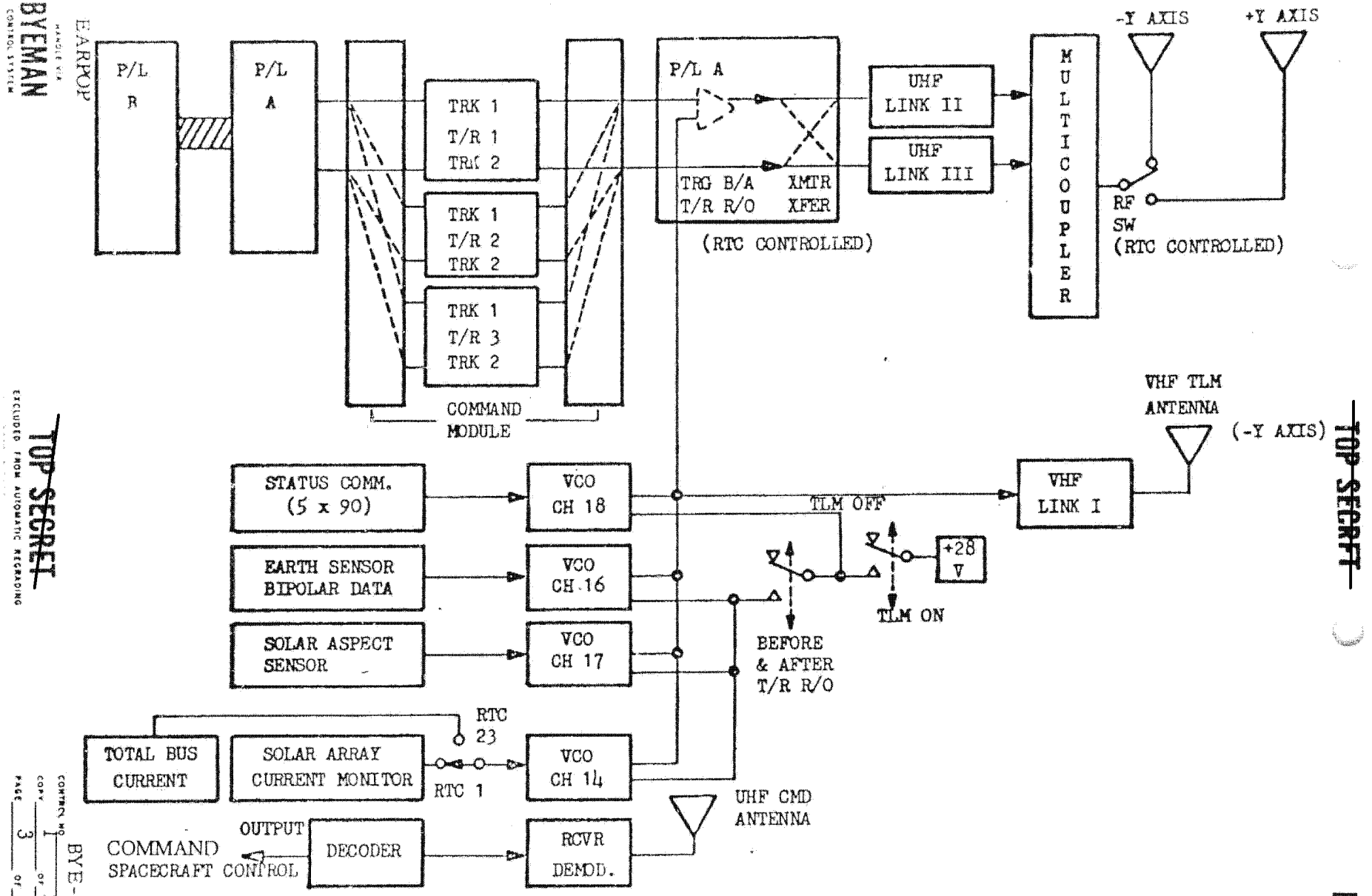


Diagram 2. Mission 7336 Simplified Block Diagram

2.1 ANTENNAS

The SAVANT II antenna system differs from the original SAVANT I system in that two antennas replace the single planar spiral. Through the use of a single monopole antenna, the low-frequency coverage for high elevation angles (θ) is improved. The second antenna is a planar spiral similar to the original, but physically smaller. This modified system provides a weight saving, and less drag resistance.

2.1.1 Monopole

A single vertical monopole mounted parallel to the +Y, -Y axis covers the lower frequency range (61 to 76 MHz). This antenna also serves as a boom for one of the two VHF telemetry antennas.

