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REVISED (JULY 1965)

COPY 24 OF 50 COPIES

STANDARD OPERATING PROCEDURES

FOR SYSTEM POPPY

DATA COLLECTION

***** ***** ***** *****

HANDLE VIA THE BYEMAN CONTROL SYSTEM

PREPARED BY:

U. S. NAVAL SECURITY GROUP (Op-94G/G54)
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LIST OF EFFECTIVE PAGES

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RECORD OF CORRECTIONS

Change No.	Date of Change	Date Entered	By Whom Entered

STANDARD OPERATING PROCEDURE FOR SYSTEM POPPY - DATA COLLECTION

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BYE-3997-62

STANDARD OPERATING PROCEDURE

FOR SYSTEM POPPY

DATA COLLECTION

I - INTRODUCTION

A. GENERAL

1. The purpose of this operation is to receive and record certain emissions from U.S. earth satellite vehicles. It has been assigned the name System POPPY, and is carried on at a number of field stations around the world. The production of useful results from this operation is governed in general by three factors: (1) Clear, concise directives and how to perform each function; (2) Adequate equipment for the job; and (3) An operator with ability to intelligently interpret and follow instructions and to correctly operate the equipment. This Standard Operating Procedure (SOP) for System POPPY has been developed to provide the instructions necessary for performing all intercept operations involved in this project. It includes the schedule to be followed for each orbit, the method for locating the satellites, adjustment procedures for the equipment, details of functions to be performed during the period of actual intercept, and instructions for handling and forwarding all collected material and associated reports.

2. The radio receiving equipment installed in the huts has been chosen, designed, and adjusted prior to shipment to provide the maximum of reliability, simplicity, and ease of operation compatible with the job to be done. But, in common with all such equipment, it is not, and cannot be made, foolproof; it will require a certain amount of intelligence and understanding on the part of the operators and technicians in order to obtain the maximum effectiveness of the project, and in some cases even to preclude failure.

3. The operation has been designed around the use of two operators in each of two huts; one to handle the CHANNEL A receiving system and manipulate the antenna, and the other to oversee the DATA CHANNEL receiving system and tape recorder. In addition, the services of one Electronics Technician will be required to make gain control adjustments, perform the sensitivity check, and correct equipment failures as they may occur. Operators and technicians involved in this project must thoroughly understand their respective portions of this SOP and must be able to carry them out without hesitation. Practice in reading the polar map, developing charts, and operating the equipment is mandatory.

REMEMBER: NO MATTER HOW COMPLETE AND DETAILED THE INSTRUCTIONS ARE, OR HOW WELL THE EQUIPMENT HAS BEEN DESIGNED AND FABRICATED, THERE IS NO SUBSTITUTE FOR HUMAN INTELLIGENCE IN PERFORMING EACH FUNCTION.

B. INTERCEPT SYSTEM DESCRIPTION

1. GENERAL: The intercept system consists of two huts, both of which are equipped with an Antenna System, four Radio Receivers, and a Tape Recorder. This permits simultaneous tracking and data reception from two satellites. Intermediate frequency receiver signals are passed between the huts by the Line Driver Detectors, to allow signals to be recorded remotely. An OSCILLOSCOPE is provided in each hut for setting system levels and as a maintenance aid. A Signal Panel, Patch Panel, Converter Control Panel, Entry Termination Panel, and two Local Audio Panels are used to achieve flexibility in interconnecting the components in each of the two huts. One of the two huts contains a TIME CODE GENERATOR and the other a Remote Time Readout. As a matter of nomenclature, the hut containing the TIME CODE GENERATOR is herein designated the "PRIMARY HUT", and the hut containing the Remote Time Readout, the "SECONDARY HUT".

2. ANTENNA SYSTEM: Each Antenna System includes two sets of yagi antenna arrays mounted on a rotatable mast; one set is intended for use with CHANNEL A, and the other, for employment with the DATA CHANNELS. A vertical whip is provided to be used in conjunction with the CHANNEL D receiver to synchronize the TIME CODE GENERATOR with observatory time.

a. YAGI ANTENNAS: The two sets of yagi antennas used for this operation have been specifically designed to provide a maximum of gain compatible with the required antenna beam pattern. The CHANNEL A antenna is a two bay, 10-element Yagi, vertically polarized, and has a gain of 14 db and a 1/2-power beamwidth of (23) degrees in azimuth and 50 degrees 28° in elevation. The DATA CHANNEL antenna is a four-bay, 10-element Yagi, vertically polarized, and has a gain of (14 db) and a 1/2-power beamwidth 16 db of 22 degrees in azimuth and 50 degrees in elevation. Due to the problems that will be encountered in staying on the DATA CHANNEL signals, extreme care will have to be taken when moving the antennas to keep the satellite in the center of the antenna beam patterns. Easy movement of the antennas is accomplished through the use of a planetary gear system, with a mechanical advantage of 6 to 1, connected to the antenna mast.

b. TIME ANTENNA: The TIME ANTENNA is a whip antenna, i.e., a vertical monopole, designed for reception in the 5-25 Mc frequency spectrum. It is a three-section stainless steel tubular member self-supported on an insulator which in turn is supported on a steel footing in the form of a cross. The antenna system is provided with a counterpoise which consists of sixteen radially arranged copper conductors approximately thirty-five feet long. In addition, a matching network is provided, mounted in a water-tight box at the base of the antenna. This matching network allows

the antenna to be matched to a 50-ohm transmission line at 10, 15 and 20 megacycles. The switch at the base of the antenna must be set to correspond with the frequency of the observatory time signals to be received. The antenna height is approximately thirty-five feet above ground level, and is designed to withstand a one-hundred mile-per-hour wind load. A fifty-foot transmission line is provided for connection to the SECONDARY HUT. The connection to the hut is accomplished through a Type N connector mounted in the wall of the hut just above the power receptacle.

3. RECEIVING SYSTEM

a. CHANNEL A AND DATA CHANNEL SYSTEMS

(1) The receiving equipment comprising the CHANNEL A and DATA CHANNEL systems consists of three R390A receivers and four amplifier-converters in each hut. The receivers are designated CHANNEL A, CHANNEL B, and CHANNEL C. One converter is associated with the CHANNEL A receiver, one is used with the CHANNEL B and C receivers, and the remaining two are ready to be substituted for the "active" converters at a moments notice by means of a switching arrangement on the Convertor Control Panel.

(2) While the R390A receivers are tunable from 0.5 Mcs to 32 Mcs, only a small part of one frequency band will be used for this project. In this system, the R390A receivers operate as the 2nd intermediate and audio frequency sections of a double conversion superheterodyne receiving system, and the converters act as the preamplifier and converter stages of the system. The converters are pre-tuned permanently to the two bands (4 to 6 or 15 to 30 mcs) on which reception will be required. Therefore, changes to the R390A receiver frequency are actually only a "vernier" tuning of the 2nd intermediate frequency of the system. Each system, with controls properly adjusted, has a sensitivity of approximately -120 dbm. bandwidth ??

(3) Any of several receiving frequencies may be employed, depending on the satellite to be monitored. Associated with each satellite are three distinct frequencies designated CHANNEL A, CHANNEL B, and CHANNEL C. The CHANNEL A frequency is amplitude modulated by a FM shifting series of tones, and will be relatively easy to follow through frequency changes caused by Doppler effect. The CHANNEL B and CHANNEL C signals, however, are intermittent bursts, sounding somewhat like keyed CW, and will be more difficult to follow during Doppler shift. Consequently, in order to ensure the highest order of system stability and resetability, both the converters and the satellite transmitter are crystal controlled. Although the R390A receivers are not crystal controlled in the strictest sense, their stability is of the same order of magnitude. Frequency accuracy in the R390A receivers can be improved through the use of the built in 100 KC crystal calibrator. The frequency settings for the R390A receivers will be promulgated separately for each satellite to be received.

(4) Additional technical specifications and details on the function of all controls can be obtained from the equipment instruction manuals.

b. CHANNEL D SYSTEM

(1) The receiving equipment of the CHANNEL D system consists of one R390A radio receiver in the PRIMARY HUT and one R390A radio receiver in the SECONDARY HUT. The purpose of these receivers is to receive Radio Time Signals transmitted by the Observatories. Since the transmissions of interest are all in the HF spectrum, no VHF converters are required, and none are provided with this system.

4. RECORDING SYSTEM: Each hut is equipped with a GR-2800 seven channel tape recorder. Each installation will be equipped with two recorders, with one acting as a "back-up" for the other on any given orbit. Normally, only one recorder is to be employed for each orbit. The hut containing the active recorder is herein designated the LOCAL hut; the hut with the inactive, or "back-up" recorder is designated the REMOTE hut. These designations are, of course, arbitrary, and the two recorders should in fact be used interchangeable to prolong equipment life and to insure the readiness of either to operate whenever required. In the event that two satellite orbits should overlap in time, and require more recording time than can be provided by one recorder, the recorder in the REMOTE hut will be started one minute before tape run-out occurs in the LOCAL hut.

a. DATA-TAPE GR-2800 RECORDER: The GR-2800 recorder is a precision recorder capable of recording seven tracks and reproducing seven tracks simultaneously. Three of the seven tracks record information in analogue form, and four of the tracks record information in FM form. There are three analogue and four FM reproduce amplifiers which allow the reproduction of all tracks simultaneously. All of the FM record and reproduce amplifiers are identical and can be interchanged with any other record or reproduce amplifier. In addition, one each spare record and reproduce FM amplifier has been provided with the equipment. All of the analogue record and reproduce amplifiers are identical except the record unit used in TRACK 6. The TRACK 6 unit multiplexes a 50 KC Time Reference Signal and Time Code onto one track of the recorder. This multiplexing system is built into the TRACK 6 record amplifier. It is possible to plug another analogue amplifier in TRACK 6 of the recorder, but the 50 KC Time Reference Signal will be lost. Therefore, a spare unit should be used in this track only in case of emergency. All other analogue record and reproduce amplifiers may be interchanged. One each spare analogue record and reproduce amplifier has also been provided with the equipment.

(1) The channel assignment of the GR-2800 recorder is as follows:

TRACK NUMBER	TYPE RECORDING	INFORMATION TO BE RECORDED
1	FM	CHANNEL B LOCAL
2	Analog	50 KC
3	FM	CHANNEL C LOCAL
4	Analog	Mike or attenuated TCG
5	FM	CHANNEL B REMOTE
6	Analog	Time Code and 50 KC
7	FM	CHANNEL C REMOTE

Changes and additions to the above will be made separately by message.

(2) Tape Speed: The GR-2800 recorder is capable of operating at various tape speeds between 1 7/8 IPS and 60 IPS. All orbits will be operated at a tape speed of 30 IPS. The 30 IPS speed is obtained by operating the machine with the belt combination that was installed when the machine was received at the site and with the TAPE SPEED Control in the LOW mode.

(3) Record level adjustments: The record level adjustments are an integral part of the entire system level adjustments. The procedure for properly setting the levels of the recorder are covered in detail in APPENDIX B, "Receiving and Recording System Level Adjustments". It is mandatory that the detailed procedure described in this appendix be followed for the initial set up and whenever there is a change in the system that would affect the adjustment of the record levels.

(4) Head cleaning: The GR-2800 recorder is susceptible to malfunctioning if the recording heads are dirty. It is essential that the record heads be cleaned prior to each mission.

5. TIMING SYSTEM: An ASTRODATA TIME CODE GENERATOR is installed in the PRIMARY HUT, and develops a binary time of day code in the form of 2000CPS carrier which is pulse width modulated by the binary time information. This information is sequentially sampled at 25 PPS, and the output is recorded simultaneously with the DATA CHANNELS to provide time correlation. In the event the ASTRODATA TIME CODE GENERATOR fails, voice annotations of time will be substituted for the time code in channel 4. (See APPENDIX D). Instructions are contained in APPENDIX L outlining in further detail the manner in which the TIME CODE GENERATOR is to be used. Since the information gathered

by this system is valuable only insofar as it is directly related to time, it behooves both operator and maintenance personnel to adhere strictly to the procedures described therein. Detailed descriptions of the TIME CODE GENERATOR may be found in the respective equipment instruction manual.

6. LOCAL AUDIO PANELS: Each operating position is equipped with a LOCAL AUDIO PANEL. The audio outputs from each receiver are terminated on the panels, and an individual GAIN control is provided for each output. In normal operations, the LOCAL GAIN controls of the CHANNELS A, B, C, and D receivers should be operated in the full gain (10) position with the GAIN control of the LOCAL AUDIO panel adjusted for a comfortable headphone level by the operator. The LOCAL AUDIO panel provides parallel outputs for all receivers. This allows an operator using split headphones to monitor receiver audio outputs in an essentially single headphone mode, or gives him the option of monitoring two different receiver outputs in a split headphone mode.

7. SIGNAL PANEL: The Signal Panel groups the microphone input for the DATATAPE recorder, the Time Receiver output, one pulse per second from the ASTRODATA TIME CODE GENERATOR, and the DATATAPE recorder record and reproduce channels. These signals are made available at the Signal Panel for monitoring on the OSCILLOSCOPE.

8. PATCH PANEL: The Patch Panel facilitates the routing of signals about the hut. On it appear seven recorder inputs; the outputs of all the receivers (current and planned for) in both huts; the LOCAL and REMOTE 50 KC Time Reference Signals; the microphone output from the Signal Panel; one pulse per second, one pulse per minute, and time code from the ASTRODATA TIME CODE GENERATOR.

9. CONVERTER CONTROL PANEL: The Converter Control Panel supplies power to the converters, distributes the converter input and outputs, and allows for the rapid changeover of converters in the event of a malfunction. It also contains the 70 db directional couplers used in the SYSTEM SENSITIVITY CHECK (APPENDIX K).

10. ENTRY TERMINATION PANEL: The Entry Termination Panel serves to terminate the cables which pass signals between the two huts.

11. LINE DRIVER DETECTOR: The Line Detector unit amplifies the 455 KC I. F. signals from the receivers prior to passing them to the REMOTE hut. The incoming 455 KC signals are detected and fed to the Patch Panel. The unit also contains a broad band amplifier to offset line losses in the 50 KC Time Reference Signals.

12. The TEKTRONIX RM-561 OSCILLOSCOPE is provided with a four-channel vertical amplifier unit, and is to be used primarily as a tuning aid for the CHANNEL B and C receivers. It is also used to monitor the reproduce channels of the recorder to insure that the data is being recorded properly.

13. An AZIMUTH DEVIATION UNIT referred to as ADU has been installed at each installation. The function of the ADU is to provide antenna steering information on a C-W signal. It does this by slewing the beam of the antenna back and forth by a small amount and comparing the phase/amplitude of the resulting modulation of the received signal with a reference derived from the slewing signal. The antenna system consists of two identical antennas connected together through a RF Lobing Switch. The RF Lobing Switch connects its output alternately to inputs one and two in response to the switch control signals from the ADU. The Indicator Meter is a center zero type and deflects to either side to indicate the direction of the steering error. Complete operation and installation instructions for the ADU are contained in PRELIMINARY INSTALLATION, OPERATION AND MAINTENANCE FOR THE ANTENNA STEERING SYSTEM, promulgated to all collection activities by NRL. In event of ADU failure, a description of the situation shall be entered in Block 14 of the OPERATOR'S LOG (APPENDIX G).

14. RECEIVER MODIFICATIONS: All R-390A receivers have been modified to provide a maximum of 27 KC bandwidth. Channel Bravo and Charlie data will always be intercepted with receivers in the 27 KC position. Should a receiver malfunction occur at the 27 KC position it will be switched to the 16 KC position and a complete explanation shall be entered in Block 14 of the OPERATOR's LOG (APPENDIX G). The modification minimizes the necessity for continual tuning adjustments due to doppler shift as set forth in CHAPTER V. Tuning adjustments at 4-5 minute intervals even when doppler shift is maximum (SATELLITE PASSES OVERHEAD) should be sufficient to obtain the desired intercept. When an intercept is made with the receiver in other than the 27 KC position, the procedures outlined in CHAPTER V apply.

