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~~(S)~~ NATIONAL RECONNAISSANCE OFFICE

WASHINGTON, D.C.

THE NRO STAFF

8 January 1968

MEMORANDUM FOR THE CHAIRMAN, SORS

SUBJECT: Mission Description of SIGINT Mission 7324 (TIVOLI)

The mission description for Mission 7324 is forwarded as an attachment to this correspondence. This ELINT reconnaissance system is designed to meet the requirements of USIB-D-41.14/246, USIB-D-41.14/303 and current attachments thereto.

Mission 7324 is contained in a spin stabalized P-11 sub-satellite which is scheduled to be launched into a nominal 275 mile circular orbit by a THORAD-AGENA booster. The TIVOLI payload is designed to intercept and record signals in the 100-4200 MHz band with sufficient bandwidth to permit derivation of technical intelligence.

The planned launch date, predicated on launch of the primary payload is 24 January 1968. Mission lifetime is expected to be 9 months. A nominal 6 collection revs per day should be available for mission accomplishment.

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

Atch: As stated

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CONTROL NO BYE 12527-68

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SYSTEM DESCRIPTION

1.1 GENERAL

The orbital payload system comprises three broad beamwidth receiving antennas, the TIVOLI intercept system, two 1-MHz tape recorders, two UHF transmitters, 1 VHF transmitter, a command receiver and decoder, earth and solar sensors, and associated telemetry equipment.

The intercept system is an extremely versatile single-channel superheterodyne receiver system that is split into two channels from the IF stages through the output terminals in order to fully utilize the available tape recorder bandwidth. The chief features of the system are:

- Choice of wide or narrow IF bandwidth
- Choice of high or low sensitivity
- Choice of manual or automatic gain control
- Detected and predetected outputs
- Tunable to any one of 3921 integer frequencies in the 100- to 4020-MHz frequency band for an indefinite period or tunable in any predetermined frequency sector ranging from 10- to 290-MHz wide throughout the entire frequency range
- Choice of 1- or 4-MHz frequency step increments
- Choice of wideband detected outputs (AM or FM)
- Precision pulse measurement output
- Capability of real time output (tape recorder bypass)

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- Internal RF calibrator that can be disabled if desired

Three antennas are required to provide the desired directional gain over the broad frequency band of interest.

The tape recorders store the intercepted data outputs from the receiver system. When the satellite is within range of a predetermined readout station, the reproduced data modulate the UHF transmitters whose radiated outputs are received and recorded by the ground station. The VHF transmitter conveys real time solar and earth sensor data and satellite status, or housekeeping data. Simultaneously during the readout period, commands are transmitted to the intercept receiver system via the command receiver and decoder to select the desired operational frequency, frequency range, bandwidth, modes, etc. for the next readin period.

Only one satellite tape recorder is required for normal system operation. The second recorder can be switched by command in place of the first recorder in the event of its failure.

The two UHF transmitters can be switched so that data links can convey data from tape recorder tracks 1 and 2, respectively, or from tracks 2 and 1, respectively.

1.2 PARAMETERS

Altitude:	275 n.m.
Inclination Angle:	$90^{\circ} \pm 20^{\circ}$
Direction of Spin:	CCW when viewed from -Y axis
Orbital Life:	9 months

Initial Spin Rate:	70 rpm
Minimum Spin Rate After Six Months on Orbit:	40 rpm
Receiving Antenna Depression Angle (angle between P-11 -Y spin axis and the center axis of the main antenna beam):	Planar spiral (100 to 500 MHz) -0°; Conical spiral (400 to 2020 MHz) 35°; Conical spiral array (1980 to 4020 MHz) -35°.
Intercept System Frequency Range:	100 to 4020 MHz
Frequency Accuracy:	Max. error, 0.01% of input frequency; nominal error, 0.005% of input frequency
Tuning (Digital):	Stationary at any one of 3921 integer frequencies within the frequency range, or tunable through any one of 15 preselected frequency bands - either the entire band or preselectable bandwidth sectors of 10, 20, 40, 80, or 160 MHz, all at a rate of 4 seconds per step.
Noise Figure (Low-Power Mode):	8 db at 100 MHz, increasing to 12 db at 4000 MHz
Noise Figure (High-Power Mode):	20 db greater than the low power mode noise figure
RF Dynamic Range:	
Low-Power Mode	-90 to -40 dbm, nominal
High-Power Mode	-70 to -20 dbm, nominal
Effective RF Bandwidths:	
Wide IF	10 MHz
Narrow IF	1 MHz
Signal Outputs Available:	a. Folded 4.5- to 3.0-MHz bandwidths compressed into 750-kHz bandwidths (Predetected) or two unfolded 750-kHz bandwidths (predetected)
	b. Envelope detector; 2.1- or 750-kHz bandwidths

c. FM discriminator: 200-, 500-, or 750-kHz bandwidths

d. 6.25 kbps NRZ PCM data signal (sample-and hold output)

e. Status, timing, and reference.

