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DESCRIPTION OF SIGINT MISSION 7339

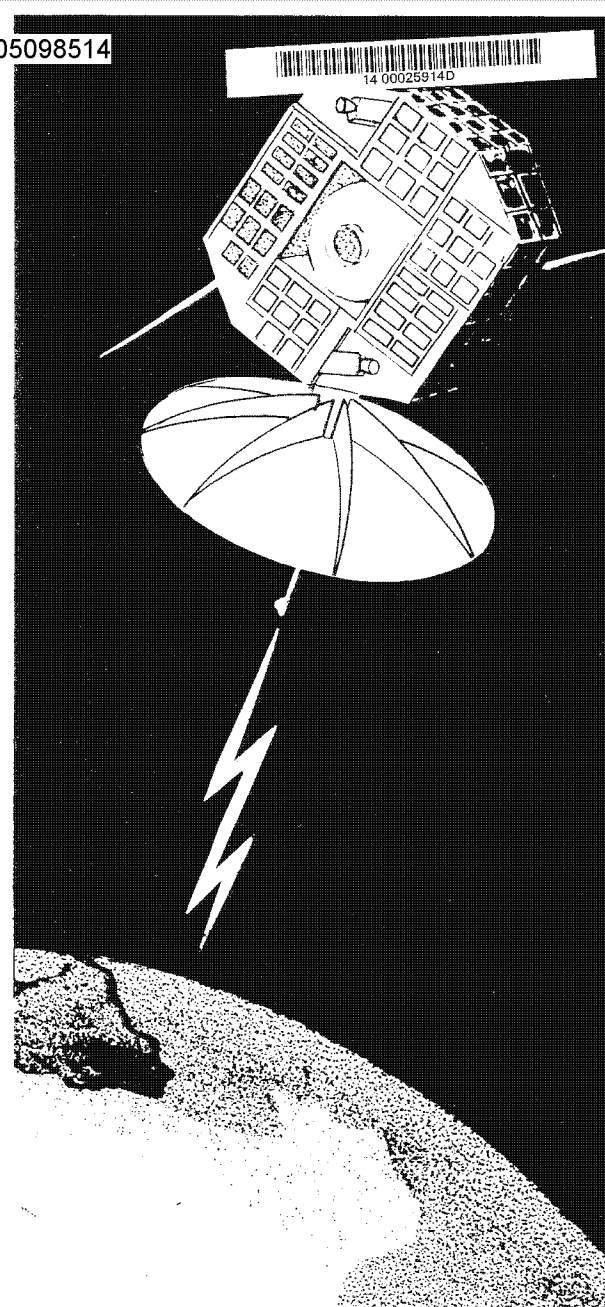
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SIGINT Mission 7339 Mission Description

1. General Information.

Mission 7339 is a special purpose SIGINT satellite designed to provide main beam technical intelligence on the Soviet ABM radar systems (HEN HOUSE, DOG HOUSE, TOP ROOST, BIG SCREEN, and TRY ADD). In particular, Mission 7339 measures antenna polarization and precision power of these emitters as well as providing predetection recordings of the intercepted signals. A simplified block diagram of the system is shown in Figure 1. 1.