C. TECHNICAL MANUALS: Technical Manuals have been provided for all major items of equipment installed in the hut. Operators and maintenance men are encouraged to study applicable portions of the manuals in order to gain the best possible understanding of the equipment and its operation.

D. SATELLITE DESIGNATION: Satellites associated with System POPPY are assigned a four digit-phonetic letter mission number. The first two digits will always be 71 and identify the satellite with System POPPY. The last two digits signify the launch number and are numbered one-up commencing with number 01. Each satellite within a launch is assigned a phonetic letter, commencing with ALFA, as well as the four digit mission number. For example, a launch containing two satellites will be designated mission 7101A and 7101B. For referencing purposes in messages and correspondence, these mission numbers will be abbreviated by omitting the first three digits, e.g., 1A and 1B. However, for magnetic tape voice annotations, intercept log entries and tape labeling, the complete mission number of each satellite concerned will be used.

E. SECURITY: "Project EARPOP" is a security clearance which allows personnel access to substantive information concerning various operational systems. "System POPPY" is a covername for one of the operational systems contained with "Project EARPOP". Both "Project EARPOP" and "System POPPY" are classified a minimum of CONFIDENTIAL - HANDLE VIA THE BYEMAN CONTROL SYSTEM. All substantive information concerning System POPPY will be handled via the BYEMAN Control System. Exceptions to this will be the electrical forwarding of (a) the Alert Message, and (b) the Alert Report Message. These two messages will be transmitted electrically outside of the BYEMAN Control System and flagged "This is a [redacted] Alert Message" and "This is a [redacted] Alert Report Message" respectively. Upon receipt, these messages will be handled and stored in accordance with security procedures established for the handling and storage of BYEMAN material. Additional instructions for the handling of non-substantive information related to System POPPYhave been provided separately from this SOP.

II - PRE-INTERCEPT EQUIPMENT ADJUSTMENTS

A. The adjustments specified in this chapter must be performed by qualified maintenance personnel who are thoroughly familiar with the instrumentation of the System POPPY huts. The successful execution of the missions is directly dependent upon the skill and care with which the technician performs the required adjustments.

B. INSTRUCTION MANUALS: Instruction Manuals which contain detailed information have been provided for the major items of equipment installed in each hut. Maintenance personnel should study the manuals in order to become familiar with the equipment to be maintained.

C. RECEIVING SYSTEM SENSITIVITY CHECK:

1. When required: Receiving System Sensitivity Checks are required on the following occasions:

a. During the initial set up of the System POPPY equipment.

b. Whenever repairs have been made which could affect the sensitivity of the receiving system (change of r-f, i-f or oscillator tubes or other components).

c. Immediately prior to the commencement of a series of ALERTS.

d. Whenever the system fails the RAPID SENSITIVITY CHECK.

e. Once each week if the station is operating at the rate of one or more orbits per week.

f. At intervals as required to insure the system is capable of operation within two hours after the receipt of an ALERT message, when there is a period of more than one week between orbits.

2. Sensitivity Check Procedure: Detailed instructions for the performance of the Receiving System Sensitivity Checks are contained in APPENDIX K, "Receiving System Sensitivity Check".

D. RAPID SENSITIVITY CHECK: A Rapid Sensitivity Check of all receiving systems is to be made once every twenty-four hours if the station is operating at the rate of one or more orbits per day. This check may be made at any time during the twenty-four hour period that is most convenient for the station. It is suggested that the RAPID SENSITIVITY CHECK, the daily synchronization of the TIME CODE GENERATOR , the setting

of the wall clocks, and the ROTATING ANTENNA CHECK be accomplished, in sequence at approximately the same time each day. A log is to be maintained on the RAPID SENSITIVITY CHECKS which will serve as a record of system performance.

E. TIME CODE GENERATOR: The ability to correlate the data transmitted by the satellite with real time is extremely important in the reduction of the data. Therefore, it is essential that the TIME CODE GENERATOR be accurately synchronized with an Obserbatory Time Broadcast. The procedure for synchronizing the TIME CODE GENERATOR with an Observatory Time Broadcast is described in APPENDIX L, "Timing System Adjustments".

1. Periodic synchronization: The TIME CODE GENERATOR is to be synchronized with an Observatory Time Broadcast at least once every twenty-four hours if the station is operating at the rate of one or more orbits per day, and as often as is considered necessary to insure the capability to operate the system within two hours after the receipt of an ALERT message, when there is a period of more than twenty-four hours between orbits. In view of experience accrued during past operations, each station should know the time of day, Observatory Time Broadcast station, and frequency on which a suitable Observatory Time Broadcast can be received at the operating site. The daily synchronization of the TIME CODE GENERATOR should be accomplished at a convenient time consistent with this information. The synchronization of the TIME CODE GENERATOR should be accomplished at approximately the same time each day, using the same Observatory Time Broadcast if possible.

2. TIME CODE GENERATOR LOG: A record is to be maintained on the TIME CODE GENERATOR which will provide history on the instrument and which will provide the information necessary to the operator for entry in Block 9 of his log. Details on the TIME CODE GENERATOR log are contained in APPENDIX L, "Timing System Adjustments".

F. WALL CLOCKS: Set the hut wall clock every twenty-four hours when TIME CODE GENERATOR is synchronized.

G. SYSTEM LEVEL ADJUSTMENTS: System level adjustments are required at the time of initial set up of the equipment, whenever a repair or adjustment had been made which may affect the system levels, or whenever a control has been manipulated which would upset the system level adjustments. Detailed instructions for the adjustment of system levels are contained in APPENDIX B, "Receiving and Recording System Level Adjustments".

H. ROTATING ANTENNA CHECK: Once each day, during daylight hours, a quick check of both rotating antenna systems is to be made. This check

is made by rotating the antennas in a wide arc and noting the rise and fall of the noise level. A rise and fall of from three to five VU as indicated by the LINE LEVEL meter of an R390A receiver is indicative of a properly operating antenna system. The R390A FUNCTION switch must be on MGC during this check.

III - PRE-INTERCEPT OPERATIONS

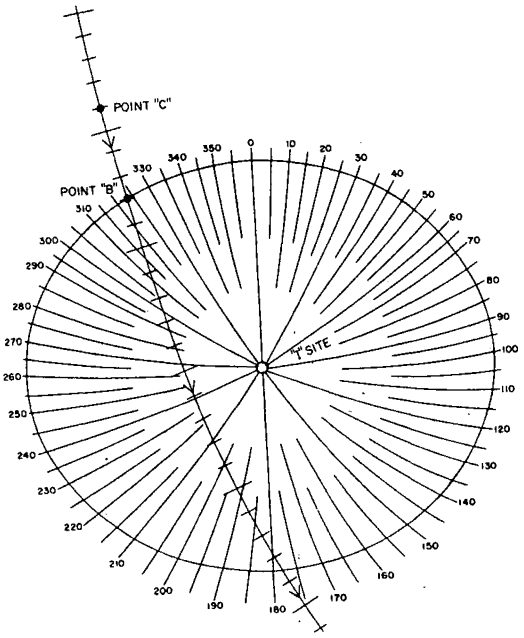
A. Pre-intercept operations will begin with the receipt of an ALERT message. The format of this message is shown in APPENDIX A, "Alert Message Format". Upon receipt of the ALERT message, proceed as follows:

1. DETERMINE PREDICTED TIME OF SIGNAL ACQUISITION:

a. NORMAL CASE:

(1) Using the polar map provided separately, rotate the plastic disk until Point A, the point at which the orbit of the satellite in question enters the Northern Hemisphere, hereinafter referred to as the point of equatorial crossing, is aligned with the longitude indicated in the Ephemeral Data Message (APPENDIX M) for the satellite and orbit tasked.

(2) Count the number of minute intervals between the point of equatorial crossing and the first point of intersection between the orbit track and the station circle of intercept probability (Point "B" in Figure III-1).

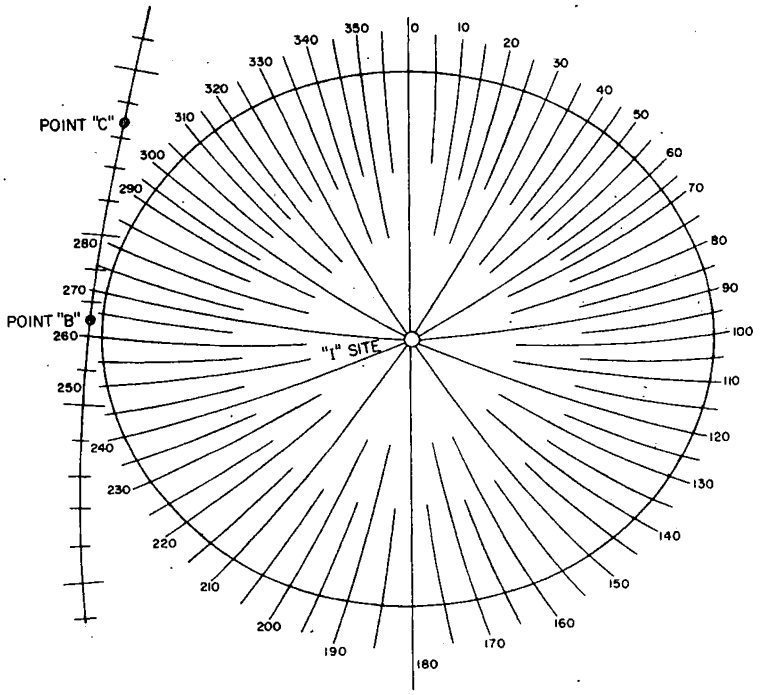


POLAR MAP ILLUSTRATION FOR NORMAL CASE
Figure III - 1

(3) Add the number of minutes obtained in paragraph A-1-a-(2) above to "Time of Equatorial Crossing" given in the Ephemeral Data Message for the satellite and orbit tasked. This will be the predicted time of signal acquisition.

(4) The time for commencement of search for the signals will be four (4) minutes prior to the predicted time of signal acquisition (Point "C" in Figure III-1). Subtract four minutes from the predicted time of signal acquisition to obtain the time for commencement of search.

(5) Determine the time for commencement of search and corresponding azimuth for each satellite mentioned in the ALERT message. When more than one satellite is to be tasked, the LOCAL hut will be assigned to the first of these satellites to enter the station circle of intercept probability. Enter the respective time and azimuth data derived above in BLOCK 4 of the Operator's log for that particular satellite and orbit.



POLAR MAP ILLUSTRATION
FOR MARGINAL CASE
Figure III-2

b. MARGINAL CASE:

(1) In certain special cases, an orbit track will not cross the station circle of intercept probability but intercept may still be possible. To determine the predicted time of signal acquisition in this case, proceed as follows. Using the polar map, visually estimate the point at which the orbit track is nearest to the station circle of intercept probability (Point "B" in Figure III-2, Page III-2).

(2) Count the number of minute intervals between the point of equatorial crossing and the point at which the orbit track is nearest to the station circle of intercept probability.

(3) Add the number of minutes obtained in paragraph A-1-b-(2) above to the "Time of Equatorial Crossing" given in the Ephemeral Data Message for the satellite and orbit tasked. This will be the predicted time of signal acquisition.

(4) The time for commencement of search for signals in this special case will be six (6) minutes prior to the predicted time of signal acquisition (Point "C" in Figure III-2). Subtract six minutes from the predicted time of signal acquisition to obtain the time for commencement of search.

(5) Determine the time for commencement of search and corresponding azimuth for each satellite mentioned in the ALERT message. When more than one satellite is to be tasked, the LOCAL hut shall be assigned to the first of these satellites to approach the station circle of intercept probability. Enter the respective time and azimuth data derived above in BLOCK 4 of the Operator's log for that particular satellite and orbit.

2. DEVELOP A TIME VERSUS AZIMUTH CHART: Using the minute marks drawn on the orbit track, determine the bearing at each mark, and develop a time versus azimuth chart for the orbit. Figure III-3 is a sample Time Versus Azimuth Chart. Develop a Time Versus Azimuth Chart for each satellite and orbit mentioned in the ALERT message.

1711 - 245°	1716 - 231°	1722 - 138°
1712 - 244°	1717 - 223°	1723 - 120°
1713 - 242°	1718 - 215°	1724 - 110°
1714 - 240°	1719 - 197°	1725 - 103°
1715 - 235°	1720 - 180°	1726 - 99°
	1721 - 157°	1727 - 95°

Figure III-3

3. PREPARE FOR OPERATION: Approximately ½ hour prior to the Predicted Time of Signal Acquisition, the operators will enter the huts and make preparations for the operation. The following steps are accomplished at this time:

a. CHECK EQUIPMENT: A sight check of equipment, paying particular attention to equipment control settings, will be made. Ensure that all controls are set in accordance with the settings provided in Figure III-4. Set the CHANNEL A, B, and C receivers to the specified frequencies. Monitor receiver noise levels to confirm that the receivers appear to be operating properly. Tune in an Observatory Time Broadcast station on the CHANNEL D receiver. Be certain that the switch on the base of the whip antenna corresponds with the frequency to which the CHANNEL D receiver is tuned. Verify that the Patch Panel and Signal Panel are patched in accordance with APPENDIX B, "Receiving and Recording System Level Adjustments".

b. CLEAN THE RECORDER HEADS: Carefully clean the heads of both recorders by swabbing them with a piece of cotton wrapped around a toothpick or other small piece of soft wood which has been moistened with an approved cleaning fluid. After cleaning, watch the heads to be certain that all of the cleaning solvent has evaporated before putting tape on the machines.

c. CHECK THE TIME CODE GENERATOR: Observe the display of the TIME CODE GENERATOR and compare it with the Observatory Time Broadcast on the CHANNEL D Receiver to determine if it is correct. If it is obviously in error, and circumstances are such that it cannot be resynchronized with an accurate time standard, voice annotations of time will be made in accordance with APPENDIX D, "Voice Annotating the Tape", and a full account of the circumstances made in Block 14 of the Operator's Log. Every effort should be made to synchronize the TIME CODE GENERATOR accurately, as it is in all respects preferable to use time code rather than voice annotations.

d. POSITION THE ANTENNA ARRAY: Position each rotatable antenna array in accordance with the TIME VERSUS AZIMUTH CHARTS developed in paragraph A-2 above. Rotate each array through the arc that it will swing during the orbit to insure that it can be rotated through this arc without striking the stops.

e. MAKE A THIRTY (30) SECOND TEST RECORDING: Load both tape recorders with fresh reels of tape. With all equipment controls set as for the operation of an orbit, make a thirty second test recording on the LOCAL recorder. The outputs of the receivers will be normal receiver noise providing there is no interfering station on the frequency.

The pre-intercept service as specified in APPENDIX D, "Voice Annotating the Tape", is to be made on the LOCAL recorder during this thirty second test recording period. Monitor the reproduce output of each channel of the recorder during this period to ensure each is functioning properly. The GR-2800 recorder is monitored by patching the Oscilloscope successively to the various RECORDER PLAYBACK outputs at the Signal Panel. Care must be taken to ensure that the Analog channels are patched to the analog reproduce amplifiers and the FM channels are patched to the FM reproduce amplifiers. One Oscilloscope trace should be connected to the Analog reproduce amplifier, and the other to the FM reproduce amplifier. (It should be noted that the reproduce equalization is affected by plugging headphones into the RECORDER PLAYBACK outputs, and as a result, the display of a pulse on the Oscilloscope under these conditions will be distorted.) At the end of the thirty second test recording, stop the recorder.

f. PREPARE THE LOG: Fill our the log heading. The log format and instructions for the completion of the log are contained in APPENDIX G, "Instructions for maintaining the Operator's Log". Log forms are to be reproduced locally as required. Separate logs are to be filled out for each satellite and orbit tasked.

g. Stand by to commence search at the time established for commencement of search.

