HANDLE VIA BYEMAN/
COMINT CHANNELS JOINTLY

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16 January 1969

U N I T E D   S T A T E S   I N T E L L I G E N C E   B O A R D

S I G I N T   C O M M I T T E E

SIGINT OVERHEAD RECONNAISSANCE SUBCOMMITTEE

MEMORANDUM FOR MEMBERS OF THE SIGINT OVERHEAD RECONNAISSANCE SUBCOMMITTEE

SUBJECT: Technical Mission Descriptions of LAMPAN II, Mission 7328, and SAMPAN III, Mission 7329.

The Technical Descriptions for SIGINT Payloads LAMPAN II, Mission 7328, and SAMPAN III, Mission 7329, have been provided to the SORS by the NRO and are forwarded herewith for your information.

[redacted] (b)(1) (b)(3)

EXECUTIVE SECRETARY
SIGINT OVERHEAD RECONNAISSANCE SUBCOMMITTEE

Attachment:
a/s

GROUP 1
Excluded from automatic downgrading and declassification

~~TS~~ NATIONAL RECONNAISSANCE OFFICE

WASHINGTON, D.C.

HANDLE VIA BYEMAN/
COMINT CHANNELS JOINTLY

COPY ________.
BYE-1101-69
SORS 11./32
16 January 1969

MEMORANDUM FOR THE CHAIRMAN, SORS

SUBJECT: Mission Descriptions of SIGINT Mission 7328 (LAMPAN II) and Mission 7329 (SAMPAN III)

The mission descriptions for Missions 7328 and 7329 are forwarded as attachments to this correspondence. These SIGINT reconnaissance systems are designed to meet the requirements of USIB-D-41.14/246, USIB-D-41.14/303, USIB-S-10.9/7, and current attachments thereto.

Mission 7328/29 is contained in a spin-stabilized P-11 sub-satellite which is scheduled to be launched into a nominal 275-mile circular orbit by a THOR-AGENA booster. It contains two separate ELINT reconnaissance systems and an add-on system to LAMPAN II for COMINT reconnaissance: LAMPAN II, which is designed to intercept and record signals in the 1000-2100 MHz band; SAMPAN III, which is designed to intercept and record signals in the 2100-4000 MHz band; and the add-on system which is designed to intercept and record Communist Chinese RVG 902/3 signals in the 1200-1470 MHz band. The ELINT reconnaissance systems will receive and record signals of interest with sufficient bandwidth to permit measurement of such parameters as frequency, [redacted] pulse repetition frequency, power, and geoposition of the emitter. A "chirp" measurement capability is provided in the LAMPAN system. The COMINT reconnaissance system will receive and record signals of interest with sufficient bandwidth to measure frequency and location of these signals. (b)(1) (b)(3)

The planned launch date, predicated on launch of the primary payload, is 19 March 1969. Mission life is expected to be nine months. A nominal 10 to 12 collection revs per day should be available for

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mission accomplishment. It would be meaningful to the NRO if the collection guidance specifies geographic area/target coverage in priority order, time of day referenced to the area/target, high or normal sensitivity mode referenced to the area/target, and priority of collection of RVG 902/3 signals referenced to the LAMPAN II mission.

1 Attachment
As stated

EDWIN F. SWEENEY
Colonel, USAF
Director
Satellite Operations Center

SECTION 1

INTRODUCTION

1.1 GENERAL.

The orbital intercept system comprises two separate receivers, receiving antennas (two conical spirals and one paraboloid) (Diagram 1), two dual-channel tape recorders, four VHF/FM telemetry transmitters, a command subsystem, and ancillary equipment, including earth and sun sensors, a time reference generator, and payload status commutators (Diagram 2).

The two conical spiral antennas provide hemispherical coverage and the parabolic antenna provides directional coverage. The antenna outputs are split by diplexers to feed both the SAMPAN III and LAMPAN II receivers. The outputs of the conical antennas are amplified, detected, and summed to provide the equivalent of an omnidirectional antenna output. This output is used to inhibit the sidelobe response of the parabolic antenna and to provide an omni video output.

Each receiver subsystem makes measures on the input signals and provides two frequency-multiplexed outputs that contain the following information:

a. DF video

b. Omni video

c. DF frequency

d. Omni frequency (LAMPAN II only)

e. [redacted] (b)(1) (b)(3)

f. Earth/sun sensor data

g. Payload status data

h. Time reference data

i. Frequency and power of [redacted] emitters (LAMPAN II optional mode only). (b)(1) (b)(3)