1.3 SYSTEM SENSITIVITY (does not include antenna loss or gain)

	Subsystem		
	Predetection Channel 1A	Predetection Channel 2	Envelope Detector & FM Discriminator
Mode A Approximate Noise Bandwidth	3.0 MHz	4.5 MHz	10 MHz*
Mode A Sensitivity			
100-500 MHz	-101 dbm	-99 dbm	-96 dbm
480-1020 MHz	-101 .5 dbm	-99.5 dbm	-96.5 dbm
980-2020 MHz	-99 dbm	-97 dbm	-94 dbm
1480-4020 MHz	-96.5 dbm	-94.5 dbm	-95.5 dbm
Mode C, D approximate Noise Bandwidth	750 kHz**	750 kHz**	1 MHz
Mode C, D Sensitivity			
100-500 MHz	-107 dbm	-107 dbm	-106 dbm
480-1020 MHz	-107.5 dbm	-107.5 dbm	-106.5 dbm
980-2020 MHz	-105 dbm	-105 dbm	-104 dbm
1980-4020 MHz	-102.5 dbm	-102.5 dbm	-101.5 dbm

2.1 INTERCEPT SYSTEM ANTENNAS

Three separate intercept system antennas (a window shade, a conical spiral and a conical spiral array) are required to cover the nearly six octaves of frequency range from 100 to 4020 MHz. The intercept antennas are deployed on the P-11 as shown in Diagram 1 when the subsatellite achieves orbit. Only one intercept antenna is used during any preprogrammed tape

* 10 MHz for Modes A and B
** 750 kHz for Modes B, C, and D

recorder readin period. The other antennas shown in the diagram are the spacecraft command and telemetry antennas.

2.2 ANTENNA SPECIFICATIONS

Nominal antenna specifications are given in the table below:

Designation:	Sensor B	Sensor A-2	Sensor A-1
Type	Planar spiral	Conical Spiral	Conical spiral array
Frequency Range (Minimum):	100-500 MHz	400 to 2020 MHz	1980 to 4020 MHz
-3 db Gain - High Freq:	0 db	+ 3 db	+ 7.5 db
-3 db Gain - Low Freq:	0 to -18 db	+ 3 db	+ 5 db
Beamwidth:	80° (bidirectional)	90°	40° X 80°
Polarization:	Circular	Circular	Circular

3. TIVOLI INTERCEPT SYSTEM

3.1 General Description

The TIVOLI intercept system is housed in two separate packages referred to as the A and B boxes and mounted on the -Z and +Z wings of the P-11 spacecraft. Diagram 2 is a block diagram of the intercept system.

The intercept system comprises a frequency translator, a receiver, a signal conditioner, and a programmer. The receiver and frequency translator when combined can tune to any integer frequency in the 100- to 4020-MHz band. The receiver subsystem alone covers the 100- to 500-MHz band. The translator downconverts incoming RF signals from 480 to 4020 MHz into the 105- to 395-MHz band for processing by the receiver. Received signals are processed into a form compatible with the telemetry system by a single conditioner. The programmer decodes, stores, and executes the commands necessary to select, initiate, and control and desired system operational mode.

3.2 FREQUENCY TRANSLATOR

The frequency translator filters, amplifies, and downconverts RF signals in the 480- to 2020-MHz and the 1980- to 4020-MHz frequency bands into a 290-MHz bandwidth (105 to 395 MHz) within the receiver tuning range. The translator has three RF input terminals: VHF (100 to 500 MHz), UHF (400 to 2020 MHz) and S-band (1980 to 4020 MHz). These terminals are fed by the VHF window shade, UHF conical spiral, and S-band conical spiral array antennas, respectively.

The translator divides the 100- to 4020-MHz spectrum into 15 discrete frequency bands referred to as translator frequency bands 0, and 1 thru 14. The translator is designed such that only one band is active during any given time, i.e., primary DC power is applied only to those amplifiers and oscillators associated with the actual frequency band; thereby, minimizing the possibility of spurious output signals.

Band 0 is fed directly to the receiver without being downconverted. When the translator is commanded to Band 0 (100 to 500 MHz), the VHF antenna is connected directly to the receiver when the intercept system is in the high-sensitivity (low-input-power) mode. A 20-db attenuator is inserted between the antenna and the receiver in the low-sensitivity (high-input-power) mode.

Bands 1 through 14 each provide downconversion of a discrete 290-MHz sector of the input frequency range from 480 to 4020 MHz. Bands 1 through 6 translate input frequencies from 480 to 2020 MHz, and bands 7 through 14 translate input frequencies from 1480 to 4020 MHz. Each of the 14 bands overlaps its adjacent frequency band(s) by 40 MHz to allow tuning across any 40-MHz sector (or less) in the entire RF range without having to switch between two translator frequency bands.

The 14 bands consist of wideband preselection filters, wideband tunnel diode or transistor amplifiers, 290-MHz bandwidth filters, frequency converters, and RF diode switches. The preselection filters and amplifiers are bypassed in the high-power mode; thereby, increasing the intercept system average noise figure from 10 to 20 db. All RF switch positions are controlled by the "translator frequency band selection" commands. The 15 bands are sub-divided as follows:

100-500 MHz	1480-1770 MHz	2730-3020 MHz
480-770 MHz	1730-2020 MHz	2980-3270 MHz
730-1020 MHz	1980-2270 MHz	3230-3520 MHz
980-1276 MHz	2230-2520 MHz	3480-3770 MHz
1230-1520 MHz	2480-2776 MHz	3730-4020 MHz

3.3 RECEIVER

The receiver is a superheterodyne type that includes a tunable RF preselector, a mixer and a frequency synthesizer, an IF power splitter, and a dual-channel predetection output subsystem (Diagram 3). The RF preselector and mixer are housed in the A box with the frequency translator, while the remainder of the receiver, the power supply, the programmer, and the signal conditioner are all housed in the B box.

