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BYE-1257-68
SORS 11.719
27 March 1968

UNITED STATES INTELLIGENCE BOARD

SIGINT COMMITTEE

SIGINT OVERHEAD RECONNAISSANCE SUBCOMMITTEE

MEMORANDUM FOR MEMBERS OF THE SIGINT OVERHEAD RECONNAISSANCE SUBCOMMITTEE

SUBJECT: Mission Description of TRIPOS III/SOUSEA II. 7326/7327

Mission Descriptions of SIGINT Satellite Payloads TRIPOS III/SOUSEA II, 7326/7327 have been provided to the SORS by the NRO and are forwarded for your information.

[redacted] 50X1

EXECUTIVE SECRETARY
SIGINT OVERHEAD RECONNAISSANCE SUBCOMMITTEE

Enclosure:
a/s

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GROUP 1
Excluded from automatic downgrading and declassification

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BYEMAN

~~(S)~~ NATIONAL RECONNAISSANCE OFFICE

WASHINGTON, D.C.

THE NRO STAFF

BYE-1257-68
SORS 11./19
27 March 1968

MEMORANDUM FOR THE CHAIRMAN, SORS

SUBJECT: Mission Descriptions of SIGINT Missions 7326 (TRIPOS III) and 7327 (SOUSEA II)

The mission descriptions for Missions 7326 and 7327 are forwarded as an attachment to this correspondence. These Elint Reconnaissance Systems are designed to meet the requirements of USIB D 41.14/246, USIB D 41.14/303 and current attachments thereto.

Missions 7326/27 are contained in a spin stabilized P-11 subsatellite which is scheduled to be launched into a nominal 325 mile circular orbit by a Thorad Agena booster. It contains two separate Elint reconnaissance systems - TRIPOS III which is designed to intercept and record signals in the 4-8 GHz band, and SOUSEA II which is designed to intercept and record signals in the 8-12 GHz band. These systems will receive and record signals of interest with sufficient bandwidth to permit measurement of such parameters as frequency, pulse width, power, pulse repetition frequency, and geoposition of the emitter.

The planned launch date, predicated on the launch of the primary payload, is July 1968. Mission life is expected to be 9 months. A nominal 6 to 11 collection revs per day should be available. Under worst case power conditions, it would appear that a minimum of six operations per day can be sustained.

HENRY C. HOWARD
Colonel, USAF
Deputy Director for
Satellite Operations
NRO Staff

Attachment
As Stated

BYEMAN
CONTROL SYSTEM

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EXCLUDED FROM AUTOMATIC REGRADING
DOD DIRECTIVE 5200.10 DOES NOT APPLY

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MISSION DESCRIPTIONS

MISSIONS 7326 (TRIPOS III) AND 7327 (SOUSEA II)

GENERAL.

The orbital payload comprises two separate antenna and receiver subsystems, two dual-channel tape recorders, four VHF telemetry transmitters, a command and control subsystem and ancillary equipment.

ANTENNA SUBSYSTEMS.

The receiving antennas for each receiver subsystem consist of a pencil-beam direction finding (DF) antenna and two broadbeam, omni-directional inhibit antennas (Diagram 1).

TRIPOS III ANTENNA SUBSYSTEM.

The pencil-beam DF antenna is a 3-foot unfurlable paraboloid having flex ribs. Characteristics of this antenna are as follows:

a.	Frequency Range	4 to 8 GHz
b.	Gain (Matched Polarization)	
	4 GHz	26.0 db
	6 GHz	29.0 db
	8 GHz	32.0 db
c.	Beamwidth	3° to 6°
d.	Type of Feed	Conical spiral (CP)
e.	Transmission Line	Air line
f.	Boresight Axis Location	115° CW from Y-Z plane measured around +Y-Y axis looking from +Y direction. Depression angle is 54°.

