TECHNICAL DESCRIPTION

of

MISSION 7107

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of
MISSION 7107

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Contents (Cont.)

Contents

TECHNICAL DESCRIPTION OF MISSION 7107

I. INTRODUCTION

The launch of Mission 7107 (Program C) marked the twelfth launch and twenty-sixth through twenty-ninth spacecraft that the Naval Research Laboratory has built for the purposes of ELINT collection. The last seven launches of twenty spacecraft have been provided under the sponsorship of the National Reconnaissance Office, whereas the first five launches and five spacecraft were developed under Navy sponsorship.

A number of common factors have characterized both phases of the Program. Chief among these are small, long-lived spacecraft injected into approximately 500 nautical mile, circular, 70° inclination orbits and carrying ELINT payloads which consist of many crystal-video receivers. These receivers detect the main beams of all radars within the receiver's radio frequency (rf) bandpass and transpond, on a pulse-for-pulse basis using stretched pulses, [redacted] to strategically located ground stations.

Details of the overall system are contained in the text of this document and will show how Mission 7107 is capable of providing outputs, such as early detection of new emitters, weapons system information, emitter location, and technical information, e.g., pulse repetition frequency (prf), scan rate, beam pattern structure, effective radiated power, and frequency band (magnetron family) of the emitters. Mission 7107 covers the complete frequency spectrum from 154 MHz to 18.0 GHz with the exception of 10.5 to 12.5 GHz. In addition, the spectrum from 34.7 to 35.0 GHz is covered.

II. LAUNCH AND ORBITAL PARAMETERS OF MISSION 7107

Mission 7107 was launched from the Pacific Missile Test Range, Vandenberg AFB, California. The four spacecraft which comprise Mission 7107 were the only payloads on this launch. Appendix 1 shows the four spacecraft in the launch configuration.

The launch resulted in a good orbit with the following parameters:

Apogee: 539.7 nautical miles
Perigee: 530.6 nautical miles
Inclination: 69.99^{o}
Period: 104.9 minutes

III. SPACECRAFT POSITIONING

Sixty-seven minutes and 40 seconds after lift-off, two spacecraft (7107A and 7107B) were simultaneously separated from the vehicle. One hundred and forty seconds later, the second pair (7107C and 7107D) were separated. The separation velocities of individual spacecraft were chosen so that the four spacecraft would arrive at their desired relative positions approximately 42 days after launch.

The prime reason for using 3-axis stabilization on the spacecraft of this Mission was because it provided a stable platform from which the microthruster system could be operated. The orbital velocity of each spacecraft may be increased or decreased by using the microthruster system.

Since all four spacecraft were injected into orbit by the same vehicle, they all traveled at the same speed (approx. 24,000 ft/sec). The spacecraft were separated simultaneously with individual calibrated springs of different energies (Appendix 2). The four spacecraft, therefore, drifted apart at predetermined rates. When they reached the desired separation distances, the microthruster systems were activated in such a direction as to cancel the very small differences in velocity. At the end of the thrusting period and after the velocities were adjusted, the spacecraft were at their desired relative positions and traveling at the same speed. The delicate balance of the "parked" orbital spacing of each pair will gradually degrade as one spacecraft is affected slightly more than its mate by aerodynamic drag. The microthrusters will be used as necessary to correct for spacing errors.

IV. BASIC FUNCTIONS OF MISSION 7107

The four spacecraft developed by the Naval Research Laboratory for use in the Program C Mission 7107 SIGINT data collection effort are known by their respective nomenclature as 7107A (ALPHA), 7107B (BRAVO), 7107C (CHARLIE), and 7107D (DELTA).

The four spacecraft carry a total of 76 ELINT receiver bands to fulfill two basic requirements:

a. Early recognition and location of major weapons systems within the denied Soviet and CHICOM areas.

b. Parametric measurements through which it is possible to detect, in any part of the world where crisis situations may develop, the advancements in radar technology which may be applied to future weapons and space systems.

Mission 7107 capabilities expand the Program's proven and highly successful history of satellite design and data collection in support of the following intelligence priorities:

a. Timely discovery of the existence of previously unknown emitter sub-systems.

b. Technical assessment of new sub-systems to ascertain their function, capabilities and limitations before they are deployed into major overall weapons systems.

c. Electronic Order of Battle (EOB) surveillance with a timely periodic determination of the locations of known emitter sub-systems and sampling by geographic area to disclose a measure of the activity level as well as the interrelationships and usable patterns of these sub-systems relative to the overall weapons systems.

d. Mission 7107 provides two major improvements in operational capability compared to Mission 7106:

[redacted]

2. Increased instantaneous collection provided by the addition of a third transmitter in each spacecraft. A total of 24 ELINT bands can now be tasked in each pass with the additional down-links.

V. OVERALL OPERATIONAL DESCRIPTION

Spacecraft 7107A and 7107B are each equipped with 17 ELINT data collection systems, including a 20-channel comb filter system in the I-band range (Band 17). Spacecraft 7107C and 7107D each contain 21 ELINT collection bands. They are all crystal-video receivers with the exception of 7107C and 7107D, Band 21 (34.7 to 35.0 GHz), which is a superheterodyne design. Any combination of bands may be tasked at one time.

Radar signals which illuminate the spacecraft with sufficient signal strength are detected and trigger an on-board threshold detector. The threshold detector output triggers a modulator which produces [redacted]

As the radar antenna scans and cyclically illuminates the spacecraft, the antenna scan characteristics are also preserved accurately in the data.

Each of the 76 ELINT receiving bands for Mission 7107 employs carefully calibrated and well-documented rf bandpass filters which define the particular frequency spectrum and response characteristics.

The pulse data from the satellite transponding (Data Link) systems are received and recorded along with precise timing information at [redacted] ground stations situated around the periphery of the Sino-Soviet Bloc. Provision is made at each of these sites to permit the simultaneous monitoring of a pair of satellites by duplicate antenna, receiving, and recording equipment.

This multiple receiving and recording capability allows increased data collection as well as the simultaneous reception of data from two similar spacecraft to be used in emitter location.

This location system requires analysis of [redacted] of a [redacted] to provide extreme accuracies in geographic emitter location.

VI. SPACECRAFT ELINT COLLECTION SYSTEMS

During the past decade, Program C ELINT intercept systems have utilized crystal-video receivers, combined with omni-directional antennas to attain a high probability of intercept. There are no spurious image products generated in the receiving systems so that the data received are of the highest confidence. These receivers are characterized by long life, high reliability and excellent calibration stability throughout the space environment. The receiving antennas associated with the space-craft ELINT system have been extensively documented and have exhibited a high degree of performance predictability during the long lifetime missions. Block diagrams of typical inter-cept receivers for Mission 7107 are provided in Appendices 3 and 4.

Using omnidirectional ELINT antenna arrays in the frequency spectrum from 154 MHz to 10.5 GHz, spacecraft are capable of intercepting any pulsed signal of sufficient level within the optical horizon of the spacecraft. Receiving systems covering 12.5 to 18.0 GHz and 34.7 to 35.0 GHz utilize high gain antennas and therefore provide intercept coverage limited to approximately 50° in azimuth.

With the inherent characteristics of wide frequency coverage and omnidirectional azimuth coverage, this type of receiving system is ideal for emitter location using the [redacted] The 7107 systems were designed so that each pair of spacecraft contain frequency bands of similar performance characteristics, such as rf bandpass, sensitivity, and antenna coverage. Similarly, the resulting data is transponded under common conditions for accurate [redacted] analysis. Simultaneous with reception of signals using normal receive mode, it is possible to make a parametric measurement of incoming radar signal amplitude. Except for Band 17 of 7107A and 7107B (comb filter), this option is available in the collection bands of all four spacecraft.

In addition to complete [redacted] through 10.5 GHz in 7107C and 7107D, spacecraft 7107A and 7107B provide additional dual coverage in the range of 9.2 to 9.6 GHz, making quadruple coverage in this portion of the spectrum. In this range Band 17 in 7107A and 7107B have channelized receivers with 20 channels of 20 MHz increments using a multiplexer-detector system preceded by a 40 db tunnel-diode rf preamplifier in order to provide system threshold sensitivity in the order of -80 dbm (Appendix 5). Transmitter and [redacted] assignments similar to those in standard bands permit the use of any combination of these 20 channels by command. This capability reduces the data density for improved analysis by selectively tasking any single high density portion of the spectrum or, inversely, by rejecting a given frequency range.

It also permits frequency definition to within ±.2% in the 9.2 to 9.6 GHz range.

A. System Performance

The system performance for Mission 7107 is summarized in Appendices 6 and 7 and given in detail in Appendices 8 through 53.

1. RF Bandpass: The 3 db bandpass responses for all receiver bands are shown in Appendix 6. The comb filter (Band 17) is shown in Appendix 7. The tabulations of Part I of Appendices 8 through 45 define the bandpass characteristics of these receivers at 3, 10, 20 and 30 db down. These data are derived from composite curves based on measurement of the characteristics of all the channels in a single band on each spacecraft. Appendices 46 through 49 are computer-plotted curves of some of the data of Appendices 8 through 45. The frequency response of each of the 20 channels of Band 17 of Mission 7107A and 7107B is shown in Appendices 50 and 51. These plots give the effective threshold sensitivity, including the antenna gain.

2. System Sensitivity: Part II in Appendices 8 through 45 provide the system sensitivity of the standard transponder mode of each band as follows:

a. Line (a), Threshold (dbm), gives the signal level required at the antenna output terminal in order to obtain solid triggering of the modulator. These data include all system losses encountered, including losses due to rf cabling, rf combining hybrids, multiplexing and video combination at the amplifier input.

Also included is the reduction of sensitivity resulting from adjustment of the threshold trigger level to the proper level above noise. The antenna gain is not included.

b. Line (b) gives the overall sensitivity as in line (a) with the antenna gain added. This is effective sensitivity data which can be used to calculate or predict system capability.

c. Line (c) gives the SLM threshold level. Since the SLM system of 7107 has a separate level control, there are measured differences in threshold settings.

SLM data is useful in the detailed analysis of emitters, but for increased accuracy it should be used in conjunction with receiving antenna patterns. (Appendices 52 and 53 are examples of this type of antenna pattern plot.) Spacecraft attitudes and received signal aspects are also required in order to establish absolute antenna gain for a particular intercept.

d. Crystal-video receivers inherently produce an

[redacted]

3. <u>Antennas</u>: Approximately 40 antenna elements, including various types of monopoles, dipoles, and horn antennas, are incorporated in each spacecraft for the ELINT collection systems. Integrated in various arrays, these elements are used to obtain omnidirectional coverage throughout the required rf spectrum from 154 to 10,500 MHz. (Coverage in the regions above 12.5 GHz is limited in azimuth and will be described later.) Detailed antenna data for each band are given in Appendices 8 through 45.

Gain is the nominal value expressed in db relative to isotropic. For gain at any specific point on the pattern, it is necessary to use the 3-dimensional antenna plots illustrated by Appendices 52 and 53. Similar plots for each band are available to analysts.

Beam Relative to Flight Line data refer to azimuthal bearing of the center of the beam measured in a clockwise direction as seen from above the spacecraft for both horizontal and vertical polarization.

Available antenna options are shown for each band.

4. <u>Transmitter and Modulator</u>: Each ELINT intercept band is assigned a particular transmitter and a modulation pulse width,

thereby giving each band a positive, but not necessarily unique, identification code. Hence, throughout a normal operation, every rf pulse received from the spacecraft is identified with a particular intercept band. Part IV of Appendices 8 through 45 show the transmitter (B, C, or D) and pulse width (W, X, Y, or Z) for each band. The absolute pulse width related to each designation is also given, ranging from 80 to 200 μsec.

B. <u>Detailed Description</u>

<u>Receiving Antennas</u>: Various types of receiving antenna elements are utilized in Mission 7107 for the ELINT collection systems aboard the spacecraft:

1. From 154 to 970 MHz (Bands 1 through 4 of 7107A, B, C, D), all bands use quarter-wave monopole antennas arranged around the polar axis of the spacecraft at various latitudes. Combinations of the detected video signals result in an omnidirectional collection antenna pattern for both vertically and horizontally polarized emissions.

2. In the frequency bands between 970 and 10,500 MHz, the standard antenna elements are half-wave dipoles symmetrically spaced in quadrature around the equatorial section of the spacecraft. For optimum elevation coverage, these antennas are mounted on inclined wedges so that the pattern is canted downward toward the earth's horizon. For the horizontal polarization option in 7107A and 7107B, Bands 5 to 11, the elements are oriented in a horizontal position. Opposite antennas are coupled together using

hybrids, where the signals are detected and applied to the video amplifier. A second such pair of antennas is similarly interconnected and detected and added to the [redacted] to produce a composite omnidirectional pattern.

3. In 7107A and 7107B, Bands 13-15, and 7107C and 7107D, Bands 5-17 (except Band 10), each dipole element is oriented to optimize the pattern for both horizontally and vertically polarized signals. Four antennas are used for each frequency band, each providing coverage of approximately 90°. These are connected in pairs by means of hybrids to form two orthogonal receiving channels which can be used together to give complete 360° azimuthal coverage or used separately (Option A or B) by [redacted] command option. Reasons for using this command option are to:

a. Depopulate the data in areas where excessive data density is encountered.

b. Eliminate interfering signals, if they were to come from one offending quadrant.

c. Provide a diagnostic tool for obtaining information on the arrival direction of signals of interest.

d. Permit a backup operational mode.

4. Band 12 uses the same antenna configuration but does not have the [redacted] option.

5. In 7107A and 7107B, Bands 5-11, vertical polarization coverage is achieved by use of a broad-band discone antenna

mounted below the spacecraft in order to produce omnidirectional patterns.

6. The only bands in 7107 which do not provide complete 360° coverage are as follows:

a. In 7107C and 7107D, Band 10 provides only port and starboard quadrant coverage.

b. In 7107A and 7107B, Band 17 (the comb filter) utilizes two horn antennas looking to port and starboard, perpendicular to the flight line. Rf combination produces two symmetrical 50° receiving lobes.

c. To obtain the required effective receiver sensitivity for bands in the frequency ranges from 12.5 to 18.0 and 34.7 to 35.0 GHz, a minimum of 15 db of antenna gain was required. Sectoral horn antennas employed for these bands were designed for optimum gain and beam widths. For the [redacted] (7107C and 7107D, Bands 18, 19, and 21), computerized plots were used to determine optimum positions for the antenna beam centers in elevation and azimuth.

Appendices 54 through 56 are measured patterns of antenna systems used in 7107A, B, C and D and represent the variety of antennas and arrays used throughout the frequency spectrum. These patterns are plotted in a conical cut with the antennas directed down toward signals eminating from the horizon. The earth's horizon is 30° below the equatorial plane of the spacecraft at an altitude of approximately 530 nautical miles.

Rf Preamplifiers: Rf preamplifiers are incorporated more extensively in 7107 than in previous missions for several reasons.

1. In utilizing video amplifiers with wider bandwidths (.1 μsec rise time) consistently in all bands, a 2 to 3 db reduction in sensitivity has resulted.

2. For providing some additional protection from the possibility of noise triggering over the life of the system, some additional loss was incurred in setting the threshold detector to a safe level.

3. Mission 7107 was designed to have higher sensitivity in many bands. Each band was optimized to provide the greatest dynamic range in the intercept of the main beam of the emitter.

Receivers used from 4.0 to 18.0 GHz incorporate low noise tunnel-diode preamplifiers with gains ranging from 15 to 40 db. These preamps are temperature compensated with thermistors and are designed to give stable performance in the space environment. Dc to Dc converter-regulators provide the critical 1.250 volts required to supply bias to the tunnel diodes.

For all applications below 4.0 GHz, transistor preamplifiers have been incorporated using microcircuits and thin film technology.

Bandpass Filters: The radio frequency definition of each band is determined by bandpass filters. The bandpass characteristic was selected so that there would be at least one known target-emitter family or one magnetron family within each band.

The degree of filtering and selectivity vary from band to band as required. For example, in the band adjacent to the DL transmitter frequency (7107A and 7107B, Band 1), there is a difficult technical requirement to reject the spacecraft's own transmission. To avoid the possibility of regeneration in this band, extensive filtering was used with well-defined skirt characteristics. The bandpass filters incorporate highly sensitive detectors which are matched to provide optimum flatness and sensitivity.

Video Amplifiers: The video amplifiers utilized throughout these systems are designed to provide miniaturization with high reliability and extremely low power consumption. These amplifiers provide a pulse response of 0.1 μsec in all bands. An input combining circuit permits combination of multiple collection channels (antenna through detector) to provide a single video output. Each associated detector receives bias from the amplifier which is optimized for the particular detector used.

A threshold detector is incorporated within each video amplifier. A separate threshold level control is used to adjust the trigger level as required for each band.

The video amplifiers are also designed with a low level video output to provide a dynamic range of 30 db. This signal is required for the SLM system.

Signal Level Measurement: The SLM system can be commanded "on" for any band or bands in the spacecraft to obtain amplitude information on incoming signal. The measurements are made on a pulse-to-pulse basis and are converted to a serial digital output consisting of a sync pulse and binary coded data describing the input signal level (Appendix 57). An input power level with a dynamic range of greater than 20 db produces a down-link train of binary words (consisting of 15 levels and a calibrated, predetermined power level change per level (approximately 1.5 db/level)). The resultant output-vs-input curve for each band is a linear function of input power in dbm, and all bands in a particular spacecraft have the same dynamic range slope (db/level). Complete calibration of each system is provided in all bands and can be used to analyze emitter antenna patterns and to measure emitter effective radiated power. Typical calibrations are given in Appendices 58 through 61 for one band in each spacecraft.