SYSTEMS CONTROL ADJUSTMENT CHART

Meter, Switch, or Control	Sensitivity Check (All Systems)	Gain Control Adjustments	CHANNEL A Tracking	CHANNEL B Recording	CHANNEL C Recording
RECEIVERS:					
Line Meter Switch	T.B.A.	T.B.A.	-10	-10	-10
Line Level Meter	T.B.A.*	T.B.A.*	-10*	-10*	-10*
Line Gain	T.B.A.*	T.B.A.*	Pre-Set*	Pre-Set*	Pre-Set*
Ant Trim	T.B.A.*	T.B.A.*	Pre-Set*	Pre-Set*	Pre-Set*
AGC	Fast	Fast	Fast	Fast	Fast
Limiter	Off	Off	Off	Off	Off
Carrier Level Meter	Variable	Variable	Variable	Variable	Variable
Bandwidth	27 kc	27 kc	2-16 kc	27 kc	27 kc
BFO Pitch	N.U.	N.U.	Variable	N.U.	N.U.
Audio Response	Wide	Wide	Wide	Wide	Wide
Break-in	Off	Off	Off	Off	Off
Function	MGC	MGC	AGC	MGC	MGC
BFO	Off	Off	On	Off	Off
Dial Lock	N.U.	N.U.	N.U.	N.U.	N.U.
Zero Adj.	T.B.A.*	N.U.	N.U.	N.U.	N.U.
Local Gain	10	10	10	10	10
RF Gain	T.B.A.*	T.B.A.*	Pre-Set*	Pre-Set*	Pre-Set*
MC Change	A.F.	A.F.	A.F.	A.F.	A.F.
KC Change	A.F.	A.F.	A.F.	A.F.	A.F.
LOCAL AUDIO PANEL:					
Gain	C.L.	C.L.	C.L.	C.L.	C.L.
LINE DRIVER DETECTOR:					
Gain Controls	N.U.	T.B.A.	Pre-Set*	Pre-Set*	Pre-Set*
TIME CODE GENERATORS					
Output Amplitude	N.U.	T.B.A.	Pre-Set*	Pre-Set*	Pre-Set*

*NOTE: TO BE ADJUSTED IN ACCORDANCE WITH APPENDIX B,"RECEIVING AND RECORDING SYSTEM LEVEL ADJUSTMENTS, BY MATERIEL PERSONNEL ONLY.

Figure III-4

SYSTEMS CONTROL ADJUSTMENT CHART (Cont'd)

Meter, Switch or Control	Gain Control Adjustments	CHANNEL A Tracking	CHANNEL B Recording	CHANNEL C Recording
GR-2800 RECORDER				
Amplifier Power Supply				
Function Switch	Ext	Ext	Ext	Ext ***
Line Light	Off	Off	Off	Off
Power Light	On	On	On	On
Burning Light	Off	Off	Off	Off
Control Panel				
Power	On	On	On	On
Low-High	Low	Low	Low	Low
Ready Light	On**	On**	On**	On**
Record	On	On	On	On
Tape Transport				
Follower Arms	Run	Run	Run	Run
50 KC Output Level	Pre-set	Pre-set	Pre-set	Pre-set
Transport PWR	On	On	On	On
Tape Speed CW	60-30	60-30	60-30	60-30
Electronics Drawer				
Record INT'L'K	T.B.A.	Norm.	Norm.	Norm.
Bias SW	T.B.A.	On	On	On
Gain Controls	T.B.A.	Pre-set	Pre-set	Pre-set

**NOTE: Ready light will extinguish when recorder is put in Record mode.

***NOTE: The 60 cycle output from the precision frequency divider unit located in the primary hut will be connected to the external frequency input jack (J7) of the recorders in the primary and secondary huts. When the precision 60 cycle frequency divider unit is functioning properly the warning lamp located on front panel is extinguished. WARNING. Illumination of this warning lamp is an indication of loss of 60 cycle output and the amplifier power supply function switch must be placed in the precision frequency position.

Legend - Figure III-4

T.B.A.	To be adjusted	C.L.	Convenient level
N.U.	Not used	N/C	No change
A.F.	Assigned frequency	C.R.	Channel to be recorded

BYE-3997-62

IV - DURING SEARCH ACQUISITION

A. GENERAL: As was mentioned in the introduction, every effort has been made to assemble a highly stable receiving system. However, the operators must keep in mind several facts which bear on receiving the signal properly:

1. Crystals in a circuit do not assure absolute frequency accuracy. The crystal accuracy will vary considerably because of temperature changes, associated circuit capacitance changes, tube variations, and grinding tolerances.

2. The accuracy of receiver dial settings is no better than the adjustment of the circuitry behind them. Mechanical linkage misadjustments or slippage, oscillator drift, calibrator shift, etc., can all cause erroneous readings.

3. Reception can be assured only when the entire system, i.e., transmitter, receiver, and the space in between, is attuned. The following possible sources of failure in reception should be kept in mind:

a. The satellite transmitter may have drifted or changed frequency.

b. The converter frequency may have drifted or changed.

c. The receiver setting may not really indicate the frequency to which the receiver is tuned, even though the calibrator seems to confirm the setting.

d. There will be a Doppler shift in the transmitted frequency enroute to the receiving point. Doppler shift is a change in frequency from that actually transmitted which occurs in space as a result of the relative velocity with which the transmitting and/or receiving stations are moving away from or toward each other. Refer to Figure IV-1, IV-2 and IV-3 for a review of relative Doppler shift to be expected on DATA CHANNEL during representative orbits. The magnitude of the shift on CHANNEL A will not be as great, but the shift will take place in the same manner.

4. The most important point to remember is that the ultimate goal of the operation is to effect reception and record a usable signal regardless of any variation of dial settings or stated figures that are involved.

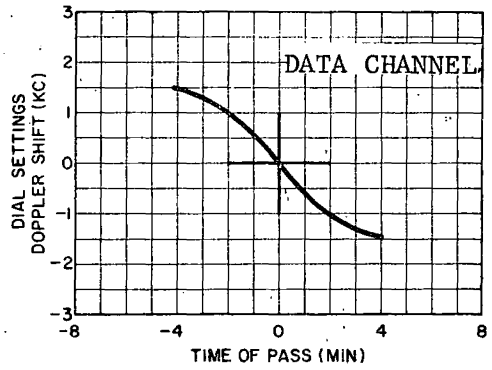


Figure IV - 1

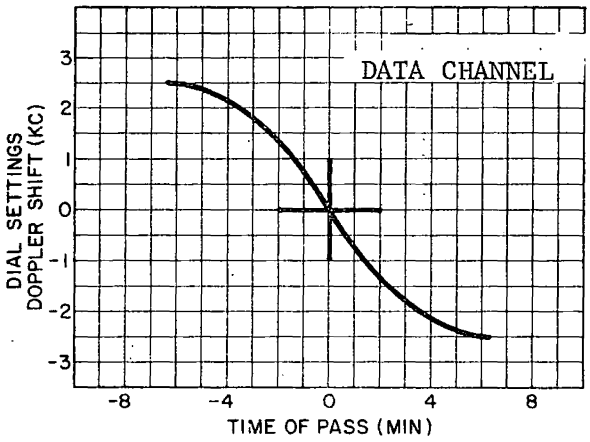


Figure IV - 2

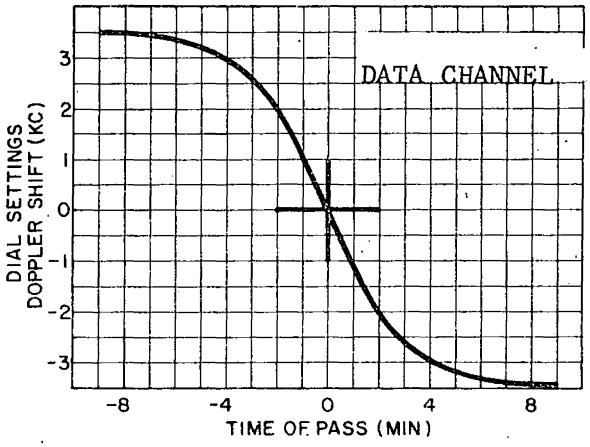


Figure IV - 3

ORIGINAL

B. DESCRIPTION OF SIGNALS:

1. The CHANNEL A signal is an amplitude modulated telemetry signal which is normally "ON" all of the time. Therefore, the CHANNEL "A" signal serves the dual purpose of (1) providing a convenient reference for the tracking of the satellite and (2) conveys the "housekeeping" information on the internal condition of the satellite.

2. The DATA CHANNEL signals convey the data from the satellite. These signals consist of groups of pulses, and are "ON" only intermittently.

C. OBJECTIVE OF THE MISSION: The objective of the operation of System POPPY is to receive and record DATA CHANNEL emissions from the System POPPY satellites. CHANNEL A is normally not to be recorded. The BFO of the CHANNEL A receiver is to be left "ON" to enable the operator to supply tuning information to the DATA CHANNEL operator. 1 mil mylar tape is to be used as the recording medium. The use of 1 mil mylar is essential to ensure adequate recording time; 1 $\frac{1}{2}$ mil tape may be used only if 1 mil tape is not available. Recordings will be classified SECRET - HANDLE VIA THE BYEMAN CONTROL SYSTEM - PROJECT EARPOP.

D. SEARCH PROCEDURES:

1. CHANNEL A SEARCH: Begin searching for the signal four minutes prior to the PREDICTED TIME OF SIGNAL ACQUISITION if the orbit falls in the NORMAL CASE and six minutes prior to the PREDICTED TIME OF SIGNAL ACQUISITION if the orbit falls in the MARGINAL CASE, as determined in paragraph A of Chapter III. With the BFO "ON" and the BFO PITCH set at "0" slowly tune the CHANNEL A receiver back and forth within +5 and -2 KCS of the dial setting specified, at a rate of not more than 0.5 KC/SEC until the CHANNEL A signal is heard. In order to increase the system sensitivity the operator may reduce the receiver bandwidth from 16 KCS to as narrow as 2 KCS until the signal is acquired. Upon acquisition of the CHANNEL A signal, rotate the antenna array until maximum signal is being received as indicated by a center reading on the AZIMUTH DEVIATION UNIT or peak reading on CARRIER LEVEL METER if ADU is inoperable. Temporarily steady the antenna and adjust the KILOCYCLE CHANGE until the CARRIER LEVEL meter is peaked. Adjust the BFO PITCH control for a zero beat. Do not change the BFO PITCH control after this zero beat setting is obtained. Note and log the receiver dial reading to the nearest 100 cycles. (The 1 KC counter has a vernier on the right side which is marked in 200 cycle increments.)

2. DATA CHANNEL SEARCH: While the operator on the CHANNEL A receiver is looking for the satellite signal, the operator on the DATA CHANNEL receiver should be following the same tuning procedure with the

receiver BFO's turned OFF. There may be occasions when a DATA CHANNEL signal is acquired before the CHANNEL A signal. Under certain circumstances, the DATA CHANNEL signal may not be heard until well after the CHANNEL A signal is heard. When this happens, the DATA CHANNEL operator should continue to search until a DATA CHANNEL signal is acquired. The headphones should be used in the "split" mode to monitor both CHANNEL B and CHANNEL C, and the receivers tuned one at a time until a signal is heard. When a signal is intercepted, tune the receiver for the maximum amplitude displayed on the OSCILLOSCOPE, maximum reading on the CARRIER LEVEL meter, maximum audible signal, or a combination of the foregoing. All conditions will occur simultaneously. In the event that more than one DATA CHANNEL is to be active, continue to search with the remaining receiver until a signal is heard and tune for maximum as before. Note and log the receiver dial readings to the nearest 100 cycles. (The 1 KC counter has a vernier on the right side which is marked in 200 cycle increments.)

E. STARTING THE TAPE RECORDERS:

1. As soon as either DATA CHANNEL signal is acquired, start the LOCAL tape recorder, making certain that the recorder has been placed in the RECORD mode. Note that to place the GR-2800 recorder in the RECORD mode, it is necessary to press the RUN and RECORD buttons simultaneously. The RECORD mode on the GR-2800 is indicated only by the lighting of the RECORD button. Insure that the data is being recorded by monitoring each of the Recorder Playback outputs with the oscilloscope as was done in the case of the thirty second test recording (SECTION III).

V - DURING INTERCEPT

A. ANTENNA TRACKING: The antenna arrays used in System POPPY are highly directive. For this reason it is necessary that the antenna array be rotated to follow the movement of the satellite as it progresses in orbit. The CHANNEL A operator, in addition to keeping the CHANNEL A receiver tuned to follow the doppler shift of the signal, is tasked with the rotation of the antenna, as required, to track the satellite. The antenna is most easily directed for best reception by slowly swinging the antenna back and forth in a short arc ($\pm$ 10 degrees) while keeping a sharp eye on the ADU and/or CARRIER LEVEL meter. The meter will start "dipping" when the antenna is too far to either side of the best direction. The antenna should always be pointed in the direction that indicates a center reading on the ADU meter. The TIME VERSUS AZIMUTH chart is to be used as a guide in the proper orientation of the antenna. Slight deviations from the TIME VERSUS AZIMUTH chart may be necessary to overcome local interference and to optimize signal strength. The operator should make every effort to keep the main beam of the antenna pointed directly at the satellite and to make certain that the signal is always retained once it has been acquired and the recorder started.

B. LOG KEEPING: Enter pertinent information in the log. Continue to enter any changes or other relevant information in the log as occurring and as time allows. Remember that a good recording is the primary requirement and that a complete log, although important, is a secondary requirement.

C. TUNING TO COMPENSATE FOR DOPPLER SHIFT: The CHANNEL A signal is an amplitude modulated telemetry emission which will be relatively easy to follow as it shifts frequency as a result of Doppler effect. The DATA CHANNEL signals, however, consist of short, intermittent bursts which may be difficult to follow during Doppler shift. Therefore, the CHANNEL A signal is to be used to provide a reference for the proper tuning of the DATA CHANNEL receivers.

D. TUNING PROCEDURE

1. CHANNEL "A" OPERATOR

a. Upon acquisition of the CHANNEL A signal, the antenna was rotated until a "0"center reading was obtained on the ADU meter,the KC CHANGE control was adjusted until the CARRIER LEVEL meter was peaked, the BFO PITCH was adjusted for a zero beat, the BANDWIDTH switch was set at

16 KC, and the receiver dial setting was noted.

b. As the orbit progresses, watch the CARRIER LEVEL meter. Follow the movement of the satellite with the antenna array by continuously positioning the antennas for a center reading on the ADU meter and/or a maximum reading on the CARRIER LEVEL METER. The TIME VERSUS AZIMUTH chart is used as a guide for the rough positioning of the array, and the ADU meter and/or CARRIER LEVEL METERS are used for fine positioning.

c. It is also necessary to follow the Doppler Shift as the orbit progresses. This is done by observing the CARRIER LEVEL meter and readjusting the KILOCYCLE CHANGE control when the meter reading starts to decrease so that the CARRIER LEVEL meter is re-peaked. Changes in the frequency of the CHANNEL A receiver should always be made in increments of less than 0.5 KCS. The frequency will always decrease as a result of the Doppler shift.

d. Approximately each two (2) minutes throughout the pass, tuning information for the DATA CHANNEL operator will be given. To do this, tune the KILOCYCLE CHANGE control until a zero beat is obtained. Do not adjust the BFO PITCH control. Note and log the frequency dial reading to the nearest 100 cycles (the 1 KC counter has a vernier on the right side which is marked in 200 cycle increments). Subtract the dial setting obtained in this zero beat operation from the dial setting obtained in the previous zero beat operation. Advise the "DATA CHANNEL" Operator of the difference.

e. Repeat paragraph D-1-b, D-1-c and D-1-d until the signals fade out.

f. Note that the LOCAL AUDIO panel has jacks that make the audio from the CHANNEL B and C receivers available to the CHANNEL A operator. The CHANNEL "A" operator should use split headphones, if available, to monitor DATA CHANNEL receiver audio as well as the CHANNEL A signal during the orbit to ensure that the antenna is always properly oriented for the reception of the DATA CHANNEL signals. It is important to note that the DATA CHANNEL signals are the signals of highest priority. All adjustments should be made to optimize the DATA CHANNEL signals. A slight misalignment of the antenna system could cause a condition in which the CHANNEL A signal will be received but the DATA CHANNEL signals will not be because they are outside the beam of the DATA CHANNEL antenna. This condition should not be allowed to occur.