3.3.1 Frequency Band Tuning

The intercept system passband (100 to 4020 MHz) is divided into 3921 linear 1-MHz frequency increments, or steps, which are grouped into the 15 translator frequency bands in the order previously mentioned. It is possible to tune to any integer frequency or through any predetermined sector within any one of the 15 translator bands by externally executing a command to downconvert the selected active band into the receiver frequency range. To complete the process, the receiver tunable preselector and frequency synthesizer are externally programmed to tune to the desired integer frequency or to tune through the desired sector within the translated frequency band. All the actual digital or step tuning performed by the intercept system is accomplished by the receiver.

3.3.2 Tunable Preselector

The tunable preselector contains six amplifiers that cover the 100-to-500 MHz receiver frequency range. Each amplifier can be tuned over its respective frequency band as shown in the block diagram. The tuning window bandwidth for all amplifiers is nominally 15 MHz (centered about the frequency of interest) for all intercept system modes. The programmer selects the appropriate amplifier and provides a control signal to hold the 15-MHz passband at any integer frequency or to move the window across the total amplifier passband as required to support any of the intercept system tuning modes. Only one preselector amplifier is active at a time.

3.3.3 Frequency Synthesizer

The frequency synthesizer generates all the local oscillator frequencies (145 of 545 MHz) required to step the receiver across its entire frequency range or to any predetermined bandwidth sector within the range in selectable 1- or 4-MHz steps. The initial output frequency from the synthesizer, whether it steps or does not step, the sector of bandwidth that it steps through, and the number of steps in a sector are all determined by the programmer.

3.3.4 Mixer, IF, and Predetection Output

The incoming RF signal is heterodyned with the frequency synthesizer or local oscillator signal, and the 45-MHz difference, of IF frequency is amplified and power split into two IF channels designated as Channels 1 and 2; this is referred to as the predetection output subsystem. Each channel downconverts unique portions of the common input frequency spectrum into respective 0.25- to 1.00MHz predetection output bandwidths as described below.

The predetection subsystem provides either "folded" or "unfolded" predetection output frequency spectrums, selectable by externally commanding either modes A, B, C, or D. When mode A or B is selected, the IF spectrum common to the input of the predetection subsystem channels is 45 ± 5 MHz; when mode C or D is selected, the input spectrum is 45 ± 0.5 MHz.

In mode A, predetection-output channel 2 simultaneously downconverts six 0.75-MHz bandwidth frequency spectrums (see Table 1) into the channel 2 output bandwidth (0.25 to 1.0 MHz) continuously during even

2-second periods. During the odd 2-second periods, channel 2 downconverts six other 0.75-MHz bandwidth frequency spectrums offset from the previous spectrums by 0.5 MHz. Each even 2-second period is in time-synchronism with the start of each new frequency step when the intercept system is in a frequency stepping mode. As can be noted in Table 1, channel 4 downconverts four 0.75 MHz bandwidth frequency spectrum in a similar manner. The downconverted output frequencies are shifted by sequentially switching in two separate local oscillators (offset by 0.5 MHz) into each predetection subsystem channel as shown in Diagram 3. The diagram also shows that three additional local oscillators (20, 24, and 28 MHz) and wideband IF filters are used for mode A, while single oscillators are used in each channel for modes B, C, or D since folding is not required, i.e., only one unique 0.75-MHz bandwidth portion of the common input spectrum is translated into the output bandwidth of each channel as indicated in Table 1.

3.3.5 Manual and Automatic Gain Control

Command selectable manual and automatic gain controls (MGC and AGC) are incorporated in the receiver so that the "optimum noise level" can be provided at the intercept system channel 1 and channel 2 output terminals, regardless of frequency or whether the system is in the high-or low-power modes.

Some type of gain control is required since the noise level presented to the input terminals of the receiver from the translated frequency bands varies over a 10-db range. This causes the output terminal noise level to vary proportionately; thereby, resulting in a substantial loss in overall system sensitivity or output terminal dynamic range.

The 45-MHz IF amplifier gain can be controlled either automatically or manually, as desired, to insure the optimum noise level at the system output terminals. When the MGC mode has been commanded, it is necessary to select one of eight IF gain levels that are in 3-db steps from -15 to +6 db relative to the nominal IF amplifier gain. In the AGC mode the noise level is adjusted automatically on a continuous basis to maintain the optimum noise level, regardless of which translator band is active, at the system output terminals.

The AGC mode uses a closed loop designed to control the noise level while being minimally affected by undesired strong signal levels. Receiver noise or noise plus signal is passed from the second IF amplifier through a 24 ± 0.5-MHz bandpass filter and is envelope detected (in modes A, B, C, or D). After detection the signal is directed through a 250- to 1000-kHz filter to a DC or average detector. The 750-kHz bandwidth filter removes any frequencies (below 250 kHz) associated with television, CW, and FM signals. The average detector reduces the effects of low-duty-factor signals (short pulse width, long interpulse period) since their DC components are small. The average detector output is used to control the gain of the first IF amplifier via the summer. The summer provides a limit on the AGC voltage such that the first IF amplifier again cannot be changed by more than -15 to +6 db relative to its nominal gain. In the MGC, or open-loop, mode the summer provides the eight separate, fixed-voltage levels required to adjust the IF amplifier gain to one of eight predetermined levels.

4.1 SIGNAL CONDITIONER

The signal conditioner conditions the intercepted signals, the timing signals and the status signals into a form compatible with the orbital tape recorder and telemetry system The signal conditioner contains the following subsystems:

a. Predetection output

b. Envelope detector

c. FM discriminator

d. Wideband video

e. Sample and hold

f. Time/reference generator

g. Status commutator

The subsystems are shown in the receiver block diagram (Diagram 3).