The SLM system consists of a pulse height analyzer, a logrithmic pulse amplifier, a video coupling unit, and a portion of the video amplifier. A control voltage to any video amplifier in the system switches a low level video pulse from that particular amplifier through the coupler unit to the log amplifier. Diode coupling assures sufficient isolation back to all unused video amplifiers. The log amp provides the required signal amplitude and slope for the pulse height analyzer. In the analyzer, the amplitude of the pulse is converted to a pulse width that varies linearly with amplitude. At the trailing edge of the input pulse, a sync pulse of 120 μsec is generated followed by the binary-coded data.

Adjustable Threshold Option: Each spacecraft of Mission 7107 is equipped with an adjustable threshold option which is available to each ELINT band in the spacecraft. This option is available by command to perform the function of reducing the effective system sensitivity in four increments, a total of approximately 15 db. These are predetermined levels which apply equally to every receiver band in a spacecraft (Appendix 62). The modulator used in conjunction with this system produces an 80 μsec (W width) pulse for the down-link transmission.

There are a number of potential uses for the adjustable thresholds:

1. To recover data in any band which may develop problems of rfi or random triggering.

2. To sort data, by eliminating low powered signals in commandable steps.

3. To calibrate the SLM system in flight.

4. To transpond signals of high prf. In this mode of operation the transponded data pulse is always 80 μsec (W pulse width); therefore, higher prf signals can be transponded from all bands having X, Y, or Z pulse width assignment.

Ephemeris Calibration "RETEP" Receiver: A specialized narrow band superheterodyne calibration receiver is installed in

Mission 7107C and 7107D. These receivers operate at approximately 800 MHz with a 2 MHz bandwidth. The output of these receivers is fed to a very narrow band pulse width discriminator to eliminate interference.

The receiver output is normally transponded as an 80 μsec pulse on the BRAVO data link transmitter; but for special information transfer, it can be brought back on the telemetry channel.

By recording both the modulating signal and the transponded signal on digital tape and knowing the accurate location of the transmitter, the ephemeris data can be improved by fitting techniques.

A specialized modulator-transmitter antenna combination is installed at the field site in [redacted] so that the calibration receivers can be interrogated.

VII. SPACECRAFT CHARACTERISTICS

A. Structure

All four spacecraft utilize the same general structure as employed for Mission 7106. The 7107 structure (Appendix 63) can be described as a 12-sided multiface, 27 inches in diameter and 34 inches high. The spacecraft weights are as follows:

7107A	270 lbs
7107B	270 lbs
7107C	282 lbs
7107D	282 lbs

The ELINT receiving antennas are located symmetrically around the polar axis at various latitudes of the spacecraft. In addition to these antennas, there is a turnstile array which is deployed downward toward the earth on the end of a four-foot boom. This turnstile antenna system serves the three data link transmitters and provides a uniform radiation pattern at the ground sites. (Appendix 64 depicts a typical radiation pattern.) A second turnstile antenna array located on the north (upper) hemisphere of the spacecraft is used in conjunction with the telemetry Channel A transmitter as well as with the command receiver.

Solar cells are located in three circumferential bands oriented at the $+20^{\circ}$, $+45^{\circ}$, and -20° latitudes of the spacecraft. To augment the solar cell recharging system previously used in 7106, a solar cell-equipped, deployable paddle has been added to the 7107 spacecraft. The addition of the paddle was necessary to support the increased electrical load required by the third data link transmitter and its associated tasking.

B. Gravity Gradient Stabilization System

Each of the four spacecraft is equipped with an identical 3-axis Gravity Gradient Stabilization (GGS) system. The GGS system consists of a 60-foot deployable boom, a damper for two-axis stability, and a momentum wheel for stabilizing the third axis. This system has been successfully used on prior Program C spacecraft and satisfies the following requirements for the 7107 system:

1. A stable, earth-centered satellite for mounting the horizon-to-horizon ELINT collection antennas.

2. A proper alignment of the solar panels for optimum battery charging capability.

3. A stable flight-oriented platform for the microthrusting operations used to maintain satellite spacing.

C. Thrusters

All four spacecraft have ammonia vapor microthrusters which are very similar to the system used so successfully on the 7106 spacecraft over the past two years. This system, coupled with the 3-axis GGS system, will permit maintaining optimum spacing between all four spacecraft for the entire useful life of the mission providing a very low thrust to spacecraft in orbit without disturbing the gravity gradient stabilization. The thrust level is in the order of 10 to 30 micropounds and is produced by exhausting anhydrous ammonia gas through a nozzle. There are two complete systems on each spacecraft; these provide either fore or aft thrust capability with redundancy when used in conjunction with the yaw maneuver. The two systems share a common fuel tank. Each system consists of two valves, a plenum chamber, a pressure switch, and a nozzle. The electronic control consists of an on-off relay, a cycle relay, and a transistor switch. Each nozzle has a 5-watt heater which decomposes the ammonia vapor exhaust and increases its specific impulse. The heaters can be turned on and off by command.

D. Thermal Design

All surfaces of the spacecraft, not covered with the solar cells, are covered with a vapor-deposited aluminum and then coated with a layer of vapor-deposited silicon monoxide to provide a second surface mirror. This passive thermal design will keep the spacecraft electronics at a temperature well within the -10°C to 60°C range. The electronics temperature range experienced operationally is approximately +5°C to +45°C.

E. Spacecraft Power Conditioning

As in previous missions, the spacecraft use a solar cell recharging system to charge nickel-cadmium batteries. Major differences to this system are in terms of the power conditioning. Mission 7107 spacecraft contain voltage and current regulators designed to maintain the spacecraft batteries at the proper state of charge consistent with temperature and battery voltage. In addition to the primary power supply, there is a secondary supply that is maintained at the proper state of charge so that it can be used at any time. Also, both supply systems have increased telemetry data, which allow closer monitoring of the supply's health and can detect problems before the system is damaged. Information concerning the status of each individual cell in the primary supply is available in telemetry data. Any degradation, especially any nonuniformity, can readily be detected. The increase in power conditioning, redundant supply, and telemetry of data on each cell, etc., should result in longer spacecraft life expectancy.

F. Basic Command and Control Systems

The basic command and control systems used in the four spacecraft of Mission 7107 are similar in operation to those used in previous missions of this Program in order to minimize the operational impact of any change. The major differences are in the areas of increased redundancy and increased capacity which are discussed below.

The command system has been expanded from the 80 commands of Mission 7106 to approximately 280 commands available with Mission 7107. This has been achieved by (1) providing two separate command "enables" and (2) by adding a "third dimension" to the command system. Increase in command system capacity has greatly enhanced the operational capability of the spacecraft by allowing far greater flexibility in tasking the operational ELINT receiving systems. Such flexibility has been attained in two different areas: (1) the choice of a wide range of parametric measurement options and (2) the selection of engineering alternatives in the solution of special operational problems.

Unlike previous missions, each 7107 ELINT receiving system (band) can, by command from the ground, be assigned to any of the three down-link data transmitters. Each ELINT band is assigned a specific pulse width which cannot be changed except by using the adjustable threshold option. As in the past missions, 7107 will use the "reset" command or the spacecraft ELINT system timer to reset the bands; however, with Mission 7107 this will also return the bands to their "normal" transmitter assignment. In addition to this command system versatility, other parametric measurement options are also available. All bands have the SLM capability, and many bands have [redacted] or selectable polarization options. In order to provide the required tasking flexibility for these options, a third dimension was added to the command system by the use of a "repeat" tone pair that is common to all bands and all spacecraft. All of the commandable options are on this third dimension of the command matrix. Otherwise, the 7107 command system procedures are identical to previous missions.

The "on" command for any ELINT band selects the normal transmitter assignment, collection antenna quadrants, and both horizontal and vertical polarizations. This command is a totally redundant command, being the logical complement of another command, so that the commandable options are obtained by the use of the command for each band followed by the repeat tone pair. This technique minimizes the sequence required under normal operation by not necessitating a command matrix change as previously required for 7106. All options for every band are commanded using this same technique.

In addition to the increased command capability, numerous features have been incorporated into the command and ELINT down link to increase the reliability. The command link consists of dual spacecraft receivers, filter detectors, and logic decoders. All units are cross-coupled, such that a short or open in any unit does not affect the performance. All ELINT commands and many critical engineering commands are completely redundant and isolated. In addition, the command enable function is redundant and isolated, the ELINT system timer can be by-passed, and all power conditioning associated with the ELINT system is redundant and can be by-passed. All ELINT bands have separate, isolated down-link modulators, such that a failure in one will have no effect on any other. Further improvements in system reliability are provided by being able to place any ELINT band on any down-link.

The duration of operation for the ELINT collection systems is the same as in the previous mission (50 min) and is provided by the on-board programmable timer. The timer provides the option for delayed execution of all ELINT collection commands in 10-minute increments for up to 140 minutes following receipt of the command by the spacecraft.

G. <u>Telemetry System</u>

[redacted]

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H. Transmitters

Each spacecraft employs four transmitters: one for telemetry and three for ELINT data transmission. The frequency and radiated power of each is tabulated in Appendix 66. It should be understood that all the power levels given in the table take into account all spacecraft losses between the transmitter and antenna. These include insertion losses of filters, hybrids, isolators and transmission lines.

[redacted]

VIII. MISSION GROUND STATIONS

A. Ground Station Configuration

The data transponded from Mission 7107 spacecraft via the three data down-link channels and the telemetry channel are intercepted by a chain of [redacted] collection sites situated around the world. These data collection sites are equipped with two identical receiving-recording instrumentation complexes. These two systems are capable of receiving data instantaneously from two spacecraft of Mission 7107 (Appendices 67 and 68). [redacted] sites [redacted] are equipped with a transmitter complex for interrogating, or commanding, the spacecraft for operational tasking. These [redacted] also employ datadigitizing systems. A block diagram, giving data flow through the ground station, is shown in Appendix 69. A more detailed description of the ground stations follows.

B. Station Locations

Mission 7107 ground stations are located around the world as follows:

C. Antenna System

Each receiving system is connected to a four-over-four array of crossed-yaggi antenna elements. These elements are mounted in a slant right (+45°), slant left (-45°) configuration on a Scientific Atlanta elevation over azimuth pedestal. This configuration gives two essentially isolated (except for mutual coupling effects) antenna systems. All the elements from the same polarization are phased together with phasing cables to provide two outputs, one from the slant right elements and one from the slant left elements. Each array has a gain of approximately 19 db with a horizontal beam width of 11 degrees and vertical beam width of 22 degrees. Other antenna details, such as the remote automatic steering and polarization switching, will be described later. Appendices 67 and 68 should be referred to in the detailed ground station description which follows.

D. Preamplifiers

The outputs of these two antenna arrays are fed to two low noise preamplifiers (2.5 db noise figure). These preamplifiers have a gain of approximately 22 db at the center frequency, with a 3 db bandwidth of 15 MHz. They are located at the antenna pedestal and have sufficient gain to overcome cable losses from the antenna to the indoor receiving system.

E. Multicoupler

Outputs from the preamplifiers on each antenna system are fed to the respective multicouplers in the primary and secondary systems as shown in Appendices 67 and 68. The signals of both polarizations are first diplexed, splitting the telemetry and data link information into two bands.

Signals of both polarizations from the telemetry band are fed to a manual polarization switch and then to the telemetry receiver. The data link frequency band is power divided and fed to two electronically controlled coaxial switches. Each switch is associated with one polarization. The control for these switches is provided in the polarization switch unit. These switches are arranged in such a way that they are always looking at opposite polarizations. The output of one of these switches is power divided to provide outputs for the four data receivers. The other switch output is fed to the polarization checking receiver whose video output is fed to the polarization switch.

F. Polarization Switch

The polarization switch is a device that works in conjunction with the polarization checking receiver, RSP on primary system and RSS on secondary system (as shown in Appendices 67 and 68), to determine the best polarization for each of the data link receivers. This is accomplished in a cyclic fashion by tuning the polarization receiver to the same frequency as the data link receiver being checked by means of the digital controlled oscillator, and comparing, on a statistical basis, in the polarization switch, the linear video outputs from the data and polarization receivers. After this determination is made the proper polarization is switched to the data receiver and the polarization receiver is tuned to the frequency of the next data receiver and the process repeated. It should be noted that the polarization receiver is always tuned to the opposite polarization from the data receiver being checked. This process is identical on both the primary and secondary systems.

G. Receiver Systems

The eight data receivers shown as R_o through R_7 in Appendices 67 and 68 and the polarization receiver are equipped with Gaussian-shaped intermediate frequency crystal filters to provide the band limiting while minimizing time delay fluctuations. The receivers employ a digital-controlled oscillator to provide remote tuning capabilities and maximum stability. The receivers also contain the Adaptive Threshold Unit, which digitizes the video pulse from the receiver. This digital pulse occurs at the half-amplitude point of the video pulse and thus adapts the threshold level to the video amplitude. [redacted] Then, the digitized or normalized pulses are sent to the Analog to Digital Data Subsystem (A/DDS).

H. <u>Analog to Digital Data Subsystem</u>

[redacted]

The clock rate in the A/DDS is 2 MHz providing about a 200 ηsec quantizing error. It should be noted that this is not a data accuracy limit.

The events from the receivers, having been assigned a time of day, are assigned channel numbers and multiplexed together and output in a six-bit format to the Buffered Digital Tape System (BTS) and the Priority Data Extractor (PDE).

I. Buffered Tape System

The Buffered Tape System accepts data from the A/DDS and writes it on digital tape for data processing. In order to handle the data rates being output from the A/DDS, the digital data is buffered into a 4096 by 8-bit core memory before being written on the digital tape. The memory is of such size to allow the average bit rate from the A/DDS to be 50 KHz before data is lost or overflow occurs.

The BTS also provides interface between the A/DDS digital tape unit and teletype unit used to put headers and trailers on the digital tape.

The digital tape, after the writing of proper headers, calibration, data and trailers is ready for processing. The data format for Mission 7107 is Header; End of File; Calibration; End of File; Data; End of File; Trailer and End of File. It is possible to pack several collection operations on one digital tape and this is usually done.

J. Timing System

The timing and frequency standard for the receiving system is provided by an ultrastable crystal oscillator. This crystal-controlled source provides timing for the time of day, time code generator, system calibration unit, automatic antenna tracker, and clock reference for the A/DDS.

K. System Calibration Unit

The System Calibration Unit (SCU) shown in Appendix 67 is used to calibrate the receiving system from preamplifier to adaptive thresholder output for time delays.

The SCU, in synchronism with the station time standard, has crystal oscillators for each of the data-link frequencies. These oscillators are pulse modulated and sent to both preamplifiers in each antenna tower via a 50 db coupler.

A calibration signal is put on both the analog and digital tape prior to the data taking phase on each mission.

L. Antenna Control Unit

The Antenna Control Unit (ACU) shown in Appendices 67 and 68 provides steering information to both antenna systems in the primary and secondary receiving complexes.

The ACU is set up with a punched paper tape, unique to the particular geometry of the mission, that was made on the computer from the system software package at each station. The intercept time of day is set into the ACU via thumb wheel switches. The ACU then waits until the time of day from the Time Code Generator (TCG) matches the time set on it. When these times match, tracking information is then fed to the antennas to point them in the proper position.

M. Data Recording System

The Model VR-2800 magnetic tape recorder built by the Consolidated Electrodynamic Corporation is used in all the ground stations. This machine is a basic 150 KHz (30 inches per second) instrumentation-type seven-track magnetic tape recorder. Provision is made for FM-type recording of four tracks of ELINT transponded data utilizing tracks 1, 3, 5, and 7 and timing information on tracks 2, 4, and 6 using analog electronics. The center frequency of the FM carrier is 54 KHz at the 30 inch per second tape speed used for the data recording. With this tape speed, and the use of one mil thick, 1/2-inch width magnetic tape, the total recording time on a 14 1/2-inch reel is 48 minutes, which is more than enough for recording the data from two pairs of satellite passes.

IX. DATA PROCESSING

A. Priority Data Extractor

The Priority Data Extractor (PDE), working in conjunction with the SEL 810A computer, is capable of receiving four channels of information from the A/DDS and four pulse widths per channel or sixteen logical information channels. The PDE, under computer control, reformats the A/DDS digital data into a format such that the computer can process the data in an on-line fashion. The on-line software programs to date include (1) pri sorting and (2) burst making. If the data rate becomes such that the real-time software cannot handle it in real time, the data is buffered to the disc unit until the data rate decreases. This prevents loss of any data.