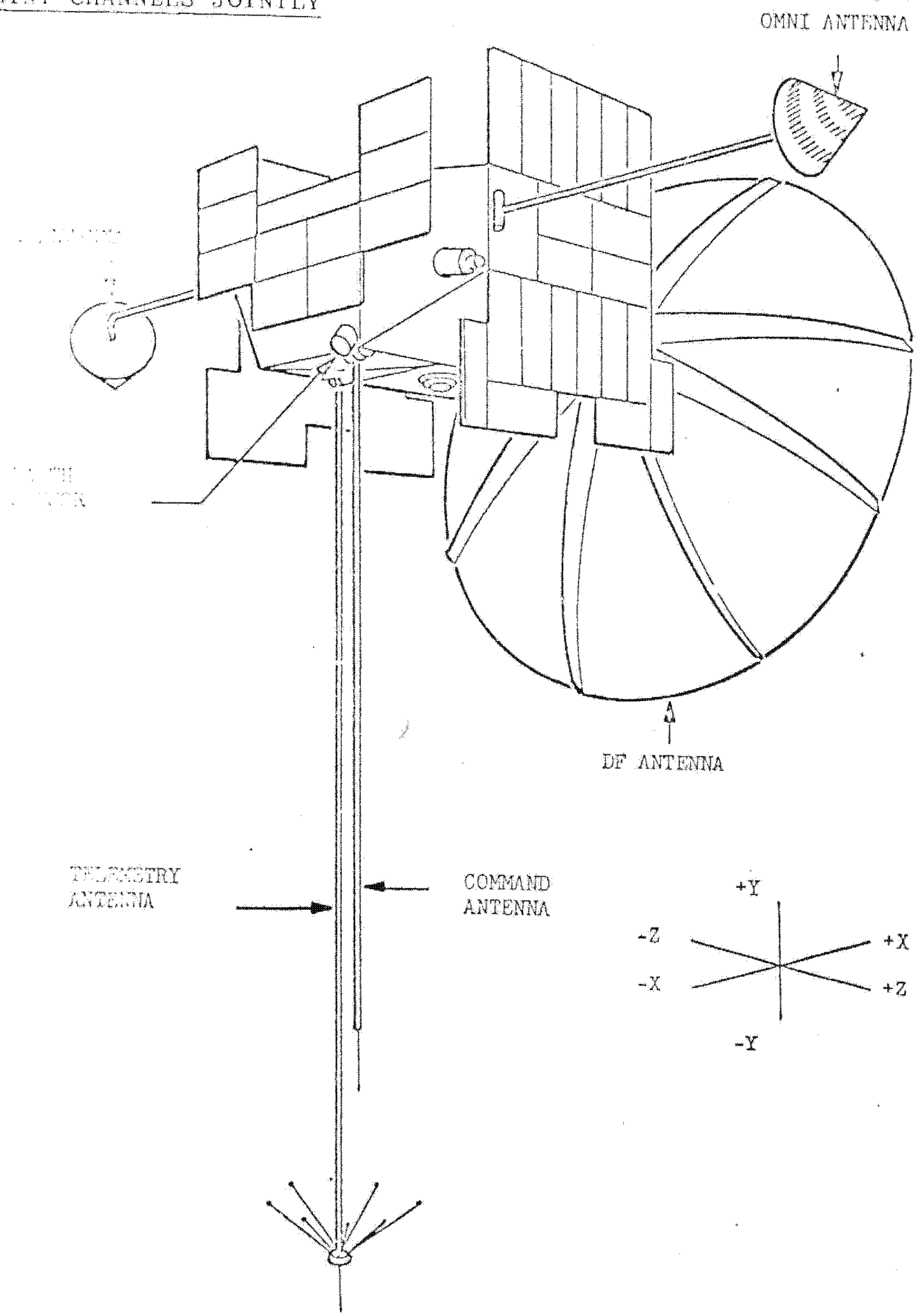

DIAGRAM 1

ANTENNA CONFIGURATION

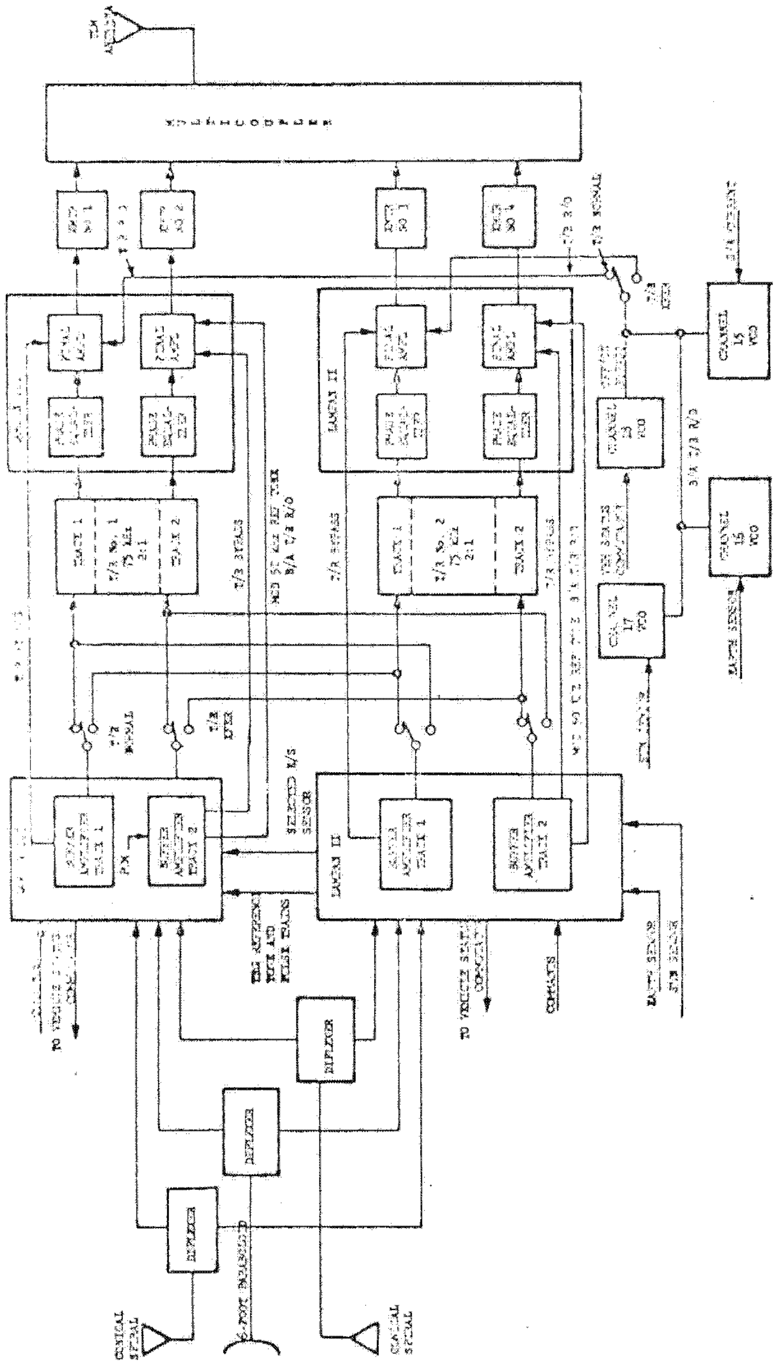

DIAGRAM 2
SIMPLIFIED BLOCK DIAGRAM

The processed receiver outputs are applied to dual-track, 75 KHz, 2:1 (readout/readin) tape recorders. Inputs to the tape recorders can be transferred (upon external command) to allow either receiver to be connected to either tape recorder. The tape recorder outputs are phase-equalized in the receivers before being applied to the VHF/FM telemetry transmitters.

1.2 PARAMETERS.

Altitude:	275 nm
Inclination Angle:	$90^{\circ} \pm 20^{\circ}$
Direction of Spin:	CCW when viewed from -Y axis
Spin Rates:	
Initial:	Normal 52 rpm
After 6 months:	Normal 44 rpm
After 12 months:	Normal 37 rpm
DF Antenna Elevation Angle:	55° (DF antenna is in X-Z plane pointing 55° up from -Y axis toward $+$X axis)
Earth Sensor Elevation Angle:	60° (Earth sensor is in X-Z plane pointing 60° up from -Y axis toward -X axis)
SAMPAN III	
Frequency Range:	2.1 to 4.0 GHz (S-band)
Frequency measurement accuracy:	$\pm$ 7.5 MHz
DF Sensitivity at Input to Diplexer:	
High:	-71 dbm (50% probability of detection)

Normal:	-65 dbm (50% probability of detection)
DF Antenna Gain at Input to Diplexer (matched polarization):	
2.0 GHz:	+23.8 db
3.1 GHz:	+27.0 db
4.0 GHz:	+30.5 db

[redacted] (b)(1) (b)(3)

Accuracy:

Omni Sensitivity at Input to Diplexer:	-55 dbm
Location Accuracy:	10 nm at nadir, 25 nm at 600 nm slant range

LAMPAN II

Frequency Range:	1.0 to 2.1 GHz (L-band)
Frequency Measurement Accuracy:	1 MHz (manual analysis) ± 5 MHz (digital analysis)
DF Sensitivity at Input to Diplexer:	
High:	-72 dbm (50% probability of detection)
Normal:	-66 dbm (50% probability of detection)

[redacted] (b)(1) (b)(3)

Accuracy:

DF Antenna Gain at Input to Diplexer (matched polarization):

1.0 GHz:	≠ 18.2 db
1.5 GHz:	≠ 23.0 db
2.0 GHz:	≠ 23.8 db
Location Accuracy:	10 nm at nadir, 25 nm at 600 nm slant range

2. ANTENNAS.

2.1 CONICAL SPIRAL (OMNI) ANTENNAS.

Each conical spiral antenna provides hemispherical coverage with an average gain of -2 db. The antennas are located on the subsatellite such that their combined patterns provide omnidirectional coverage. The conical antennas provide both receivers with omnidirectional video signals and with inhibit signals that inhibit the parabolic antenna sidelobes. Characteristics of the conical spiral antennas are as follows:

a. Frequency Range: 1.0 to 4.0 GHz

b. Nominal Gain: -2 db

c. Polarization: Circular

2.2 PARABOLIC (DF) ANTENNA.

The 6-foot-diameter, pencil beam, parabolic antenna, connected to its diplexer via an equiangular flat spiral feed, provides a direction-finding (DF) output to the receiver subsystems. The antenna is positioned on the subsatellite such that its boresight axis is 180 degress from that of the earth sensor and its elevation angle is 55 degrees from the spin axis of the subsatellite. Typical 3-db antenna gains (from linear to circular polarization) and beamwidths are as follows:

Frequency (GHz)	Gain (db) (At -3 db Point Linear-to-Circular Polarization)		Beamwidth at -3 db Points (Degrees)	
	E Plane	H Plane	E Plane	H Plane
1.0	13.0	12.4	9.8	11.1
1.5	16.6	17.0	7.4	7.4
2.0	17.8	17.7	5.4	5.4

2.6	20.0	19.7	4.4	4.3
3.1	21.5	20.3	3.3	4.1
3.5	21.5	22.3	3.0	3.4
4.0	23.9	24.5	2.6	2.5

2.3 DIPLEXERS.

Three diplexers (one for each antenna) are used to frequency divide the antenna outputs into a 1.0- to 2.1-GHz output (0.75-db attenuation, maximum) and into a 2.1- to 4.0-GHz output (1.25-db attenuation, maximum).

3. SAMPAN III RECEIVER.

3.1 GENERAL.

The SAMPAN III receiver system is similar to the SAMPAN I and II, with the exception that SAMPAN III has a frequency measurement capability in the DF channel that will provide a 100 percent probability of measurement.

Three antennas provide inputs to SAMPAN III: two antennas provide hemispherical coverage and the third provides directional coverage. The receiver system consists of three crystal video receivers with RF amplification and ancillary items such as logic circuits, amplifiers, VCO's, a commutator, etc. The following outputs are provided:

a. Omnidirectional video

b. DF video

c. DF frequency and pulsewidth measurement

d. Earth/sun sensor and payload status measurements

e. 50-KHz reference tone modulated by AN/GSQ-53A time word

f. Test signal generator (TSG) signal output switched into the three inputs for 1 second once every minute.

3.2 DETAILS.

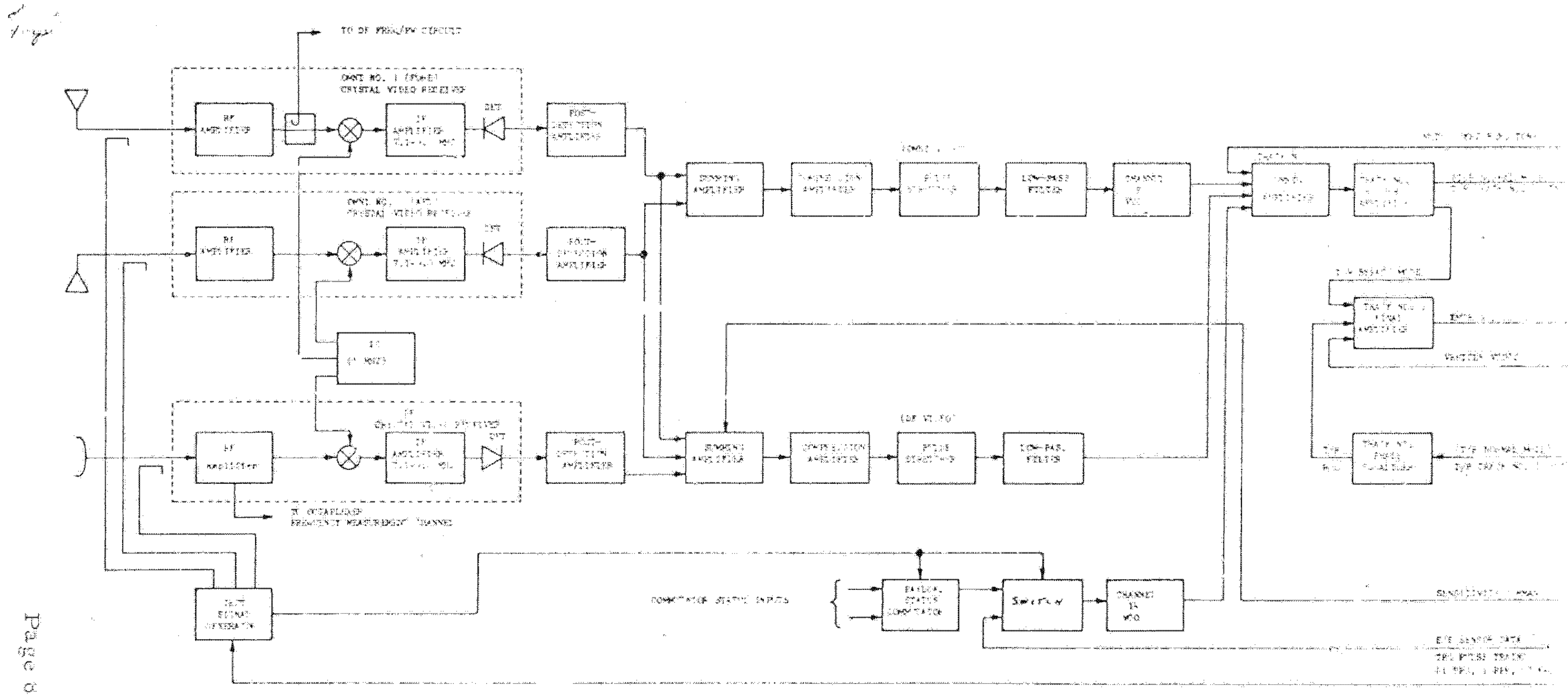

DIAGRAM 5A - [illegible] Space Channel Block Diagram

3.2.1 OMNI VIDEO CHANNEL (DIAGRAM 3A).

The omni video channel consists of two crystal video receivers, each having RF amplification. An input signal between 2.1 and 4.0 GHz from either or both of the conical spiral antennas is tunnel-diode amplified and mixed with a 5.0-GHz local oscillator signal to produce an upconverted signal between 7.1 and 9.0 GHz. The upconverted signal is tunnel-diode amplified and diode detected. The detector outputs are postdetection amplified, summed (in the omni video summing amplifier), compression amplified, stretched (in a constant-width pulse stretcher), and low-pass filtered.

The filter output modulates an IRIG channel E VCO, is summed, buffer amplified, and applied to a tape recorder. The postamplified omni video signals are also summed in the DF video summing amplifier.

To reduce the output signal density, the omni video channel gain is set such that a -55 dbm signal is just above system noise. The maximum sensitivity (-75 dbm) is used for inhibiting the DF antenna sidelobes.