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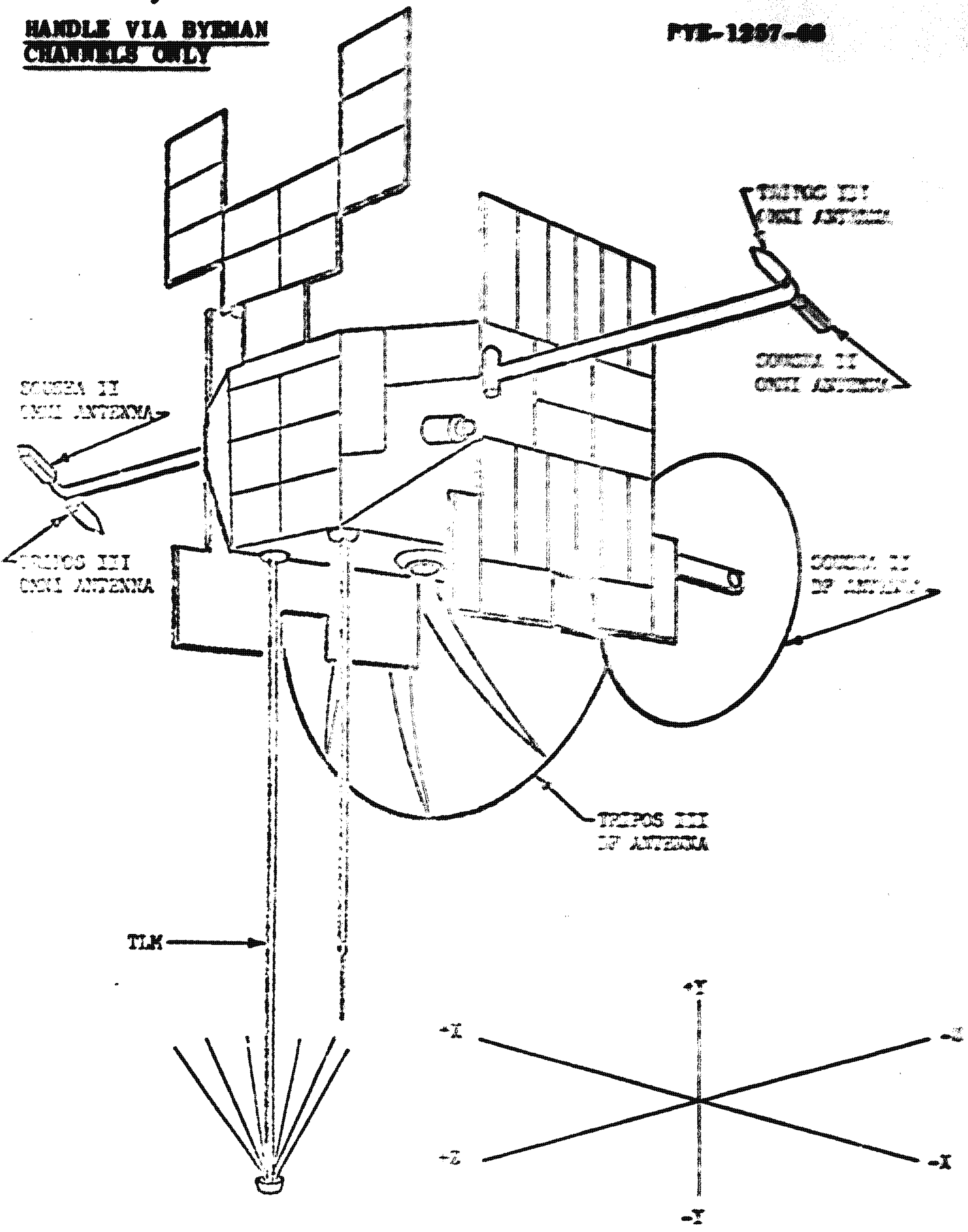

DIAGRAM 1. Spacecraft Antenna Configuration (This configuration is for illustrative purposes only and does not reflect the actual antenna mounting.)

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The two inhibit antennas are boom-mounted conical spirals located 180 degrees apart on the spacecraft. Antenna characterisitcs are as follows:

a.	Beam Pattern:	Each antenna provides hemispheric coverage; combined antennas provide omni-directional coverage.
b.	Polarization:	Circular
c.	Transmission Line:	Air line

SOUSEA II ANTENNA SUBSYSTEM.

The SOUSEA II DF antenna is an 18-inch, solid magnesium paraboloid. Characteristics of this antenna are as follows:

a. Frequency Range: 8 to 12 GHz

b. Nominal Gain (Matched Polarization)

8 GHz	29.0 db
10 GHz	31.0 db
12 GHz	32.0 db

c.	Beamwidth:	4° to 6°
d.	Type of Feed:	Waveguide with circular polarizing section
e.	Transmission Line:	Rigid waveguide
f.	Boresight Axis Location:	Along +Z axis with depression angle of 54°

The two inhibit antennas are boom-mounted, rigid waveguides located 180 degrees apart on the spacecraft. Antenna characteristics are as follows:

a. Beam Pattern: Each antenna provides hemispheric coverage; combined antennas provide omni-directional coverage

b. Polarization: Circular

c. Transmission Line: Rigid waveguide

RECEIVER SUBSYSTEMS.