B. Computer Processing

The SEL 810A computer system has been provided with some 80 or 90 software programs which are used selectively in the data processing, quality control, and editing efforts at the sites. This data processing effort has extended the mission of the sites to include (1) the development of significant technical intelligence and (2) time critical location fixes on priority targets. Location of emitters intercepted by Mission 7107 will be accomplished by observing the [redacted] through two spacecraft of Mission 7107 and then treating this [redacted] analysis to develop a series of Lines of Position (LOP) which cross on the right and left sides of the flight path. One of these points is the real position of the emitter and the other is the image. Resolving this ambiguity can readily be done by noting that the rotation of the earth causes the intersection of LOPs at the real point to converge and diverge at the image point. The two intercepting spacecraft must have similar collection systems so that the maximum opportunity for [redacted] analysis is provided. Thus 7107A and 7107B are very nearly alike in the ELINT collection receiving systems. Similarly, 7107C and 7107D are very much alike. The collection coverage provided by Mission 7107 is given in Appendices 8 through 45 where one can determine that the spectrum from 154 MHz to 35,000 MHz is covered except from 10,500 to 12,500 and from 18,000 to 34,700 MHz. There are only a few additional parts of the spectrum where dual coverage is not provided and this is between 12.5 to 14.5 GHz and 3 bands between 15.0 and 18.0 GHz. In these parts of the spectrum the collection will provide general search capability.

It is primarily in the area of increased frequency coverage in the upper portions of the radar spectrum where Mission 7107 will make its major improvement over previous missions. Also of great importance is the improved potential for Mission 7107 being able to collect all of the known elements of a weapons system and at the same time search all other parts of the spectrum for other unknown elements of this weapons system. This program is ideally suited for exploitation of this type of associative analysis through imaginative tasking and diligent study. The flexibility built into these spacecraft systems far exceeds that attained by past missions of this family.

X. OPERATIONAL PERFORMANCE

Using the [redacted] (seen through 2 cooperative spacecraft systems), the computers at the sites can provide a geo-location analysis. When a computer analyst has located an emitter, he can make a quality assessment of the location accuracy based on a number of factors: (1) time span of the data, (2) number of burst pairs, (3) intercept geometry, (4) miss-distance of individual LOPs, and (5) rms residue in the [redacted] calculations. The combination of all these factors has been determined by empirical means to provide an assessment scheme with five adjective ratings: (1) Outstanding, (2) Excellent, (3) Good, (4) Fair, and (5) Poor.

This rating system has been in use since July 1969 and has shown a remarkable consistency at any site in the grouping of emitter locations of the same quality. For example, of a group of 25 emitter locations from Mission 7106, the resulting accuracies were as shown in the following table:

Group 1 (Outstanding)

100% locations less than
80% locations less than
50% locations less than

Group 2 (Excellent)

100% locations less than
80% locations less than
50% locations less than

Group 3 (Good)

100% locations less than
80% locations less than
50% locations less than

Group 4 (Fair)

100% locations less than
80% locations less than
50% locations less than

Program C systems inherently measure Pulse Repetition Interval (PRI) and Antenna Scan Rate with accuracies surpassing those realized at conventional ground based intercept sites. PRI is measured and reported to better than 0.001 μsec.

The outstanding level of Program C system performance is demonstrated by the fact that in each intercept band every known radar of sufficient power level has been intercepted.

The history of these systems shows a predictable life expectancy of at least two years.

Although Mission 7107 has a command capability for turning on any combination of ELINT bands in a spacecraft, operationally only 12 bands are used at a time so that the pulse width coding and data link transmitter channel assignment will provide unambiguous identification of each pulse and its band of origin. Normally the load on the converter/regulator which supplies all the power for the ELINT bands should be limited to 750 milliamperes. This is not a hard limit beyond which one must not task, but rather a nominal full load limit which if exceeded may cause the performance of the ELINT components to become unpredictable. Consult Appendices 70 and 71 for the drain per band for each of the spacecraft. In addition, these Appendices give examples of total current requirements when the highest current drain bands are turned on, assuming a tasking combination of eight bands and the SLM option.

XI. COMSEC PLANS

No encryption of the data from the satellite has been attempted in this Program; however, by careful limitations of the power transmitted and restriction on the reception link, the probability of detection of this signal remains quite low with the spacecraft in the desired 535 naut. mi. high orbit. The antenna system required on the ground in order to consistently receive this data must have approximately 19 db gain relative to a dipole and must track in azimuth and elevation. The signal is sufficiently low in power so that a very low noise receiving system is required to provide usable data. No residual power is radiated from the satellite data transmitter between the pulses of data. The signal is sporadic and intermittent in nature and is thus much more difficult to detect by accidental means. The information bandwidth of the data is reduced considerably by stretching out the time duration of the intercepted radar pulses, thus reducing the transmitter power required from the satellite. Studies have indicated that interception of the data signals by conventional countermeasure installations is literally impossible, and only through the use of high gain intercept antennas and considerable knowledge of the orbital elements of the satellites would intercept be likely.

LIST OF APPENDICES

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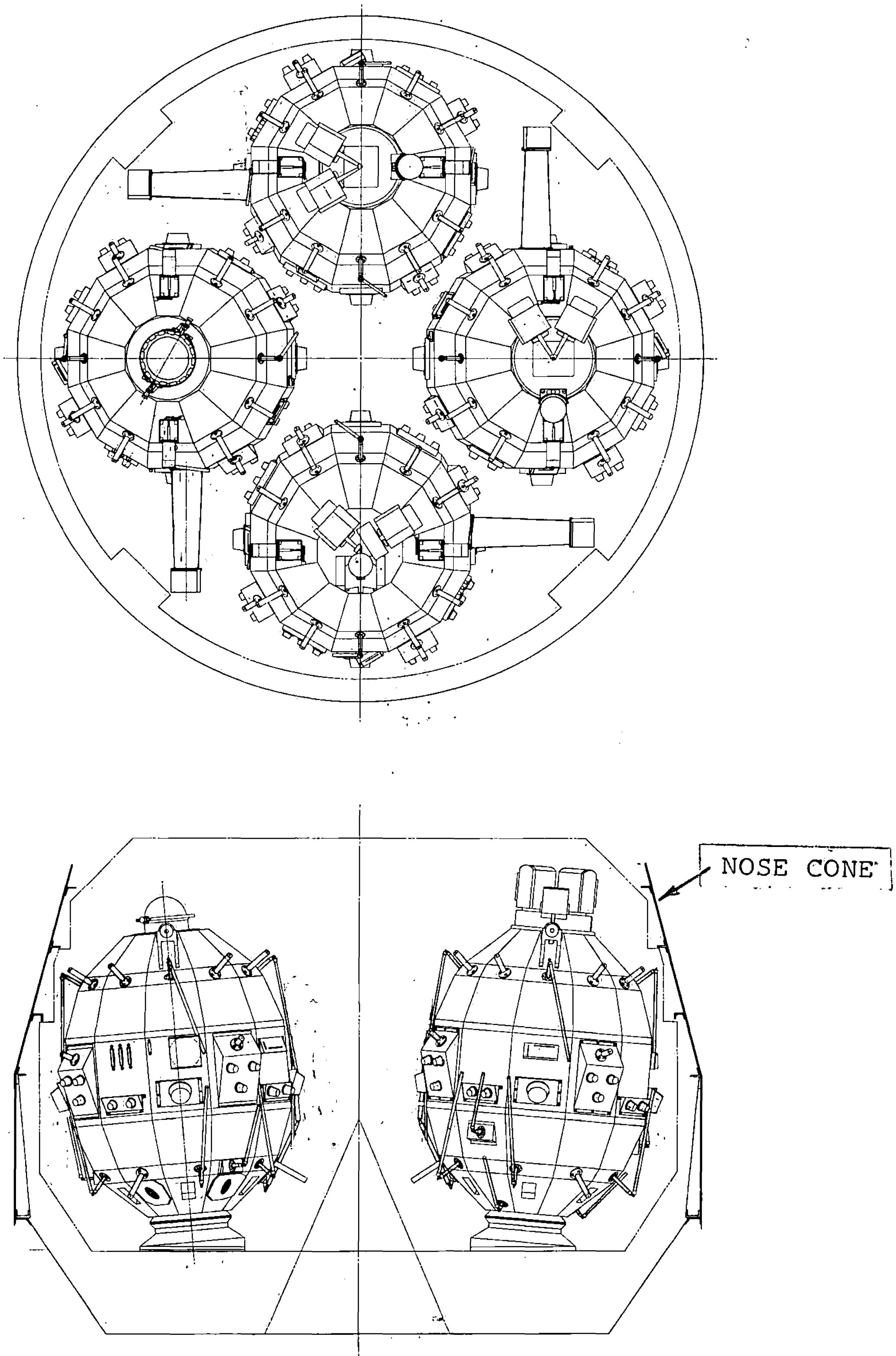
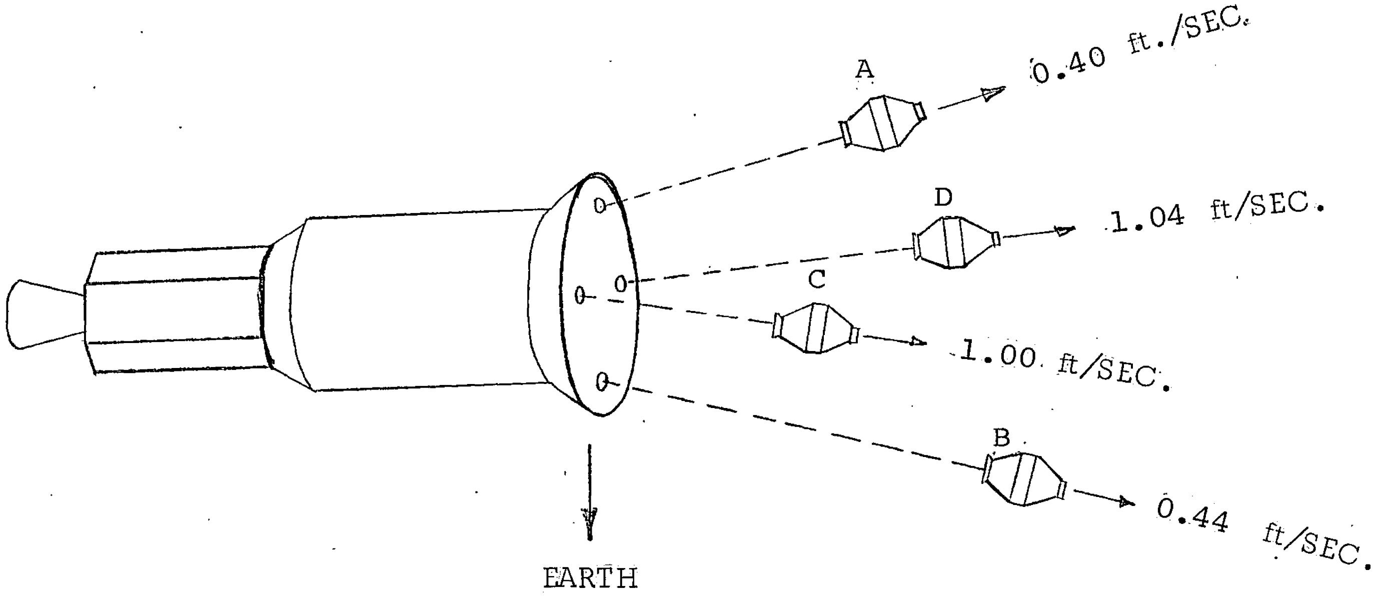


MISSION 7107 PAYLOADS IN LAUNCH CONFIGURATION

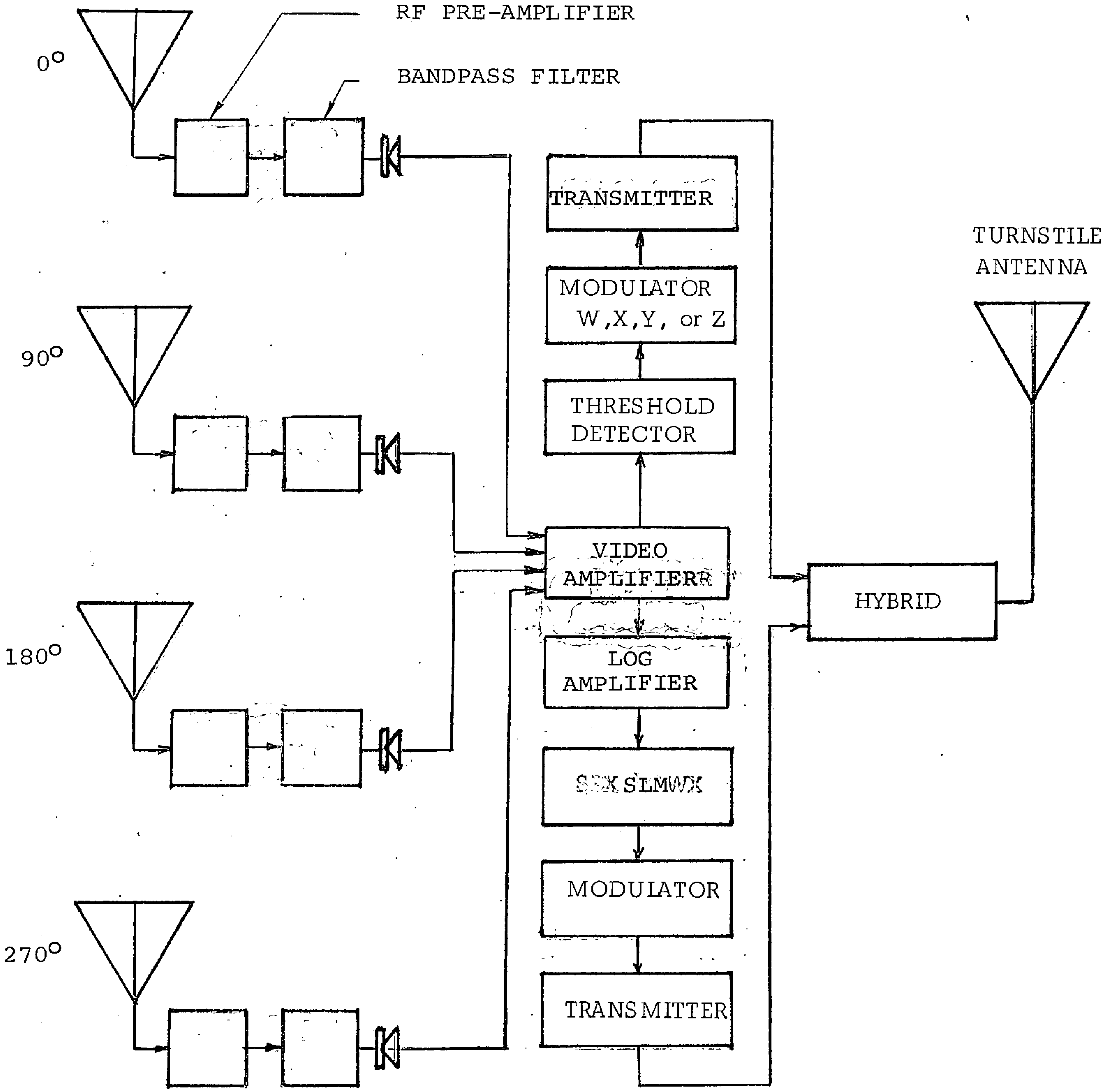
APPENDIX 1



SEPARATION OF MISSION 7107 SPACECRAFT

Appendix 2

TYPICAL RECEIVER FOR FREQUENCY RANGES BELOW 4000 MHZ



Appendix 3

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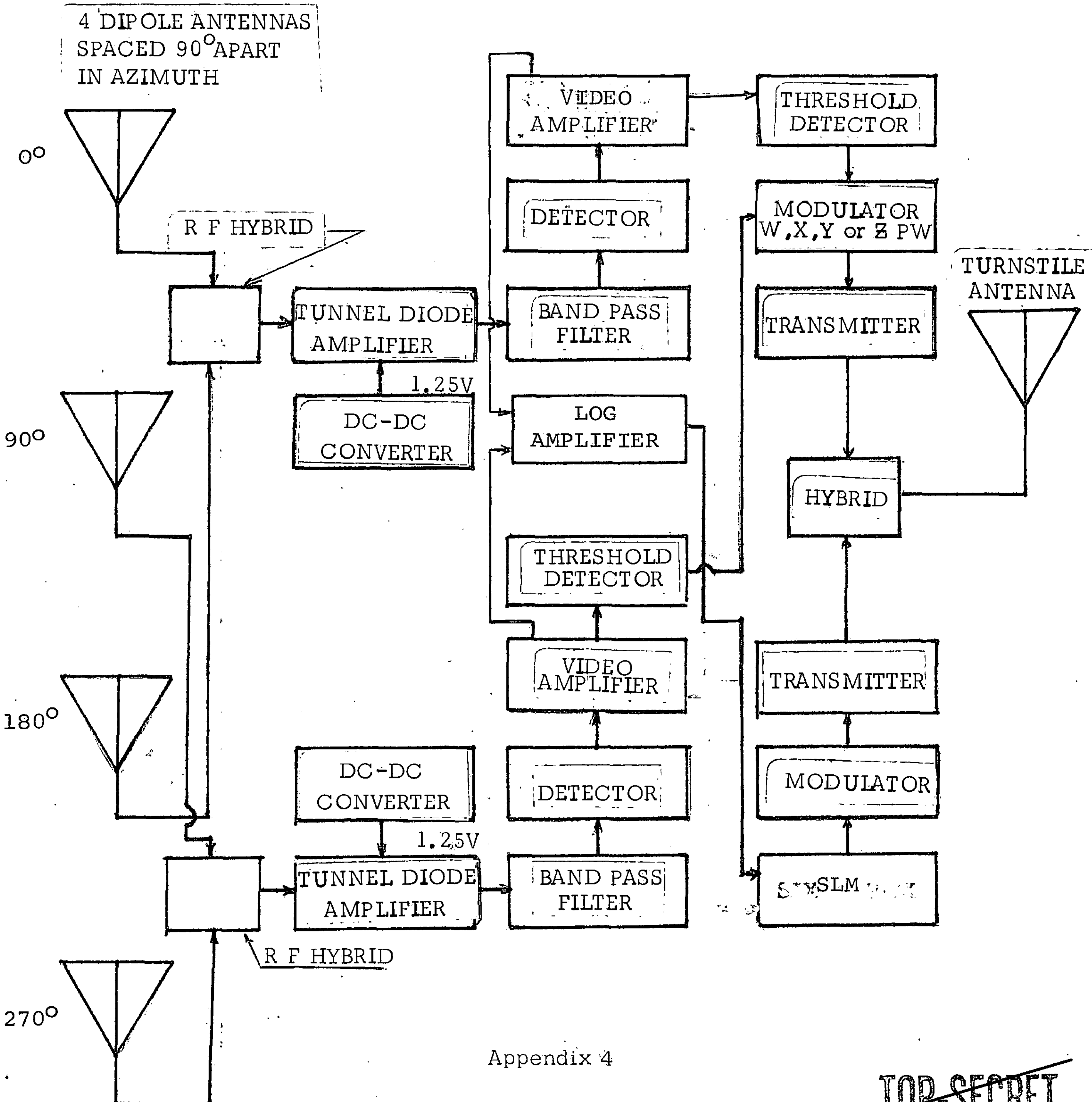
TYPICAL COLLECTION RECEIVER FOR FREQUENCIES ABOVE 4000 MHZ