3.2.2 DF VIDEO CHANNEL.

The DF video channel consists of a crystal video receiver having RF amplification and having a maximum sensitivity of -75 dbm. An input signal in the 2.1- to 4.0-GHz band received by the DF parabolic antenna is tunnel-diode amplified and mixed with a 5.0-GHz local oscillator signal to produce an upconverted signal in the frequency range of 7.1 and 9.0 GHz. This upconverted signal is tunnel-diode amplified and diode detected. The detector output is postdetection amplified and summed with the two omni postdetection amplifier outputs (of opposite polarity) in the DF summing amplifier. The negative omni pulses are clipped, and the positive DF pulses are compressed in a compression amplifier. There are two gain modes 6 db apart. Signals from the sidelobes of the DF parabolic antenna are thus inhibited by the signals from the conical spirals. The compressed output is stretched (in a [redacted] low-pass filtered, summed, buffer amplified, and applied to a tape recorder. (b)(1) (b)(3)

3.2.3 DF FREQUENCY MEASUREMENT CHANNEL (DIAGRAM 3B).

SAMPAN III incorporates a different DF frequency measurement technique than that used in previous SAMPAN receivers. The technique used provides a 100 percent probability of frequency measurement even though intercept time is constrained by the narrow beamwidth of the DF antenna and the vehicle spin rate. In SAMPAN III, the frequency band is

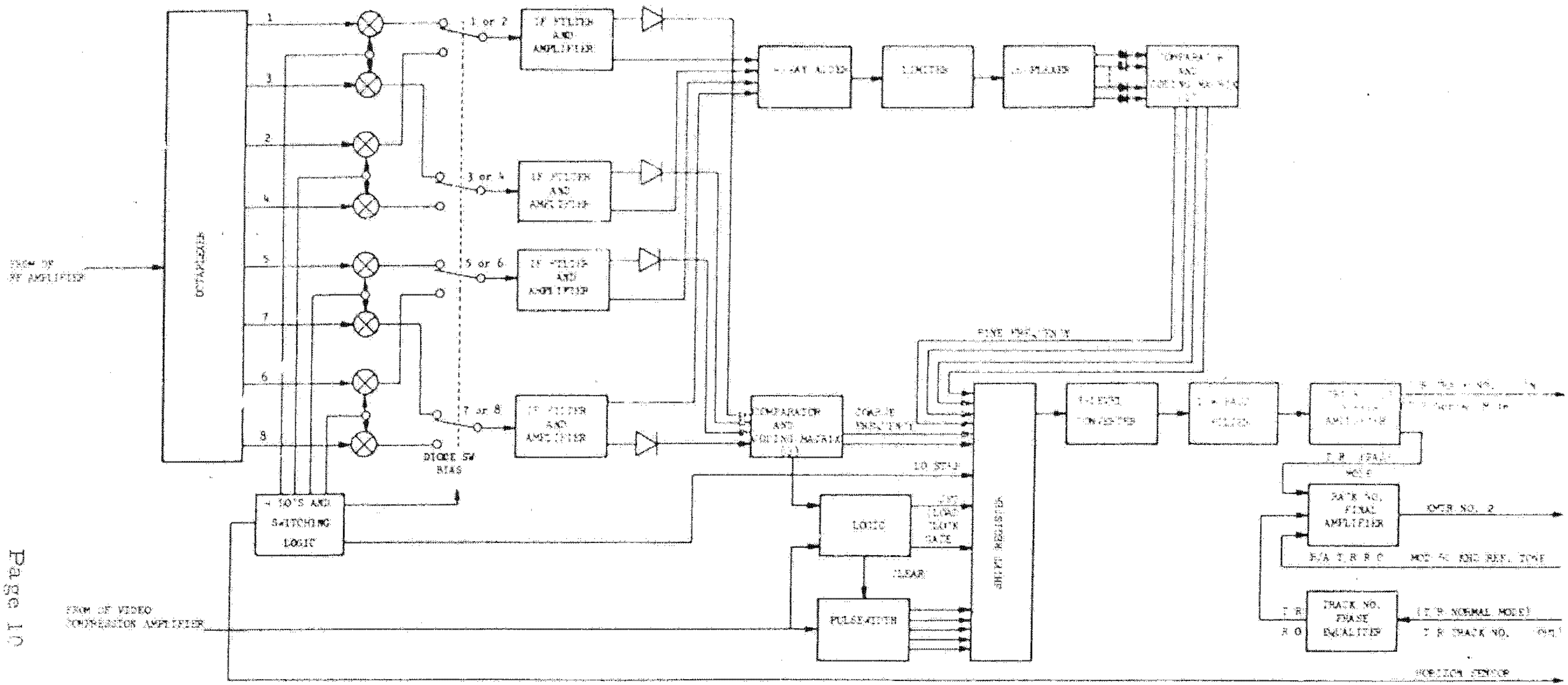

DIAGRAM 3B - SAMPAN III Frequency [redacted] Measurement Channel Block Diagram

(b)(1)
(b)(3)

divided into subfrequency bands by the superheterodyne receivers and filters.

The 2.1- to 4.0-GHz frequency band is first divided by an octaplexer into eight subbands. At any one time, four of these subbands are applied to four superheterodyne receivers. The other four subbands are applied to the four superheterodyne receivers during the next spin of the vehicle. The horizon sensor output controls the logic to step from the first four subbands to the second four subbands and then back to the first four subbands, etc. Stepping will be freerunning (approximately every two seconds) if there is no horizon sensor of if externally commanded. Each superheterodyne receiver mixes an incoming signal with a local oscillator (LO) signal to produce an IF signal which is filtered and amplified. (All four channels have the same IF of 120 to 360 MHz.)

Signals from the four superheterodyne receivers are detected and compared to establish which of the subbands may have a signal or which has the largest signal (coarse frequency). The four superheterodyne outputs are also added together and then divided by a 16-plexer into 16 subbands. These 16 subbands are detected and compared to establish which of these subbands may have a signal or which has the largest signal. Two guard bands are utilized to ensure that out-of-band signals do not appear as inband signals.

The outputs of the comparators are stored in the frequency portion (7 bits) of a shift register, which also contains pulsewidth information (5 bits). The shift register is read out through a 3-level converter to form a 17-bit, bipolar nonreturn-to-zero PCM word which is at a 100-KHz rate. The PCM word is low-pass filtered, buffer amplified, and applied to a tape recorder.

[redacted]

(b)(1)
(b)(3)

3.2.5 STATUS COMMUTATOR AND EARTH/SUN SENSOR CHANNEL.

The status commutator and earth/sun sensor channel provide either the earth sensor data or the sun sensor data (selected externally by a command in the other payload) to VCO. Once every minute the earth/sun sensor data are interrupted, and the status commutator output is switched to the VCO. Two complete frames of the commutator are recorded before switching back to the earth/sun sensor data. The output of the VCO is summed, buffer amplified, and applied to a tape recorder. The commutator is switched into the VCO at the same time that the RF test signal generator is switched on.

3.2.6 TIME REFERENCE GENERATOR (TRG).

A time reference generator, external to SAMPAN III, supplies a 50-KHz reference tone modulated by an AN/GSQ-53A time word, a 100-KHz and a 50-KHz tone, a 1-PPS wavetrain, and a 1-PPM wavetrain to the SAMPAN payload. The 50-KHz reference tone modulated by the AN/GSQ-53A time word is summed, buffer amplified, and applied to a tape recorder.

3.2.7 RF TEST SIGNAL GENERATOR.

An RF test signal generator (TSG) is switched into each of the three SAMPAN RF signal inputs simultaneously for one second once every minute. The 3.0-GHz RF test signal is modulated by a 2-usec pulse and has an amplitude equal to approximately -50 dbm as referenced to the receiver input terminals. The test signal appears at the DF and omni video outputs at a 500-PPS rate.

The TSG takes the 50-KHz signal from the TRG and converts it to a 1-KHz test signal. If the 50-KHz reference signal is lost, the TSG would still function at a lower and less accurate PRF. If the 1-PPS or 1-PPM signal from the TRG is lost, the TSG will also still function. The RF pulse train is switched between the two omni channels according to the following four-step sequence:

a. No RF pulse

b. RF pulse to fore omni only

c. No RF pulse

d. RF pulse to aft omni only.