2.1.2 Planar Spiral

A planar spiral antenna similar to the SAVANT I antenna covers the remaining frequency range (181.1 to 247.8 MHz), and lies in the XY plane of the spacecraft. The antenna is deployed through the initiation of a pinpuller and by the inertial forces induced by the rotating vehicle. The signal coverage is provided through the arms of the 4-turn logarithmic spiral.

2.2 RECEIVER

2.2.1 General Description

The SAVANT II receiver system consists of the following subsystems: (1) receiver, (2) processing, and (3) logic and status. (Diagram 3). The SAVANT II receiver system is similar to the SAVANT I receiver system except for the following:

a. Ten single conversion superheterodyne receivers are used to cover the frequency band

b. A second recognizer technique has been implemented to insure data processing of those signals recognized

c. An increased command capability has been provided to allow greater flexibility of individual receiver operation.

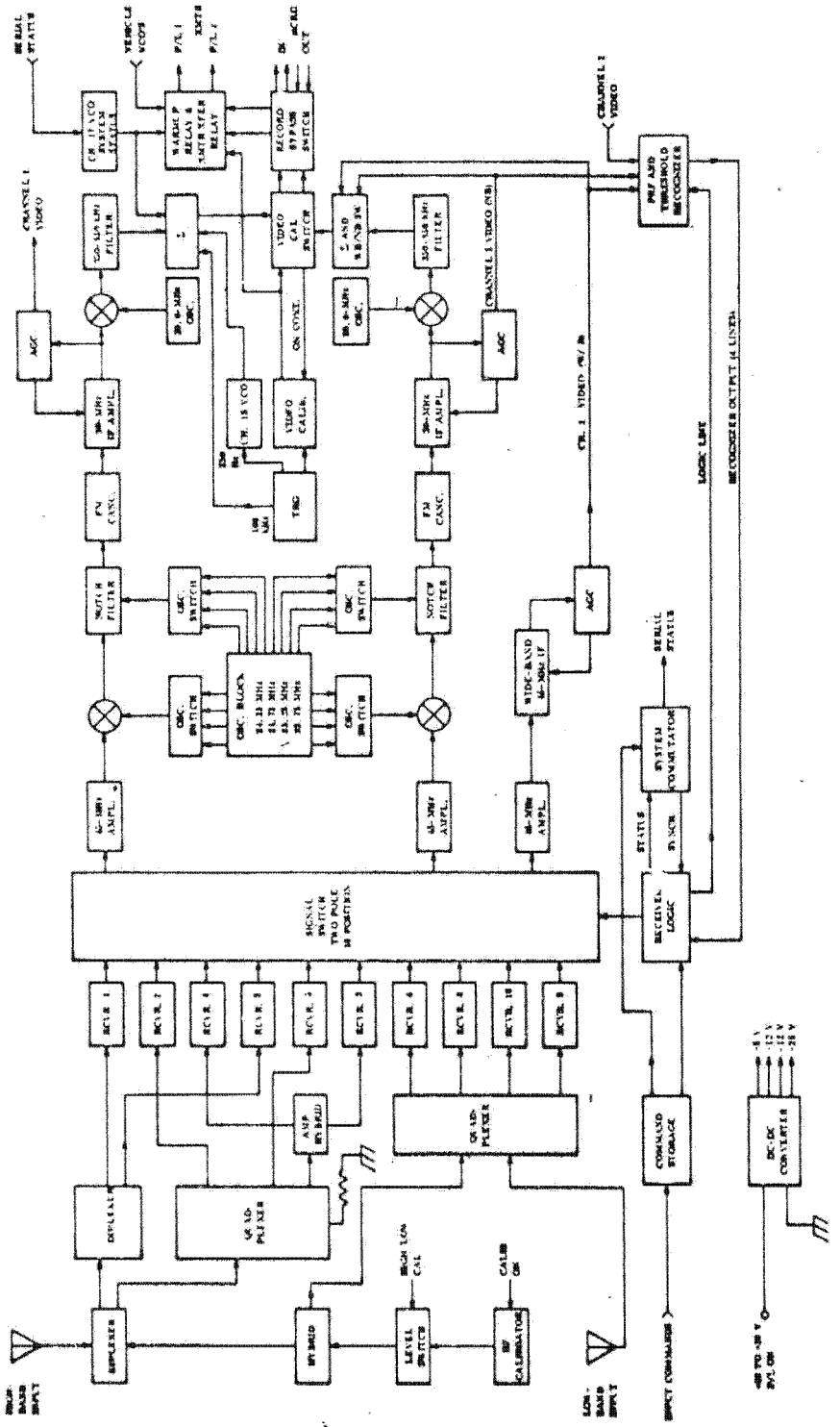


Diagram 3. System Block Diagram

2.2.1.1 Receiver. The RF section of the SAVANT II receiver splits the input band into 10 channels through two quadruplexers and one diplexer. The low-band quadruplexer has a 3-db bandwidth of 4.5 MHz and an insertion loss of 3.0 db. The 3-db bandwidth of the high band quadruplexer and diplexer are 9.0 MHz with an insertion loss of 0.5 db and 1.2 db respectively. The output frequencies of the low-band quadruplexer are 61.0, 66.0, 71.0 and 76.0 MHz. The high-band quadruplexer and diplexer frequencies are 163.8, 165.8, 181.1, 192.4, and 240.2, and 247.8 MHz, respectively. All frequencies are then amplified (37 db) and downconverted through local oscillator-mixer combinations to 45 MHz.

2.2.1.2 Processing Subsystem. The two processing channels each consist of a first IF amplifier, stepped second local oscillator, notch filter, FM canceller, and second IF amplifier/AGC circuit. The second local oscillator is step-tuned to four 500-kHz increments; two on each side of the receiver center frequency. The stepping of the local oscillator is synchronized with the 45-point commutator and remains for 2 seconds on each subband or 500-kHz step.