Appendix 4

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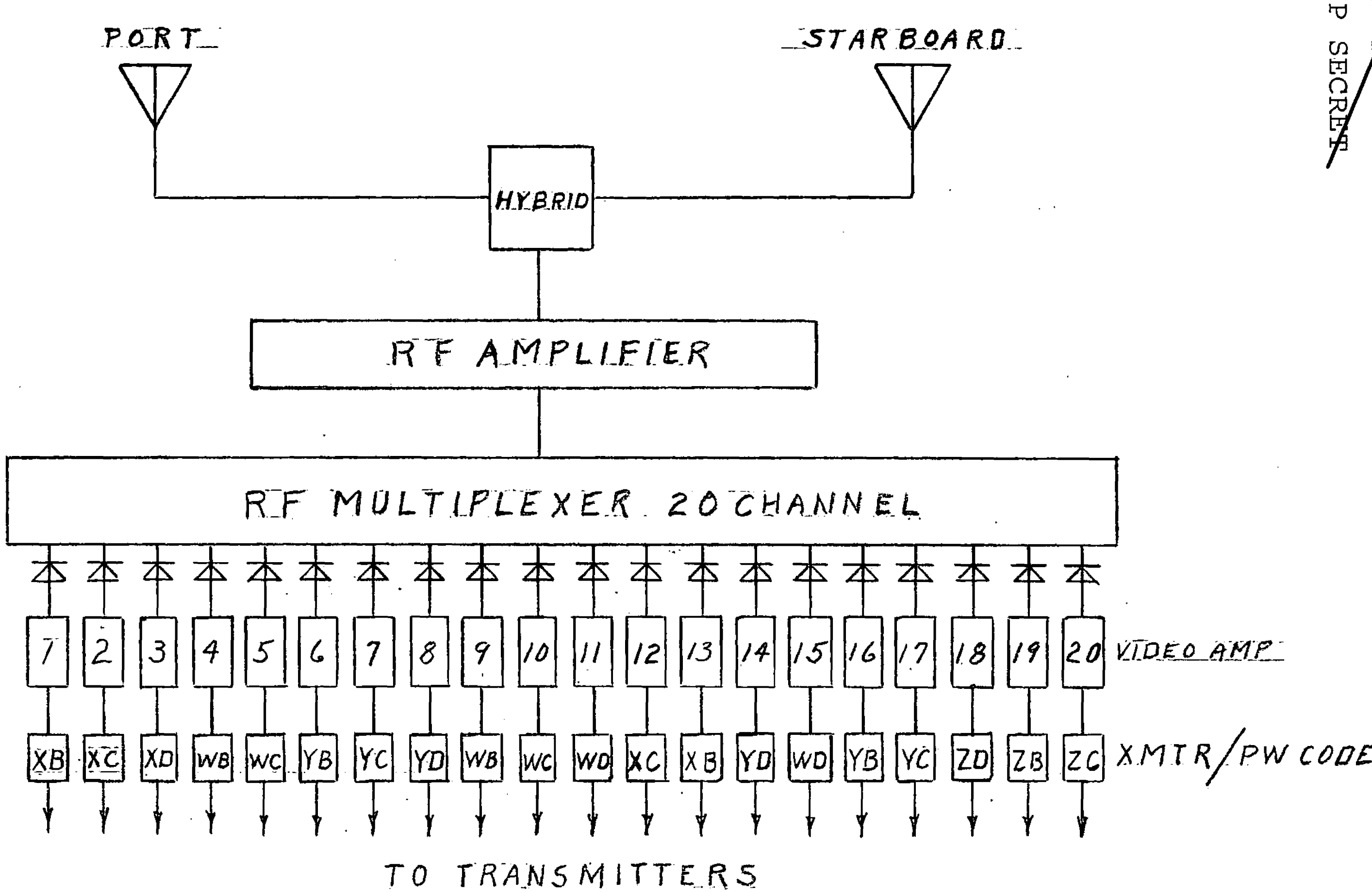

Appendix 5: 7107A & B BAND 17 (9.2 - 9.6 GHz)

Approved for Release: 2024/06/13 C05026367

APPENDIX 6: MISSION 7107 FREQUENCY COVERAGE

Band	XMTR/PW	7107A	7107B	Band	XMTR/PW	7107C	7107D
1	BW	153.7-166.5	153.4-167.3	1	CZ	202-353	204-350
2	BX	164-200.5	164-200	2	BZ	347-452	349-450
3	BZ	545-817	546-815	3	CY	449-551	448-550
4	DW	810-970	813-975	4	DX	813-979	814-976
5	BX	1785-2110	1782-2108	5	DZ	965-1215	963-1210
6	CX	2072-2592	2685-2610	6	BY	1193-1813	1195-1810
7	CY	2558-2698	2540-2695	7	CX	2082-2596	2082-2590
8	DY	2680-2928	2680-2933	8	DY	2682-2928	2682-2931
9	DX	2924-3128	2920-3129	9	CX	4837-5265	4825-5268
10	BY	3102-3318	3100-3319	10	BX	6410-6744	6398-6750
11	CZ	3285-3610	3285-3607	11	DX	6675-7940	6675-7985
12	DZ	3598-4056	3595-4062	12	CX	7855-8625	7895-8640
13	CY	4043-4857	4040-4862	13	BW	8590-9128	8585-9122
14	DW	5227-5925	5208-5872	14		9085-9352	9095-9345
15	BW	5800-6785	5795-6755	15	DW	9335-9403	9340-9405
16		16,980-18,040	12,570-14,520	16	CY	9395-9615	9385-9620
17	*	9201-9603 (20 channels)	9201-9604 (20 channels)	17	DZ	9570-10,550	9575-10,545
				18	BW	14,465-14,860	14,438-14,850
				19		14,785-15,250	14,760-15,155
				20	DW	14,990-16,070	15,950-17,060
				21	BW	34,680-35,000	34,680-34,980

Note: All frequencies are 3-db bandwidths in MHz.
* Refer to Appendix 7 for channel assignments.

Appendix 7

COLLECTION COVERAGE
FOR MISSION 7107 A&B, BAND 17

Channel	7107A	XMTR/PW	7107B
1	9201-9221 MHz	B/X	9201-9219 MHz
2	9221-9243	C/X	9222-9241
3	9238-9262	D/X	9239-9264
4	9260-9282	B/W	9261-9281
5	9278-9299		9280-9300
6	9297-9320	B/Y	9298-9320
7	9320-9341	C/Y	9322-9341
8	9338-9362	D/Y	9340-9362
9	9361-9379	B/W	9358-9380
10	9379-9402		9380-9403
11	9399-9421	D/W	9397-9422
12	9421-9444	C/X	9420-9438
13	9438-9461	B/X	9437-9460
14	9458-9482	D/Y	9459-9481
15	9480-9502	D/W	9479-9502
16	9499-9524	B/Y	9500-9522
17	9521-9542	C/Y	9520-9540
18	9540-9561	D/Z	9537-9562
19	9558-9581	B/Z	9558-9580
20	9578-9603	C/Z	9578-9604

Appendix 8: Performance Characteristics

BAND 1

	7107A	7107B
I. RF BANDPASS (MHz)		
3 db	153.7-166.5	153.4-167.3
10 db	153.1-167.5	153.0-167.6
20 db	152.5-168.1	152.4-168.1
30 db	152.2-168.5	152.0-168.5
II. SYSTEM SENSITIVITIES		
(a) Threshold (dbm)	-42.5	-41.5
(b) Threshold & Antenna Gain (dbm)	-45.5	-44.5
(c) SLM Threshold (dbm)	-42	-42
(d) (db)	>30	>30
III. ANTENNA		
Type	Turnstile	Turnstile
Pattern	Omni	Omni
Gain, Nominal (db)	3	3
Beam Relative to Flight Line	NA	NA
Options	None	None
IV. XMTR & MODULATOR	BW	

Appendix 9: Performance Characteristics

BAND 2

	7107A	7107B
I. RF BANDPASS (MHz)		
3 db	164.0-200.5	164.0-200.0
10 db	162.5-202.0	162.5-201.5
20 db	161.0-204.0	161.0-203.5
30 db	160.0-206.5	159.5-206.0
II. SYSTEM SENSITIVITIES		
(a) Threshold (dbm)	-42	-42
(b) Threshold & Antenna Gain (dbm)	-45	-45
(c) SLM Threshold (dbm)	-41.5	-43.5
(d) [redacted] (db)	>30	>30
III. ANTENNA		
Type	Turnstile	Turnstile
Pattern	Omni	Omni
Gain, Nominal (db)	3	3
Beam Relative to Flight Line	NA	NA
Options	None	None
IV. XMTR & MODULATOR	BX	
[redacted]		

Appendix 10: Performance Characteristics

BAND 3

	7107A	7107B
I. RF BANDPASS (MHz) 3 db	545-817	546-815
10 db	537-823	536-825
20 db	527-831	522-834
30 db	503-842	513-846
II. SYSTEM SENSITIVITIES (a) Threshold (dbm)	-50.5	-50
(b) Threshold & Antenna Gain (dbm)	-53.5	-53
(c) SLM Threshold (dbm)	-53.5	-54
(d) [redacted] (db)	+26	>30
III. ANTENNA Type	4 Monopoles	4 Monopoles
Pattern	Omni	Omni
Gain, Nominal (db)	3	3
Beam Relative to Flight Line	0-360°	0-360°
Options	None	None
IV. XMTR & MODULATOR	BZ	
[redacted]		

BAND 4

	7107A	7107B
I. RF BANDPASS (MHz) 3 db	810-970	813-975
10 db	805-975	807-978
20 db	800-981	800-988
30 db	791-990	792-998
II. SYSTEM SENSITIVITIES (a) Threshold (dbm)	-48.5	-50.5
(b) Threshold & Antenna Gain (dbm)	-51.5	-53.5
(c) SLM Threshold (dbm)	-48.5	-50
(d) [redacted] (db)	+18	>30
III. ANTENNA Type	4 Monopoles	Monopoles
Pattern	Omni	Omni
Gain, Nominal (db)	3	3
Beam Relative to Flight Line	0-360°	0-360°
Options	None	None
IV. XMTR & MODULATOR	DW	
[redacted]		

Appendix 12: Performance Characteristics

BAND 5

	7107A		7107B	
	Horizontal	Vertical	Horizontal	Vertical
I. RF BANDPASS (MHz)				
3 db	1785-2110	1790-2105	1782-2105	1790-2108
10 db	1772-2121	1775-2115	1760-2117	1780-2123
20 db	1755-2140	1757-2132	1752-2135	1763-2142
30 db	1735-2161	1738-2151	1733-2157	1744-2164
II. SYSTEM SENSITIVITIES				
(a) Threshold (dbm)	-50	-53.5	-51.5	-53.5
(b) Threshold & Antenna Gain (dbm)	-55	-55.5	-56.5	-55.5
(c) SLM Threshold(dbm)	-49	-53.5	-52	-53.5
(d) [redacted] (db)	>30	>30	>30	>30
III. ANTENNA				
Type	4 Dipoles	Discone	4 Dipoles	Discone
Pattern	Omni	Omni	Omni	Omni
Gain, Nominal (db)	5	2	5	2
Beam Relative to Flight Line	0-360°	0-360°	0-360°	0-360°
Options	Horizontal or Vertical or Both			
IV. XMTR & MODULATOR	BX			
[redacted]				

Appendix 13: Performance Characteristics

BAND 6

	7107A		7107B	
	Horizontal	Vertical	Horizontal	Vertical
I. RF BANDPASS (MHz)				
3 db	2072-2592	2086-2586	2086-2610	2085-2606
10 db	2052-2606	2056-2602	2068-2635	2069-2628
20 db	2028-2635	2030-2626	2041-2661	2044-2652
30 db	1993-2676	2000-2655	2009-2700	2008-2684
II. SYSTEM SENSITIVITIES				
(a) Threshold (dbm)	-50.5	-53	-50.5	-54
(b) Threshold & Antenna Gain (dbm)	-55.5	-55	-55.5	-56
(c) SLM Threshold(dbm)	-51.5	-52.5	-50	-54
(d) [redacted] (db)	>30	>30	>30	>30
III. ANTENNA				
Type	4 Dipoles	Discone	4 Dipoles	Discone
Pattern	Omni	Omni	Omni	Omni
Gain, Nominal (db)	5	2	5	2
Beam Relative to Flight Line	0-360°	0-360°	0-360°	0-360°
Options	Horizontal or Vertical or Both			
IV. XMTR & MODULATOR	CX			
[redacted]				

Appendix 14: Performance Characteristics

BAND 7

	7107A		7107B	
	Horizontal	Vertical	Horizontal	Vertical
I. RF BANDPASS (MHz) 3 db	2558-2695	2560-2698	2558-2694	2540-2695
10 db	2550-2704	2552-2705	2550-2704	2532-2704
20 db	2535-2716	2540-2717	2537-2716	2520-2714
30 db	2522-2730	2524-2731	2523-2729	2502-2726
II. SYSTEM SENSITIVITIES (a) Threshold (dbm)	-50.5	-54	-50.5	-54.5
(b) Threshold & Antenna Gain (dbm)	-55.5	-56	-55.5	-56.5
(c) SLM Threshold (dbm)	-52.5	-54	-52	-54.5
(d) [redacted] (db)	>30	>30	>30	>30
III. ANTENNA Type	4 Dipoles	Discone	4 Dipoles	Discone
Pattern	Omni	Omni	Omni	Omni
Gain, Nominal (db)	5	2	5	2
Beam Relative to Flight Line	0-360°	0-360°	0-360°	0-360°
Options	Horizontal or Vertical or Both			
IV. XMTR & MODULATOR	CY			
[redacted]				

Appendix 15: Performance Characteristics

BAND 8

	7107A		7107B	
	Horizontal	Vertical	Horizontal	Vertical
I. RF BANDPASS (MHz)				
3 db	2680-2928	2682-2928	2680-2933	2680-2920
10 db	2668-2937	2670-2936	2666-2943	2670-2932
20 db	2652-2955	2662-2952	2645-2957	2655-2950
30 db	2632-2975	2640-2973	2622-2978	2635-2972
II. SYSTEM SENSITIVITIES				
(a) Threshold (dbm)	-49	-53	-51.5	-53
(b) Threshold & Antenna Gain (dbm)	-54	-55	-56.5	-55
(c) SLM Threshold (dbm)	-52	-53	-54	-53
(d) [redacted] (db)	>30	>30	>30	>30
III. ANTENNA				
Type	4 Dipoles	Discone	4 Dipoles	Discone
Pattern	Omni	Omni	Omni	Omni
Gain, Nominal (db)	5	2	5	2
Beam Relative to Flight Line	0-360°	0-360°	0-360°	0-360°
Options	Horizontal or Vertical or Both			
IV. XMTR & MODULATOR	DY			
[redacted]				

Appendix 16: Performance Characteristics

BAND 9

	7107A		7107B	
	Horizontal	Vertical	Horizontal	Vertical
I. RF BANDPASS (MHz) 3 db	2924-3128	2924-3127	2920-3129	2922-3123
10 db	2914-3133	2914-3137	2912-3137	2912-3132
20 db	2902-3146	2900-3151	2900-3150	2900-3144
30 db	2878-3160	2883-3165	2884-3165	2881-3158
II. SYSTEM SENSITIVITIES (a) Threshold (dbm)	-49	-53	-51	-53.5
(b) Threshold & Antenna Gain (dbm)	-54	-55	-56	-55.5
(c) SLM Threshold (dbm)	-53	-53	-57	-53.5
(d) [redacted] (db)	>30	>30	>30	>30
III. ANTENNA Type	4 Dipoles	Discone	4 Dipoles	Discone
Pattern	Omni	Omni	Omni	Omni
Gain, Nominal (db)	5	2	5	2
Beam Relative to Flight Line	0-360°	0-360°	0-360°	0-360°
Options	Horizontal or Vertical or Both			
IV. XMTR & MODULATOR	DX			
[redacted]				