2. DATA CHANNEL OPERATOR:

a. Upon acquisition of the DATA CHANNEL signals, the operator tuned his receivers for maximum amplitude displayed on the oscilloscope and maximum audible signal, and noted and logged the receiver dial settings.

b. Continue to tune the DATA CHANNEL receivers in direct response to tuning information received from the CHANNEL A operator in order to maintain signal amplitude at a maximum. Tuning information passed to the DATA CHANNEL operator will be in the form of the difference in dial reading from the previous check to the current check and should be provided approximately every two (2) minutes. The DATA CHANNEL operator will multiply this difference in dial reading by a factor of 1.1 and check to ensure that the DATA CHANNEL receivers have been changed in frequency by this amount in the course of tuning for maximum signal. The DOPPLER SHIFT NOMOGRAPH, Figure V-1, may be used to assist in obtaining the new dial setting at the two minute check point.

CHANNEL A Difference (Cycles)	DATA CHANNEL Change Required (Cycles)
100	110
200	220
300	330
400	440
500	550
600	660
700	770
800	880
900	990
1000	1100

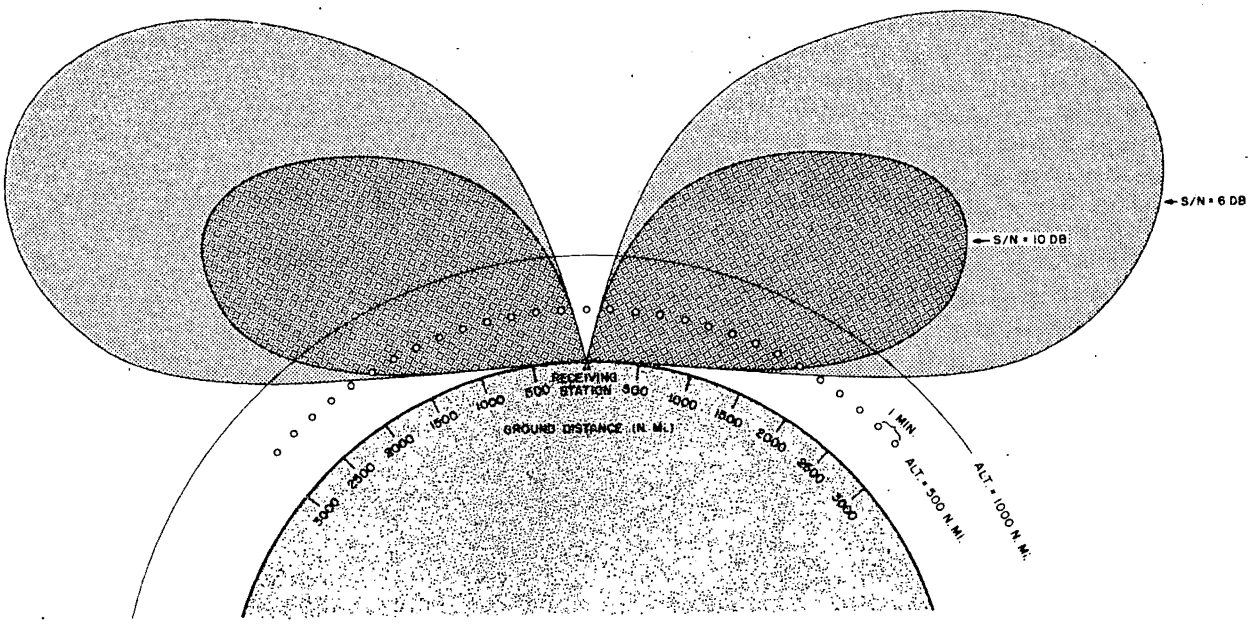
DOPPLER SHIFT NOMOGRAPH
Figure V-1

If it is found that a receiver has not been changed in frequency by the amount determined to be required by this computation, tune the KILOCYCLE CHANGE control until the receiver is adjusted to the computed new dial reading. Note and log this receiver dial reading. Insure that in making this correction to the receiver dial reading that the amplitude of the DATA CHANNEL signal does not decrease. This tuning procedure is employed to give the DATA CHANNEL operator a rough reference point for proper tuning. The operator should always fine tune the receivers for maximum amplitude of the DATA CHANNEL signals.

d. Repeat paragraphs D-2-b, and D-2-c until the signals fade out.

3. SPECIAL CASE IN WHICH A SATELLITE PASSES OVERHEAD: In some cases a satellite may pass directly, or nearly so, over the intercept site.

If this condition occurs, a very rapid fade, a loss of signal for up to two minutes, and then a rapid return of the signal will be observed during the middle of the intercept. This loss of signal is occasioned by a vertical gap in the antenna coverage pattern directly over the site. (See Figure V-2)



VERTICAL COVERAGE FOR TRACKING
Figure V-2

E. TAPE RUNOUT:

1. In the event that the intercept operation should require more recording time than can be provided by one tape recorder, the recorder in the REMOTE hut will be started one minute before tape runout occurs in the LOCAL hut. The total time required for the intercept operation, from the predicted time of signal acquisition of the first satellite to the exit of the last satellite from the station circle of intercept probability, will be used to asess the required recording time. If this interval approaches the available recording time to within one minute, the REMOTE recorder shall be started one minute before LOCAL recorder runout, and the LOCAL recorder allowed to complete the recording in a

normal manner. In any case, the REMOTE recorder should be loaded with tape, properly patched, and in all respects ready to record should the LOCAL recorder become inoperable.

VI - AFTER INTERCEPT

A. STOPPING RECORDER: Stop the recorder when the last satellite has travelled beyond the station circle of intercept and faded out. Be certain that the satellite is beyond the circle of intercept probability and that the fade is not a temporary one occasioned by a change in the attitude of the satellite with respect to the earth or due to small nulls in the intercept antenna pattern.

B. VOICE SERVICE: Make the final voice service on the tape as specified in APPENDIX D, "Voice Annotating the Tape". Do not remove the tape from the machine prior to making this service. Do not erase any tape, or re-record over previously recorded tape for the purpose of making the final voice service.

C. CHECKING THE TAPE: Rewind approximately one minute of playing time of the tape on the DATATAPE recorder. Put the recorder in the REPRODUCE mode and monitor the reproduce outputs of the seven tracks of recorded information. The reproduce outputs of the recorder are to be monitored in the same manner as was done when monitoring the pre-pass thirty second test recording. In the event that the DATA CHANNEL operator in the LOCAL hut was able to visually monitor reproduce signals during the operation, as directed in the section above, it will be unnecessary to make this check.

D. REMOVE THE TAPE FROM THE RECORDER: After the tape is complete with the final voice service and has been checked, remove the tape from the machine. This is done by putting the machine in the REPRODUCE mode and running the tape onto the take-up reel. Do not operate the recorder in the FAST FORWARD mode for this purpose. DO NOT REWIND THE TAPE. When all tape is wound on the take-up reel, remove the tape from the machine. Complete the tape identification labels as described in APPENDIX H, "Labeling the Tape".

E. COMPLETE THE LOG: Enter any remarks or amplifying information in the log and sign it off.

F. SECURING THE HUTS: Due to increased daily routine tasking and the anticipation of non-routine tasking at any time, all equipment in the huts will be left TURNED ON at all times. The R-390A receiver FUNCTION SELECTOR switch will be placed in the AGC or MGC position, not on standby. The TIME CODE GENERATOR should be kept on all times in order to maintain the stability of the instruments. When not in use, the ASTRODATA TIME CODE GENERATOR should be placed in standby.

G. FINAL CHECK OF THE OPERATOR: Upon completion of the operation, the site Evaluation Officer and/or the Officer in Charge should review the tapes and logs to ensure accuracy and completeness. The final winding of the tape, after the review, should be done with the recorder in the REPRODUCE mode to ensure constant tension. The tapes should be shipped with a good tape pack to prevent damage in shipment.

H. REPORT RESULTS: Unless otherwise directed, forward combined results from assigned tasking electrically at the end of each ZULU day, using format prescribed in APPENDIX JULIET, "Alert Report Message Format".

TO: DIRNAVSECGRU

INFO: DIRNSA [redacted]

I. FORWARD MATERIAL: Forward logs and tape recordings (unrewound), via the BYEMAN CONTROL SYSTEM, with the first available courier to:

Director, National Security Agency — SHIPPING MEANS
Fort George G. Meade, Maryland
[redacted] — ARFCOS

J. MAGNETIC TAPE SUPPLY: NSA supplies all stations with magnetic tape used in POPPY operations. Each station is responsible for maintaining an onboard supply for 90 days. Advise DIRNSA [redacted] and DIRNAVSECGRU (G54), when this low level limit is reached.

K. COMMENTS AND RECOMMENDATIONS: Submit comments and recommendations to DIRNAVSECGRU by message or speedletter, depending on urgency. Comments and recommendations will be classified on the basis of the degree of information concerning the system that has been divulged, and will be a minimum of CONFIDENTIAL. Messages and speedletters containing substantive information related to System POPPY operations must be forwarded via the BYEMAN Control System.

VII - MAINTENANCE

A. In order to ensure maximum performance of the equipment, strict adherence to standard maintenance perocedures as outlined in the equipment instruction manuals and the installation manual is mandatory. All malfunctions should be repaired immediately so that equipment will be ready for the next ALERT.

B. Each malfunction and the action to repair it shall be reported on an "as-occurring" basis. Electronic Failure Report forms (DD Form 787) should be used (see APPENDIX I). Forward these reports direct to:

CODE 5435A
U.S. Naval Research Laboratory
Washington 25, D. C.

Enter "NRL HUT" in block 20. Ensure that only UNCLASSIFIED information is submitted with these failure reports, and that no reference is made to operational details of System POPPY.

C. Any difficulties encountered with the equipment which cannot be handled by station forces should be reported in detail immediately to DIRNAVSECGRU by message.

D. Equipment being returned to NRL from POPPY field stations will be marked "RETURN OF NRL EQUIPMENT" and shipped to:

Naval Research Laboratory
Code 5435
Washington, D. C.

APPENDIX A

ALERT MESSAGE FORMAT
(SEE NOTE 3)

PRECEDENCE

DATE/TIME GROUP

FM DIRNAVSECGRU/(DIRNSA SEE NOTE 4)

TO

INFO

CLASSIFICATION/NOFORN/HANDLE VIA COMINT CHANNELS ONLY

THIS IS A ____ ALERT MESSAGE (NOTE 1)

1. READ SIX/SEVEN COLUMNS

ONE (PHONETIC LETTER OF SATELLITE TASKED) NOTE 2	TWO THREE FOUR FIVE (SATELLITE ORBIT TO BE INTERCEPTED)	SIX (CHANNELS ACTIVE NOTE 3)	SEVEN (CHANNELS ACTIVE NOTE 3)

2. REMARKS (REMARKS PERTINENT TO OPERATION) (NOTE 1)

NOTE 1: The abbreviated mission number (ZERO THREE or ZERO FOUR) will appear to indicate which satellite (s) is/are to be tasked. AIERT messages are to be so worded that no reference or inference is being made to satellite operations. In order to make reference to a specific satellite and corresponding orbit in the remarks section of this message, the term "TASK" will be used followed by the abbreviated satellite mission number and corresponding orbit number. e.g. "TASK 01A1234".

NOTE 2: The phonetic letter for the appropriate satellite will appear to indicate which satellite is being tasked. For simultaneous operation with two satellites the phonetic letter for each will appear.

NOTE 3: The channels active on each satellite to be intercepted are stuttered for reliability through redundancy. Column six refers to the channels to be active on the first satellite; column seven refers to the channels to be active on the second satellite. For single satellite tasking, column seven will not appear.

NOTE 4: Tasking will normally be promulgated by DIRNAVSECGRU; however, under certain special circumstances tasking will be promulgated by DIRNSA [redacted] when occurring during periods other than those where the POPPY satellites have been tasked by DIRNAVSECGRU on a routine basis. At times, special tasking promulgated by DIRNSA may modify existing routine tasking promulgated by DIRNAVSECGRU. Upon receipt of a [redacted] ALERT tasking message originated by DIRNSA, deviation from previously assigned tasking by DIRNAVSECGRU is authorized.

EXAMPLE:

CLASSIFICATION/NOFORN / HANDLE VIA COMINT CHANNELS ONLY

THIS IS A ZERO ONE [redacted] ALERT MESSAGE

1. READ SEVEN COLUMNS:

ONE	TWO	THREE	FOUR	FIVE	SIX	SEVEN
ALFA/BRAVO	ONE	ZERO	ZERO	TWO	BBB/CCC	BBB/CCC
ALFA	ONE	ZERO	ZERO	THREE	BBB/CCC	BLANK

APPENDIX B

RECEIVING AND RECORDING SYSTEM LEVEL ADJUSTMENTS

A. RECORDER CHANNEL ASSIGNMENT

1. The DATA TAPE recorder channel assignment is as follows:

Track Number	Type Recording	Information to be Recorded
1	FM	Channel B Local
2	Analog	50 KC
3	FM	Channel C Local
4	Analog	Mike or Attentuated TCG*
5	FM	Channel B Remote
6	Analog	Time Code and 50 KC
7	FM	Channel C Remote

B. SIGNAL PATCHING ARRANGEMENT

1. Patch Panel - LOCAL HUT:

Recorder Inputs	Patch From
Channel 1	Rec B Local
Channel 2	CHAN 6A-"T"
Channel 3	Rec C Local
Channel 4	Mike or Attentuated TCG*
Channel 5	Rec B Remote
Channel 6	Time Code
Channel 7	Rec C Remote
Channel 6A-"T"	50 KC

2. Patch Panel - REMOTE HUT

Recorder Inputs	Patch From
Channel 1	Rec B Remote
Channel 2	CHAN 6A-"T"
Channel 3	Rec C Remote
Channel 4	Mike or Attentuated TCG*
Channel 5	Rec B Local
Channel 6	Time Code
Channel 7	Rec C Local
Channel 6A-"T"	50 KC Remote

* During the pre-intercept service and at the end-of-intercept service, voice annotations will be made with attentuated TCG signal removed. Microphone will not be patched during recording of attentuated TCG on Channel 4.

3. Signal Panel - LOCAL HUT

Oscilloscope Trace	Patch From
1	Recorder Input Channel 1
2	Recorder Input Channel 3
3	Recorder Playback*
4	Recorder Playback*

*The lower oscilloscope traces are used in the LOCAL HUT to monitor the RECORDER PLAYBACK outputs during the mission. In monitoring the GR-2800, the oscilloscope traces are patched successively to the various RECORDER PLAYBACK outputs at the Signal Panel.

4. Signal Panel - REMOTE HUT

Oscilloscope Trace	Patch From
1	Recorder Input Channel 5
2	Recorder Input Channel 7
3	Not used
4	Not used

C. PRELIMINARY CONTROL SETTINGS

1. Receivers: The DATA CHANNEL Receivers in both huts are to be set up in accordance with Paragraph B1 of Appendix K, "Receiving System Sensitivity Check". Steps C, D, S, K and L.

2. Line Driver Detectors: Set all controls on the Line Driver Detectors in both huts to the clockwise stop.

3. TIME CODE GENERATOR: Set the output level controls of the TIME CODE GENERATOR to the clockwise stop.

4. GR-2800 RECORDER: Set up the GR-2800 recorders as follows:

a. Amplifier Power Supply

Function Switch	EXT

b. Control Panel

Power	On
Low-High	Low

c. Tape Transport

Follower Arms	Run
Transport Power	On
Tape Speed Switch	10 $\frac{1}{2}$ reel 60-30

d. Electronics Drawer

Record Interlock	Normal
Bias	On

e. The GR-2800 Recorders are now ready for gain control adjustments.