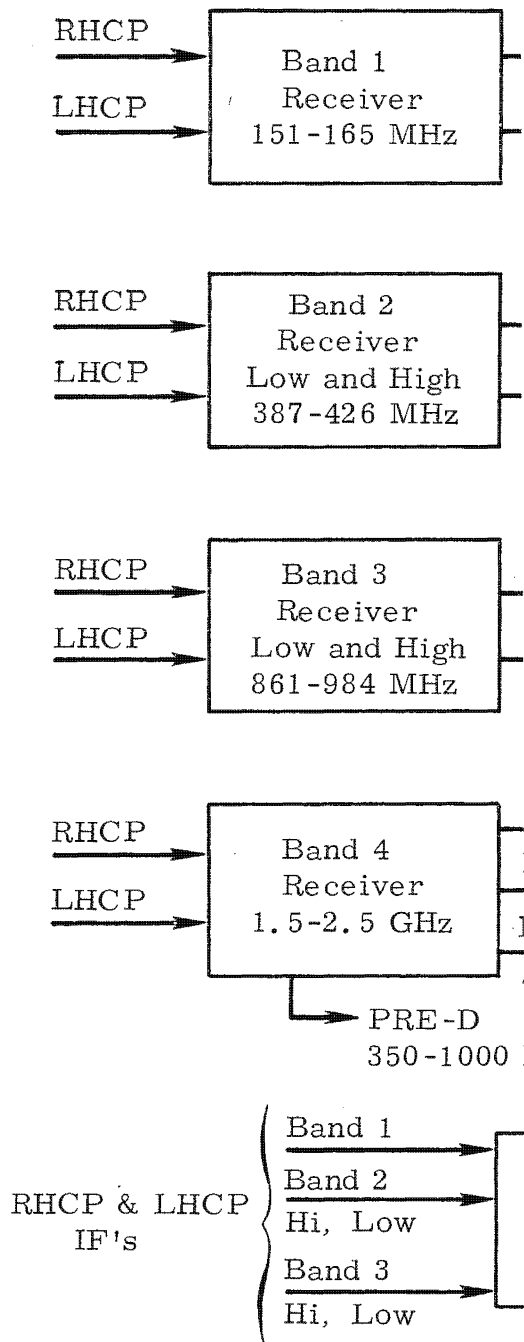
This mission description discusses the following:

- a. Antenna subsystems
- b. Receiver subsystem
- c. Polarimeter subsystems
- d. Predetection tracking filter subsystem
- e. Priority control logic
- f. Parameter encoder subsystem
- g. Tape recorders
- h. Mission tasking considerations
- i. Payload characteristics

2. Antenna Subsystems.

The antenna subsystems, shown in Figure 2.1, consist of five wide-beamwidth conical spiral antennas which are designed to input signals into four dual-channel receivers. Antennas A1, A2, and A3 (covering 151-165, 387-426, and 861-965 MHz respectively) consist of two concentrically wound four-arm spirals of which one is right-hand

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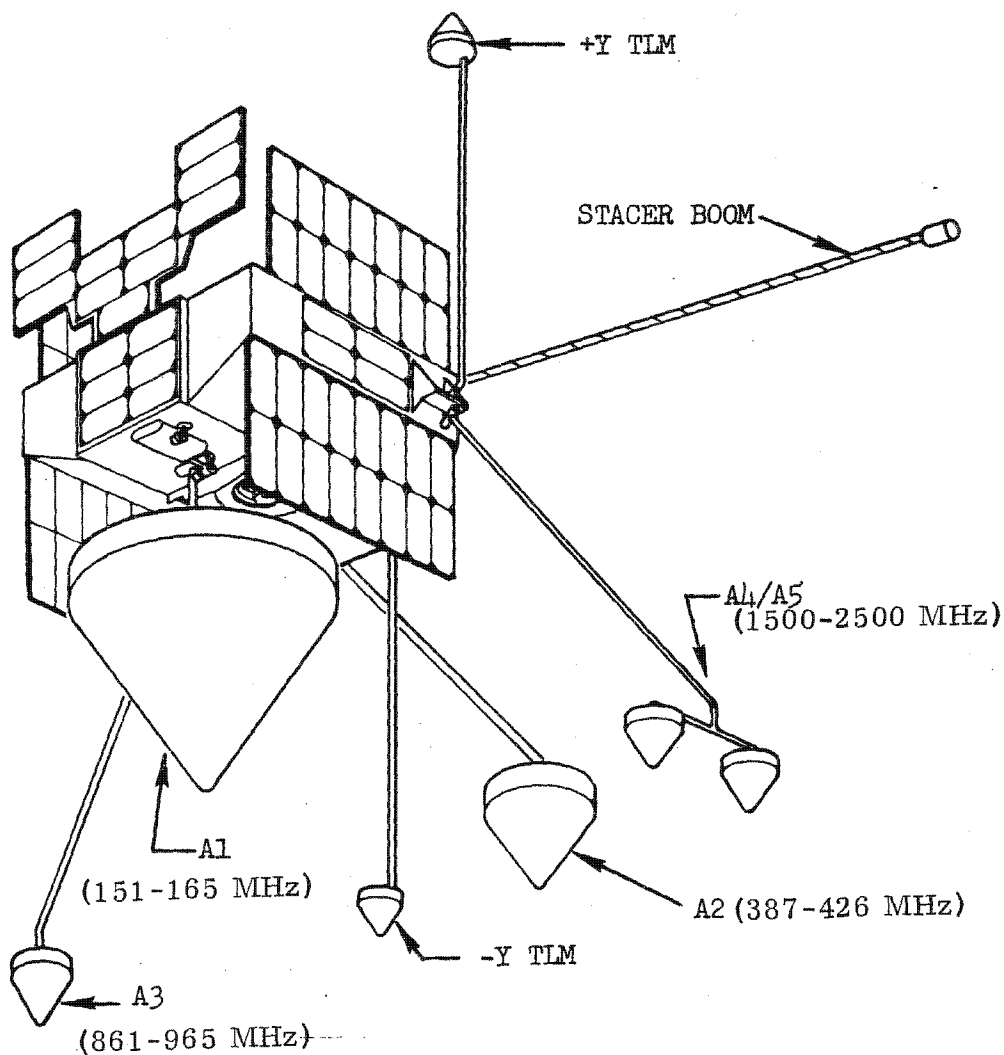