Appendix 17: Performance Characteristics

BAND 10

	7107A		7107B	
	Horizontal	Vertical	Horizontal	Vertical
I. RF BANDPASS (MHz)				
3 db	3102-3315	3102-3318	3100-3319	3104-3316
10 db	3085-3331	3087-3336	3089-3330	3092-3328
20 db	3067-3346	3069-3352	3072-3347	3078-3345
30 db	3045-3366	3048-3372	3052-3367	3050-3362
II. SYSTEM SENSITIVITIES				
(a) Threshold (dbm)	-51.5	-54	-56	-53
(b) Threshold & Antenna Gain (dbm)	-56.5	-56	-61	-55
(c) SLM Threshold (dbm)	-53	-54	-48.5	-51.5
(d) [redacted] (db)	>30	>30	>30	>30
III. ANTENNA				
Type	4 Dipoles	Discone	4 Dipoles	Discone
Pattern	Omni	Omni	Omni	Omni
Gain, Nominal (db)	5	2	5	2
Beam Relative to Flight Line	$0-360^{\circ}$	$0-360^{\circ}$	$0-360^{\circ}$	$0-360^{\circ}$
Options	Horizontal or Vertical or Both			
IV. XMTR & MODULATOR	BY			
[redacted]				

Appendix 18: Performance Characteristics

BAND 11

	7107A		7107B	
	Horizontal	Vertical	Horizontal	Vertical
I. RF BANDPASS (MHz)				
3 db	3285-3610	3294-3605	3285-3607	3294-3605
10 db	3276-3616	3277-3611	3277-3614	3277-3611
20 db	3267-3625	3267-3620	3267-3625	3267-3620
30 db	3257-3635	3256-3633	3255-3636	3256-3633
II. SYSTEM SENSITIVITIES				
(a) Threshold (dbm)	-53	-54.5	-55	-54.5
(b) Threshold & Antenna Gain (dbm)	-58	-56.5	-59.5	-56.5
(c) SLM Threshold (dbm)	-55.5	-54.5	-57	-54.5
(d) [redacted] (db)	>30	>30	>30	>30
III. ANTENNA				
Type	4 Dipoles	Discone	4 Dipoles	Discone
Pattern	Omni	Omni	Omni	Omni
Gain, Nominal (db)	5	2	5	2
Beam Relative to Flight Line	0-360°	0-360°	0-360°	0-360°
Options	Horizontal or Vertical or Both			
IV. XMTR & MODULATOR	CZ			
[redacted]				

Appendix 19: Performance Characteristics

BAND 12

	7107A	7107B
I. RF BANDPASS (MHz)		
3 db	3598-4056	3595-4062
10 db	3582-4073	3569-4080
20 db	3558-4100	3558-4107
30 db	3536-4136	3533-4142
II. SYSTEM SENSITIVITIES		
(a) Threshold (dbm)	-63	-63.5
(b) Threshold & Antenna Gain (dbm)	-68	-68.5
(c) SLM Threshold (dbm)	-64	-65
(d) (db)	+16	+18
III. ANTENNA		
Type	4 Dipoles	4 Dipoles
Pattern	Omni	Omni
Gain, Nominal (db)	5	5
Beam Relative to Flight Line	NA	NA
Options	None	None
IV. XMTR & MODULATOR	DZ	

Appendix 20: Performance Characteristics

BAND 13

	7107A		7107B	
	Option A	Option B	Option A	Option B
I. RF BANDPASS (MHz)				
3 db	4043-4857	4043-4857	4050-4858	4040-4862
10 db	4030-4871	4030-4870	4035-4890	4026-4878
20 db	4005-4898	4005-4894	4016-4903	4005-4905
30 db	3977-4928	3977-4927	3988-4920	3982-4938
II. SYSTEM SENSITIVITIES				
(a) Threshold (dbm)	-58	-59	-62	-62
(b) Threshold & Antenna Gain (dbm)	-60	-61	-64	-64
(c) SLM Threshold (dbm)	-60	-60	-65	-63
(d) [redacted] (db)	>30	>30	+26	>30
III. ANTENNA				
Type	4 Dipoles			
Pattern	Omnidirectional			
Gain, Nominal (db)	2			
Beam Relative to Flight Line H	17°ϕ197°	107°ϕ287°	17°ϕ197°	107°ϕ287°
Beam Relative to Flight Line V	330°ϕ157°	61°ϕ245°	330°ϕ157°	61°ϕ245°
[redacted]				
IV. XMTR & MODULATOR	CY			
[redacted]				

Appendix 21: Performance Characteristics

BAND 14

	7107A		7107B	
	Option A	Option B	Option A	Option B
I. RF BANDPASS (MHz) 3 db	5227-5909	5227-5925	5213-5872	5208-5860
10 db	5210-5930	5203-5955	5183-5906	5180-5900
20 db	5183-5960	5169-5990	5148-5935	5150-5936
30 db	5153-5997	5132-6033	5127-5965	5120-5970
II. SYSTEM SENSITIVITIES (a) Threshold (dbm)	-69.5	-69.5	-68	-68
(b) Threshold & Antenna Gain (dbm)	-71.5	-71.5	-70	-70
(c) SLM Threshold (dbm)	-68	-69	-73	-68
(d) [redacted] (db)	+19	+18	+18	+18
III. ANTENNA Type	4 Dipoles			
Pattern	Omnidirectional			
Gain, Nominal (db)	2			
Beam Relative to Flight Line H V	45 & 225 0 & 180	135 & 315 90 & 270	45 & 225 0 & 180	135 & 315 90 & 270
[redacted]				
IV. XMTR & MODULATOR	DW			
[redacted]				

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Appendix 22: Performance Characteristics

BAND 15

	7107A		7107B	
I. RF BANDPASS (MHz)	Option A	Option B	Option A	Option B
3 db	5815-6780	5800-6785	5795-6755	5805-6755
10 db	5780-6810	5765-6815	5770-6790	5765-6792
20 db	5735-6850	5710-6860	5725-6845	5720-6840
30 db	5675-6925	5650-6905	5660-6900	5645-6890
II. SYSTEM SENSITIVITES (a) Threshold (dbm)	-71	-71	-70.5	-70.5
(b) Threshold & Antenna Gain (dbm)	-74	-74	-73.5	-73.5
(c) SLM Threshold (dbm)	-71.5	-71	-71.5	-72
(d) [redacted] (db)	+12.5	+14	+12	+10.5
III. ANTENNA Type	4 Dipoles			
Pattern	Omnidirectional			
Gain, Nominal (db)	3	3	3	3
Beam Relative to Flight Line H V	20 & 200 334 & 152	110 & 290 62 & 243	20 & 200 334 & 152	110 & 290 62 & 243
[redacted]				
IV. XMTR & MODULATOR	BW			
[redacted]				

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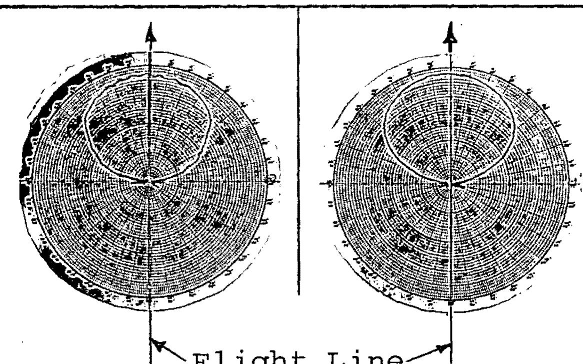
Appendix 23: Performance Characteristics

BAND 16

	7107A	7107B
I. RF BANDPASS (MHz)		
3 db	16980-18040	12570-14520
10 db	16880-18120	12480-14600
20 db	16790-18215	12410-14680
30 db	16710-18240	12330-14750
II. SYSTEM SENSITIVITIES		
(a) Threshold (dbm)	-78	-81
(b) Threshold & Antenna Gain (dbm)	-93	-97
(c) SLM Threshold (dbm)	-80	-83
(d) [redacted] (db)	+12.5	+10
III. ANTENNA		
Type	Horn	Horn
Pattern	Sectoral	Sectoral
Gain, Nominal (db)	15	16
Beam Relative to Flight Line	0° (62° BW)	0° (54° BW)
Options	None	
		
IV. XMTR & MODULATOR	[redacted]	
[redacted]		

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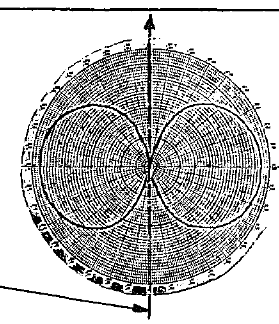
Appendix 24: Performance Characteristics

BAND 17

Channel	XMTR/PW	7107A		7107B	
		Bandpass (3 db)	Sensitivity* (dbm)	Bandpass (3 db)	Sensitivity* (dbm)
1	B/X	9201-9221	-82	9201-9219	-80
2	C/X	9221-9243	-82	9222-9241	-80.5
3	D/X	9238-9262	-82	9239-9264	-80
4	B/W	9260-9282	-82	9261-9281	-80.5
5		9278-9299	-82.5	9280-9300	-80.5
6	B/Y	9297-9320	-82.5	9298-9320	-79
7	C/Y	9320-9341	-82.5	9322-9341	-78.5
8	D/Y	9338-9362	-82.5	9340-9362	-79
9	B/W	9361-9379	-81	9358-9380	-79
10		9379-9402	-81	9380-9403	-80
11	D/W	9399-9421	-81	9397-9422	-78.5
12	C/X	9421-9444	-82	9420-9438	-78.5
13	B/X	9438-9461	-81	9437-9460	-78.5
14	D/Y	9458-9482	-83.5	9459-9481	-79.5
15	D/W	9480-9502	-83	9479-9502	-79.5
16	B/Y	9499-9524	-81.5	9500-9522	-79.5
17	C/Y	9521-9542	-81	9520-9540	-79
18	D/Z	9540-9561	-80.5	9537-9562	-80
19	B/Z	9558-9581	-81	9558-9580	-79
20	C/Z	9578-9603	-80	9578-9604	-79.5

ANTENNA	
Type	2 Horns
Pattern	Dual Sector
Gain (db)	9
Beam Relative to Flight Line	H. 95° (56° BW) and 273° (54° BW) V. 87° (57° BW) and 272° (60° BW)
Options	None



Flight Line

* Threshold Sensitivity including antenna gain.

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Appendix 25: Performance Characteristics

BAND 1

	7107C	7107D
I. RF BANDPASS (MHz)		
3 db	202-353	204-350
10 db	199-356	199-353
20 db	195-361	195-358
30 db	191-367	192-363
II. SYSTEM SENSITIVITIES		
(a) Threshold (dbm)	-52	-52
(b) Threshold & Antenna Gain (dbm)	-52	-52
(c) SLM Threshold (dbm)	-53	-50.5
(d) [redacted] (db)	>30	>30
III. ANTENNA		
Type	3-Blade array	
Pattern	Omnidirectional	
Gain, Nominal (db)	0	
Beam Relative to Flight Line	$0^{\circ}-360^{\circ}$	
Options	None	
IV. XMTR & MODULATOR	CZ	
[redacted]		

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Appendix 26: Performance Characteristics

BAND 2

	7107C	7107D
I. RF BANDPASS (MHz)		
3 db	347-452	349-450
10 db	342-455	343-454
20 db	332-460	334-461
30 db	321-467	322-470
II. SYSTEM SENSITIVITIES		
(a) Threshold (dbm)	-51	-51
(b) Threshold & Antenna Gain (dbm)	-51	-51
(c) SLM Threshold (dbm)	-51.5	-51
(d) (db)	>30	>30
III. ANTENNA		
Type	3-Blade Array	
Pattern	Omnidirectional	
Gain, Nominal (db)	0	
Beam Relative to Flight Line	0 - 360^{o}	
Options	None	
IV. XMTR & MODULATOR	BZ	

Appendix 27: Performance Characteristics

BAND 3

I. RF BANDPASS (MHz)	7107D	7107D
3 db	449-551	448-550
10 db	444-554	440-554
20 db	434-560	435-558
30 db	418-568	424-568
II. SYSTEM SENSITIVITIES (a) Threshold (dbm)	-45	-45
(b) Threshold & Antenna Gain (dbm)	-45	-45
(c) SLM Threshold (dbm)	-46	-44
(d) [redacted] (db)	>30	>30
III. ANTENNA Type	4 Monopoles	
Pattern	Omnidirectional	
Gain, Nominal (db)	0	
Beam Relative to Flight Line	0°-360°	
Options	None	
IV. XMTR & MODULATOR	CY	
[redacted]		

Appendix 28: Performance Characteristics

BAND 4

	7107C	7107D
I. RF BANDPASS (MHz) 3 db	813-979	814-976
10 db	809-985	810-981
20 db	803-992	804-988
30 db	793-997	796-995
II. SYSTEM SENSITIVITIES (a) Threshold (dbm)	-53	-52.5
(b) Threshold & Antenna Gain (dbm)	-55	-54.5
(c) SLM Threshold (dbm)	-53	-52
(d) [redacted] (db)	>30	>30
III. ANTENNA Type	4 Monopoles	
Pattern	Omnidirectional	
Gain, Nominal (db)	2	
Beam Relative to Flight Line	0^{o}-360^{o}	
Options	None	
IV. XMTR & MODULATOR	DX	
[redacted]		

Appendix 29: Performance Characteristics

BAND 5

I. RF BANDPASS (MHz)	7107A Option A	7107A Option B	7107B Option A	7107B Option B
3 db	965-1214	970-1215	963-1207	963-1210
10 db	955-1222	963-1224	954-1215	954-1216
20 db	942-1235	950-1240	943-1226	943-1220
30 db	929-1285	937-1269	931-1241	931-1242
II. SYSTEM SENSITIVITIES (a) Threshold (dbm)	-55	-55	-56	-56
(b) Threshold & Antenna Gain (dbm)	-57	-57	-58	-58
(c) SLM Threshold (dbm)	-55.5	-56	-56	-55.5
(d) [redacted] (db)	>30	>30	>30	>30
III. ANTENNA Type	4 Dipoles			
Pattern	Omnidirectional			
Gain	2			
Beam Relative to Flight Line H V	0 & 183 75 & 255	90 & 275 165 & 345	0 & 183 75 & 255	80 & 275 165 & 345
[redacted]				
IV. XMTR & MODULATOR	DZ			
[redacted]				

Appendix 30: Performance Characteristics

BAND 6

	7107C		7107D	
I. RF BANDPASS (MHz)	Option A	Option B	Option A	Option B
3 db	1193-1810	1298-1813	1195-1810	1203-1810
10 db	1170-1830	1175-1828	1171-1820	1187-1830
20 db	1135-1850	1145-1846	1139-1837	1153-1846
30 db	1080-1875	1098-1865	1090-1857	1108-1870
II. SYSTEM SENSITIVITIES (a) Threshold (dbm)	-53.5	-53.5	-52.5	-51.5
(b) Threshold & Antenna Gain (dbm)	-56.5	-56.5	-55.5	-54.5
(c) SLM Threshold(dbm)	-53.5	-54.0	-51	-51
(d) [redacted] (db)	>30	>30	>30	>30
III. ANTENNA Type	4 Dipoles			
Pattern	Omnidirectional			
Gain, Nominal (db)	3			
Beam Relative to Flight Line H V	25 & 195 52 & 235	98 & 275 148 & 320	25 & 195 52 & 235	98 & 275 148 & 320
[redacted]				
IV. XMTR & MODULATOR	BY			
[redacted]				

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Appendix 31: Performance Characteristics

BAND 7

	7107C		7107D	
	Option A	Option B	Option A	Option B
I. RF BANDPASS (MHz) 3 db	2084-2596	2082-2596	2087-2580	2082-2590
10 db	2066-2615	2062-2615	2068-2596	2068-2616
20 db	2040-2643	2036-2646	2044-2621	2042-2631
30 db	2006-2678	2007-2671	2010-2655	2010-2660
II. SYSTEM SENSITIVITIES (a) Threshold (dbm)	-54	-54	-52.5	-52.5
(b) Threshold & Antenna Gain (dbm)	-57	-57	-55.5	-55.5
(c) SLM Threshold (dbm)	-54	-54	-52	-50.5
(d) [redacted] (db)	>30	>30	>30	>30
III. ANTENNA Type	4 Dipoles			
Pattern	Omnidirectional			
Gain, Nominal (db)	3			
Beam Relative to Flight Line H	70 & 253	163 & 328	70 & 253	163 & 328
Beam Relative to Flight Line V	50 & 223	138 & 320	50 & 223	138 & 320
[redacted]				
IV. XMTR & MODULATOR	CX			
[redacted]				

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Appendix 32: Performance Characteristics