Introduction. Each receiver subsystem consists of three crystal video receivers consisting of RF amplifiers and crystal detectors, sum and difference circuits, log-video amplifiers, pulse stretchers, and a pulsewidth multiplier.

RECEIVER SUBSYSTEM PARAMETERS

Parameter	TRIPOS III	SOUSEA II
Frequency Range	4-8 GHz	8-12 GHz
Sensitivity		
DF channel (S/N = 15 db)		
High-gain mode	-73 dbm ± 3 db	-73 dbm ± 3 db
Low-gain mode	-67 dbm ± 3 db	-67 dbm ± 3 db
Omni channels (S/N - 15 db)		
DF inhibit function	-75 dbm ± 3 db	-75 dbm ± 3 db
Omni video output	-65 dbm (or greater) ± 3 db	-65 dbm (or greater ± 3 db
Dynamic Range	30 db	30 db
DF Frequency Measurement		
With temperature calibration	± 30 MHz	± 30 MHz

Without temperature calibration	± 35 MHz	± 41 MHz
PW Measurement		
Range	0.25 to 10 usec	0.25 to 10 usec
Accuracy	±0.25 usec or ± 1% whichever is greater	±0.25 usec or ±1% whichever is greater
Geopositioning Accuracy	[redacted]	50X1

TRIPOS III RECEIVER SUBSYSTEM.

Since both receiver subsystems are identical except for frequency coverage, only the TRIPOS III subsystem will be described (Diagram 2). Differences between the two receiver subsystems will be noted.

The signal received by the pencil-beam DF antenna is applied via a 30 db coupler (forward loss less than 1.0 db) to a tunnel-diode amplifier (TDA) consisting of four cascaded tunnel diode and circulator combinations that provide a nominal gain of 32 db. The TDA output is coupled into a 10-db directional coupler (forward loss of approximately 0. 5 db) to a tunnel-diode detector and a postdetection amplifier having a bandwidth of 2. 3 ± 0. 2 MHz. The output of the postdetection amplifier is summed with the outputs of the omni-directional inhibit receivers. The summed signal is applied to a bipolar log-video amplifier. A portion of the RF energy from the DF channel is coupled through the 10-db directional coupler to the frequency measurement circuitry.

Signals received by the two conical spiral inhibit antennas are coupled into a 20-db directional coupler (forward loss less than 1.0 db) to their respective crystal video receivers. With the exception of the 20-db couplers, the two omni channel receivers are identical to the DF channel receiver. The outputs from the two omni channels are summed and coupled to a log-video amplifier and then to a summing network for the DF channel and omni channel outputs. The combined output is used to inhibit sidelobe responses from the pencil-beam antenna in the DF channel and to provide an output that is effectively omni-directional in coverage.