3.2.8 TAPE RECORDER BUFFER AMPLIFIERS.

The SAMPAN III receiver system has two buffer amplifiers, each having two outputs. Each output has an independent gain adjustment. One output is used as an input to a dual-track, 75-KHz readin/150-KHz readout tape recorder. The other output is used as final amplifier input when in the tape recorder bypass mode.

3.2.9 PHASE EQUALIZERS.

Two phase equalizers are used to restore the phase response of recorded pulses on the 75-KHz 2:1 tape recorder. Gain transfer function is approximately 1 to 1. The outputs of the phase equalizers are applied to the final amplifiers.

3.2.10 FINAL AMPLIFIER.

The SAMPAN III receiver system has two final amplifiers whose outputs are applied to transmitters No. 1 and No. 2. The final amplifiers have up to three inputs; one or two of the inputs may be present at any one time. Each final amplifier has a gain adjustment.

3.2.11 TAPE RECORDER BYPASS MODE.

The SAMPAN III receiver system, on receipt of an external command, can bypass the tape recorder. During a tape recorder bypass condition, the second output from each of the buffer amplifiers replaces the phase-equalizer outputs to the final amplifiers.

4. LAMPAN II RECEIVER (DIAGRAM 4).

4.1 GENERAL.

The LAMPAN II receiver comprises three crystal video receivers with RF amplification, four superheterodyne receivers, and ancillary items, including amplifiers, pulse stretchers, logic circuits, phase equalizers, voltage-controlled oscillators (VCO's), a commutator, and a time reference generator. The receiver is divided into two sections: the omni section that receives its inputs from the two conical spiral antennas and the DF section that receives its inputs from the parabolic antenna.

COMINT CHANNELS JOINTLY

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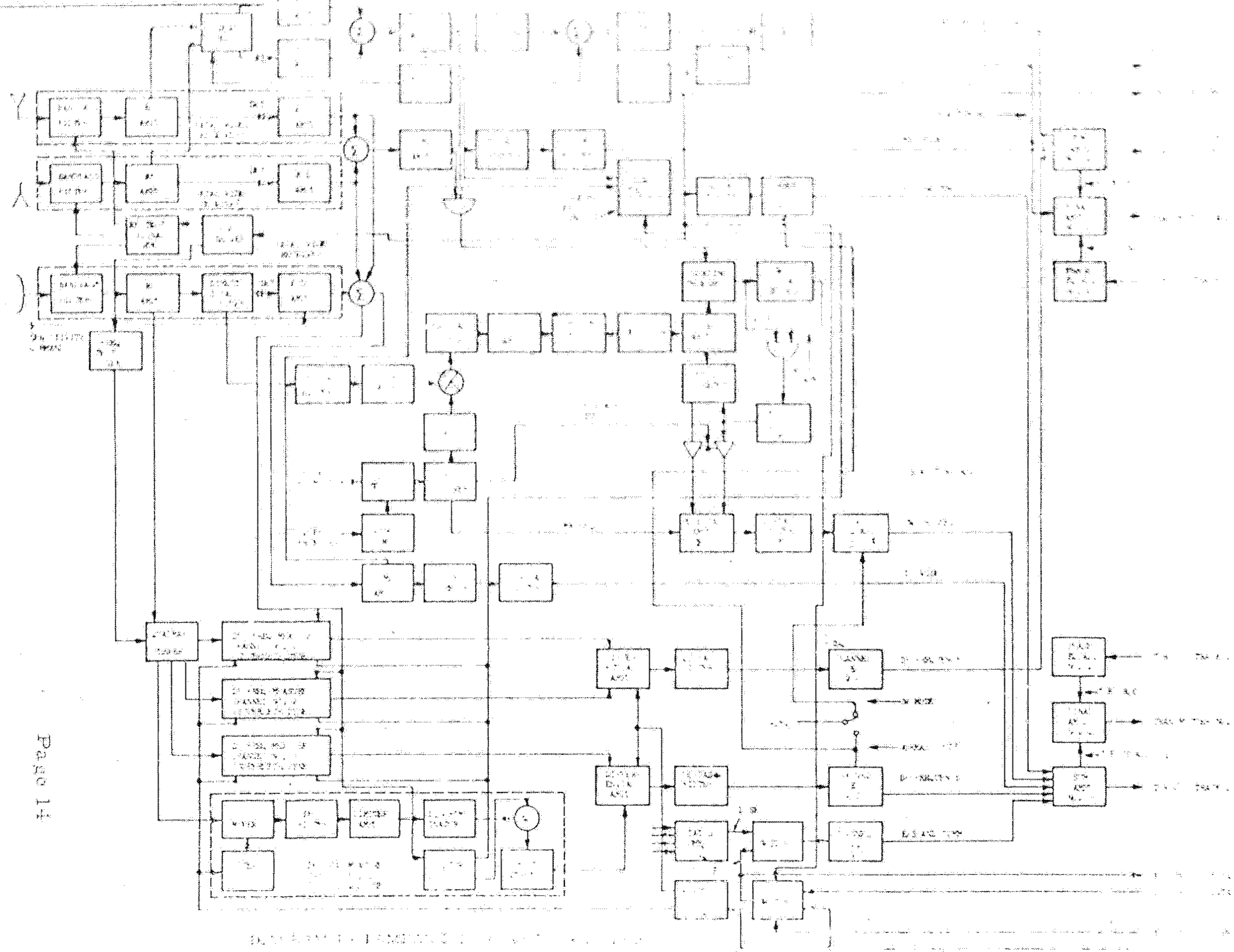


The two conical spiral antennas are connected to two of the crystal video receivers. The receiver outputs are summed and the combined output is used to inhibit the sidelobe responses of the parabolic antenna and to provide an omni video output of the received omnidirectional signals. The output of each crystal video receiver RF amplifier is also applied to a swept dual YIG filter. The filter outputs are detected and summed to provide an omni frequency measurement.

The parabolic antenna is connected to the third crystal video receiver, which has a DF video output only when signals are received by the main beam of the antenna, thus, providing target emitter geoposition information. The DF channel sensitivity can be attenuated by 6 db on command to increase the sidelobe inhibit level. The crystal video receiver RF amplifier output is also applied to four frequency-stepped, superheterodyne FM receivers. The receiver outputs provide frequency measurement on signals received by the main DF antenna beam.

An output from the omni YIG channel and an output from the DF video channel are applied to a [redacted] circuit whose (b)(1)
output provides a [redacted] of signals in both channels. (b)(3)

[redacted] (b)(1) (b)(3)

Earth sensor or sun sensor data are selected by command. The output of the selected sensor is used with the DF video output to provide emitter geoposition information. Earth sensor and sun sensor information is interrupted once a minute for one second to allow readout of the status commutator.

The LAMPAN received signal measurements are summed in two summing amplifiers whose outputs are applied to a dual-track, 2:1 (readout/readin) tape recorder. The tape recorder outputs are phase-equalized in the receivers and are then applied to two VHF FM telemetry transmitters.

A tape recorder bypass mode is selected by command to permit real time telemetry readout of the received data.

The system time reference is a 50-KHz signal modulated by the AN/GSQ-53A time code word.

4.2 DETAILS.

4.2.1 OMNI VIDEO CHANNEL.

The minimum sensitivity of the omni video channels for an inhibit output is -74 dbm (50 percent detection probability). To reduce its signal density, the omni video channel is thresholded and its minimum sensitivity is -60 dbm (50 percent detection probability). The dynamic range of the omni video channel is 20 db, minimum.