The tuning of the fixed notch filter in the 61-, 66-, and 76-MHz receivers is the same as in SAVANT I. However, the filter characteristics have been modified so that the 3-db bandwidth is less than 180 kHz and the 40-db bandwidth is greater than 70 kHz. Similarly, the FM canceller notch filters now have a 3-db bandwidth of less than 80 kHz and a 40-db bandwidth of greater than 20 kHz.

Both processing channels (1 and 2) have a predetected output (350 to 850 kHz) while channel 2 also has a postdetected output (10 to 250 kHz). The channel 2 processor may also be commanded to a postdetected wideband mode (10 to 1000 kHz).

The SAVANT II AGC circuitry will again allow full use of the receiver dynamic range by varying the gain of the 20-MHz IF amplifier. The variation in gain will depend upon the difference between a preset reference voltage, and a DC signal voltage proportional to the number of times per second the received signal crosses a preset threshold level. The AGC voltage level will be sampled four times a second by the commutator.

The PRF-type recognizer used by SAVANT I, designated as type 1, will be supplemented by another recognizer for SAVANT II. The additional threshold recognizer, designated as type 2, requires a 6-db signal-to-noise ratio for operation. The new recognizer counts detected signals for a predetermined time, and after a certain count has been reached, a pulse is generated. The transmission of this pulse and a pulse from the type 1 recognizer constitutes signal qualification. This type of qualification is designated as method X. The

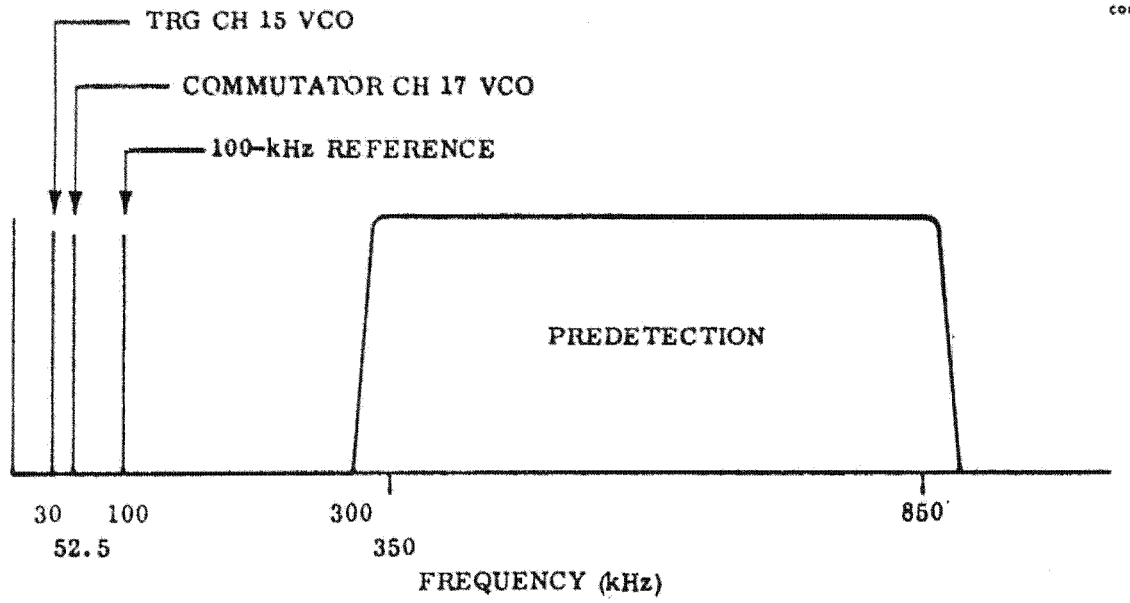
type 2 recognizer may be inhibited by command and qualification obtained by only the type 1 recognizer. This type of qualification is defined as method Y.