4.1.1 Predetection Output Subsystem

(Discussed in 3.3.4)

4.1.2 Envelope Detector Subsystem

This subsystem continuously detects the peak envelope of received signals at the channel 2 24-MHz log IF amplifier output terminals and conveys the information in terms of proportional signal voltage to the intercept system channel 2 output terminals via a pulse stretcher and a VCO. The pulse stretcher adds to each received pulse an exponentially decaying tail which has a time constant of approximately 500 usec. Hence, all pulses inserted into the VCO will have a width of 500 usec plus the width of the received pulse at the input of the pulse stretcher. The stretching technique is used to reduce the frequency spectral width of the received pulse to a width that can be handled by the VCO without a loss in signal sensitivity.

The envelope detector subsystem also provides nonstretched wider bandwidth video outputs to both the wideband video subsystem and the sample-and-hold subsystem. The envelope detector subsystem incorporates a threshold device which issues a "start" pulse to the sample-and-hold subsystem whenever a detected pulse exceeds a preset signal-to-noise ratio.

The envelope detector subsystem has two operational bandwidths. When the intercept system is in mode A the predetection bandwidth is 10 MHz and the postdetection bandwidth is 4 MHz, in mode B the bandwidths are 2.75 MHz and 4.0 MHz, respectively, and in modes C and D the bandwidths are 1.0 MHz and 400 kHz, respectively.

4.1.3. FM Discriminator Subsystem

This subsystem accepts detected, nonstretched video signals from either the envelope detector or the FM discriminator subsystems and conveys them to the intercept system channel 1B output terminals via a pulse stretcher and a 750-kHz low-pass filter.

In modes A, B, or C the option exists to automatically alternate between the two subsystems with a 2-second dwell time at each position. When mode D is commanded, the pulse stretcher is bypassed, the 750-kHz filter is replaced by a 400-kHz low-pass filter, and channel 1B is automatically connected to the intercept system channel 1 output terminals.

4.1.4 Sample-and-Hold Subsystem

The sample-and-hold subsystem provides the capability of making precision measurement on signals whose bandwidths are greater than the predetection subsystem or wideband video subsystem outputs. This subsystem periodically samples and stores wideband information from either the predetection outputs, the envelope detector, or the FM discriminator subsystems and sends the information to the intercept system channel 2 output terminals via a VCO. The input signals prior to being sampled are bandwidth limited to 3 MHz when the intercept system is in modes A and B and 300 kHz when in modes C and D.

4.2 DATA OUTPUT FORMAT

The composite output signals of the intercept system, referred to as the channel 1A, channel 1B, and channel 2 composite signals, can be applied to the tape recorder for storage (tape recorder normal mode) or connected directly to the UHF transmitters (tape recorder bypass mode). The composite signals are frequency multiplexed as shown in Diagram 4. The channel 2 composite signal is always present at the system channel 2 output terminals. Either channel 1A or 1B composite signals are present at the system channel 1 output terminals. When mode D is commanded, composite signals 1B and 2 are present, except that the wideband detected video bandwidth on channel 1B is reduced to 400 kHz.

The channel 1 and 2 composite signals are telemetered via the UHF links. The VHF link is used to relay real time spacecraft status and attitude data.

4.3 PROGRAMMER SUBSYSTEM

All the intercept system operational modes are controlled by external commands issued to the programmer via the command receiver and command decoder. The intercept system programmer accepts both discrete-pulse real time commands (RTC's) and command address commands (CAC's). The intercept programmer has a non-destructible memory (latching relays) to store all external commands. This type of memory is required since power is normally not applied to the intercept system when the external commands are executed. Also, an advantage of the non-destructable memory is that the system need not be reprogrammed after each power turnoff.

When power is applied to the intercept system, the logic circuitry in the programmer is set into the status dictated by the positions of the latching relays; thereby, initiating the desired operational modes and controlling the tuning of the frequency synthesizer.

4.4 ANALYTICAL DISCUSSION OF INTERCEPT SYSTEM OPERATIONAL MODES

Modes A, B, C, and D and the frequency tuning modes are the major operational modes since they have the largest effect on the system operational configuration; hence, they should be carefully selected.

The tape recorder bypass command should be used with discretion since it is possible to turn on both the intercept system and the telemetry system over any geographical area on the earth.

4.4.1 Mode A

Mode A is used whenever it is desired to operate the intercept system with an effective receiver tuning window bandwidth of 10 MHz. The ideal situation for this mode would be to telemeter a full 10-MHz predetected bandwidth to the ground station, but because of the limited bandwidth capability (two channels of 1 kHz to 1 MHz) of the telemetry system, the receiver IF was split into two channels, and the IF-folding technique previously described was adopted. Mode A will be most effective when receiving a signal whose carrier frequency changes as a function of time from ±0.5 to ±5.0 MHz about the center frequency to which the intercept system is tuned. If the signal slowly changed frequency such that it swept from one end to the other end of the tuning window during an "even" 2-second tuning period, the predetection output signal level would rise and fall and rise and fall again at the predetection channel 2 output terminal. As the signal was diminishing in level the second time, the signal would begin to appear at the predetection channel 1 output terminal. After rising and falling twice in channel 1, it would move back over to channel 2 and repeat the cycle for a second time. Then the signal would rise and fall again two more times in channel 2, and the 10-MHz sweep would be completed.