An RF input signal from each of the two conical spiral antennas is applied to a crystal video receiver, where it is filtered, RF amplified by a transistor amplifier, detected by a tunnel-diode detector, amplified by a postdetection amplifier, and applied to two summing networks. The omni summing network resistively combines and then amplifies (in an operational amplifier) the two omni video signals. The summed omni video is further amplified and compressed in a compression amplifier, exponentially pulse stretched (with γ = 66 usec), and low-pass filtered (with f_c = 15 KHz) by a 3-pole filter. The filter output (omni video) is applied to summing amplifier No. 4, final amplifier No. 2, and then to transmitter No. 4.

4.2.2 DF VIDEO CHANNEL.

The minimum sensitivity of the DF video channel is -72 dbm (50 percent detection probability) for the high-gain mode and -66 dbm (50 percent detection probability) for the normal mode. In the high-gain mode the dynamic range of the DF video channel is 35 db, minimum.

An RF input signal from the DF antenna is applied to a crystal video receiver where it is filtered, RF amplified by a transmitter amplifier, detected by a tunnel-diode detector, amplified by a post-detection amplifier, and applied to a summing network. The post detection amplifier has two gain modes: high and normal. The sensitivity in the normal mode is 6 db less than that in the high-gain mode.

The DF summing amplifier resistively combines the DF and the omni video of opposite polarities and amplifies the difference in an operational amplifier. The negative omni pulses are clipped, and only the positive DF pulses are amplified by the compression amplifier. Signals from the sidelobes of the DF parabolic antenna are thus inhibited by signals from the conical spirals. Since the sensitivity of the omni crystal video receivers is normally 2 db higher than that of the DF crystal video receivers, an extra 2-db margin of inhibit level is provided.

The inhibited DF video is amplified and compressed in a compression amplifier, exponentially pulse-stretched (with τ = 66 usec), and low-pass filtered (with f_c = 15 KHz), by a 3-pole filter. The filter output (DF video) is applied to summing amplifier No. 3, to final amplifier No. 1, and then to transmitter No. 3.

4.2.3 OMNI YIG CHANNEL.

The minimum sensitivity of the omni YIG channel is -60 dbm and its dynamic range is 20 db, minimum. The 3-db YIG bandwidth is 40 MHz and the total sweep time is 1.110 sec., of which 1.100 sec. is sweep, 0.006 sec. is flyback, and 0.004 sec. is dwell between flyback and sweep.

An RF input signal from each of the conical spiral antennas is coupled from each omni cyrstal video preamplifier and applied to each filter of a dual YIG filter, both of which are swept synchronously in frequency by a sweep generator. Each YIG filter output is detected by a tunnel-diode detector, amplified by a postdetection amplifier and applied to a summing network. The summing network resistively combines and then amplifies the output from both YIG filters. The summed omni video is further amplified and compressed in a compression amplifier, exponentially pulse-stretched (with τ = 480 usec) and summed with bandend and sync markers from the sweep generator YIG driver. The markers are a 1.0 usec, + 4 V upper sweep marker followed by a 1.0 msec, -1 V sync marker. The signal in the omni YIG channel is then low-pass filtered (with f_c = 2 KHz) by a 3-pole filter and applied to an IRIG channel B (30 KHz ± 15%) VCO whose output is applied to summing amplifier No. 4, to final amplifier No. 2, and to transmitter No. 4.

4.2.4 DF FREQUENCY CHANNEL.

The DF frequency channel has a minimum sensitivity of -60 dbm, a 20-db minimum dynamic range, and a measurement accuracy of ± 5 MHz.

An RF signal from the DF parabolic antenna is amplified in the crystal video receiver and applied through a quadraplexer where the 1.0- to 2.1-GHz frequency band is divided into four 275-MHz subbands (1.000 to 1.275, 1.275 to 1.550, 1.550 to 1.825, and 1.825 to 2.100 GHz). Each quadraplexer output subband signal is applied to one of four superheterodyne receivers where it is mixed with a stepping local oscillator (LO) signal and downconverted to a 300-MHz IF. Each LO generates a series of five discrete frequencies and is stepped synchronously (through a fixed time delay) with the earth sensor output. When there is no earth sensor pulse, or when the pulse is not acceptable, or when externally commanded, the LO is free-running at a rate of two seconds per step.

The IF signal is applied through a 60-MHz passband filter (which provides a 5-MHz overlap over the 55-MHz passband resulting from one-fifth of the 275-MHz quadraplexer output). The filtered signal is then amplified, amplitude limited, and FM discriminated. The discriminator converts the frequency of a signal in the IF to a voltage output which is linear with frequency (approximately 30 mv/MHz) over the 60-MHz IF bandwidth.

The output of the discriminator is applied to a pulse stretcher (having a 400-msec constant [redacted] and summed with another superhet channel output and a 4-bit binary word (providing LO step information) in a differential amplifier. The composite signal is applied through a 3-pole, low-pass filter (f_c = 2 KHz) to an IRIG channel E (70 KHz, ± 15%) VCO. The output of the VCO having inputs from superheterodynes No. 1 and No. 2 is applied to summing amplifier No. 3, final amplifier No. 1 and transmitter No. 3. The output of the VCO having inputs from superheterodynes No. 3 and No. 4 is applied to summing amplifier No. 4, final amplifier No. 2 and transmitter No. 4. (b)(1) (b)(3)

The inputs to the channel E VCO's are bipolar, consisting of positive and negative signals from the superheterodyne receivers. The input to one VOC is a negative signal from superheterodyne No. 1 and a positive signal from superheterodyne No. 2; the input to the other channel E VCO is a positive signal from superheterodyne No. 3 and a negative signal from superheterodyne No. 4.

The discriminator output is switched into the pulse stretcher via an FET field effect transistor) switch which is controlled by the output of the stretcher logic circuitry. The stretcher logic provides an output when the following criteria are met:

a. A signal is present in the IF amplifier

b. A signal is present in the inhibited DF channel

c. The pulse stretcher is not in the process of stretching a previously received pulse

d. The companion superheterodyne channel is not processing a signal.

The stretcher logic also performs the following two functions:

a. Provides a chirp measurement when a superheterodyne channel receives two or more pulses. Chirp detection is accomplished by allowing the pulse stretcher to sample the discriminator output voltage (and, therefore, the input frequency) only at the following times: for the first usec on the first pulse, the output voltage at the end of the second pulse, the first usec on the third pulse, etc. (Chirp detection is not possible on pulses having the same leading and trailing edge frequencies.)

b. Alternately measures the outputs of two companion superheterodyne channels when simultaneous pulses are received in both channels.

The 4-bit binary word summed with the pulse stretcher output in the differential amplifier provides the LO step information. The binary word is generated in the earth sensor processor, which also performs the two following functions:

a. Steps the superheterodyne LO through five fine-frequency steps.

b. Generates a 4-bit, return-to-zero binary word that indicates the frequency to which the LO has been stepped.

The earth sensor pulse is delayed for 250 milliseconds in the earth sensor processor before being acted upon. If the pulse is unacceptable, or nonexistent, the earth sensor processor functions at a free-running rate of approximately two seconds.

(b)(1)
(b)(3)

(b)(1)
(b)(3)

[redacted]

5.2 CIRCUITRY.

LO and Driver. The LO is a solid state, varactor-tuned fundamental oscillator voltage-tunable between 1.184 to 1.486 GHz. It has approximately 20 mw of power output across the band, which is attenuated by 10 db. This attenuator provides a constant impedance match to the oscillator and, thereby, stabilizes its performance.