2.2.1.3 Logic and Status Subsystem. The logic and status subsystem consists of a command matrix, RF calibrator, video calibrator, and payload status points. The processing channels (Diagram 4) are directed to the correct receiver outputs through the command storage and signal switch units. The stepping of the processing channels is synchronized with the payload commutator, which operates at two frames per second. Processing Channel #1 may be commanded to only the narrow band sampling mode, 500 kHz. Processing Channel #2 may be commanded to either a narrow band or wideband (2 MHz) sampling mode. When commanded to Search Mode A Narrow Band, the processing channel remains on each 500-kHz subband for two seconds. When channel 2 processor is in Search Mode B Wide Band, the processor will dwell on each receiver for four seconds. The command matrix will control the processing channels as described below.

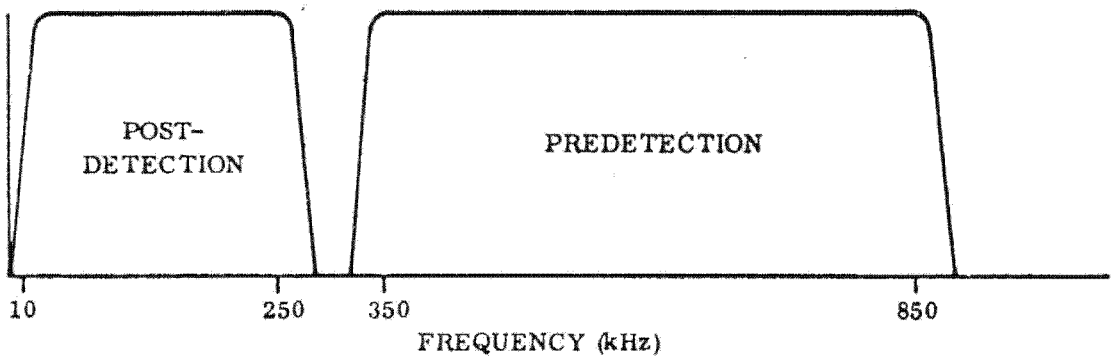
Search Mode A

In Search Mode A, the two processing channels may search any combination of receiver outputs, up to a maximum of 10. When a signal is qualified by the recognizer, an inhibit pulse prevents the processor from advancing to the next receiver subband. Another recognition time interval (2 seconds) is provided, and upon receipt of a second recognition, the tape recorder starts. The receipt of two signal recognitions within two consecutive 2-second intervals defines signal qualification. If a second recognition is not received, the processor will continue its scan cycle as originally commanded. For qualified signals, the receiver and step in which the intercept is made is stored and the scan is completed. If, in the process of completing the scan, another valid intercept is made, the processor returns to the receiver having the highest priority and locks on for the remainder of the read-in period. The receiver priority (highest to lowest) is as follows: 247.8, 240.2, 165.8, 163.8, 181.1, 76.0, 192.4, 71.0, 61.0, and 66.0 MHz. When the signal is qualified in only one of the four 500-kHz steps, the processor returns to that step. If the signal is qualified in any two, three or four subbands, the processor returns to the second of those subbands in which the signal was qualified. The remaining processor samples the outputs of the remaining receivers, and upon qualification, the scan is completed and the intercept with the highest priority is selected for recording.