In the example, the predetection output frequency would change continuously as the input signal swept in frequency. But it is not possible to measure the actual input signal frequency from the predetection output data alone, since the signal could be in any one of six 0.75-MHz passbands (channel 2) or four 0.75-MHz passbands (channel 1) in any even or odd 2-second period. The FM discriminator subsystem provides a coarse measurement of the received carrier frequency and can be used to indicate which of the 0.75-MHz bands the signal should be in as a function of time. Once the correct signal spectrum is determined, finer frequency measurements can be obtained from the predetected output signals.

The FM discriminator subsystem continuously looks into the full 10-MHz tuning window; thus, its output will not rise and fall as did the predetection output signals as the received signal sweeps across the band. The discriminator signal will change in amplitude, of course, as the frequency of the received signal changes.

From the previous discussion it may be concluded that mode A should always be operated with channel 1A connected to the intercept system channel 1 output terminals. When channel 1B is connected, the predetection data from channel 1 are not available and, also, the FM discriminator output is not available unless the FM discriminator has been selected as the input to the wideband video subsystem.

In modes B, C, and D the FM discriminator subsystem is not required in conjunction with the predetected output signals for frequency measurement because there is no folding process.

The frequency of the input signal may be determined by measuring the frequency of the predetected output signal and translating it back to the input terminals of the system to determine the actual signal frequency.

4.4.2 Mode B

Mode B is used when it is desired to make precision wideband measurements on a particular signal while several other signals of different frequencies are present in the receiver passband.

Mode B uses a 10-MHz tuning window first IF bandwidth as does mode A. However, the IF bandwidth is narrowed thereafter and the predetection subsystem outputs are unfolded. The IF bandwidth is narrowed to 2.75 MHz in channel 2 and is available as an unfolded, wideband, predetected signal to the input terminals of the sample-and-hold subsystem. Hence, assuming the signal carrier frequency to be in the 2.75 MHz passband the sample-and-hold subsystem, which uses a 10-MHz sampling frequency in modes A and B, takes enough amplitude samples of the predetected waveform so that it may be reconstructed at the output of the ground processor digital-to-analog converter. If mode A were used in a similar situation, some of the other signals in the receiver passband may be folded into the same band of frequencies as the desired signal, thereby resulting in a sample-and-hold subsystem output signal that is very difficult to interpret.

Further filtering and narrowing the bandwidth of all the inputs to the sample-and-hold subsystem can be achieved by commanding mode C, since the postdetection filters are reduced in bandwidth to 400 kHz, and the input filter bandwidth of the sample-and-hold subsystem is reduced from 3 MHz to 300 kHz. However, the sampling frequency is also reduced from 10 MHz to 1 MHz.

4.4.3 <u>Mode C</u>

Mode C is used when:

a. A higher intercept system sensitivity is desired. The sensitivity of the predetection subsystem is improved approximately 5 db and the sensitivity of the envelope detector and FM discriminator subsystem is increased by about 10 db.

b. The intercept system is operated in a dense signal environment.

c. A narrow 1-MHz tuning window is desired.

d. A longer sample-and-hold subsystem sampling period is desired. In Modes C and D the total sampling period is 30 usec (30 samples at 1-usec-per-sample), compared with modes A and B where the total sampling period is only 3 usec (30 samples at 0.1-usec-per-sample).

4.4.4 Mode D

Mode D is identical to mode C except that the wideband video subsystem is automatically connected to the intercept system channel 1 output terminals. Also the output bandwidth of the wide and video subsystem is reduced to 400 kHz and the pulse stretcher is bypassed.

4.4.5 Frequency Tuning Modes

In Modes A, B, or C, the intercept system may be fixed-tuned to any one of the 3921-MHz integer frequencies within the intercept system pass-band or may be continuously step-tuned across any 10, 20, 40, 80, 160, 290 MHz, or f_I to f_{BE} sector of bandwidth within any of the translator bands, including bands 0 through 14. Frequency f_I is any preselected "initial" or "start" frequency and, therefore, is one band edge of the selected sector. f_{BE} is always the band end frequency of the selected translator band and becomes the other edge frequency of the selected sector. f_{BE} is the highest frequency in "normal" translator bands and the "lowest" frequency in inverted translator bands. When the system is in a frequency stepping mode it tunes at a rate of one step per four seconds.

5.1 DATA STORAGE

The reconnaissance system contains two 1-MHz dual track 1:1 (readin/readout) 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 on period not exceeding 34 minutes or split into any two readin not exceeding 34 minutes. However, the payload on time should not normally be programmed for a greater duration than the tape recorder capacity. Maximum tape recorder readin time is approximately 335 seconds which can be split into any duration not exceeding this time. Diagram 4 displays the data format from each recorder track that modulates the two telemetry transmitters.

5.2 GROUND SUPPORT EQUIPMENT

5.2.1 Tracking Stations

The existing USAF command and tracking network contains the required equipment for generating and transmitting commands to the spacecraft. The recording of the readout of the intercepted data can only be accomplished at the stations located at Vandenberg AFB, California and New Boston, New Hampshire.