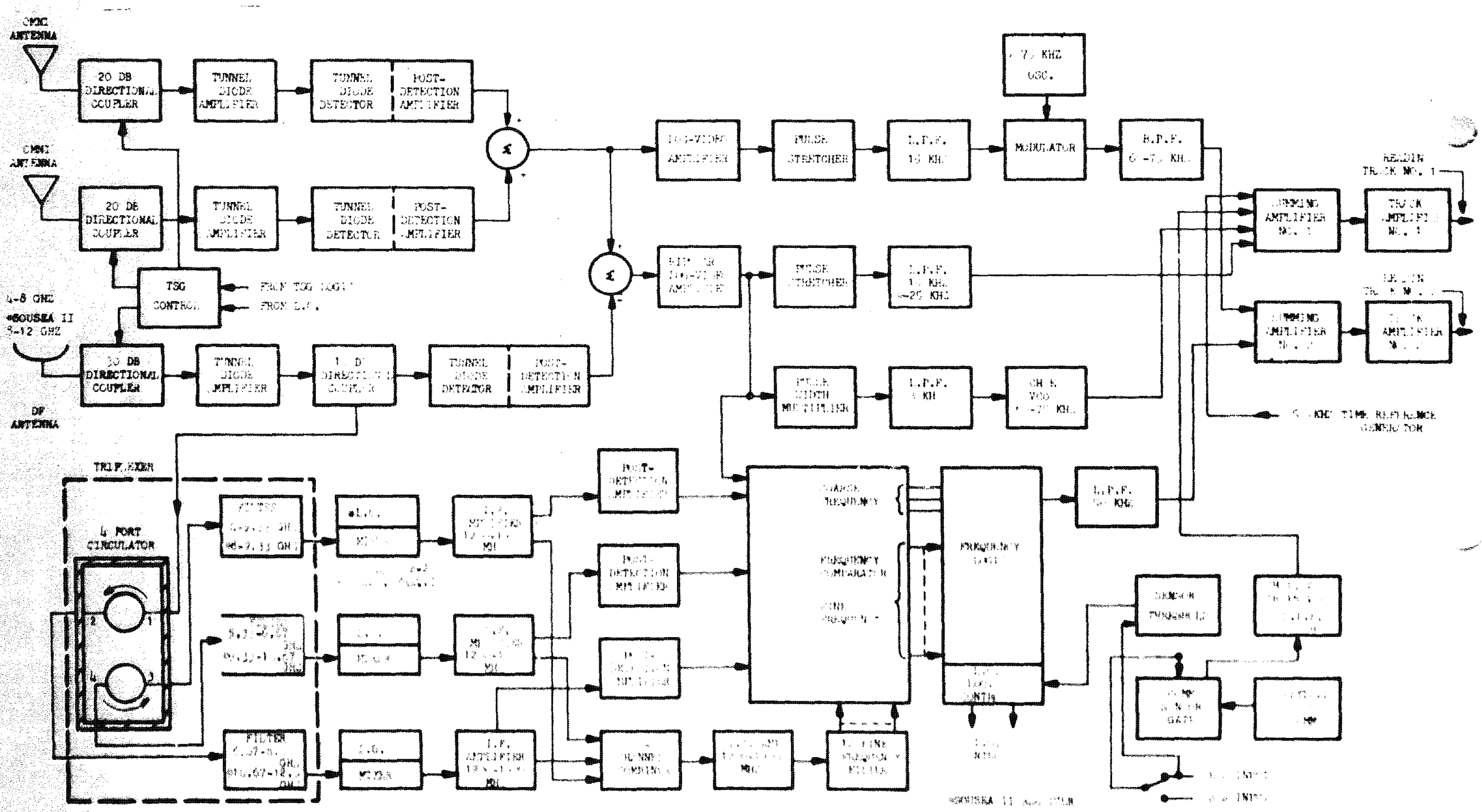
ANTENNA
20 DB DIRECTIONAL COUPLER
TUNNEL DIODE AMPLIFIER
TUNNEL DIODE DETECTOR
POST-DETECTION AMPLIFIER
PULSE STRETCHER
L.P.F.
MODULATOR
B.P.F.
OSC.
TSG CONTROL
4-8 GHZ
DF ANTENNA
TRIPLEXER
4 PORT CIRCULATOR
FILTER
MIXER
I.F. AMPLIFIER
SUMMING AMPLIFIER
FREQUENCY COMPARATOR
FREQUENCY GATE

DIAGRAM 2

The DF channel has two sensitivity modes: a high-gain (-73 dbm) mode and a low-gain (-65 dbm) mode. The 8-db insertion loss required for the low-gain mode is achieved by changing the bias on the TDA's in the DF channel by a relay closure initiated by external commands. The 8-db insertion loss provides for an inhibit margin between the response of the DF and omni antennas required for keeping "poke-through" to a minimum. The summed outputs from the omni channels are amplified in a log-video amplifier and applied to a pulse stretcher having a time constant of approximately 54 usec. The amplitude of the flat-top pulse stretcher is dependent upon the amplitude of the leading edge of the incoming pulse. If a second pulse having less amplitude is received while the pulse stretcher is processing the first pulse, the second pulse will be rejected. If the amplitude of the second pulse is greater than that of the first pulse, the flat top of the pulse stretcher will assume the amplitude of the second pulse for 54 usec. Both receiver systems use the same time constant for the omni pulse stretcher.

The DF video output is amplified in a bipolar log-video amplifier and applied to the DF channel pulse strecher, to the pulse-width multiplier, and to the frequency measurement threshold circuit.

The DF pulse stretchers of both receiver systems operate in the same manner as the omni pulse stretcher except that the SOUSEA II DF pulse stretcher has a time constant of 35 usec.