The LO sweeps between its frequency limits in 9.8 msec and retraces in 0.2 msec. This tuning is performed by the LO driver (a sawtooth voltage generator). The driver also provides a -1 volt, 200-usec pulse during flyback as a band-end marker to the output VCO through the summing amplifier. The signal output amplifiers are blanked during the flyback time.

5.3 SYNCHRONIZATION.

The receiver tuning is synchronized to the time reference generator (TRG) in such a way that the beginning of a sweep will always occur at the start of the TRG time word, and all successive sweeps will be stabilized to the 50-KHz reference. This is done so that the 50-KHz reference tone may be used for automatic readout of the frequency of intercepts. The count of the 50-KHz cycles from the start of the TRG word to the time of intercept may be directly related to frequency. This is accomplished as follows: The 50 KHz is divided by 500, and the resultant 100-cycle output provides the 10-msec synchronization. The 1-PPS output of the TRG triggers a one-shot multivibrator that resets the divide-by-500 circuitry. This synchronizes the 100-cycle output to the 1-PPS output, which, in turn, is synchronized to the TRG output word.

[redacted]

(b)(1)
(b)(3)

abundance of pulsed intercepts that would not only confuse the signal recognizer, but would also modify the setting of the floating threshold. Therefore, the LAMPAN omni and DF video outputs are summed, and the resultant output gates-off the floating threshold. Pulse signals are thus inhibited from reaching the signature recognizer. LAMPAN is wide band, its sensitivity is approximately -70 dbm. This results in pulsed signals between -101 and -70 dbm not being inhibited, but the signature recognizer can make the decision that these are not acceptable intercepts, since the density has been reduced significantly.

5.6 FLOATING THRESHOLD.

The [redacted] receiver channel incorporates a floating threshold that monitors the noise level and sets the threshold at a present voltage increment above this level which optimizes the system's sensitivity (threshold setting) for all temperatures. (b)(1) (b)(3)

The pulse inhibit blanks the receiver off when a pulse is received by the main LAMPAN receiver system. During this blanking time the noise level is also reduced. With a large pulse density, the average noise power is reduced, but in between pulses the peak noise remains the same. This blanking causes the monitoring circuitry in the floating threshold to see less average noise and, thereby, to lower the threshold setting. Since the peak noise has not changed, the false alarm probability has increased. The threshold setting will take approximately 1.0 second to set to a new level, so the duration of the high-pulse density will also determine the change in threshold setting. The threshold is set far enough above noise to offset the maximum degradation resulting from the highest pulse density expected within the LAMPAN DF and omni receiver systems.

5.7 EARTH/SUN SENSOR AND STATUS COMMUTATOR CHANNEL.

This channel provides either earth sensor or sun sensor (selected by command) to a VCO. Once per minute the earth/sun sensor data are blanked for one second and two complete frames of status commutator data are switched to the VCO. The 1-sec pulse is generated in the RF test signal generator. The commutator is switched in at the same time as the RF test signal generator. The VCO output is applied to summing amplifier No. 3, to final amplifier No. 1, and to transmitter No. 3.

5.8 TIME REFERENCE GENERATOR CHANNEL.

The time reference generator (TRG) is physically located in the LAMPAN II receiver; however, its operation is independent of the operational status of either the SAMPAN III or LAMPAN II receivers. Power for the TRB is obtained from the P-11 spacecraft. A 50-KHz reference tone modulated by an AN/GSQ-53A time code word is passively filtered and resistively split before being applied to the respective receivers. A 1-PPS output, and a 1-PPM output are also used by both receivers after being resistively split. Frequency stability of the TRG is as follows:

Short term	One part in 10^8 parts or better
Long term	One part in 10^6 parts or better

Short-term stability, as used herein, is defined as the frequency deviation for averaging times from 100 usec to 10 sec; long-term stability is defined as the frequency deviation for averaging times greater than 10 sec. Frequency accuracy is 5 parts in 10^5 parts or better.

5.9 RF TEST SIGNAL GENERATOR.

An RF test signal generator (TSG) signal is switched into the three RF input bandpass filters simultaneously for one second once per minute. The test signal as seen at the video outputs is 1.5 GHz modulated by 2-usec pulse at a rate of 500 PPS.

Actually, the RF TSG provides a 1000-PPS signal synchronized with (but not dependent upon) the TRG signal. This signal is applied via a PIN diode switch to the DF input and is also divided by four and applied to one omni input. A complementary signal is divided by four and applied to the other omni input.

Since the power level of the TSG signal applied to the omni inputs is higher than that applied to the DF input, the DF signal is inhibited during the presence of a TSG signal in either omni channel. The effective DF video output will be at a 500-PPS rate. The omni video output will also be at a 500-PPS rate because the omni inputs are summed in a video stage.

5.10 RF FREQUENCY TEST SIGNAL GENERATOR.

An RF frequency test signal generator (FTSG) is switched into each DF frequency measurement channel via a quadraplexer for the first 20 seconds after power is applied to the LAMPAN II receiver subsystem. (The first second is blanked to allow for settling.) A 112-MHz crystal oscillator having harmonics at 1014, 1352, 1690 and 2028 MHz is used to calibrate the superheterodyne channels.

5.11 SUMMING AMPLIFIERS.

The LAMPAN II receiver contains two summing amplifiers that resistively sum and then amplify all of the LAMPAN II measurements previously described. The outputs of the summing amplifiers are applied to a dual-track, 75-KHz readin/150-KHz readout tape recorder; amplifier No. 3 output is applied to track No. 1, and amplifier No. 4 output is applied to track No. 2.

Inputs to summing amplifier No. 3 are as follows:

a. DF video channel (15-KHz data)

b. Earth/sun sensor and status commutator channel on an IRIG channel 14 VCO (22 KHz ± 7.5%, 330-KHz data)

c. [redacted] (b)(1) (b)(3)

d. DF frequency measurement channel No. 1 (superheterodyne channel No. 1 negative and superheterodyne channel No. 2 positive) on an IRIG channel E VCO (70 KHz ± 15%, 2-KHz data) normal mode only

e. [redacted] (b)(1) (b)(3)

Inputs to summing amplifier No. 4 are as follows:

a. Omni video channel (15-KHz data)

b. Omni YIG channel on an IRIG channel B VCO (30 KHz ± 15%, 2-KHz data)

c. 50-KHz reference tone modulated by an AN/GSQ-53A time word

d. DF frequency measurement channel No. 2 (superheterodyne channel No. 3 positive and superheterodyne channel No. 4 negative) on an IRIG channel E VCO (70 KHz ± 15%, 2-KHz data).

5.12 PHASE EQUALIZERS.

Two phase equalizers are used to restore the phase response of pulses that have been recorded on the tape recorder. Gain transfer function is approximately 1 to 1. The outputs of the phase equalizers are applied to the final amplifiers.

5.13 TAPE RECORDER BYPASS MODE.

On command the outputs of the summing amplifiers can be switched directly to the input of the final amplifiers; thus, bypassing the tape recorders. The bypass command latches a relay in the receiver whose contacts enable the bypass mode and also turn on telemetry power. In the event of tape recorder failure, delayed command can also be used to turn on telemetry power as well as both receivers for real time readout over a tracking station that does not have commanding capability.