5.2.2 Data Processing

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

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Table #-1

FREQUENCY TRANSLATION ASSIGNMENTS

(Output Terminal Bandwidths Referred to 45-MHz IF Amplifier)

	Even 2-Second Periods		Odd 2-Second Periods	
	Channel 1 (Freq. in MHz)	Channel 2 (Freq. in MHz)	Channel 1 (Freq. in MHz)	Channel 2 (Freq. in MHz)
Mode A		40.00 to 40.75		
				40.50 to 41.25
		41.25 to 42.00		
				41.75 to 42.50
	42.00 to 42.75			
			42.50 to 43.25	
	43.25 to 44.00			
			43.75 to 44.50	
		44.00 to 44.75		
				44.50 to 45.25
		45.25 to 46.00		
				45.75 to 46.50
	46.00 to 46.75			
			46.50 to 47.25	
	47.25 to 48.00			
			47.75 to 48.50	
		48.00 to 48.75		
				48.50 to 49.25
		49.25 to 50.00		
				49.75 to 50.00
Modes B, C or D	44.50 to 45.25		44.50 to 45.25	
		44.75 to 45.50		44.75 to 45.50

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Page 21 of 25 Pages
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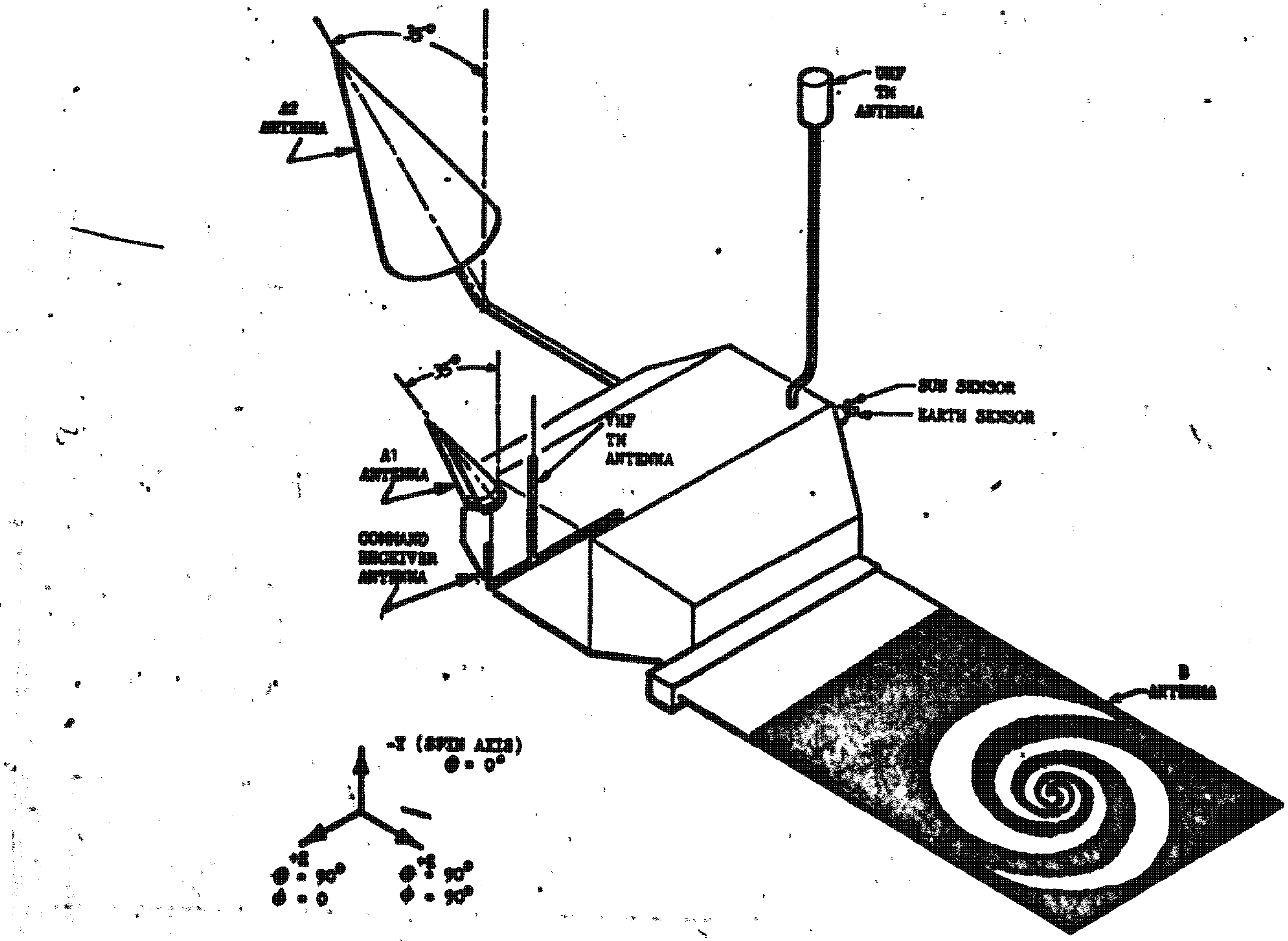