FREQUENCY MEASUREMENT SUBSYSTEM.

The frequency measurement subsystem for each receiver is the same with the exception of the frequency range covered. Each subsystem can measure the frequency of a received pulse in half its RF band during each spin of the vehicle with an accuracy up to ± 30 MHz (temperature compensated). A DF video signal having an S/N ratio of 15 db or greater is required to activate the frequency measurement subsystem encoder. The measurement subsystem consist of three superheterodyne receivers, three coarse and twelve fine-frequency filters, fine-frequency shift register, frequency encoder and associated control logic, and local oscillator controls.

RF energy from the DF channel is coupled through a 10-db directional coupler to a triplexer consisting of a four-port circulator and three interdigital filters, each having a bandwidth of 1.33 GHz. The output of the three filters are separately applied to single-ended mixers and converted to an IF of 1.2 to 1.9 GHz.

The bandwidth requirements of each of three IF amplifiers is one-half that of the interdigital filter since only one-half of the band is sampled at one time. Each IF amplifier has two outputs: one to a postdetection amplifier and the other to a 3-channel combiner. The postdetection amplifier outputs are the coarse-frequency measurements. The output of the 3-channel combiner is amplified in a 1.2 to 1.9 GHz IF amplifier having a bandwidth of 700 MHz and applied to a bank of 12 fine-frequency filters, each having a bandwidth of 55.55 ± 0.2 MHz.

The outputs of the 12 fine-frequency filters are amplified and applied to threshold and comparison circuits in the frequency comparator. A processed signal in the frequency channel is stored in a 12-position shift register.

The data stored in the coarse and fine-frequency registers are converted into a PCM bipolar code by the frequency encoder. The encoder is actuated by an "AND" circuit when the following three conditions are met:

a. An input signal (S/N 15 db or greater) from the DF channel bipolar log-video amplifier is present.

b. A signal is present in one of the fine-frequency filter shift registers.

c. No signal is presently being processed.

DATA STORAGE AND TRANSMISSION SUBSYSTEM.

Data Storage. The receiver system contains two 75 KHz, dual-track, 2:1 (readout/readin) tape recorders. Delayed commands are used to turn on the recorders for readin; readout is accomplished by real time command. The payload timer permits selective readin for any time delay between 2 and 16,378 seconds. The payload on duration can be programmed for a continuous 14 minute period or split into two 7 minute periods. Maximum tape recorder readin time is approximately 12 minutes which can be split into a 7 minute and 5 minute recording. Data inputs can be interchanged between the two recorders by command

and can be returned to normal operation by command. In case of failure of both of the tape recorders, they may be bypassed and payload data is routed directly to the down link transmitters.

TRIPOS III Data Readin. Tape recorder track No. 1 records the following data from summing amplifier No. 1: maximum readin time is 12.5 minutes.

a. DF video (up to 15 kHz).

b. Earth sensor, sun sensor, and payload status commutator data via channel 14 VCO.

c. AN/GSQ-53A digital time word at 50 kHz.

d. DF channel pulsewidth measurement via channel E VCO.

Tape recorder track No. 2 records the DF channel frequency measurement PCM word at a 50 kilobit-per-second rate and the omni channel video (up to 15 kHz) translated to the 60 to 75 kHz frequency band.

SOUSEA II Data Readin. Tape recorder track No. 1 contains the DF frequency measurement and the omni channel video. (Same as TRIPOS III tape recorder track No. 2). Track No. 2 records the following:

a. DF video (up to 25 kHz).

b. Earth sensor, sun sensor, and payload status commutator data via channel 16 VCO.

c. AN/GSQ-53A digital time word at 50 kHz.

d. DF channel pulsewidth measurement via channel E VCO.

Tape speed compensation for both recorders is accomplished using the 50 kHz tone associated with the digital time word.

Tape Recorder Readout. Data from both receiver subsystems are read out at twice readin speed through phase-compensating networks.

During the readout period of the TRIPOS III tape recorder data, the vehicle 60-point status commutator is summed to the track No. 1 output. The data format for before and after tape recorder readout is shown in Diagram 3. Maximum readout time is 6.25 minutes.

Data Transmission. Each transmitter is rated at two watts minimum power output. The output of each transmitter is applied via a multicoupler to a common telemetry antenna.

The telemetry antenna is a VHF monopole having extended radial elements to provide a good ground plane. The location of the telemetry antenna on the spacecraft is shown in Diagram 1.