Figure 2.1 Mission 7339 Concept Diagram

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circularly wound and the other left-hand circularly wound. Antennas A4 and A5 (covering 1500-2500 MHz) are two-arm conical spirals with one right-hand circularly wound and the other left. The purpose of the right- and left-hand circularly wound spiral antennas is to provide both left- and right-hand circularly polarized (LHCP and RHCP) sensors which are required for antenna polarization measurements.

3. Receiver Subsystem.

The receiver RF subsystem consists of four dual-channel receivers, each of which covers a separate frequency range and each of which may be operated simultaneously with any or all of the others. The frequency range covered by each receiver is as follows:

<u>Band</u>	<u>Frequency (MHz)</u>
1	151 to 165
2	387 to 426
3	861.8 to 964.2
4	1500 to 2500

The dual channels permit measurement of power from the RHCP antenna in one channel, and with the use of a polarimeter subsystem permit measurement of power in the LHCP antenna in the second channel. Also, the phase difference between signals from the two antennas can be measured. The measurement of LHCP power and phase difference can be made simultaneously by the Band 4 receiver and any selected one of the other three receivers.

3.1 Band 1 Receiver.

The Band 1 receiver is designed to cover the HEN HOUSE frequency range of 151 to 165 MHz. The dynamic range is -57 to +3 dbm, and within this range, power is measured to an accuracy of ± 2 db. Signals intercepted in this frequency range which exceed a certain threshold (command adjustable from -57 to -15 dbm in 6-db steps) initiate a sampling sequence which permits parameter measurements of both HEN HOUSE I and II signals. At each subinterval measurement time (5, 80, 170, and 245 usec after threshold crossing), the following parameters are measured by the encoder:

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- a. RHCP power
- b. LHCP power (when polarimeter is connected to Band 1 receiver)
- c. Phase between RHCP and LHCP signals (when polarimeter is connected to Band 1 receiver)
- d. Frequency

In addition, the time of arrival (TOA) and the signal duration (pulsewidth) are measured.

When the signal is determined to be qualified, the measurements are retained in four data buffers in the encoder; otherwise they are rejected. The criterion for qualification consists of a signal crossing the commandable threshold and remaining there for a period greater than 70 usec but less than 1280 usec.

In addition to the signal measurement outputs listed above, the RHCP IF signal is output to the frequency tracking predetection filter subsystem for PRE-D recording.