5.14 FINAL AMPLIFIERS.

The outputs of the two final amplifiers are applied to VHF telemetry transmitters No. 3 and No. 4. Although the final amplifiers have more than one input, only one input is present at any one time. Inputs to final amplifier No. 1 are as follows:

a. TRG 50-KHz reference tone modulating the AN/GSQ-53A time word; on before and after tape recorder readout (with telemetry on)

b. Phase equalizer No. 1 output; on during tape recorder readout with telemetry on

c. Summing amplifier No. 3 output; on during tape recorder bypass.

Inputs to final amplifier No. 2 are as follows:

a. Phase equalizer No. 2 output; on during tape recorder readout with telemetry on

b. Summing amplifier No. 4 output; on during tape recorder bypass mode.

6. DATA STORAGE AND TRANSMISSION SUBSYSTEM.

6.1 DATA STORAGE.

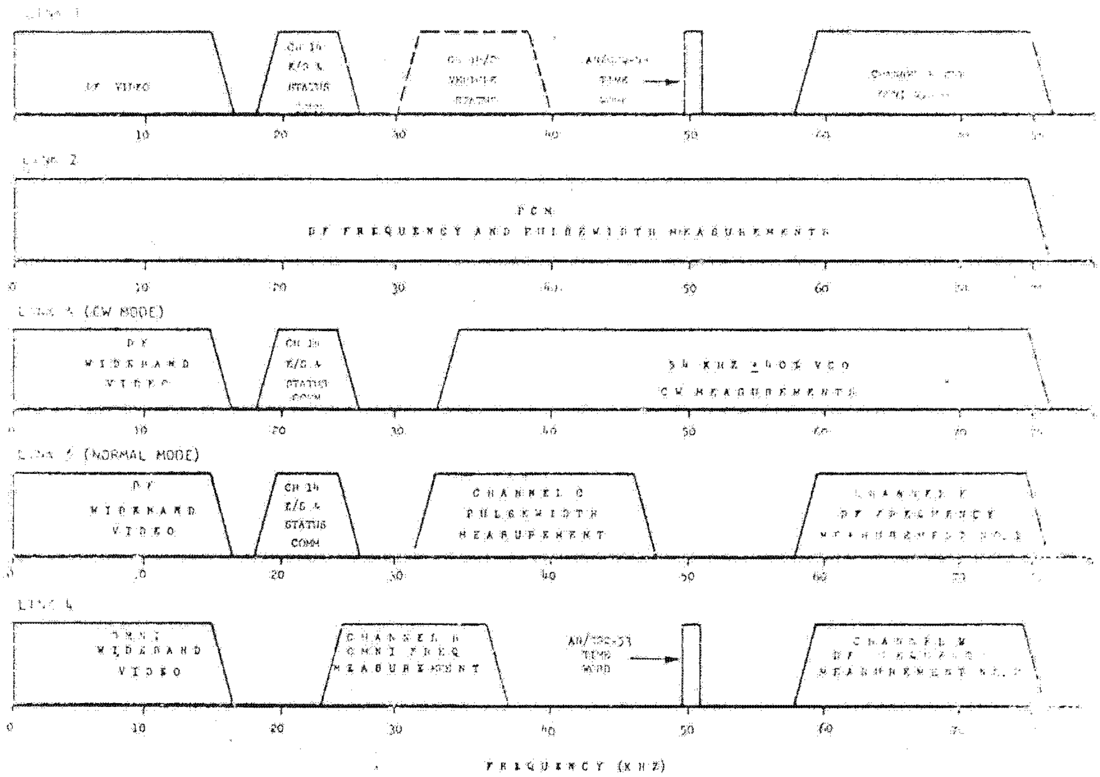
The receiver system contains two 75-KHz, dual-track, 2:1 (readout/readin) tape recorders. Delayed commands from the orbit programmable module are used to turn on the recorders for readin; readout is accomplished by real time command. Maximum tape recorder readout time is approximately 375 seconds. Diagram 5 shows how the data from each recorder track are used to modulate the four telemetry transmitters. Data inputs can be interchanged between the two recorders by commands.

6.2 DATA TRANSMISSION.

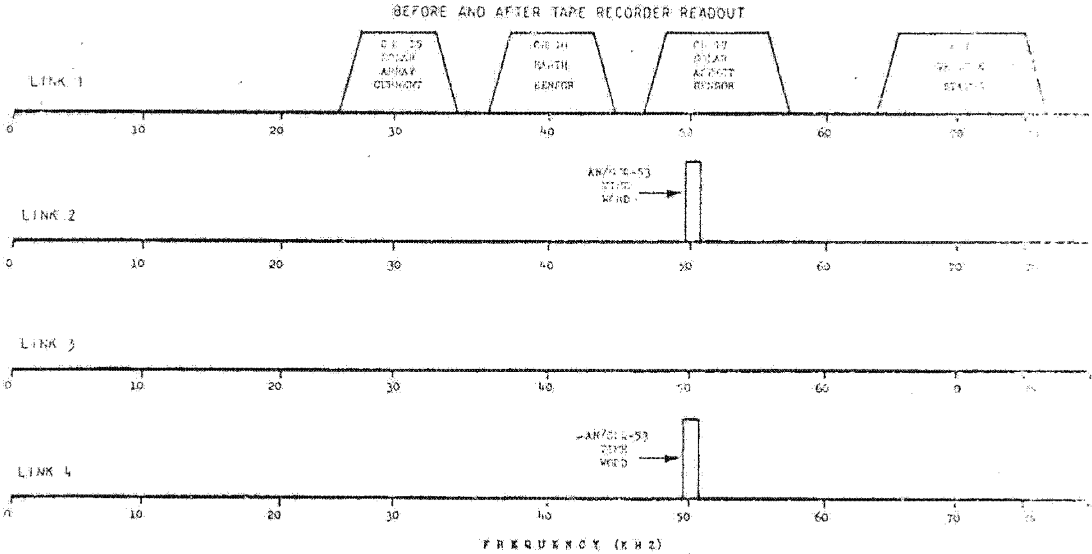
The telemetry data link configuration is shown in Diagram 5. Each transmitter is rated at two watts minimum power output. The output of each transmitter is applied via a multicoupler to a common telemetry antenna. Vehicle status data are transmitted via telemetry link No. 1, except during tape recorder transfer mode when data are transmitted via link No. 3. Vehicle status and payload mode monitor telemetry points appear on a 5-rps, 60-point commutator that frequency-modulates an IRIG channel 18 VCO. Earth sensor and sun sensor data modulate IRIG channels 16 and 17 VOC's, respectively, and the solar array current monitor data modulates an IRIG channel 15 VCO. During the tape recorder bypass mode the foregoing VCO's are inoperative.

With the tape recorders operating in the normal mode, the transmitters will be modulated as follows:

SAMPAN III READOUT LINKS 1 AND 2, LAMPAN II READOUT LINKS 3 AND 4



BEFORE AND AFTER TAPE RECORDER READOUT



Link	Before and After T/R Readout	During T/R Readout
1	IRIG chan 15, 16, and 18	IRIG chan 18 and T/R No. 1, Track No. 1 (SAMPAN III Data)
2	50-KHz Reference Generator Tone	T/R No. 1, Track No. 2 (SAMPAN III Data)
3	----	T/R No. 2, Track No. 1 (LAMPAN II Data)
4	50-KHz Reference Generator Tone	T/R No. 2, Track No. 2 (LAMPAN II Data)

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 2.