GROUND SUPPORT EQUIPMENT.

Tracking Stations. The existing United States Air Force command and tracking network contains the required equipment for generating and transmitting commands to the spacecraft and for recording the readout of the intercepted data.

DATA PROCESSING.

Data processing includes shipment of recordings from the collection site to the West Coast facilities, performing engineering evaluation of demultiplexed payload status data, and delivery of ELINT intercept to NSA for exploitation.

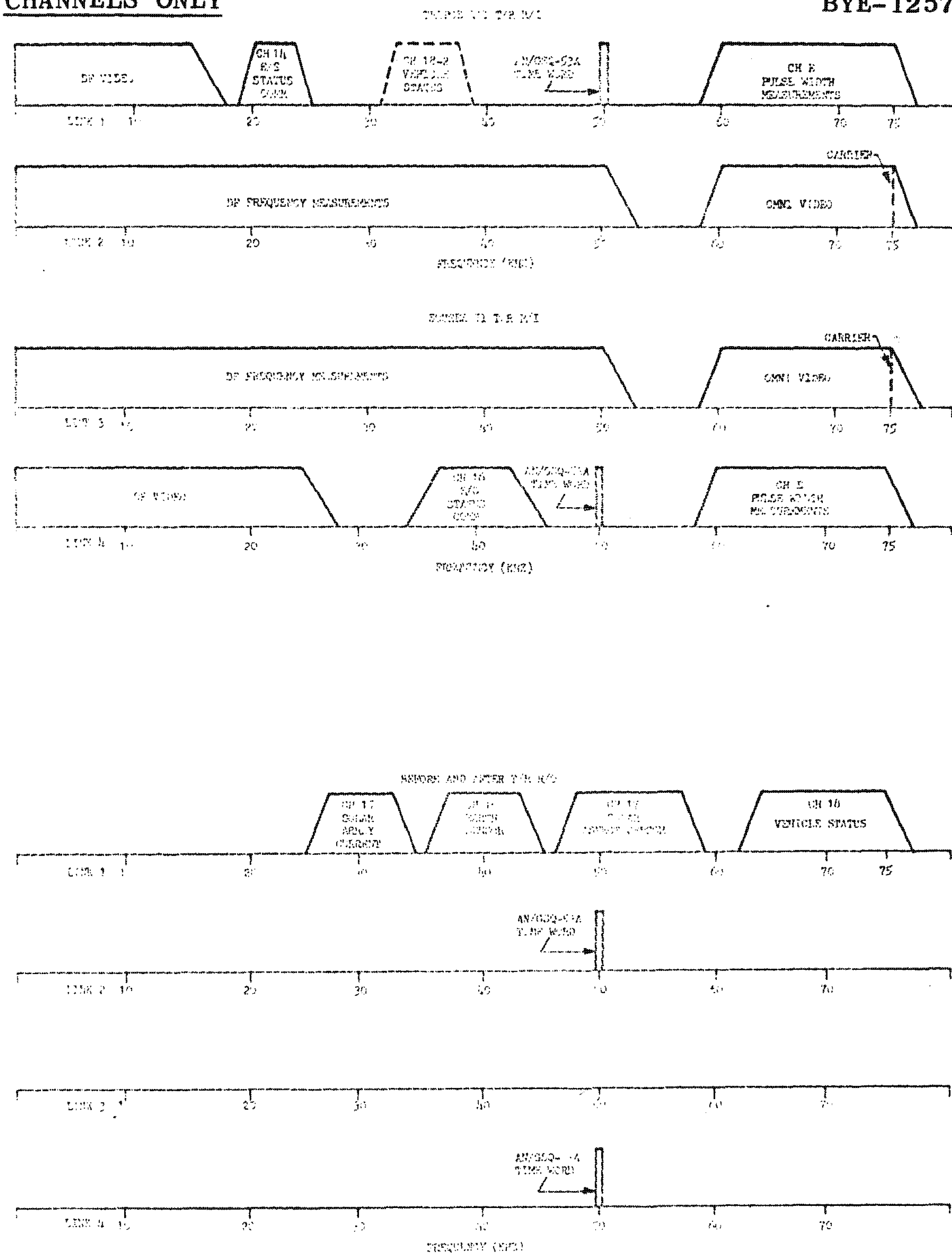

DIAGRAM 3. Intercept System Data Format