3.2 Band 2 Receiver.

The Band 2 receiver is designed to cover the DOG HOUSE and TOP ROOST frequency ranges of 387 to 426 MHz. This range is divided into two subbands: 387 to 405.6 MHz (2 low) and 405.6 to 426 MHz (2 high). The dynamic range is from -57 to +3 dbm, and within this range, power is measured to an accuracy of ± 2 db. Frequency measurement accuracy is provided over a dynamic range of -52 to +3 dbm.

The DOG HOUSE/TOP ROOST signals are frequency-swept CW. Whenever the receiver threshold (command adjustable from -57 to -15 dbm in 6-db steps) is first exceeded, the following measurements are made:

- a. RHCP power
- b. LHCP power (whenever polarimeter is connected to Band 2 high or low)
- c. Phase between RHCP and LHCP signals (when polarimeter is connected to Band 2 high or low)
- d. Frequency

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In addition, the time (referenced to the PCM frame start) when measurements are made is provided. The measurements are repeated every 300 usec. The measurements indicated above are retained in the encoder buffers provided the signal is qualified; if nonqualified, the measurement data are rejected. The criterion for qualification is that the received signal exceed the commandable threshold and remain above this level for 575 $\pm$ 36 usec, or longer.

In addition to the signal measurement outputs listed above, RHCP detected and RHCP IF signals are output to the frequency tracking predetection filter subsystem for PRE-D recordings.

3.3 Band 3 Receiver.

The Band 3 receiver is designed to cover the BIG SCREEN frequency range of 861.8 to 964.2 MHz. This range is divided into subbands: 861.8 to 913 MHz (3 low) and 913 to 964.2 MHz (3 high). The dynamic range is -76 to -16 dbm, and within this range, power is measured to an accuracy of $\pm$ 3 db. Frequency is accurately measured over a dynamic range from -66 to -16 dbm.

The BIG SCREEN is a frequency-agile pulsed emitter. Whenever the receiver threshold (command adjustable in 6-db steps from -76 to -34 dbm) is exceeded, the parameter measurements listed below are made 200 usec following the threshold crossing:

- a. RHCP power
- b. LHCP power (when polarimeter is connected to Band 3 high or low)
- c. Phase between RHCP and LHCP signals (when polarimeter is connected to Band 3 high or low)
- d. Frequency

In addition, the TOA and pulsewidth of the pulsed signal are measured.

The measurements indicated above are retained in the encoder buffers provided the signal is qualified; if nonqualified, the measurement data are rejected. The criterion for qualification is that the received signal exceed the commandable threshold for a duration greater than 300 usec, but not more than 500 usec.

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In addition to the above signal measurement outputs, RHCP IF signal is output to the frequency tracking predetection filter subsystem for PRE-D recording.

3.4 Band 4 Receiver.

The Band 4 receiver is designed to cover the TRY ADD frequency range of 1500 to 2500 MHz in four subbands (referred to as wideband channels) as follows:

<u>Wideband Channel</u>	<u>Frequency (GHz)</u>
4-1	1.5 - 1.75
4-2	1.75 - 2.0
4-3	2.0 - 2.25
4-4	2.25 - 2.5

The receiver is dual channel to provide measurements of RHCP and LHCP power and the relative phase difference between these signals. Each of the above wideband channels is command selectable one at a time. For each frequency range there is one channel for RHCP and one for LHCP. The pair of channels selected is downconverted to an IF frequency range of 125 to 375 MHz. The RHCP channel IF is connected to the following:

- Detector and log video amplifiers
- Narrowband video and predetection circuitry
- Polarimeter

The LHCP channel IF is connected to detectors, log video amplifiers, and to the polarimeter. The dynamic range of each wideband channel is -61 to -1 dbm, and within this range power is measured to an accuracy of ± 2 db. The signal threshold is command adjustable between -61 and -19 dbm in 6-db steps.