BAND 8

	7107C		7107D	
I. RF BANDPASS (MHz)	Option A	Option B	Option A	Option B
3 db	2683-2928	2682-2927	2682-2927	2683-2931
10 db	2670-2936	2670-2935	2672-2936	2670-2942
20 db	2653-2952	2652-2951	2654-2952	2650-2959
30 db	2630-2971	2629-2970	2630-2971	2630-2978
II. SYSTEM SENSITIVITIES				
(a) Threshold (dbm)	-52.5	-52.5	-52	-52
(b) Threshold & Antenna Gain (dbm)	-54.5	-54.5	-54	-54
(c) SLM Threshold (dbm)	-54.5	-54.5	-50.5	-50
(d) [redacted] (db)	>30	>30	>30	>30
III. ANTENNA				
Type	4 Dipoles			
Pattern	Omnidirectional			
Gain, Nominal (db)	2			
Beam Relative to Flight Line H	65 & 245	150 & 328	65 & 245	150 & 328
Beam Relative to Flight Line V	40 & 222	130 & 312	40 & 222	130 & 312
[redacted]				
IV. XMTR & MODULATOR	DY			
[redacted]				

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Appendix 33: Performance Characteristics

BAND 9

	7107C		7107D	
I. RF BANDPASS (MHz)	Option A	Option B	Option A	Option B
3 db	4840-5262	4837-5265	4825-5268	4837-5268
10 db	4830-5270	4823-5284	4813-5285	4825-5284
20 db	4816-5290	4810-5299	4800-5300	4810-5297
30 db	4800-5318	4792-5318	4788-5318	4796-5314
II. SYSTEM SENSITIVITES (a) Threshold (dbm)	-67	-66	-67.5	-67.5
(b) Threshold & Antenna Gain (dbm)	-71	-70	-71.5	-71.5
(c) SLM Threshold (dbm)	-66.5	-66	-67	-66
(d) [redacted] (db)	+17	+15	+15	+14
III. ANTENNA Type	4 Dipoles			
Pattern	Omnidirectional			
Gain, Nominal (db)	4			
Beam Relative to Flight Line H / V	82 & 264 / 30 & 218	174 & 352 / 122 & 302	82 & 264 / 30 & 218	174 & 352 / 122 & 302
[redacted]				
IV. XMTR & MODULATOR	CX			
[redacted]				

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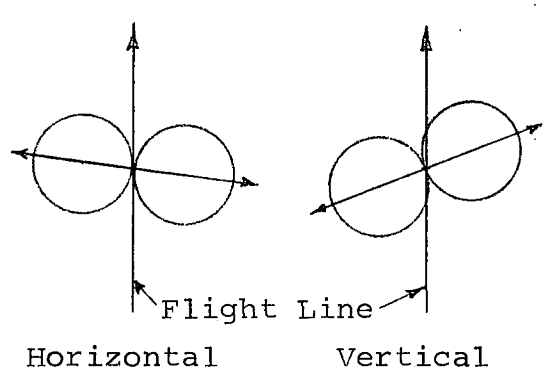
Appendix 34: Performance Characteristics

BAND 10

	7107C	7107D
I. RF BANDPASS (MHz) 3 db	6410-6744	6398-6750
10 db	6379-6774	6372-6770
20 db	6352-6800	6344-6797
30 db	6320-6828	6314-6816
II. SYSTEM SENSITIVITES (a) Threshold (dbm)	-72.5	-70
(b) Threshold & Antenna Gain (dbm)	-75.5	-73
(c) SLM Threshold (dbm)	-73	-69
(d) [redacted] (db)	+12	+11
III. ANTENNA Type	2 Dipoles	
Pattern	Opposite Quadrants	
Gain, Nominal (db)	3	
Beam Relative to Flight Line H	98 & 282	98 & 282
Beam Relative to Flight Line V	69 & 245	69 & 245
Options	None	
	 	
IV. XMTR & MODULATOR	BX	
[redacted]		

Appendix 35: Performance Characteristics

BAND 11

	7107C		7107D	
I. RF BANDPASS (MHz)	Option A	Option B	Option A	Option B
3 db	6675-7940	6700-7925	6675-7985	6700-7940
10 db	6635-8020	6650-7975	6635-8030	6655-7990
20 db	6573-8100	5685-8035	6572-8090	6595-8045
30 db	6525-8175	6510-8090	6510-8155	6530-8110
II. SYSTEM SENSITIVITES (a) Threshold (dbm)	-73	-73	-72	-71.5
(b) Threshold & Antenna Gain (dbm)	-76	-76	-75	-74.5
(c) SLM Threshold (dbm)	-73.5	-74	-72	-70.5
(d) [redacted] (db)	+ 9	+ 9	+13	+13
III. ANTENNA Type	4 Dipoles			
Pattern	Omnidirectional			
Gain, Nominal (db)	3			
Beam Relative to Flight Line H V	88 & 258 40 & 222	175 & 350 132 & 310	88 & 258 40 & 222	175 & 350 132 & 310
[redacted]				
IV. XMTR & MODULATOR	DX			
[redacted]				

Appendix 36: Performance Characteristics

BAND 12

	7107C		7107D	
I. RF BANDPASS (MHz)	Option A	Option B	Option A	Option B
3 db	7855-8620	7895-8625	7895-8628	7880-8640
10 db	7810-8645	7865-8680	7860-8673	7840-8673
20 db	7755-8685	7830-8750	7820-8715	7796-8720
30 db	7715-8710	7800-8785	7778-8740	7760-8748
II. SYSTEM SENSITIVITIES (a) Threshold (dbm)	-75	-75	-74.5	-75
(b) Threshold & Antenna Gain (dbm)	-77	-77	-76.5	-77
(c) SLM Threshold (dbm)	-76.5	-75	-74	-74.5
(d) (db)	+12	+13	+12	+12
III. ANTENNA Type	4 Dipoles			
Pattern	Omnidirectional			
Gain, Nominal (db)	2			
Beam Relative to Flight Line H	20 & 200	110 & 290	20 & 200	110 & 290
Beam Relative to Flight Line V	335 & 155	65 & 245	335 & 155	65 & 245
IV. XMTR & MODULATOR	CX			

Appendix 37: Performance Characteristics

BAND 13

	7107C		7107D	
I. RF BANDPASS (MHz)	Option A	Option B	Option A	Option B
3 db	8590-9128	8595-9120	8585-9105	8600-9122
10 db	8567-9164	8570-9150	8554-9133	8570-9146
20 db	8538-9196	8543-9180	8538-9162	8550-9172
30 db	8515-9218	8520-9208	8518-9192	8530-9192
II. SYSTEM SENSITIVITES				
(a) Threshold (dbm)	-76	-75	-76	-76
(b) Threshold & Antenna Gain (dbm)	-78	-77	-78	-78
(c) SLM Threshold (dbm)	-77.5	-77.5	-74.5	-75
(d) [redacted] (db)	+11	+13	+ 9	+ 9
III. ANTENNA				
Type	4 Dipoles			
Pattern	Omnidirectional			
Gain, Nominal (db)	2			
Beam Relative to Flight Line H / V	20 & 200 / 335 & 155	110 & 290 / 65 & 245	20 & 200 / 335 & 155	110 & 290 / 65 & 245
[redacted]				
IV. XMTR & MODULATOR	BW			
[redacted]				

Appendix 38: Performance Characteristics

BAND 14

	7107C		7107D	
I. RF BANDPASS (MHz)	Option A	Option B	Option A	Option B
3 db	9085-9348	9096-9352	9097-9340	9095-9345
10 db	9040-9370	9075-9380	9055-9368	9060-9375
20 db	8993-9390	9048-9392	9020-9388	9032-9395
30 db	8967-9408	9030-9432	8990-9397	9010-9412
II. SYSTEM SENSITIVITIES (a) Threshold (dbm)	-72.5	-72.5	-72.5	-72.5
(b) Threshold & Antenna Gain (dbm)	-75.5	-75.5	-75.5	-75.5
(c) SLM Threshold (dbm)	-74.5	-75	-72	-72.5
(d) [redacted] (db)	+16	+13	+13	+10
III. ANTENNA Type	4 Dipoles			
Pattern	Omnidirectional			
Gain, Nominal (db)	3			
Beam Relative to Flight Line H / V	20 & 200 340 & 160	110 & 290 70 & 250	20 & 200 340 & 160	110 & 290 70 & 250
[redacted]				
IV. XMTR & MODULATOR	[redacted]			
[redacted]				

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Appendix 39: Performance Characteristics

BAND 15

	7107C		7107D	
I. RF BANDPASS (MHz)	Option A	Option B	Option A	Option B
3 db	9340-9403	9335-9403	9340-9405	9345-9405
10 db	9328-9412	9327-9408	9335-9407	9337-9415
20 db	9318-9430	9318-9415	9325-9418	9332-9430
30 db	9311-9442	9313-9420	9315-9427	9325-9437
II. SYSTEM SENSITIVITIES (a) Threshold (dbm)	-75	-75	-76.5	-78
(b) Threshold & Antenna Gain (dbm)	-78	-78	-79.5	-81
(c) SLM Threshold (dbm)	-76	-77	-75.5	-75.5
(d) [redacted] (db)	+12	+11	+11	+10
III. ANTENNA Type	4 Dipoles			
Pattern	Omnidirectional			
Gain, Nominal (db)	3			
Beam Relative to Flight Line H V	20 & 200 340 & 160	110 & 290 70 & 250	20 & 200 340 & 160	110 & 290 70 & 250
[redacted]				
IV. XMTR & MODULATOR	DW			
[redacted]				

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Appendix 40: Performance Characteristics

BAND 16

	7107C		7107D	
I. RF BANDPASS (MHz)	Option A	Option B	Option A	Option B
3 db	9400-9615	9395-9612	9385-9607	9391-9620
10 db	9375-9645	9368-9633	9358-9633	9371-9646
20 db	9355-9675	9330-9660	9328-9663	9352-9680
30 db	9338-9708	9305-9682	9305-9693	9347-9707
II. SYSTEM SENSITIVITIES (a) Threshold (dbm)	-74	-74.5	-74	-74.5
(b) Threshold & Antenna Gain (dbm)	-77	-77.5	-77	-77.5
(c) SLM Threshold (dbm)	-75.5	-75	-73	-73
(d) [redacted] (db)	±12	+13	+14	+12
III. ANTENNA Type	4 Dipoles			
Pattern	Omnidirectional			
Gain, Nominal (db)	3			
Beam Relative to Flight Line H V	20 & 200 340 & 160	110 & 290 70 & 250	20 & 200 340 & 160	110 & 290 70 & 250
[redacted]				
IV. XMTR & MODULATOR	CY			
[redacted]				

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Appendix 41: Performance Characteristics

BAND 17

	7107C		7107D	
I. RF BANDPASS (MHz)	Option A	Option B	Option A	Option B
3 db	9570-10550	9580-10500	9575-10520	9610-10545
10 db	9520-10580	9530-10570	9520-10575	9560-10580
20 db	9470-10625	9480-10615	9475-10630	9500-10615
30 db	9425-10670	9435-10660	9440-10660	9470-10650
II. SYSTEM SENSITIVITIES (a) Threshold (dbm)	-73	-73	-73.5	-73
(b) Threshold & Antenna Gain (dbm)	-76	-76	-76.5	-76
(c) SLM Threshold (dbm)	-74.5	-73.5	-73	-72
(d) (db)	+13	+12	+13	+10
III. ANTENNA Type	4 Dipoles			
Pattern	Omnidirectional			
Gain, Nominal (db)	3			
Beam Relative to Flight Line H / V	20 & 200 340 & 160	110 & 290 70 & 250	20 & 200 340 & 160	110 & 290 70 & 250
IV. XMTR & MODULATOR	DZ			

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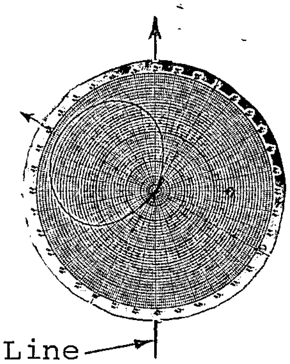
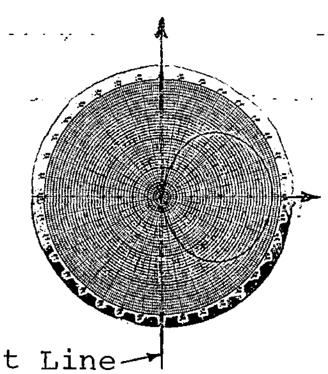
Appendix 42: Performance Characteristics

BAND 18

	7107C	7107D
I. RF BANDPASS (MHz) 3 db	14465-14860	14438-14850
10 db	14415-14906	14403-14900
20 db	14380-14940	14363-14933
30 db	14360-14960	14325-14965
II. SYSTEM SENSITIVITIES (a) Threshold (dbm)	-78.5	-78
(b) Threshold & Antenna Gain (dbm)	-93.5	-93
(c) SLM Threshold (dbm)	-79.5	-76
(d) [redacted] (db)	+5	+5
III. ANTENNA Type	Horn	Horn
Pattern	Sectoral	Sectoral
Gain, Nominal (db)	15	15
Beam Relative to Flight Line	303° (51°BW)	303° (51°BW)
Options	None	None
	 Flight Line	
IV. XMTR & MODULATOR	BW	
[redacted]		

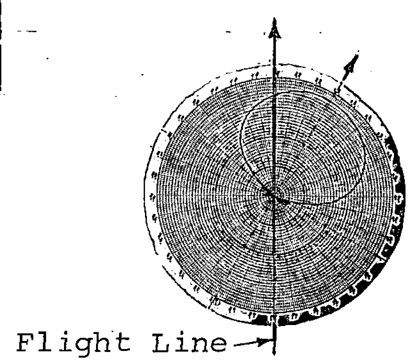
Appendix 43: Performance Characteristics

BAND 19

	7107C	7107D
I. RF BANDPASS (MHz) 3 db	14785-15250	14760-15155
10 db	14710-15260	14713-15225
20 db	14630-15280	14677-15290
30 db	14960-15310	14650-15340
II. SYSTEM SENSITIVITIES (a) Threshold (dbm)	-77.5	-78
(b) Threshold & Antenna Gain (dbm)	-92.5	-93
(c) SLM Threshold (dbm)	-79.5	-77
(d) [redacted] (db)	+9	+9
III. ANTENNA Type	Horn	Horn
Pattern	Sectoral	Sectoral
Gain, Nominal (db)	15	15
Beam Relative to Flight Line	90° (51°BW)	90° (51°BW)
Options	None	
	 Flight Line	
IV. XMTR & MODULATOR	[redacted]	
[redacted]		

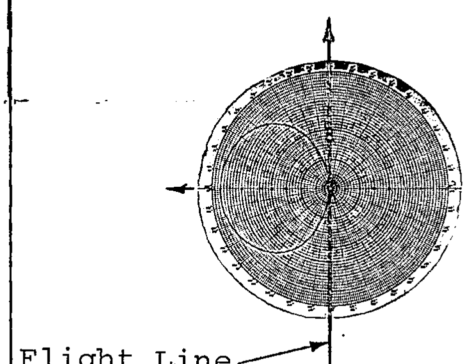
Appendix 44: Performance Characteristics

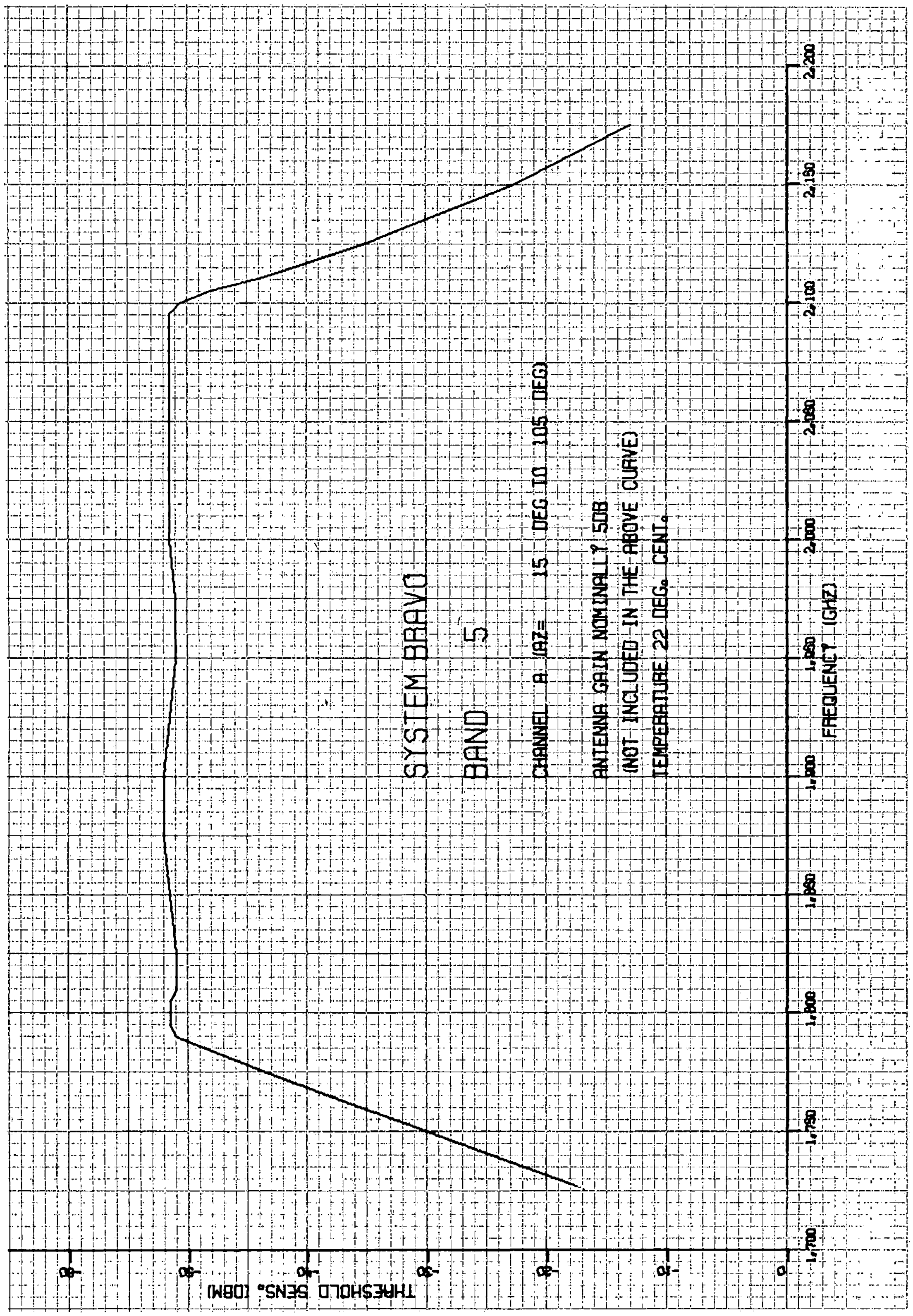
BAND 20

I. RF BANDPASS (MHz)	7107C	7107D
3 db	14990-16070	15950-17060
10 db	14950-16160	15892-17130
20 db	14860-16270	15840-17180
30 db	14800-16400	15800-17240
II. SYSTEM SENSITIVITIES (a) Threshold (dbm)	-78.5	-78.5
(b) Threshold & Antenna Gain (dbm)	-93.5	-93.5
(c) SLM Threshold (dbm)	-78.5	-78
(d) (db)	+9	+7
III. ANTENNA Type	Horn	Horn
Pattern	Sectoral	Sectoral
Gain, Nominal (db)	15	15
Beam Relative to Flight Line	29° (52°BW)	29° (52°BW)
Options	None	
		