Diagram # 1

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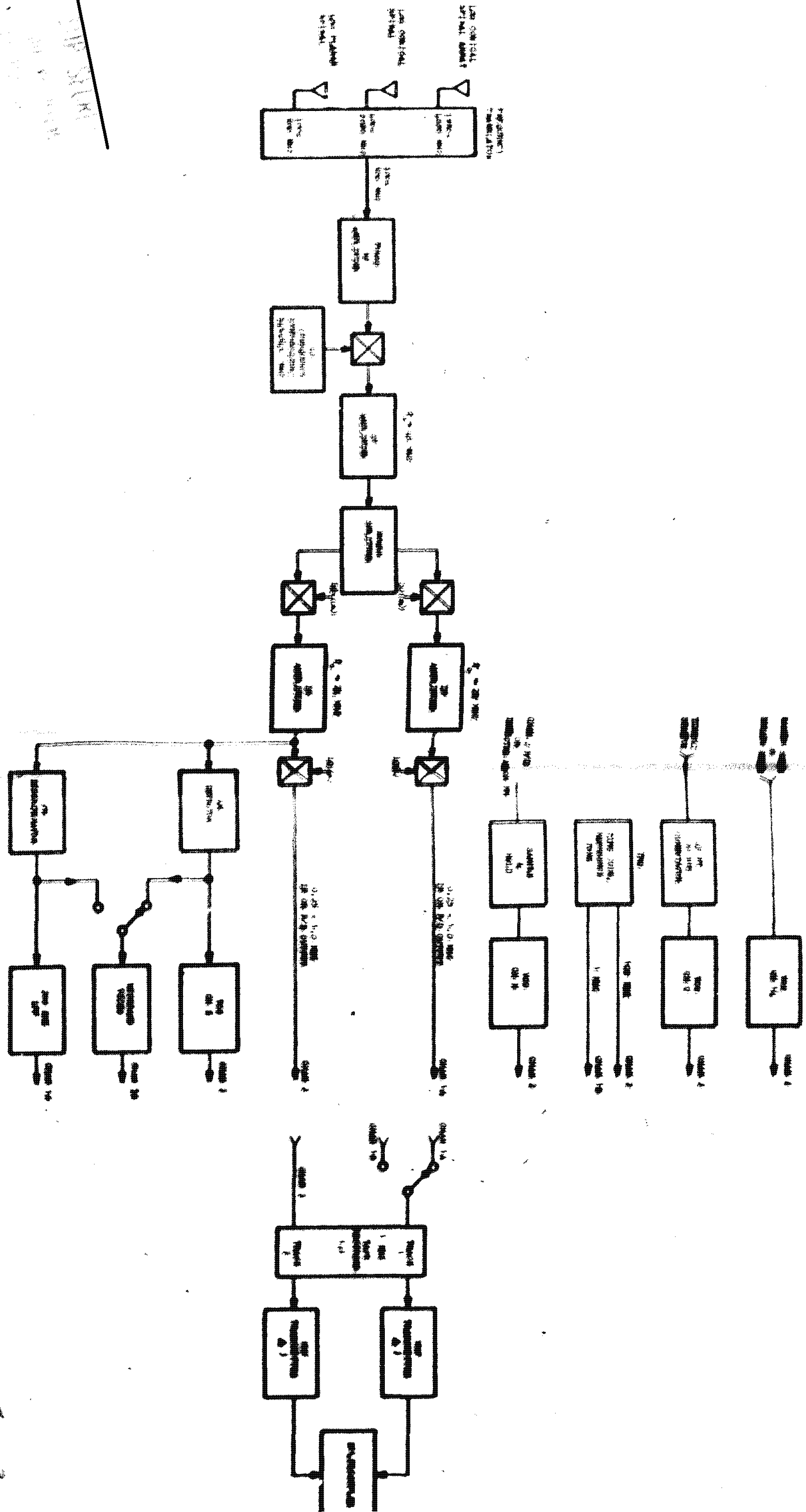

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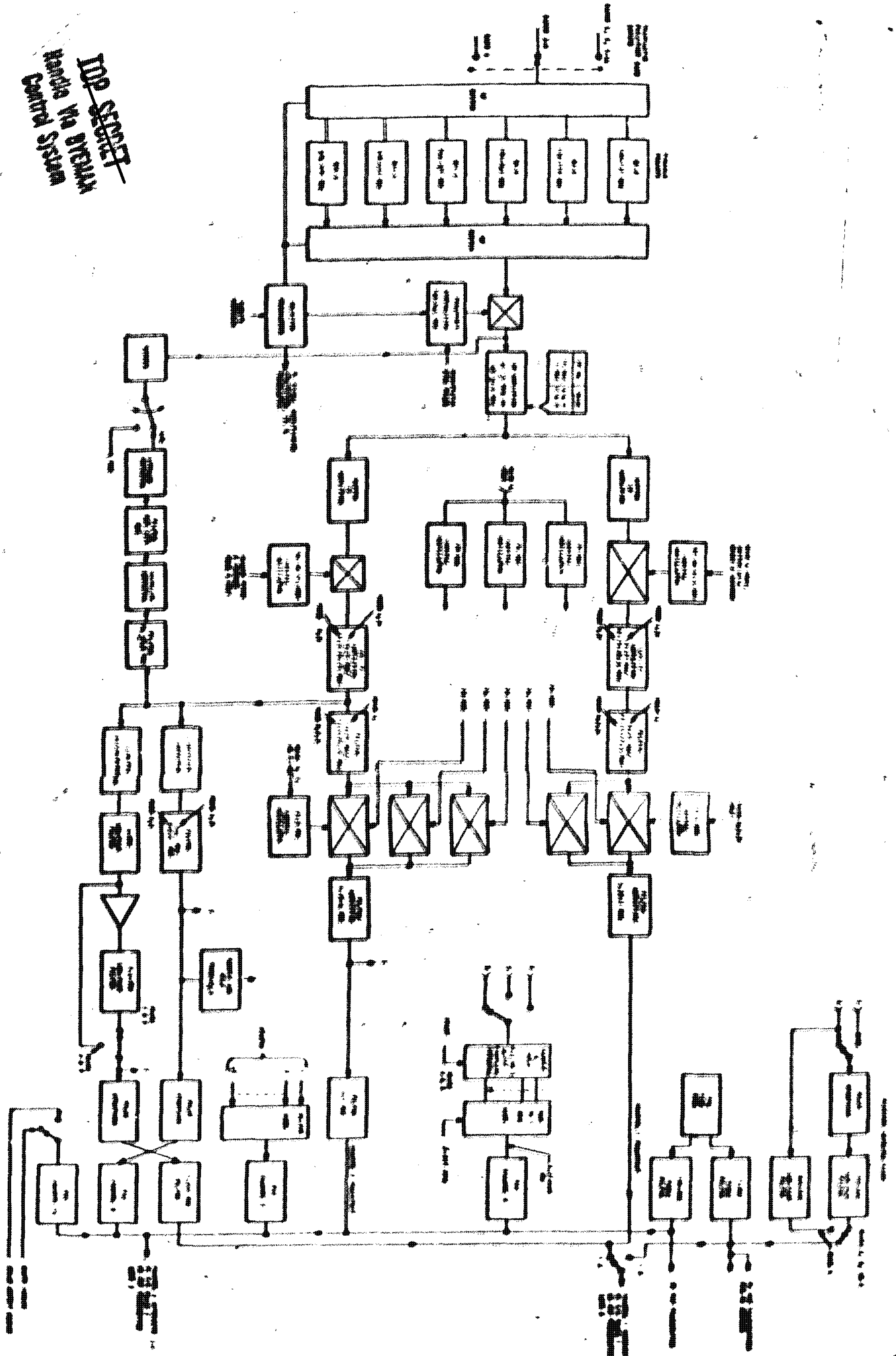