Predetection and narrowband circuitry are included in the Band 4 receiver. The wideband channel RHCP IF signal is input to a

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narrowband receiver which tunes the 125 to 375 MHz frequency range with a 1 MHz bandwidth in .5-MHz steps. The narrowband receiver can be fixed tuned or stepped over a sector of 10, 20, or 40 steps or to band edge from any selected frequency. The stepping rate is selectable at 1 or 10 steps per second. Any one of the 250-MHz wideband channels can be selected by programmed control which permits changing the channel during a readin. By command, a band look-through function may be selected which, upon completion of step tuning to the sector edge, causes each of the other three wideband channels to be selected for a period of 5 seconds each.

The Band 4 receiver provides outputs for the following parameters to be encoded:

- a. RHCP and LHCP power
- b. Phase difference between RHCP and LHCP signals
- c. RHCP narrowband amplitude
- d. Pulsewidth
- e. Pulse time of arrival (TOA)

If the signal is qualified, the measurements indicated above are retained in the encoder buffers; if not, the measurement data are rejected. The signal is qualified if the command selectable threshold is crossed. When a second signal crosses the threshold 150 usec or more after the termination of the first signal, this signal will also be processed.

The narrowband receiver outputs a 350-KHz to 1-MHz predetected output signal. The dynamic range of the predetection output is adjustable to provide correlation with corresponding signals in the narrowband and wideband channels.

4. Polarimeter Subsystem.

The polarization characteristic of a received signal is determined by the measurement of the power received by the two input parts (i. e., RHCP and LHCP power) and the phase relationship between them. The logarithmic amplification, detection, and encoding of the RHCP signal is accomplished within the various receivers (Bands 1, 2, and 3). The corresponding processing of the LHCP signal and the measurement of the

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phase relationship is accomplished within the polarimeter subsystem. The polarimeter subsystem is shared by the Band 1, 2, and 3 receiver subsystems and are assigned on a commandable priority basis.

The Band 4 receiver contains its own polarimeter subsystem which measures polarization continuously.

5. Frequency Tracking and Predetection Filter Subsystem.

The receiver subsystem has the capability of frequency tracking and of recording predetection signals from frequency-agile emitters in Bands 1, 2, and 3. This is accomplished with the frequency tracking predetection filter subsystem (FTPFS) which is connected to the same band as the polarimeter subsystem. In addition, the FTPFS outputs (in a digital format) the RF frequency of each intercepted pulse. The signals that are processed and recorded are in all cases those that are intercepted by the RHCP antenna system. The FTPFS is always connected to the same receiver (Band 1, 2, or 3) as the polarimeter subsystem. See section 6 for description of assignment control logic.

6. Priority Control Logic.

The polarimeter and FTPFS can at any one time be connected to only one of the following receivers: Band 1, Band 2 low, Band 2 high, Band 3 low, or Band 3 high. A priority command system is provided so that each receiver can be given one of four priorities. If more than one receiver is intercepting a qualified signal, then the polarimeter and FTPFS are assigned to the receiver with the highest priority. If two or more receivers with the same priority intercept qualified signals, then each will be connected for a period of 16 seconds. With the priority control logic circuitry, it is also possible to operate all, none, one, two or three receivers.

7. Parameter Encoder Subsystem.

The parameter encoder subsystem digitally measures and stores, for subsequent multiplexing, the signal parameters from the intercept receivers. Associated with each receiver are signal threshold and pulse

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width criteria which must be satisfied before parameter measurements are made and stored. The following is the resolution of the parameter encoders:

Frequency (Bands 1, 2, 3)	± 100 KHz
Frequency (Band 4)	500 KHz (synthesizer stop size)
Pulse width (Bands 1, 3)	5 usecs
Pulse width (Band 4)	.1 usec
TOA (Bands 1, 3, 4)	2 usecs
Time of measurement (Band 2)	2 usecs
Amplitude (RHC and LHC)	1 db (nominal)

In addition, measurement of emitter frequency from the predetected video will be within the following limits:

Band 1	± 6 KHz
Band 2 low	± 7 KHz
Band 2 high	± 5 KHz
Band 3 low	± 19 KHz
Band 3 high	± 38 KHz
Band 4	± 112 KHz

8. Tape Recorders.

Mission 7339 is equipped with three magnetic tape recorders for storage of payload data of which two are in standby redundancy. Each recorder has two tracks capable of recording data between 1 KHz and 1 MHz for a period of 5.5 minutes or 1 KHz to 250 KHz for a period of 22 minutes. Either readin capability is command selectable on a rev-by-rev basis.