IV. XMTR & MODULATOR	DW	

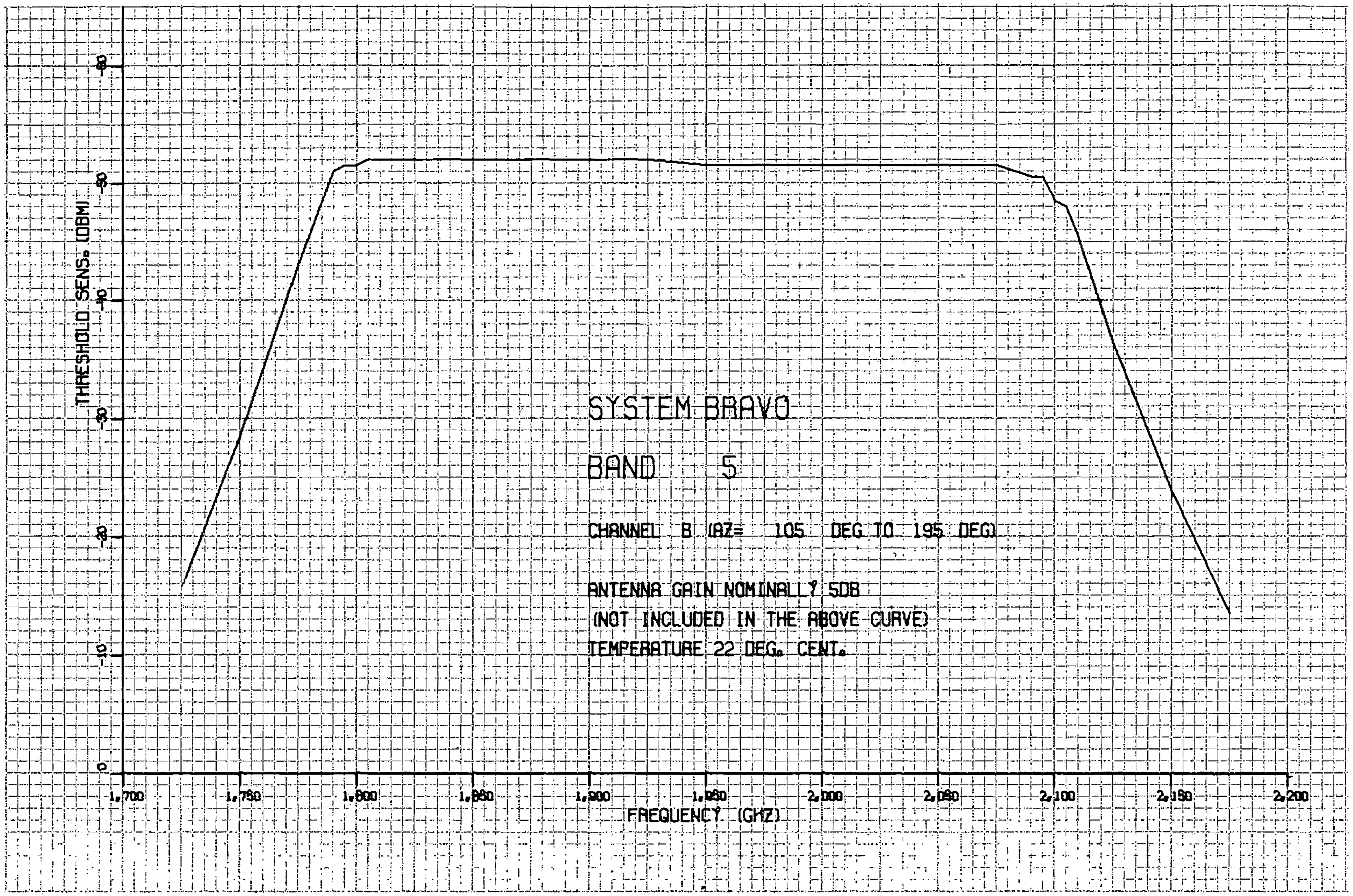
Appendix 45: Performance Characteristics

BAND 21

I. RF BANDPASS (MHz)	7107C	7107D
3 db	34680-35000	34680-34980
10 db	34666-35024	34674-35010
20 db	34600-35044	34646-35032
30 db	34540-35070	34624-35044
II. SYSTEM SENSITIVITIES (a) Threshold (dbm)	-63	-62.5
(b) Threshold & Antenna Gain (dbm)	-80	-79.5
(c) SLM Threshold (dbm)	-65.5	-62
(d) (db)	+ 9	+12
III. ANTENNA Type	Horn	Horn
Pattern	Sectoral	Sectoral
Gain, Nominal (db)	17	17
Beam Relative to Flight Line	270°	270°
Options	None	
		
IV. XMTR & MODULATOR	BW	



Appendix 46: Frequency Response for Typical Band (Channel A)



Appendix 47: Frequency Response for Typical Band (Channel B)

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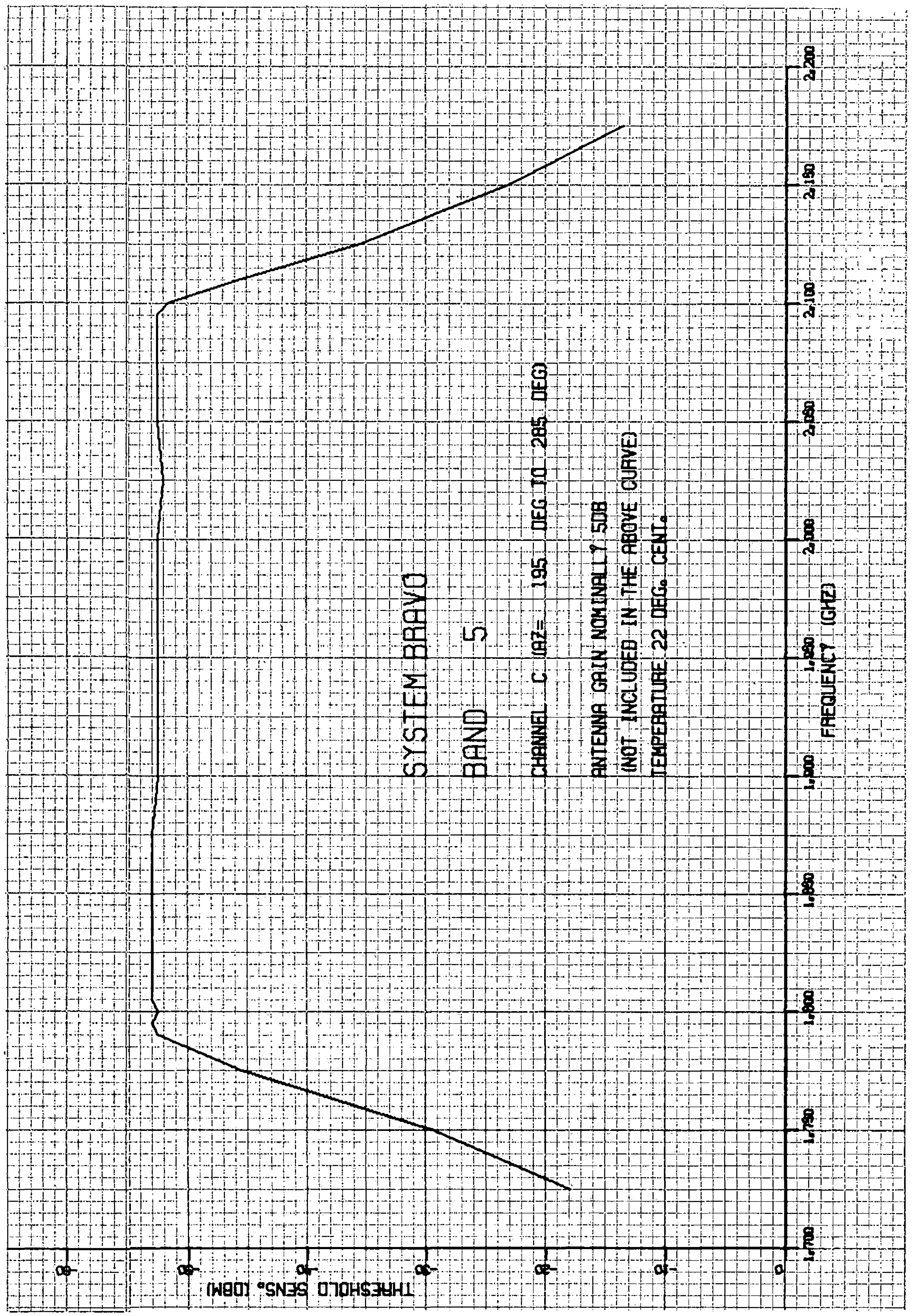

Appendix 48: Frequency Response for Typical Band (Channel C)

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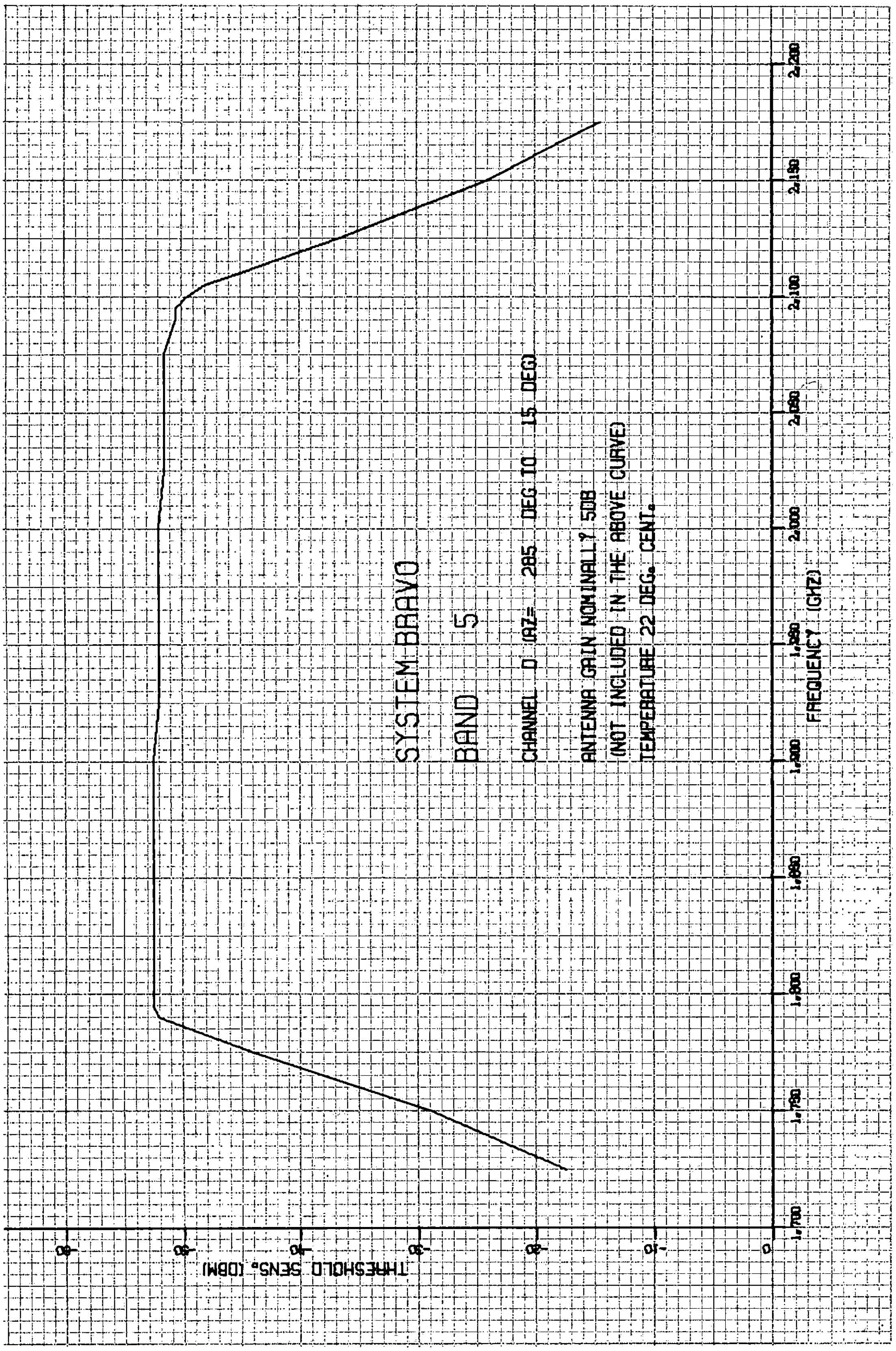
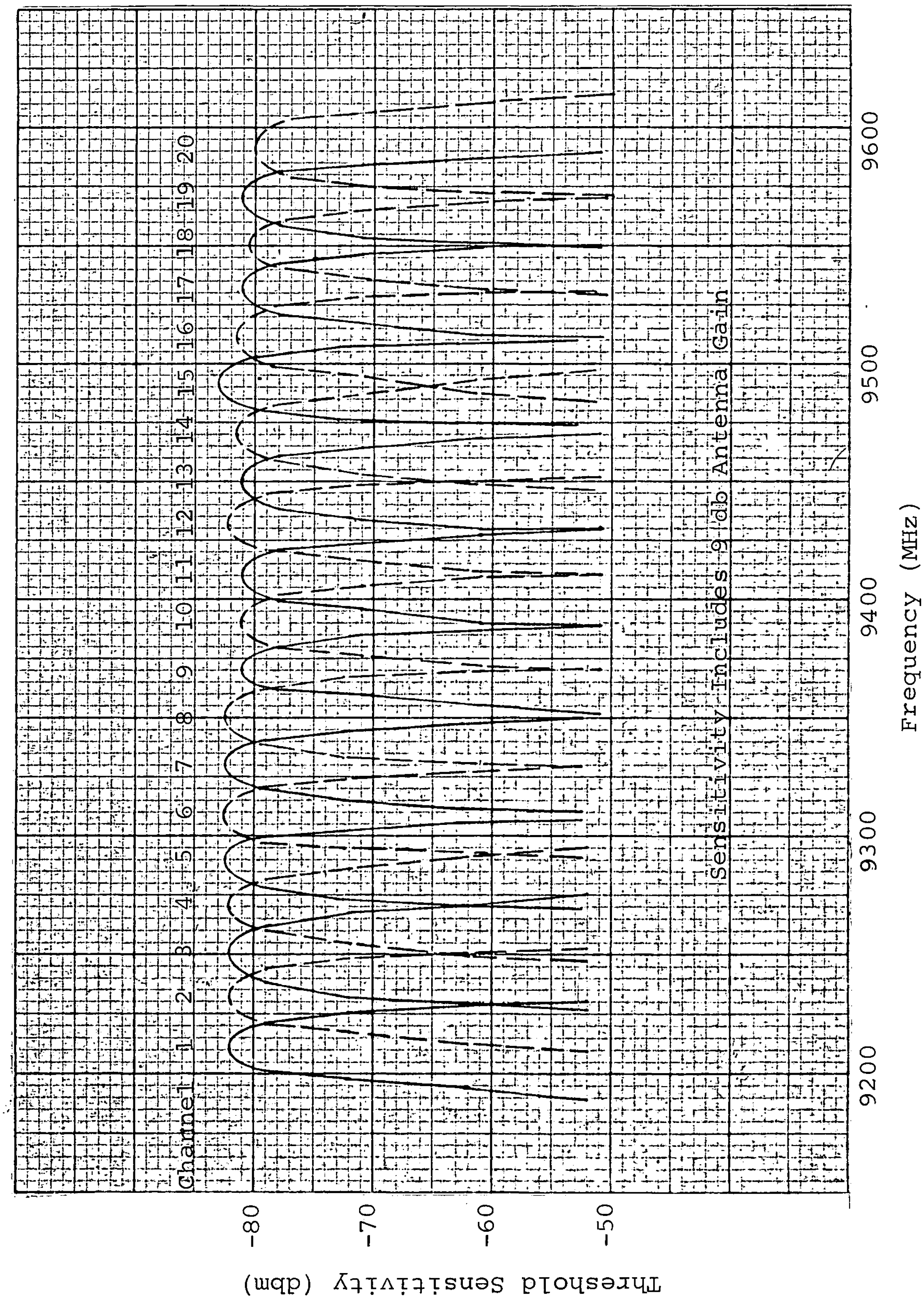
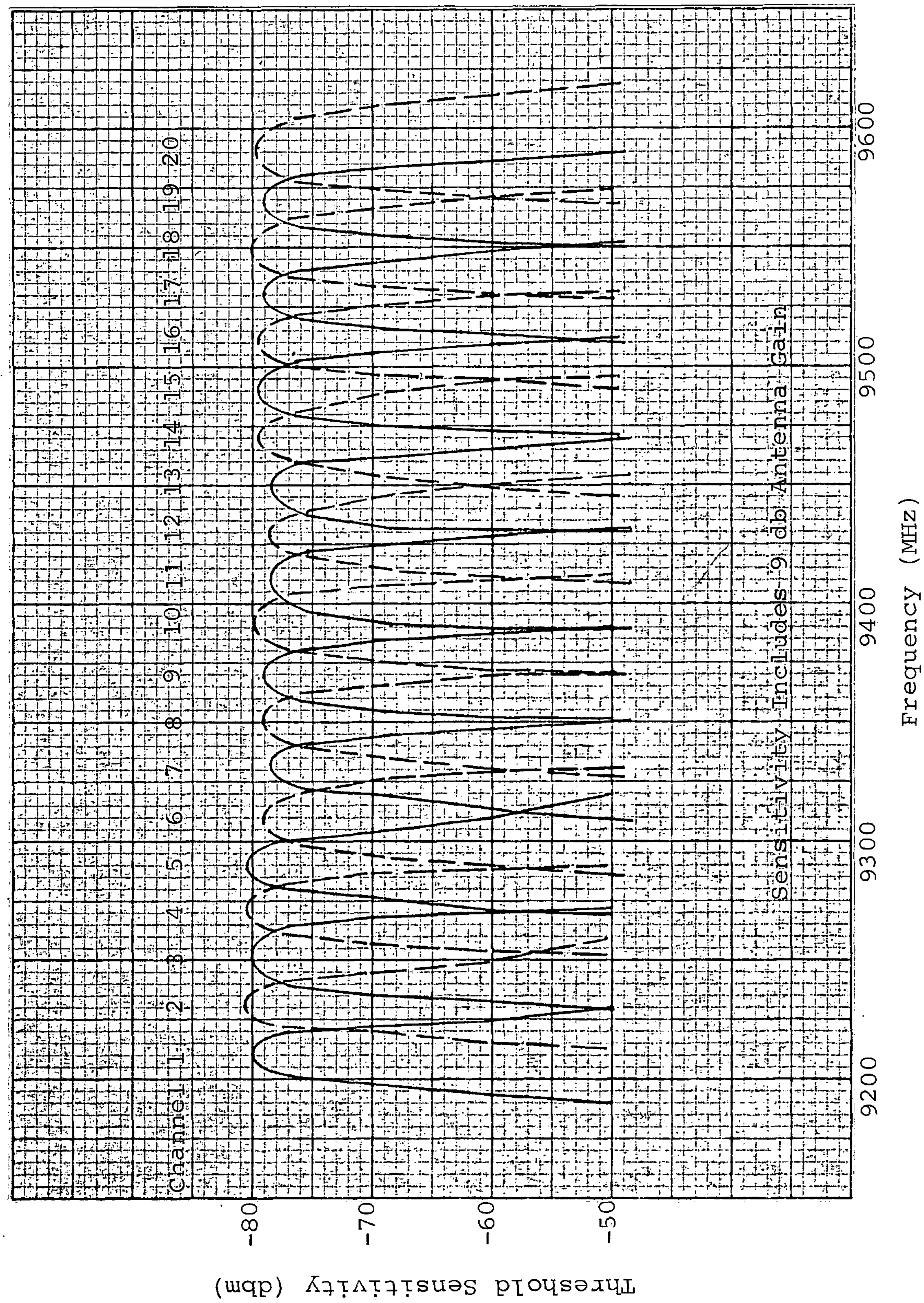