D. LINE DRIVER DETECTOR ADJUSTMENT:

1. With the DATA CHANNEL receivers set in accordance with paragraph B1 of APPENDIX K, connect the Patch Panel as follows:

Recorder Inputs	Patch From
Channel 1	Rec B Local
Channel 3	Rec C Local
Channel 5	Rec B Remote
Channel 7	Rec C Remote

2. Connect the Signal Panel as follows:

Oscilloscope Trace	Patch From
1	Recorder Input Channel 1
2	Recorder Input Channel 3
3	Recorder Input Channel 5
4	Recorder Input Channel 7

3. Place the TRIG LEVEL control of the oscilloscope on AUTO and set all VOLTS/CM controls to the same calibrated sensitivity. Noise should appear on all four traces of the oscilloscope.

4. Adjust the CHANNEL B detector gain control on the front of the Line Driver Detector unit to give the same deflection on the third trace as is observed on the first trace. Similarly, adjust the CHANNEL C detector gain to give the same deflection on the fourth trace as is observed on the second trace. This operation enables repatching of the hut without resetting levels.

5. Disconnect the oscilloscope from the Recorder Inputs at the Signal Panel, and connect TRACE 1 of the oscilloscope to CHANNEL 2 Recorder Input. At the Patch Panel, connect the CHANNEL 2 input jack and the 50 KC jack to a tee connection at the CHANNEL 6A input.

6. Note the amplitude of the 50 KC oscillator as displayed on the oscilloscope in the local hut.

7. Adjust the 50 KC gain control located on top of the chassis of the line driver detector in the local hut so that the amplitude of the 50 KC signal observed on the oscilloscope in the remote hut is equal to the amplitude noted in the local hut.

8. This completes the Line Driver Detector adjustment. Disconnect the oscilloscope from CHANNEL 2 Recorder Input.

E. GR-2800 RECORDER LEVEL ADJUSTMENTS:

1. Lower the hinged cover on the front of the electronics drawer to obtain access to the controls.

2. Load the recorder with tape.

3. Connect the oscilloscope as follows:

Trace Number	Patch From
1	Recorder Playback CHANNEL 1
2	Recorder Playback CHANNEL 3
3	Recorder Playback CHANNEL 5
4	Recorder Playback CHANNEL 7

Adjust the VOLTS/CM controls to give a calibrated deflection sensitivity of one volt per centimeter. Place the TRIG LEVEL control on AUTO.

4. Place the recorder on the RECORD mode, and monitor the reproduced signals on the oscilloscope.

5. Adjust the SENSITIVITY control (R1) on the Record Amplifiers for CHANNELS 1, 3, 5 and 7 to give a one volt (one centimeter) peak-to-peak signal on the oscilloscope.

6. Reconnect the oscilloscope as follows:

Track Number	Patch From
1	Recorder Playback CHANNEL 2
2	Recorder Playback CHANNEL 6

7. Adjust the Record Gain Control (R1) on the Record Amplifier for CHANNEL 2 and the % MOD Control (R10) on the Record Amplifier for CHANNEL

6 to give a three volt (three centimeter) peak-to-peak signal on the oscilloscope.

8. Disconnect all cables from the CHANNEL 6A Recorder Input at the Patch Panel, and connect the TIME CODE output to CHANNEL 6 Recorder Input.

9. Increase the oscilloscope TRACE 2 deflection sensitivity to 0.1 volt per centimeter and adjust the Record Gain Control (R1) on the Record Amplifier for CHANNEL 6 to give an 0.3 volt (three centimeter) peak-to-peak signal on the oscilloscope.

10. This completes the GR-2800 Recorder level adjustments. Stop the recorder. When the instructions in SECTION D and E of this APPENDIX have been carried out in both huts, the Receiving and Recording System Level Adjustments are complete.

CAUTION: ANY CHANGE IN THE SETTINGS OF THE CONTROLS AFFECTING THESE ADJUSTMENTS WILL REQUIRE THAT SYSTEM LEVELS BE READJUSTED. UNDER NO CIRCUMSTANCES ARE SUCH CONTROLS TO BE ADJUSTED BY PERSONS OTHER THAN THOSE QUALIFIED TO DO SO.

APPENDIX C

RAPID SENSITIVITY CHECK

A. Upon completion of an orbit the control settings of the receivers should not be changed. Providing there has been no change in the receiver control settings, the following method of rapid sensitivity check may be used.

1. Connect the Signal Generator at the TEST INPUT jack of the converter of the system to be checked in the case of Systems A, B and C and to the receiver antenna input cable at jack 1A on the ENTRY TERMINATION PANEL in the case of System D.

2. Rotate the antenna array so that it points in a southerly direction.

3. The RF GAIN control and LINE GAIN control settings have been previously established. The LINE LEVEL meter should read -10 VU from system noise. If the LINE LEVEL meter does not read -10 VU, it must be assumed that the setting of the RF GAIN control or the LINE GAIN control have been changed, or that trouble has developed in the system. Therefore, if the LINE LEVEL meter does not read -10 VU, it will be necessary to reset the levels of the system in accordance with the instructions in APPENDIX B, "Receiving and Recording System Level Adjustments", prior to using the Rapid Sensitivity Check procedures.

4. Adjust the Signal Generator FREQUENCY to the operating frequency of the system.

5. Adjust the Signal Generator OUTPUT until the LINE LEVEL meter of the Receiver reads 0 VU.

6. Determine the "S" value of the system. The "S" value for Channels A, B and C is the SIGNAL GENERATOR output in dbm added to -70 db to compensate for the loss of the directional coupler. The "S" value for the CHANNEL D system is the output level of the SIGNAL GENERATOR in dbm. There is no directional coupler in the CHANNEL D system. If the "S" value shows a system sensitivity of -105 dbm or better, the system can be considered to be operating satisfactorily.

7. Disconnect the Signal Generator.

8. Repeat the above procedure for each converter and each receiver of the CHANNELS A, B and C Systems and for the CHANNEL D System.

9. Reconnect the CHANNEL D Receiver antenna input to jack 1A on the Entry Termination Panel.

APPENDIX D

VOICE ANNOTATING THE TAPE

A. GENERAL: Voice annotations are to be recorded at the beginning and at the end of each intercept operation. It is important that no information other than that specified in this Appendix be annotated on the tape, lest the security classification of the tape be unnecessarily upgraded.

B. PRE-INTERCEPT SERVICE: At the beginning of the thirty second test recording, make the following voice announcement on CHANNEL 4 of the LOCAL tape recorder.

The classification of this tape is SECRET - HANDLE VIA THE BYEMAN CONTROL SYSTEM Project EARPOP. Recorded at US (number of intercept unit) from task (complete satellite mission number) during pass (indicate corresponding satellite orbit). . .(for simultaneous operations from two satellites, list the satellite mission number and corresponding orbit number for the second satellite).

FOR EXAMPLE (voice annotation for two satellite operation)

The classification of this tape is SECRET - HANDLE VIA THE BYEMAN CONTROL SYSTEM Project EARPOP. Recorded at [redacted] from task 7101B during pass 1234 and task 7102A during pass 0023.

C. END OF INTERCEPT SERVICE:

1. If the REMOTE recorder is not used in the latter part of the intercept operation, a short announcement shall be made at the termination of intercept on CHANNEL 4 of the LOCAL Recorder:

"End of intercept. The information on this tape is classified SECRET HANDLE VIA THE BYEMAN CONTROL SYSTEM Project EARPOP."

2. If circumstances are such that the intercept operation cannot be recorded in its entirety on the LOCAL recorder, the END OF INTERCEPT SERVICE will be made on the REMOTE recorder at the termination of intercept. No annotation will be required at the end of the LOCAL recording, nor will a PRE-INTERCEPT SERVICE be made on the REMOTE recording.

D. VOICE ANNOTATIONS OF TIME: If the TIME CODE GENERATOR should become inoperative, an accurate time standard (WWV, WWVH, or JJY if Available) and voice annotations of time will be substituted on CHANNEL 4 of the recording. The annotations are to be as accurate as possible, and should be derived from the most precise time source available. At

five minute intervals, make the following announcement:

"On the mark, the ZULU time will be_____
. . . . . .Mark."

Continue to make timing announcements until the end of the intercept operation.

APPENDIX E

TIME CHECK OBSERVATORY DESIGNATION LIST

A. The following list is provided only as a guide line, and does not preclude the use of any station listed in APPENDIX F if the suggested stations do not provide adequate signals:

940. TECHNICAL RADIO BROADCAST SERVICES, RADIO STATIONS WWV AND WWVH

A. RADIO STATION WWV

The technical radio services broadcast continuously by the National Bureau of Standards Boulder Laboratory, include a total of six radio frequencies, 2.5, 5, 10, 15, 20, and 25 mc., which are on the air at all times, day and night. This insures reliable coverage of the United States and extensive coverage of other parts of the world.

The services are: (1) standard radio frequencies, (2) time announcements, (3) standard time intervals, (4) standard audio frequencies, including the standard musical pitch, 440 cycles per second, corresponding to A above middle C; (5) radio propagation disturbance warning notices. All of the frequencies are useful for field intensity recording by persons interested in studies of radio propagation. The two highest frequencies are broadcast particularly for this purpose. Vertical non-directional antennae are used.

The Bureau welcomes reports on reception, methods of use, or special applications of the service, particularly with reference to the higher frequencies which have been recently added. Correspondence should be addressed to National Bureau of Standards, Boulder Laboratories, Boulder, Colo.

WWV

Lat. 38°59'33"N., Long. 76°50°52"W.

Megacycles	Broadcast	Power (kw.)	Modulation, c/s
2.5	Continuously, night and day	1.0	1, 440, 600.
5	do	8.0	1, 440, 600
10	do	9.0	1, 440, 600.
15	do	9.0	1, 440, 600.
20	do	1.0	1, 440, 600.
25	do	.1	1, 440, 600.

WWVH

Lat. 20°46'02"N., Long. 156°27'42"W.

5	Continuously, night and day	2.0	1, 440, 600.
10	do	2.0	1, 440, 600.
15	do	2.0	1, 440, 600.

Regular interruptions explained under sec. B.

941. Standard Radio Frequency

The national standard of frequency is of value in radio, electronic, acoustic, and other measurements requiring an accurate frequency. Any desired radio frequency, including microwave frequencies, may be accurately measured in terms of the standard frequencies. This may be done precisely by the aid of one or more auxiliary oscillators, harmonic generators, and radio receivers. The accuracy of each of the radio carrier frequencies, as transmitted, is better than a part in 100,000,000. However, if received accuracies of this order are required it is necessary to make measurements over a long interval or apply corrections for errors introduced by transmission effects in the medium (Doppler effect, etc.).

942. Time Announcements

The audio frequencies are interrupted at precisely 2 minutes before each hour. They are resumed precisely on the hour and each 5 minutes thereafter.

The beginnings of the periods, when the audio frequencies are resumed, are in agreement with the basic time service of the United States Naval Observatory so that they mark accurately the hour and the successive 5-minute periods.

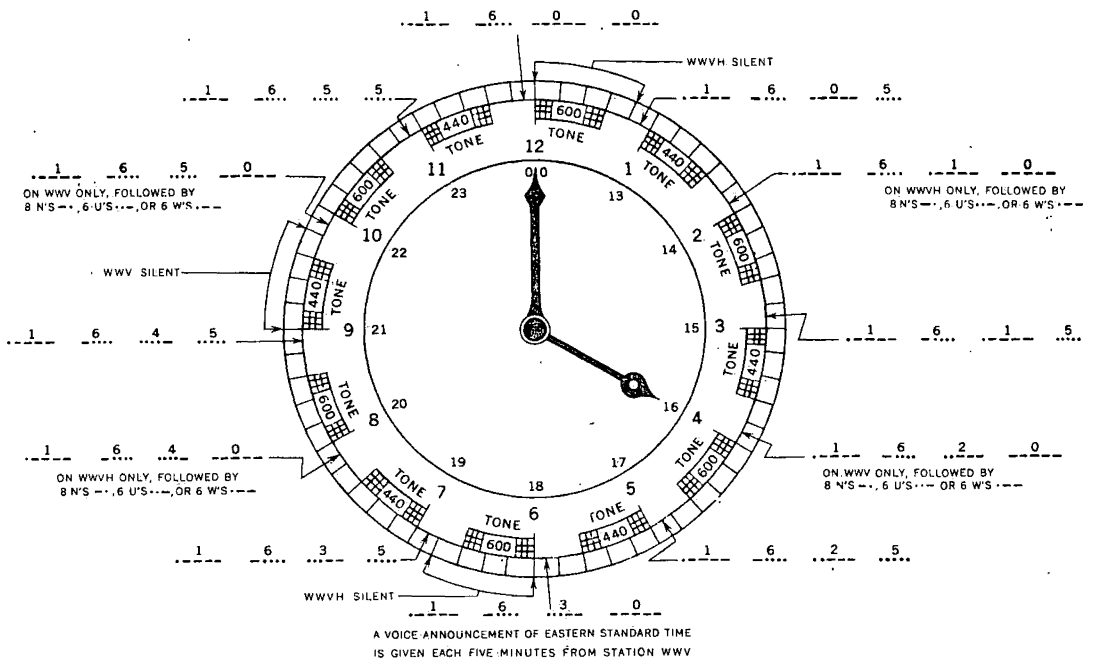
Universal time (Greenwich civil time or Greenwich mean time) is announced in telegraphic code each 5 minutes. This provides a quick reference to correct time where a timepiece may be in error by a few minutes. The zero- to 24-hour system is used starting with 0000 at midnight. The first two figures give the hour and the last two figures give the number of minutes past the hour when the tone returns. For example, at 1655 UT, or 11:55 a.m. eastern standard time, four figures (1, 6, 5, and 5) are broadcast in code. The time announcement refers to the end of an announcement interval ie.., when the audio frequencies are resumed.

A voice announcement of eastern standard time is given following each telegraphic code announcement. For example, at 9:10 eastern standard time the voice announcement in English is: "This is radio station WWV; when the tone returns it will be 9:10 a.m. eastern standard time; 9:10 a.m."

STRUCTURE OF TIME SIGNALS

STATIONS WWV AND WWVH

THE HOUR ILLUSTRATED IS 1600 TO 1700 IN 24 HOUR TIME.



943. Standard Time Intervals

There is a pulse on each carrier frequency of 0.005-second duration which occurs at intervals of precisely 1 second. The pulse consists of five cycles, each of 0.001-second duration, and is heard as a faint tick when listening to the broadcast; it provides a useful standard time interval, for purposes of physical measurements, and for quick and accurate measurement or calibration of timing devices or very low frequency oscillators. It may be used as an accurate time signal. The pulse is omitted at the beginning of the last second of every minute. The 1-minute, 4-minute, and 5-minute intervals, sychronized with the second pulses, are marked by the beginning or ending of the periods when the audio frequencies are off.

A time interval of 1 second marked by the pulse is accurate, as transmitted, to one microsecond (0.000001) second). A 1-minute or longer interval is accurate to a part in 50,000,000.

944. Standard Audio Frequencies and Musical Pitch

Two standard audio frequencies, 440 cycles per second and 600 cycles per second, are broadcast on all radio carrier frequencies. The audio frequencies are given alternately, starting with 600 cycles on the hour for 3 minutes, interrupted 2 minutes, followed by 440 cycles for 3 minutes, and interrupted 2 minutes. Each 10-minute period is the same.

The two standard audio frequencies are useful for accurate measurement or calibration of instruments operating in the audio or supersonic regions of the frequency spectrum. They may also be used for accurate measurement of short time intervals. The 440 cycles per second is the standard musical pitch. A above middle C, the standard in the music industry of the United States since 1925.

The accuracy of the audio frequencies, as transmitted is better than a part in 100,000,000. Transmission effects in the medium (Doppler effect, etc.) may result at times in slight fluctuations in the audio frequencies as received; the average frequency received is, however, of the same order of accuracy as that transmitted.