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The Mission 7339 command circuitry provides considerable flexibility in the operation of the payload. The following options are commandable on a rev-per-rev basis:

Band 1	Enable/Disable
Band 2 low	Enable/Disable
Band 2 high	Enable/Disable
Band 3 low	Enable/Disable
Band 3 high	Enable/Disable
Band 4	Enable/Disable
Band 4	
B and Look-Thru	Enable/Disable
Sweep	Enable/Disable
Sweep width	Sub-band end, 10 steps, 20 steps or 40 steps
Sweep rate	1, 10 steps/sec
Manual Gain Control	3 db steps -21 to 0 db
Signal Recognition Threshold	
Band 1, 2, 3 and 4	6 db steps, 0 to 42 db
Priority Assignment	
Bands 1, 2-low, 2-high, 3-low, 3-high	none, 1, 2, or 3
Buffer Mode Select	Adaptive/nonadaptive

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Frequency range:

Band 1	151.0 to 165.0 MHz
Band 2 low	387.0 to 405.6 MHz
Band 2 high	405.6 to 426.0 MHz
Band 3 low	861.8 to 913.0 MHz
Band 3 high	913.0 to 964.2 MHz
Band 4	1500 to 2500 MHz

Predetection frequency accuracy:

Maximum error:	$\pm 0.010\%$ of input frequency
Nominal error:	$\pm 0.005\%$ of input frequency

Logarithmic range (input):

Band 1	+3 to -57 dbm
Band 2 (low and high)	+3 to -57 dbm
Band 3 (low and high)	-16 to -76 dbm
Band 4	-1 to -61 dbm

Accuracy of RHCP and LHCP

Amplitude Measurements: ± 2 db over the specified frequency range

Resolution of the parameter encoders:

Frequency (Bands 1, 2, 3)	± 100 KHz
Frequency (Band 4)	500 KHz step increments of synthesizer
Pulse widths (Bands 1, 3)	5 usec
Pulse widths (Band 4)	.1 usec
TOA (Bands 1, 3, 4)	2 usec
Time of measurement (Band 2)	2 usec
Amplitude (RHCP and LHCP)	1.0 db
Phase	12 degree over ± 180 degree unambiguous range

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Tuning modes:

Band 1	Fixed
Band 2 (low and high)	Fixed
Band 3 (low and high)	Fixed
Band 4	Digitally controlled with the following modes available upon command:

(1) Wideband channels fixed tuned to one of four contiguous 250-MHz bands within the 1.5 to 2.5 GHz range. Narrowband channel fixed tuned to any one of 501 half-integer steps within the band.

(2) Narrowband sweep within a selected 250-MHz band with the wideband channels fixed, followed by a 5-second dwell in each of the three remaining 250-MHz bands with the narrowband sweep stationary. Capability of changing the 250-MHz band that is swept by responding to a stored command executed part way through a given operating cycle.

(3) When in a narrowband sweep mode, tune with a 0.5-MHz step increment from a commanded fixed frequency to the edge of the selected 250-MHz band or through preselectable increments of 5, 10, or 20 MHz, all at a selectable rate of 1 step/sec or 10 steps/sec.

Threshold level (command adjustable):

	<u>Lowest Nominal Setting (dbm)</u>
Band 1	-57
Band 2 (low and high)	-57
Band 3 (low and high)	-76
Band 4	-61

Signal outputs available:

1. Digitized signal data
2. Bands 1, 2 low, 2 high, 3 low, 3 high predetection (one at a time);
250 to 1000 KHz
3. Band 4 predetection; 350 to 1000 KHz. Band 2 low video
4. Band 2 high video
5. Frequency of predetection tracking filter

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