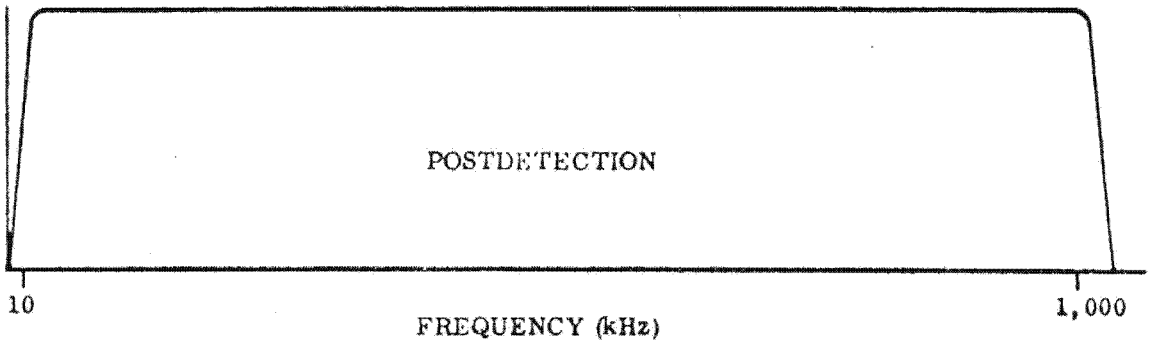
With both processing channels in Search Mode A, narrowband, and with either processor locked onto a receiver, the remaining processor will scan, in addition to its own receivers, those assigned to the locked processor. It will not



PROCESSING CHANNEL NO. 1



PROCESSING CHANNEL NO. 2, SEARCH MODE A



PROCESSING CHANNEL NO. 2, SEARCH MODE B

Diagram 4. Processor Data Spectrum

scan the receiver already locked. The processor will return to the highest priority receiver upon qualification during the completion of its expanded search cycle. Both processors will not simultaneously search the same receiver output, even though commanded. The Channel 2 processor will have priority under these conditions with the Channel 1 processor advancing to the next receiver. The recognizer input is inhibited for 100 msec after stepping to a new receiver subband to allow quieting of the AGC voltage. The recognizer circuitry samples and holds the receiver output when a signal is present for approximately four frames of the commutator. A recognized signal may then be recorded by the commutator for two frames beyond that time in which it was recognized.

Search Mode B

Search Mode B will command the Channel 2 processor to a wideband post-detection mode. The processor will search the receiver outputs as in search Mode A but with a 4-second dwell on each receiver. As in search Mode A, two consecutive recognitions are required for qualification. After the first recognition, another 4-second dwell will be provided to allow for a second recognition. The commutator sampling time is identical to that of search Mode A, i.e., a recognition will be held for 2 additional commutator frames beyond the recognition sampling period.

If no recognitions are received in either of the recognizer sample periods, the processor advances to the next highest priority receiver. Upon qualification, the tape recorder will be turned on, if not on already, and the processor will complete its scanning cycle and return to the highest priority receiver with qualification.

With the Channel 1 processor locked onto a receiver output, the Channel 2 processor will search in addition to its own receiver, all of Channel 1's receivers, including the receiver it is locked onto. When in the wideband mode, there is no longer a distinction between preselect A and preselect B.

Preselect Mode A

Preselect mode A will command either or both processing channels to a specific receiver output for the entire read-in period. If qualification is made in any one of the four 500-kHz subbands, the processor will lock onto that subband for the remainder of the read-in period. When qualification is made in more than one of the subbands, the processor will lock onto the second subband of those subbands in which qualifications were made.

Preselect Mode B

Preselect mode B will command either or both processing channels to a specific receiver and 500-kHz subband for the entire read-in period.

Time Reference Generator

The time reference generator (TRG) is located within the SAVANT II payload and receives continuous power from the P-11 spacecraft. The Series I TRG has highly stable coherent outputs and utilized the AN/GSQ-53 time code format. Frequency stability and accuracy are as follows:

a. Short-Term Frequency Stability. The short-term frequency stability is four parts in 10^9 parts. (Short-term stability as defined herein is the frequency deviation for an averaging time of 10 seconds.)

b. Long-Term Frequency Stability. The long-term frequency stability is 1.8 parts in 10^8 parts. (Long-term frequency stability as defined herein is the frequency deviation for an averaging time of five minutes.)

c. Frequency Accuracy. The frequency accuracy is 1.8 parts in 10^5 parts or better (worst case for any temperature).

3.1 Data Storage

The payload data will be stored during the payload readin period on a Leach, 2-channel recorder. Three recorders will be available to satisfy mission requirements with selection of recorder by ground command. Each recorder will have approximately 6 minutes of read-in and read-out time. The recorder frequency response will be +3 db from 1 kHz to 1 MHz. The dynamic range is 25 db with a linear input-output response. The payload processing channel 2 will be recorded on track 1 and processing channel 2 on track 2.