945. Radio Propagation Disturbance Warning Notice

The National Bureau of Standards will broadcast short wave radio disturbance forecasts via the NBS standard frequency broadcasting stations WWV and WWVH. The broadcasts will tell users or radio transmission paths over the North Atlantic the condition of the ionosphere at the time of the announcement and also how good or bad communication conditions are expected to be for the next 12 hours.

The NBS radio disturbance forecasts, prepared four times daily, will be transmitted in Morse code twice each hour-19½ and 49½ minutes past the hour-on WWV standard frequencies of 2.5, 5, 10, 15, 20, and 25 megacycles. Notices include a letter indicating present radio reception conditions and a digit indicating the expected quality of future reception. The letters used will be "N," "U," and "W," signifying that radio propagation conditions are normal, unsettled, or disturbed, respectively. The digit will be the forecast of expected quality of transmitting conditions on the NBS-CRPL scale of 1 (impossible) to 9 (excellent).

If, for example, propagation conditions at the time the forecast is made are normal but are expected to be only "fair to poor" within the next 12 hours, the forecast statement would be broadcast as N4 in Morse code, repeated five times, i.e., "N4, N4, N4, N4, N4."

The NBS forecasts are based on information obtained from a world-wide network of geophysical and solar observatories. Data on the development of sunspots, solar eruptions, and other activities of the sun are funnelled into the NBS Central Radio Propagation Laboratory in Washington, D.C. Radio soundings of the upper atmosphere, short wave reception data, and similar information are also readily available. Trained forecasters digest the information and formulate the predictions. The forecasts are issued by NBS regularly each day at 0500, 1200, 1700

and 2300 G.M.T. Each forecast statement will be broadcast by WWV for a period of about 6 hours—until the next forecast is issued. Thus the forecast prepared at 1700 G.M.T. will be first broadcast at 1719½ and then at half-hourly intervals through 2249½. The broadcast at 2319½ will then carry the next disturbance forecast issued at 2300 G.M.T.

The letter portion of the forecast statement, describing the quality of radio propagation conditions, is valid only for the North Atlantic transmission path at the time the forecast is issued from NBS. The digit portion is a forecast of the average quality of communication conditions along these paths in the 12-hour period beginning at 0000, 0600, 1200, or 1800 G.M.T.-about an hour after the time at which the letter describes the condition. For example, a forecast statement of "W5" issued at 0500 G.M.T. means that at 0500 the conditions across the North Atlantic path were disturbed and that in the period 0600-1800 the average of conditions is expected to improve to quality 5 (fair).

The NBS radio disturbance forecasts refer only to North Atlantic paths, such as Washington to London or New York to Berlin. The forecasters assume that the most suitable radio frequencies for communications are available and in use along these paths. Because of this assumption, their notices must be interpreted on a relative scale in terms of experience on each radio circuit in use. It is impossible to rate conditions on an absolute scale because the varied effects of transmitter power, type of communications traffic and procedure, antennas, and receivers prevent an evaluation that will be valid for all systems and all circuits. One purpose of broadcasting both a description and a forecast is to show more clearly whether propagation conditions are expected to deteriorate or improve in the 12-hour period.

Digit (forecast)	Propagation condition	Letter (current)
1	Impossible	W
2	Very poor	W
3	Poor	W
4	Poor to fair	W
5	Fair	U
6	Fair to good	N
7	Good	N
8	Very good	N
9	Excellent	N

946. Distance Range of Reception

Of the standard radio frequencies (2.5, 5, 10, 15, 20, and 25 mc.), the lowest provide service to short distances, and the highest to great distances. Reliable reception is in general possible at all times throughout the United States and the North Atlantic and Pacific Oceans and reception at times throughout the world. One should select the frequency that gives best reception at any particular place and time. This can be done by two methods:

(a) By tuning to the different frequencies and selecting the one most suitable at that time. For nighttime conditions over the propagation path, lower frequencies than those used during the day are usually necessary because of skip. Received intensities on usable frequencies are much greater for nighttime than for daytime conditions.

(b) By making use of techniques of prediction of usable frequencies. Although there are a great number of variables affecting radio wave propagation and distance range, techniques exist for the prediction of usable frequencies over any specific path during any future month. By means of such techniques and the Central Radio Propagation Laboratory's prediction service, it is possible for a user to prepare a graph or table for his locality showing the best frequency for any period of the day in any month, three months in advance. National Bureau of Standards publications useful for this purpose are the reports of the CRPL-D series, "Basic Radio Propagation Predictions," which are issued monthly 3 months in advance of the month of prediction, and Circular 465 of the National Bureau of Standards, "Instructions for the Use of Basic Radio Propagation Predictions." These two publications may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., price in United States $1 per year (12 issues(and 30 cents per copy, respectively (foreign $1.25 and 40 cents).

For continuous 24-hour reception without a break, the use of more than one receiver and antenna is necessary. With skilled operators to anticipate times for frequency shifting and with schedules prepared as in *(b)* above as a guide, it may in some cases be possible to operate continuously with two receivers. For maximum certainty of reception it is necessary to employ as many receivers as there are satisfactorily receivable WWV frequencies at the location, leaving them all in operation continuously and combining their outputs. A separate and directive antenna for each radio receiver is desirable.

B. RADIO STATION WWVH (HAWAII)

Radio station WWVH, established by the National Bureau of Standards on the island of Maui, Hawaii, broadcasts on 5, 10, and 15 megacycles. Station WWVH extends to the Pacific area the following technical services: standard radio frequencies, time announcements, standard time intervals, standard audio frequencies, and standard musical pitch. Omnidirectional antennas radiate approximately 2,000 watts of power at each carrier frequency.

The program of broadcasts of WWVH, on its three frequencies, 5, 10, and 15 mc., is the same as that of station WWV for standard time intervals, time announcements in code, standard audio frequencies, and accuracy. Reports received indicate that station WWVH may be usefully received at many locations not served by station WWV and that simultaneous reception of WWV and WWVH does not interfere with ordinary use of the standard frequencies and time signals.

The WWVH broadcast is interrupted for 4 minutes following each hour and half hour and for periods of 34 minutes each day beginning at 1900 G.M.T. In using time interval markers for high precision work it is necessary to remember that step adjustment of precisely ± 20 milliseconds may be made at the transmitter on Wednesday at 1900 UT; this is explained under Sec. 942, Time Announcements. The second pulses from WWVH are adjusted if necessary each day during the interval 1900 to 1935 UT so as to commence simultaneously with those from WWV.

950. TECHNICAL RADIO BROADCAST SERVICES, RADIO STATION JJY

Technical radio services from the Standard Frequency Station, Koganei, Tokyo (JJY) are broadcast continuously, except for the period from 29 to 39 minutes past each hour, and include the following:

(1) Standard radio frequencies.
(2) Time announcements.
(3) Radio propagation disturbance warning notices.

TIMES:	FREQ.:	MODULATION:
0659-2259*- -	2,500 Kc., A1, A2, A3-----	1000 c/s.
0000-2400*- -	5,500,10,000, 15,000 Kc.,A1, A2, A3.	1000 c/s.

*Continuous, except for the period from 29 to 39 minutes past each hour.

951. Standard Radio Frequency

The standard frequencies as broadcast have an accuracy of 2 parts in 100,000,000. (For uses of standard frequencies, see sec. 941.) The modulation tone commences on the exact minute of each hour and continues for a period of four minutes. This is repeated every five minutes during transmission, i.e. at 05, 10, 15, 20, 25, 40, 45, 50, and 55 minutes past each hour.

952. Time Announcements—Radio Propagation Forecasts

Throughout the hour, both audio and carrier frequencies are interrupted for 0.02 second at each second and 0.2 second at each whole minute. The exact time is marked by the resumption of transmission following these interruptions.

The audio and carrier (A2) frequencies are interrupted at precisely one minute before each hour and the fifth minute of each five minute period thereafter, i.e. from 59-00, 04-05, 09-10, 14-15, 19-20, 24-25, 39-40, 44-45, 49-50, and 54-55 minutes past each hour, when the call sign, time code, and radio propagation forecast will be transmitted in the following order:

1. Identification signals (modulation–1000 c/s).
   (a) Call sign (JJY) (•▬▬▬ •▬▬▬ ▬•▬▬) 2 times.
   (b) Time code (expressed in 24 hour time, Japanese Standard Time) 1 time.
   (c) Propagation forecast codes:

N (▬•)	Normal	5 times.
W (•▬▬)	Warning	
U (••▬)	Uncertain	

2. Voice announcements.
   (a) Call sign (JJY) 2 times.
   (b) Time----in Japanese and Enlish and the letters J.S.T. (Japanese Standard Time).

Chapter 3
RADIO TIME SIGNALS

300. GENERAL

Under the radio stations listed as sending radio time signals, the time shown is the Greenwich civil time of the beginning and ending of the transmission of the time signal proper.

ACCURACY OF SIGNALS: The majority of radio time signals are transmitted automatically, being controlled by the standard clock of an astronomical observatory. Absolute reliance may be had in these signals, and they should be correct to 0.05 second. Some stations transmit by a combination of hand and automatic signals, and care should be exercised to differentiate between the two at the time of actual comparison of the chronometer.

Other radio stations, however, have no automatic transmission system installed, and the signals are given by hand. In this instance the operator is guided by the standard clock at the station. The clock is checked by either astronomical observations or by reliable time signals. The hand transmission should be correct to 0.25 second.

STATIONS TO AVOID INTERFERENCE: During the transmission of time signals, stations are prohibited from making any transmissions which might interfere with the reception of these signals by other stations.

301. RADIO TIME SIGNAL SYSTEMS

At the present time there is a lack of uniformity in the systems employed for the broadcast of radio time signals. The systems most frequently used and more likely to be heard in most parts of the world are as follows:

A. The United States system.
B. The International (ONOGO) system.
C. The New International (modified ONOGO) system.
D. The rhythmic (coincidence) system.
E. U.S.S.R. ordinary time signals.
F. The Japanese ordinary system.
G. The Japanese "NDB" system.
H. The English system ordinary time signals.

Special systems not related to the above mentioned categories are described in detail under their respective stations.

301A. The United States System

The transmission of signals begins at 55 minutes 0 seconds of some hour, and continues for 5 minutes. Signals are transmitted on every second during that time, except that there is no signal on the 29th second of any minute, nor on certain seconds at the ends of the minutes, as shown in the diagram below.

The dashes in the diagram below indicate seconds on which signals are transmitted. The seconds marked "60" are the zero seconds of the following minutes. All seconds from 0 to 50, inclusive, are transmitted except the 29th second, as explained above. The dash on the beginning of the hour (shown as 59 minutes 60 seconds below) is much longer than the others (i.e., 1.3 seconds.

In all cases the beginnings of the dashes indicate the beginnings of the seconds, and the ends of the dashes are without significance.

It will be noted that the number of dashes sounded in the group at the end of any minute indicates the number of minutes of the signal yet to be sent.

REPETITIONS: In the event of a failure or an error occurring in any of the time signals another time signal will be transmitted one hour later on the same frequency.

HIGH PRECISION: For ordinary navigational purposes no special precautions need be observed in receiving the signals other than to avoid those signals which are marked in the station schedule as unsatisfactory for navigational purposes.

However, in work which requires a knowledge of time to the hundredth of a second certain precautions must be observed in receiving the signals.

When tuning in the radio time signals, especially when automatic recorders are used, great care must be exercised to insure reception at the beginning of the signal on each second. Apparently the 121.95 kilocycle Annapolis signals build up in strength each time the circuit is keyed, the process requiring several hundredths of a second. If the signals are faintly received, the recorder may operate with considerable delay. The obvious remedy is to increase the amplification, so as to insure operation at the beginning of each signal.

In the case of the high-frequency or short-wave signals, a different difficulty exists. Although the signals on each second begin full strength, there is evidently a slight shift of frequency taking place each time the circuit is keyed. A sharply tuned received may appear to receive the signals perfectly, when, as a matter of fact, it is out of tune with the beginning of all the signals, and consequently operating with a delay of several hundredths of a second.

The United States System

Minute	Second										
	50	51	52	53	54	55	56	57	58	59	60
55	—		—	—	—	—					—
56	—	—		—	—	—					—
57	—	—	—		—	—					—
58	—	—	—	—		—					—
59	—										—

301B. The International (ONOGO) System

This system was adopted at the Conference Internationale de l'Heure, 1912. It is better known as the ONOGO system because of the sequence of the Morse letters used in the time code. The transmission of the actual time signals lasts for three minutes.

As transmitted by the majority of stations, the signals proper are preceded by the preparatory signals as shown under the respective stations.

The signal proper lasts three minutes and is sent as follows:

In the transmission of the signals ONOGO, each dash (▬)=1 second, and each dot (•)=0.25 second.

The particular signal of this series, that is accepted as the time signal, varies. In some cases the end of the final dash in the letter O (▬ ▬ ▬), representing an even minute, is used; while another country specifically mentions the dot of the letters N (▬•) and G (▬ ▬•). As the exactitude of the signals O, N, G, can be depended upon, either method can be safely employed.

The international system is used in Turkey, India, Ceylon, West Australia, and South Australia.

Signal	Times				Diagram
	m.	*s.*	*m.*	*s.*	
Series of X's sent every 5 seconds	57	00	to 57	49	— • • — — • • — etc.
Letter O	57	55	to 58	00	55 56 57 58 59 60
Letter N	58	08	to 58	10	08 09 10
Letter N	58	18	to 58	20	18 19 20
Letter N	58	28	to 58	30	28 29 30
Letter N	58	38	to 58	40	38 39 40
Letter N	58	48	to 58	50	48 49 50
Letter O	58	55	to 59	00	55 56 57 58 59 60
Letter G	59	06	to 59	10	06 07 08 09 10
Letter G	59	16	to 59	20	16 17 18 19 20
Letter G	59	26	to 59	30	26 27 28 29 30
Letter G	59	36	to 59	40	36 37 38 39 40
Letter G	59	46	to 59	50	46 47 48 49 50
Letter O	59	55	to 00	00	55 56 57 58 59 60

301C. The New International (Modified ONOGO) System

The International Time Commission, July 1925, recommended that the International (Onogo) System of radio time signals be amended, by the substitution of 6 dots (•) sent at the fifty-fifth, fifty-sixth, fifty-seventh, fifty-eighth, fifty-ninth, and sixtieth, seconds of each minute, instead of the 3 one-second dashes that commence at the fifty-fifth, fifty-seventh, and fifty-ninth seconds of the last 3 minutes, and which constitute the time signals.

The New International System of radio time signals has now been adopted by Germany, France, South Africa, China, Java, Australia, and New Zealand.

The signal proper is as follows:

Signal	Times				Diagram
Series of X's sent every 5 seconds	57	00	to 57	50	— • • — — • • — etc.
A dot each second (time signals)	57	55	to 58	00	55 56 57 58 59 60 • • • • • •
Letter N (time signal)	58	08	to 58	10	8 9 10 ▬ •
Letter N (time signal)	58	18	to 58	20	18 19 20 ▬ •
Letter N (time signal)	58	28	to 58	30	28 29 30 ▬ •
Letter N (time signal)	58	38	to 58	40	38 39 40 ▬ •
Letter N (time signal)	58	48	to 58	50	48 49 50 ▬ •
A dot each second (time signals)	58	55	to 59	00	55 56 57 58 59 60 • • • • • •
Letter G (time signal)	59	06	to 59	10	6 7 8 9 10 ▬ ▬ •
Letter G (time signal)	59	16	to 59	20	16 17 18 19 20 ▬ ▬ •
Letter G (time signal)	59	26	to 59	30	26 27 28 29 30 ▬ ▬ •
Letter G (time signal)	59	36	to 59	40	36 37 38 39 40 ▬ ▬ •
Letter G (time signal)	59	46	to 59	50	46 47 48 49 50 ▬ ▬ •
A dot each second (time signals)	59	55	to 00	00	55 56 57 58 59 60 • • • • • •

301D. The Rhythmic (Coincidence) System

The International Time Commission of 1925 adopted the New International System of rhythmic wireless time signals, which is described herein. This system has been adopted by Australia, Brazil, France, Germany, Japan, U.S.S.R. and other countries.