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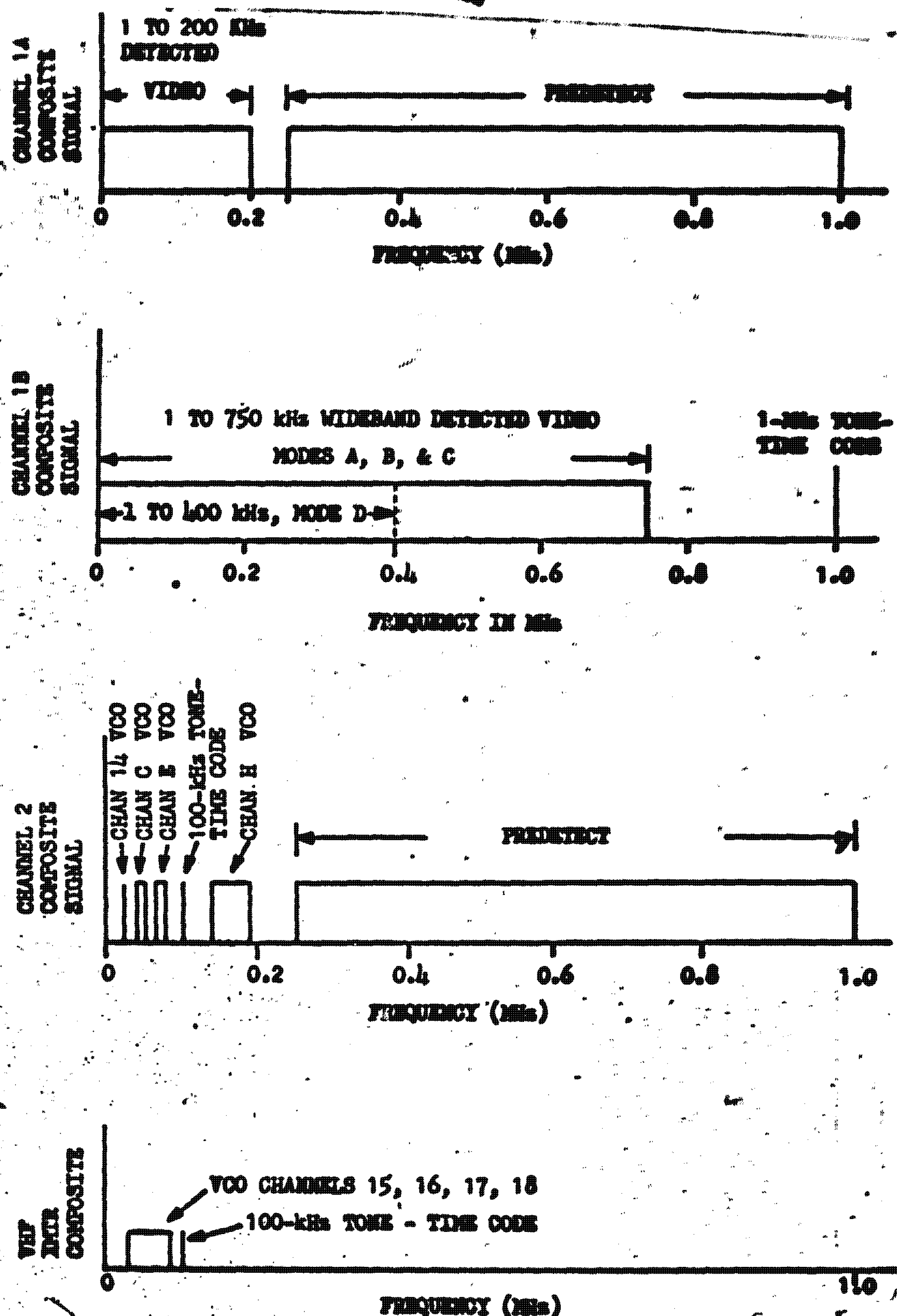

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Diagram # 4