Appendix 49: Frequency Response for Typical Band (Channel D)



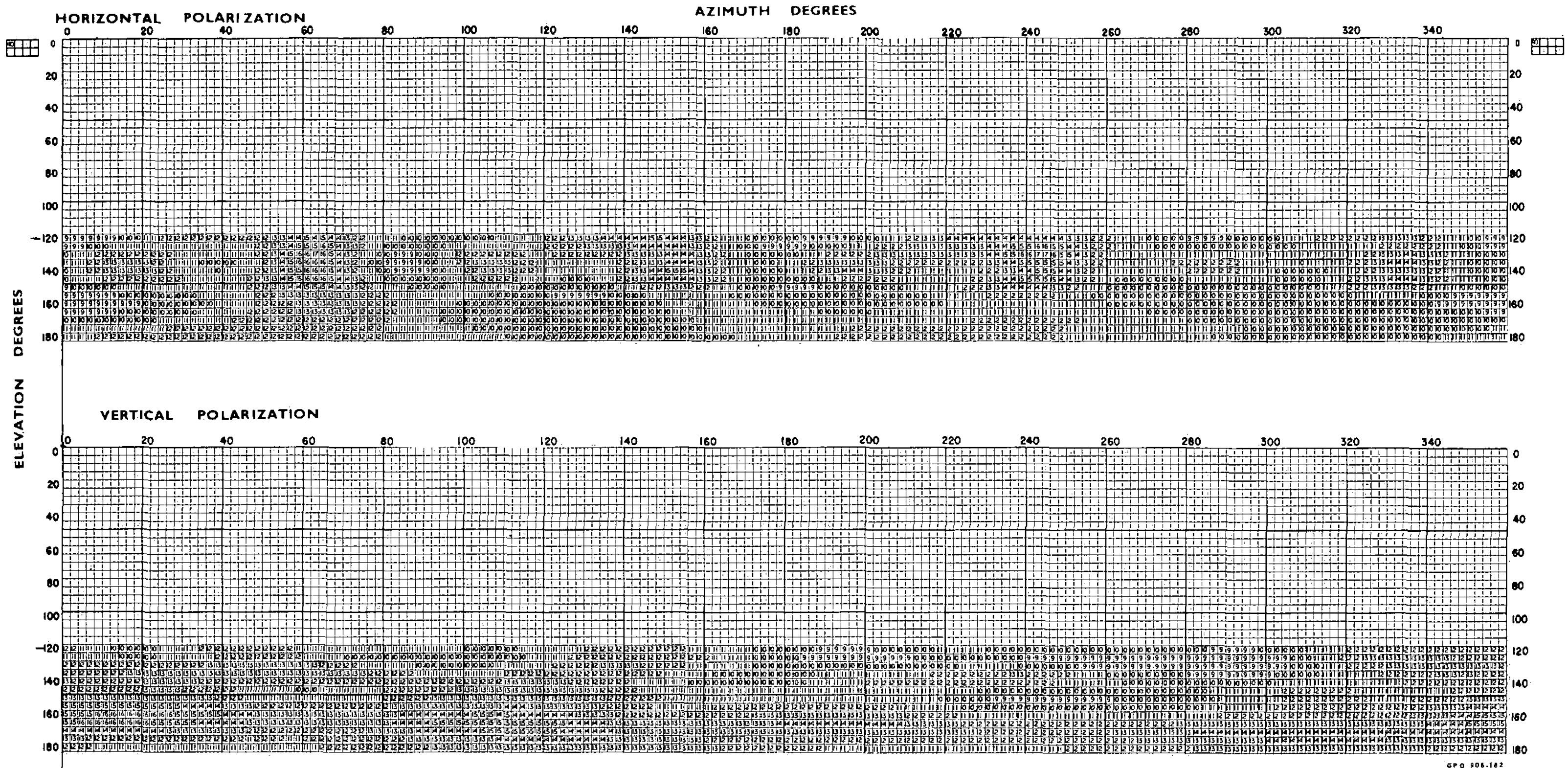
Appendix 50: Mission 7107A--Band 17



Appendix 51: Mission 7107B--Band 17

NAVAL RESEARCH LABORATORY

PATTERN NO. 170115



FLIGHT LINE

PATTERN NO. 170115 BAND 3 ALL DIGITS IN GRAPH ARE DECIBELS BELOW A REFERENCE OF 16.5

ANTENNA TYPE * FREQUENCY 750 MHZ SYSTEM 7107A

COMMENTS: * Four Monopoles

Appendix 52: Antenna Pattern of Typical Omnidirectional System

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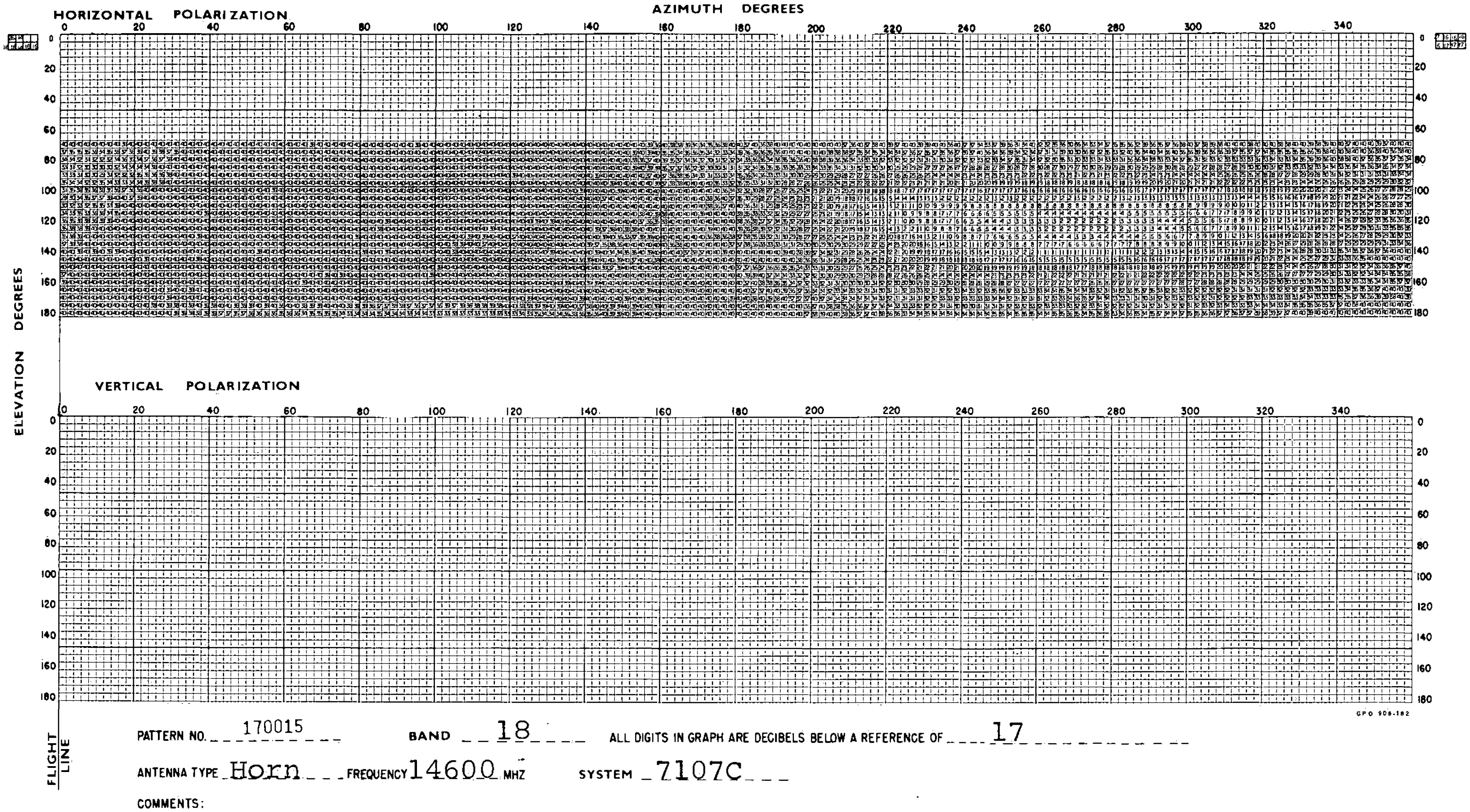
NAVAL RESEARCH LABORATORY

PATTERN NO. 170015



PATTERN NO. 170015 BAND 18 ALL DIGITS IN GRAPH ARE DECIBELS BELOW A REFERENCE OF 17

ANTENNA TYPE Horn FREQUENCY 14600 MHZ SYSTEM 7107C

COMMENTS:

A-53

Appendix 53: Antenna Pattern of Typical Sectoral Horn Antenna

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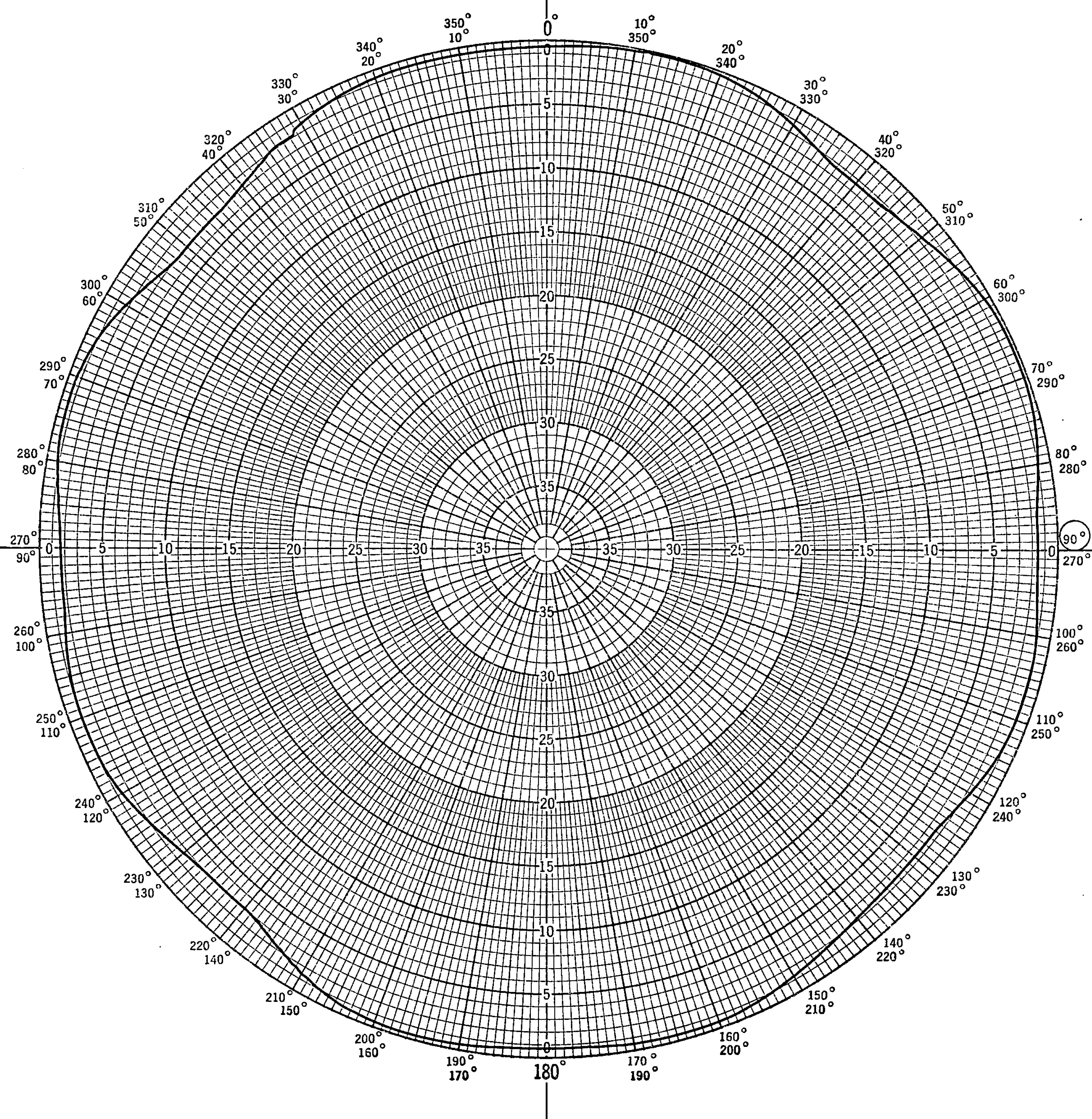
APPENDIX 54: ANTENNA PATTERN OF BAND 3, 7107A.

Frequency = 690 MHz, Hor. Pol.

(Plotted in db)



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APPENDIX 55: ANTENNA PATTERN OF BAND 13, 7107A, SHOWING COMPOSITE OF 4 DIPOLES

Frequency = 4450 MHz, Hor. Pol.
(Plotted in db)