The rhythmic system consists of 306 signals transmitted in the space of 300 seconds or 5 minutes of mean time. The signals falling exactly on the minute are short dashes (▬) of 0.4 second duration. Between the dashes 60 dots (●) of 0.1 second each are transmitted. Each minute therefore is divided into 61 intervals. This vernier arrangement permits coincidence to be obtained between the chronometer beat (tick) and the radio signal. Chronometers beating half seconds will afford two coincidences each minute, while those beating only on the second will give on coincidence each minute. Due to the vernier arrangement, these signals permit chronometer comparisons of accuracy approaching 0.01 second.

PROCEDURE: To permit adjustment of the receiving apparatus, the Signal proper is preceded by a preparatory signal or by 30 or 45 seconds of dots. As some stations neither begin nor end their signals on the hour, the minutes given in the following table are relative only, the 0 minute representing the time that the signal starts and the 5 minute representing the time that it ends.

00 m. 00s.—first signal, a dash (▬) followed by 60 dots (●●● etc.).
01 m. 00s.—sixty-second signal, a dash (▬) followed by 60 dots (●●● etc.).
02 m. 00s.—one hundred and twenty-third signal, a dash (▬) followed by 60 dots (●●● etc.).
03 m. 00s.—one hundred and eighty-fourth signal, a dash (▬) followed by 60 dots (●●● etc.).
04 m. 00s.—two hundred and forty-fifty signal, a dash (▬) followed by 60 dots (●●● etc.).
05 m. 00s.—three hundred and sixth signal, a dash (▬).

The beginnins of the dots and dashes must be used, not their endings.

FOR ORDINARY NAVIGATING: As the beginning of each short dash is exactly at the beginning of the minute, the chronometer may be compared as in any other system without attention to the dots transmitted. This is normally accurate enough for ordinary navigational purposes. If the signals are used in this manner, five comparisons may be obtained.

FOR HIGH PRECISION: If greater accuracy is required, the error to the nearest second is obtained from the beginning of the dash that marks the exact minute and the fractions of the second are obtained by counting the dots from this dash to the dot which exactly coincides with some chronometer beat, and entering the appended table. With a chronometer beating to the half second, ten coincidences may be obtained, and the errors of these coincidences as given in the table should be averaged to reduce observational errors. When the greatest possible accuracy is desired, the above results should be corrected for the error in the time signal itself as published in correction sheets, notices to mariners, or similar papers.

Rhythmic correction table

Number of radio signal	Chronometer faster	Number of radio signal	Chronometer faster	Number of radio signal	Chronometer slower
	Second		*Second*		*Second*
1	0.016	21	0.344	41	0.328
2	.033	22	.361	42	.312
3	.049	23	.377	43	.295
4	.066	24	.393	44	.279
5	.082	25	.410	45	.262
6	.098	26	.426	46	.246
7	.115	27	.443	47	.230
8	.131	28	.459	48	.213
9	.148	29	.475	49	.197
10	.164	30	.492	50	.180
11	.180	31	.492	51	.164
12	.197	32	.475	52	.148
13	.213	33	.459	53	.131
14	.230	34	.443	54	.115
15	.246	35	.426	55	.098
16	.262	36	.410	56	.082
17	.279	37	.393	57	.066
18	.295	38	.377	58	.049
19	.312	39	.361	59	.033
20	.328	40	.344	60	.016

NOTE.—Care should be taken to identify the precise moment of coincidence as accurately as possible. The limits within which erroneous readings are probable are considerable (several seconds on either side); a coincidence recorded too early tends to give a low value for the corrected time, and vice versa (approximately one-sixtieth second for each unit of displacement).

301E. The U. S. S. R. Ordinary System

These signals are used by certain stations in the Union of Soviet Socialist Republics.

For the majority of stations, the preparatory signals and the signal proper take five minutes to transmit. The preparatory signals for the majority of the stations consist of the call signal of the station and a series of dashes as shown under the stations concerned. The signal proper is as follows:

Signal	Times				Diagram
	m.	*s.*		*m.* *s.*	55 56 57 58 59 60
A dot each second (time signal)	57	55	to	58 00	• • • • • •
Series of M's	58	14	to	58 46	— — — — — — etc.
					55 56 57 58 59 60
A dot each second (time signal)	58	55	to	59 00	• • • • • •
Series of O's	59	14	to	59 46	— — — — — — etc.
					55 56 57 58 59 60
A dot each second (time signal)	59	55	to	00 00	• • • • • •

301F. The Japanese "NDB" System

The time signal proper occupies 3 minutes, each exact minute being marked by the beginning of a one-second dash. A continuous dash is transmitted from the 5th to the 15th second of the first minute. From the 30th to the 55th second of each minute a Morse letter is transmitted; "N" in the first minute, "D" in the second minute, and "B" in the third minute, as shown in the following diagram.

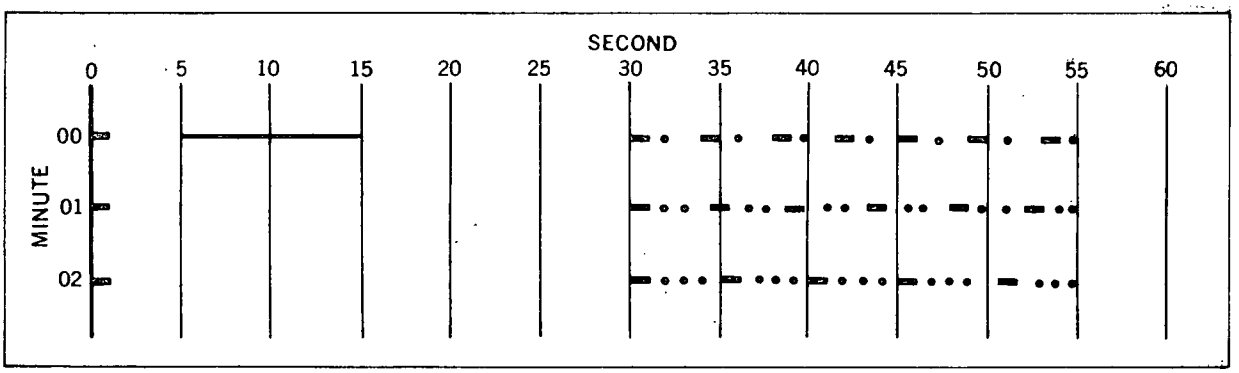
As some stations do not commence the time signal on the hour, the minutes shown in the diagram are relative only.

301G. The Japanese Ordinary System

The time signal consists of 60 pulses per minute. Time is indicated by short interruption of the radio wave, 0.02 second for each whole minute.

The exact time is indicated by the resumption of transmission after these brief interruptions.

The Japanese NDB System



301H. The English System Ordinary Time Signals

The transmission of time signals commences at 55 minutes 00 seconds before the scheduled hour and continues for a period of 5 minutes with a 0.1 second dot at each second, 1 through 59, and a 0.4 second dash at the exact minute. The beginning of each dot or dash is the time reference point.

MINUTE	SECOND												
	1	2	3	4	5	6	(7 thru 54)	55	56	57	58	59	60
55	•	•	•	•	•	•	•	•	•	•	•	•	—
56	•	•	•	•	•	•	•	•	•	•	•	•	—
57	•	•	•	•	•	•	•	•	•	•	•	•	—
58	•	•	•	•	•	•	•	•	•	•	•	•	—
59	•	•	•	•	•	•	•	•	•	•	•	•	—

CANADA—Atlantic Coast

3020. Ottawa, Ont. (CHU)

HOURS OF TRANSMISSION: Continuous.

FREQ.: 3330, 7335, 14670 kc., A2.

CHARACTERISTIC SIGNAL: A dot for every second with the exception of the following seconds, 29, 51 to 59 inclusive, which are omitted during each minute. At the exact hour a one second dash is sent, the beginning of the dash indicating the Time Signal. Between 50 and 60 seconds of each minute a voice announcement "Dominion Observatory, Canada, Eastern Standard Time ---- hours ---- minutes" and at the exact hour "---- hours exactly" is made followed by the time of the next beat. In addition, during the first half minute of each hour, the identifying signal CHU CANADA CHU is transmitted once in Morse Code.

REMARKS: Source is the Dominion Observatory, Ottawa, Ontario.

UNITED STATES—Atlantic Coast

303. The United States Naval Observatory at Washington, D.C., is the origin of all Government time signals broadcast in the United States and its possessions. See section 301A for description of the United States system of time signal transmission. See section 940 for Time Announcements of Stations WWV and WWVH. For the Great Lakes see WWV, Sec. 940, and Station No. 8020 Ottawa, Ont.

3030. Washington, D. C. (NSS).

HOURS OF TRANSMISSION:

	FREQ.:
0155–0200 0555–0600 0755–0800 1155–1200 1355–1400 1755–1800 2355–2400	121.95*, 5870, 9425, 13575, 17050.4, 23650 kc., A1.

REMARKS: Average error less than 0.01 second.

NOTE: 121.95* kc. replaced by 162 kc. at 1800 on Tuesdays, Wednesdays, and Thursdays.

MEXICO

304. Stations use the U.S. System, except the 28th second signal is also omitted. (See sec. 301A.) Preparatory signal from the 54th to 55th minute is "VVVV de - - - - (stations call sign) - - - - . Source is Tacubaya Observatory.

3040. Chapultepec (XDD) (XDP).

HOURS OF TRANSMISSION:

	FREQ.:
0155–0200 1555–1600 1755–1800	4800 kc., 13043 kc., A1.

NOTE: On Sundays and public holidays only the 1755 signal is sent.

3041. Tacubaya (XBA).

HOURS OF TRANSMISSION:

	FREQ.:
0155–0200 1555–1600 1755–1800	6977, 13953.5 kc., A1.

NOTE: On Sundays and public holidays only the 1755 signal is sent.

BRAZIL

305. Stations use the Rhythmic (Coincidence) Systems, (See sec. 301D.) and English System (See Sec. 301H). Station 3050 (PPR) is preceded by the Preparatory Signal VVV de PPR local time signal. (Repeated several times) commencing at 20 minutes past the hour. Station 3060 (PPE) is preceded by the Preparatory Signal CQ DE PPE SHRJ (repeated several times) commencing at 24 minutes past the hour.

3050. Rio de Janeiro (PPR).

HOURS OF TRANSMISSION:

	FREQ.:
0125–0130 1425–1430 2125–2130	300, 4244, 6421, 8634, 17194 kc., A2.

NOTE: English System (See sec. 301H) commences on the above times, followed by the Rhythmic System (System (See sec. 301D).

3060. **Rio de Janeiro (National Observatory) (PPE).**
HOURS OF TRANSMISSION: FREQ.:
0025–0030 }
1325–1330 } 8721 kc., A1.
2025–2030 }
NOTE: English (See sec. 301H) commences on the above times, followed by the Rhythmic System (See sec. 301D).

3065. **Radio Relogio Federal (ZYZ)**
HOURS OF TRANSMISSION: FREQ.:
0000–2200 — 4905 kc., A3.
2300–2400 — 590 kc., A3.
REMARKS: Time signal consists of 57 dots followed by 3 dashes, the exact minute coincides with the beginning of the third dash.
NOTE: Signal is retransmitted from National Observatory, Rio de Janeiro.

URUGUAY

3070. **Montevideo (CX6) (CXA6).**
HOURS OF TRANSMISSION: FREQ.:
1500 }
2000 } 650 kc., 9620 kc., A3.
CHARACTERISTIC SIGNAL: Consists of a 10-second dash and a 5-second silent period followed by 6 dots. The sixth dot marks the exact hour.

ARGENTINA

3080. **Buenos Aires (Control de Communicaciones) (LOL).**
HOURS OF TRANSMISSION: FREQ.:
0055–0100 }
1255–1300 } 195, 2162.5, 4856, 8030, 13,101, 17,180, 22,840 kc., A1.
2055–2100 }
REMARKS: Preparatory signal consists of a dot for each second from 54 min. 30 sec. to 54 min. 50 sec., followed by an 8-second dash. The time signal is a modification of the United States System (See sec. 301A), whereby all signals are dots, except the beginning of each whole minute is indicated by a 0.5-second dash. An 8-second dash indicates the conclusion of the time signal transmission. Error is normally less than 0.03 second.

3081. **Buenos Aires (Radio Nacional) (LRA).**
FREQ.: 710, 870 kc., A3.
1070, 6120, 9660, 15290 kc., A3.
HOURS OF TRANSMISSION: On each hour and half hour from 0700–2400 (zone time).
TIME SIGNAL: From 59m.00s. to 59m.59s. a series of 5 dots representing each second, followed by a dash for time signal. From 29m. 58s. to 29m.59s. two dots representing each second, followed by a dash for time signal. From 20h.29m.45s. to 20h.29m.55s. there are eleven additional dots one on each second, in addition to regular time signal above. Error normally less than 0.03 second.

3090. **Monte Grande (LQC) (LQB).**
HOURS OF TRANSMISSION: FREQ.:
1000–1005 }
1145–1150 } (LQC) 17,550 kc., A2.
2345–2350 — (LQB) 8650 kc., A2.
REMARKS: Preparatory signal is CQ CQ CQ de LQC LQC LQC or LQB LQB LQB followed by a long continuous dash which terminates at 1000, 1145, and 2345. Ordinary Time Signals (See sec. 301H) are transmitted at 1000 with the dot omitted at the 59th second of each minute. At 1145 and 2345 a modified Rhythmic Time Signal (See sec. 301D) is transmitted with signal nos. 1, 62, 123, 184, and 245 being omitted, while a 5-second dash is the 306th signal.

SWEDEN

310. The following Swedish stations commence Time Signal transmissions at 11h 57m 55s daily as follows:

TIME SIGNAL:
m. s. m. s.
57 55 – 57 59 } Five dots (one at each second).
58 00 } A 0.6-second dash.
In the 58th and 59th minutes a dot is sent every second except at the 51st, 52nd, 53rd and 54th seconds. At the 60th second of each minute a 0.6-second dash is sent, the commencement of which is the Time Signal.

3100. **Goteborg Broadcasting Station (SBB).**
FREQ.: 980 kc., A3. POWER: 10 kilowatts.

3110. **Horby Broadcasting Station (SBH).**
FREQ.: 1178, 9620, 11880 kc., A3. POWER: 100 kilowatts.

3120. **Motala Broadcasting Station (SBG).**
FREQ.: 191, 7270 kc., A3. POWER: 200 kilowatts.

3130. **Stockholm Broadcasting Station (SBX).**
FREQ.: 773 kc., A3. POWER: 55 kilowatts.

3140. **Sundsvall Broadcasting Station (SBD).**
FREQ.: 593 kc., A3. POWER: 150 kilowatts.

3150. **Ostersund Broadcasting Station (SBF).**
FREQ.: 719 kc., A3. POWER: 10 kilowatts.

3160. **Lulea Broadcasting Station (SBS).**
FREQ.: 182 kc., A3. POWER: 10 kilowatts.

3170. **Falun Broadcasting Station (SBV).**
FREQ.: 1223 kc., A3. POWER: 100 kilowatts.

U.S.S.R.

3200. **Moscow (RES) (RWM) (ROR).**

HOURS OF TRANSMISSION: "A" "B"	FREQ.:
0200–0206	100, 10000 kc.
0400–0406	25, 100, 10000 kc.
0600–0606	100, 20000 kc.
0800–0806	25, 100, 15000 kc.
1000–1006	100, 15000 kc.
1200–1206	25, 100, 15000 kc.
1400–1406	100, 10000 kc.
1600–1606	25, 100, 10000 kc.
1800–1806	100, 5000 kc.
2000–2006	25, 100, 5000 kc.
2200–2206	100, 5000 kc.
2400–0006	25, 100, 5000 kc.

REMARKS: (A) The English Ordinary System (see sec. 301H); (B) the Rhythmic System (see sec. 301D). Time signals commence 5 on one or several of the listed frequencies and commence five minutes before the scheduled times. They are preceded by a preparatory signal consisting of the station call sign followed by a warning signal of a series of dashes.

NOTE: On the 5th, 15th, and 25th of each month, 25 kc. is used only at 0400, 2000 and 2400. On the first and third Wednesdays of each month all other frequencies omit 0600–1400 broadcasts.

POLAND

3250. **Poland Broadcasting System.**

STATION:	FREQ.:	
Warszawa I	227 kc., A3.	Weekdays: 0400–1000, 1200–1900, 2200 (No 1700–1900, 2200 broadcast on Saturdays). Sundays: 0500, 1000, 1400, 1600, 1900, 2000, 2100, 2300.
Bialystok	1367 kc., A3.	Weekdays: 0600, 1200, 1400, 1500, 1600, 1800, 2000, 2300. (No 2300 broadcast on Saturday) Sundays and holidays: 0500, 1000, 1400, 1600, 1900, 2000, 2100, 2300.
Gdansk	1304 kc., A3.	
Katowice	1079 kc., A3.	
Krakow	1502 kc., A3.	
Lodz	1367 kc., A3.	
Lubin	1367 kc., A3.	
Poznan	737 kc., A3.	
Rzeszow	1502 kc., A3.	
Szezecin	1304 kc., A3.	
Torun	1304 kc., A3.	
Warszawa II	818 kc., A3.	
Wroclaw	1259 kc., A3.	
Zielona Gora	1259 kc., A3.	

NOTE: During Summer, broadcasts are one hour earlier.
TIME SIGNAL: 6 pips transmitted by the quartz crystal clock at 55, 56, 57, 58, 59, 60.
REMARKS: Error does not exceed 0.1 second.

GERMANY

3300. **Kiel (DAO).**

HOURS OF TRANSMISSION:	FREQ.:	POWER:
1157–1200	2775 kc., A1.	500 watts.

REMARKS: The New International System (see sec. 301C). Station relays the time signal of Norddeich (3310).

3310. **Norddeich (DAN) (DAM).**

HOURS OF TRANSMISSION:		FREQ.:
March 21 to Sept. 20	0000	2614, 6475.5, 12763.5.
	1200	2614, 8638.5, 16980.
Sept. 21 to March 20	0000	2614, 4265, 8638.5.
	1200	2614, 8638.5, 16980.

REMARKS: The New International System (see sec. 301C) commences 5 minutes before scheduled time, followed by a 10-second dash at 10 seconds past the hour. The English System (see sec. 301H) (not on 2614 kc.) is transmitted from 30 seconds to 6 minutes past the hour. Signals are transmitted automatically from German Hydrographic Institute, Hamburg.

3320. **Mainflingen (DCF77).**

FREQ.: 77.5 kc., A1.

HOURS OF TRANSMISSION:

0000–0010	1930–1940	
0100–0110	2000–2010	Mar.–Oct.
0200–0210	2100–2110	
0600–0810	2200–2210	Weekdays.
1100–1110	2300–2310	
1900–1910		

REMARKS: Rhythmic Time Signal. (See sec. 301D.)

NOTE: All other times daily.

3330. **North German and West German Broadcasting System, Osterloog, from German Hydrographic Institute, Hamburg.**

HOURS OF TRANSMISSION:	FREQ.:
(a) 0400–0800, 1100, 1300, 1500, 1600, 1800, 2100, 2300, 2400	701, 971, 1570, 1586 kc., A3.
(b) 1200	
(a) 0400–0800, 1300, 1500, 1600, 1800, 2100, 2300, 2400	6075.
(c) 10h.54m.30s. to 11h.00m.00s.	

REMARKS:

(a) Dot at 50, 55, 58, 59 and 60th second.
(b) Dot at 30–40, 45, 50, 55, 58, 59 and 60th second.
(c) English System.

GREAT BRITAIN

3400. **Rugby (GBR).**

TIMES:	FREQ.:
0255–0300	16 kc., A1.
0855–0900	
1455–1500	
2055–2100	

PREPARATORY SIGNAL: From 54 m. 00 s. to 55 m. 00 s., GBR TIME repeated 4 times (24 seconds), silent (6 seconds), carrier (24 seconds), silent (6 seconds).

TIME SIGNAL: From 55 m. 00 s. to 60 m. 00 s., minute markers of 500 milliseconds are followed by second markers of 100 milliseconds. The hour is marked by the beginning of the final minute marker. From 60 m. 00s. to 00 m. 30 s., silent (5 seconds), carrier (20 seconds), silent (5 seconds).

REMARKS: English System Ordinary Time Signals transmitted. (See sec. 301H.)

NOTE: Time signal is also transmitted in general at the following supplementary frequencies and times:

	FREQ. (kc., A1)			
	Sept. 1–Oct. 31.	Nov. 1–Feb. 28	Mar. 1–Apr. 30	May 1–Aug. 31
0900 (GIC 37)	17685	17685		
(GPB 30B)	10331.5	10331.5		10331.5
(GIC 27)			7397.5	
(GIC 33)			13555	13555
2100 (GIC 33)	13555		13555	
(GPB 30B)	10331.5	10331.5		10331.5
(GIC 27)		7397.5	7397.5	7397.5

3410. **B.B.C. Time Signals (Home Service and Light Program).**

NATURE OF BROADCAST: The B.B.C. time signal consists of an automatic transmission by the standard clock at the Greenwich Observatory of 6 dots, one for each second from the 55th to the 60th inclusive. The final dot is the time signal.

ERROR: Normally accurate to 0.1 second.

B.B.C. Home Service.

HOURS OF TRANSMISSION:	FREQ.:
0700 (except Sunday)	1457, 1151, 1088, 1052, 908, 881, 809, 692 kc., A3.
0800 (except Sunday)	
0900	
1100 (except Sunday)	
1300	
1800	
2300	93500, 94400 kc., F3.

B.B.C. Light Program.

HOURS OF TRANSMISSION:	FREQ.:
0645	200 kc., A3.
0900	1214, 200 kc., A3. 89100, 90000 kc., F3.
1000 (except Sunday)	
*1200	
*1400 (except Sunday)	
*1500 (except Sunday)	
1900 (except Sunday)	
1930 (Sundays only)	
2030 (except Sunday)	

*Not on Saturdays; liable to be cancelled other days.

3420. **B.B.C. Time Signals. (Overseas Service).**

TIMES:	FREQ.:
0000	6,195†, 7,110, 7,230, 9,510†, 9,580, 9,690, 9,825, 11,750, 11,820, 12,040.
0200	6,195†, 7,110, 7,230, 9,510†, 9,580, 9,690, 11,750, 12,040.
0300	6,195†, 7,230, 9,510†, 9,580, 12,040.
0400	6,150*, 7,185*, 9,410*, 9,580*, 12,095*.
0500	6,110*, 6,150*, 7,185*, 9,410*, 9,510*, 9,580*, 11,820*, 12,095*, 15,140*.
0600	6,110*, 7,120, 7,185, 9,410*, 9,510*, 9,580*, 11,750, 11,820*, 12,095*, 15,070*, 15,140*, 17,790*, 17,810*.
0700	6,110*, 7,120, 7,185*, 9,410*, 9,510*, 11,750, 11,820*, 11,955, 12,095*, 15,070*, 15,140*, 17,790*, 17,810*, 21,470*, 21,710*.
0800	9,510, 11,750, 11,955.
1000	21,630*, 25,720*.
1100	15,070, 15,310, 15,435, 17,790*, 21,470*, 21,530, 21,550, 21,615*, 21,710*, 25,670*, 25,720*, 25,840.
1200	21,530, 25,840.
1300	11,780*, 15,070*, 15,230*, 17,790*, 21,470*, 21,530*, 21,550, 21,710*, 25,720*.
1400	15,070*, 17,695*, 17,790*, 21,470*, 21,550, 21,710*, 25,720*.
1500	15,110, 18,080, 21,530*.
1530	15,110, 18,080, 21,530*.
1600	12,095*, 15,070*, 15,310†, 15,435, 17,695*, 17,790, 17,810†, 21,470*, 21,550, 21,595*, 21,710*.
1700	15,310†, 17,810†.
1800	11,820*, 11,860*, 12,095*, 15,070*, 15,300*, 17,790, 21,470*.
2000	7,185*, 7,230, 9,410*, 11,820*, 11,860*, 12,095*, 15,070*, 15,260, 17,740, 17,870, 21,470*.
2200 (not Sun.)	7,150*, 7,185*, 9,410*, 9,580†, 11,750*, 11,780†, 11,820*, 12,095†, 15,070*, 15,260*, 15,375†, 17,740*, 17,870*.
2200 (Sun. only)	15,310.
2200 (Tues. only)	9,750.
2200 (Sun. & Tues. only)	11,945.
2300	7,110, 7,230, 9,510†, 9,580, 9,825†, 11,750, 11,780†, 11,820, 12,040, 15,070, 15,260.

* Directed to Africa. † Directed to North America.

NOTE: Above frequencies vary throughout year.

FRANCE

3500. **Pontoise (FTH 42) (FTK 77) (FTN 87), St. Andre-de-Corcy (FTA 91).**

HOURS OF TRANSMISSION:	FREQ.:
(a) 0800	91.15, 10775 kc., A1.
0930	91.15, 13873 kc., A1.
(b) 0900	91.15, 7428 kc., A1.
2100	
2000	91.15, 10775 kc., A1.
1300	91.15, 13873 kc., A1.
2230	

TIME SIGNAL:

(a) 55 (or 25) m. 00 s.-00m. 00 s.: English System. (See sec. 301H.)
00 (or 30) m. 15 S.-00 m. 45 s.: Long dash.
01 (or 31) m. 00 s.-06 m. 00 s.: English System.
06 (or 36) m. 15 s.-06 m. 45 s.: Long dash.

(b) During the 56 (or 26) m. the dots are replaced by a long dash from the 25th second to the 30th second.

REMARKS: Signal commences 5 minutes before the above times. The signals are transmitted automatically from the Paris Observatory.

ITALY

3600. **Roma (IMB).**

HOURS OF TRANSMISSION: — FREQ.:

0256–0300	3172.5, 5887.5 kc., A1.
1756–1800	5887.5, 11453 kc., A1.

PREPARATORY SIGNAL:
56^m05^s–57^m00^s : "IMB IMB SEGNALE ORARIO IMB IMB."

CHARACTERISTIC SIGNAL:

	m.	s.	m.	s.
N (▬•) 5 times	57	05	57	50
6 dots (••••••)	57	55	58	00
D (▬••) 5 times	58	05	58	50
6 dots (••••••)	58	55	59	00
B (▬•••) 5 times	59	05	59	50
6 dots (••••••) The final dot is the time signal.	59	55	60	00

3610. **Radiotelevisione Italiana.**

STATION	FREQ.:	POWER	
Firenze	656 kc., A3	80 kilowatts.	0600, 0700, 1200, 1400, 1600, 1900, 2200.
Milano	899 kc., A3	150 kilowatts.	
Roma	845 kc., A3	150 kilowatts.	

TIME SIGNAL: From 59m. 54s. to 59m. 58s. a dot representing each second. Silent at 59m. 59s. At 60m. 00s. a dot representing time signal.

TURKEY

3700. **Istanbul.**

HOURS OF TRANSMISSION: — FREQ.:

0835–0845 (except Sunday)	7615 kc.
1335–1345 (except Sat. and Sun.)	

REMARKS: English Modified System. Automatic transmission from Kandilli Observatory, Istanbul. Preparatory Signal consists of TA03 (▬ •▬ ▬•▬• •••▬▬) repeated six times. Time Signal consists of a 0.1^s dot every second; the 59th second omitted. Error not over 0.04^s. Time announced in Turkish before each minute.

REPUBLIC OF SOUTH AFRICA

3800. **Capetown (ZCS).**

HOURS OF TRANSMISSION: — FREQ.:

0755–0800	500, 17165.6 kc., A2.
1655–1700	500 kc., A2.

REMARKS: English System. (See sec. 301H) Automatic transmission from Cape Observatory.

CHILE

302. Where information to the contrary is not given under station details the following system is in effect:
A dot is transmitted every second for 5 minutes except that the 29th, the last 5 seconds in the first four minutes and the last 10 seconds in the last minute are omitted. The time signal concludes with a one-second dash, the beginning of which marks the exact hour.
In case of irregularity or error, the signal "Senal Nula" will be transmitted 3 times one minute after the end of the time signal.

302B. Certain Chilean broadcasting stations offer 3-minute time signals in which a dot is transmitted each second. Whole minutes are indicated by a 1-second dash, and the even hour is marked by the beginning of a 3-second dash which ends the time signal.

3020. Punta Arenas Broadcasting Station (CE 113).

HOURS OF TRANSMISSION:	FREQ.:
1557–1600	1130 kc., A3.

3030. Puerto Montt Broadcasting Station (CE 101).

HOURS OF TRANSMISSION:	FREQ.:
1557–1600	1010 kc., A3.

3040. Valdivia Broadcasting Station (CE 59).

HOURS OF TRANSMISSION:	FREQ.:
1557–1600	590 kc., A3.

3050. Temuco Broadcasting Station (CE 125).

HOURS OF TRANSMISSION:	FREQ.:
1557–1600	1250 kc., A3.

3060. Concepcion Broadcasting Station (CC 141).

HOURS OF TRANSMISSION:	FREQ.:
1557–1600	1410 kc., A3.

3070. Santiago de Chili Station (CB 73, CB 76, CD 970, CB 154).

HOURS OF TRANSMISSION:	FREQ.:
1557–1600	730 kc., 760 kc., 1540 kc., 9699 kc., A3.

3080. Valparaiso–Las Salinas (CCV).

HOURS OF TRANSMISSION:	FREQ.:
0055–0100	139.5 kc., 8205 kc., A2.
1355–1400	

REMARKS: United States Systems (See Sec. 301A.).

PERU

310. Peruvian Time Signals originate at the Transmitter Clock at the Naval School of Peru, controlled by observation of Washington time signals.

3110. Callao (OBE).

HOURS OF TRANSMISSION:	FREQ.:
0055–0100	490 kc., 8360 kc., 12307 kc., A1.
1555–1600	
1855–1900	

REMARKS: Time signal consists of a dot for each second except that during the first four minutes from the 56th to 59th seconds and for the fifth minute from the 51st to 58th seconds the dots are omitted. The last signal begins at the 59th second of the 5th minute (lasting 1 second) and its end indicates the exact time.

PANAMA CANAL ZONE

3120. Balboa (NBA).

HOURS OF TRANSMISSION:	FREQ.:
0000–2400 (except for maintenance period 1300–1900 each Wednesday)	18 kc. A1, A2.
0455–0500, 0955–1000, 1655–1700, 2255–2300	147.85, 5448.5, 11080, 17697.5 kc., A1.

REMARKS: Station uses United States system. (see sec. 301A). Rebroadcast of Washington time signal by automatic relay; error normally less than 0.5 second.

UNITED STATES—Pacific Coast

3130. San Francisco, Cal. (NPG).

HOURS OF TRANSMISSION:	FREQ.:
0555–0600, 1155–1200, 1755–1800, 2355–2400	114.95, 4010, 6428.5, 9277.5, 12966, 17055.2, 22635 kc., A1.

REMARKS: Second-order time signals; normally correct to less than 0.5 second, having generally a constant lag.

REPUBLIC OF SOUTH AFRICA

3300. Johannesburg (ZUO).

HOURS OF TRANSMISSION:	FREQ.:
H+ every 15 min. (except 0630–0700)	5,000, 10,000 kc., A2.

REMARKS: A .005 sec. pulse transmitted every second. The first second of each minute is .5 sec. pulse. Time announcement is made in Morse code between 14–15, 29–30, 44–45 and 59–60 minutes in the following form: GMT (at *next* minute) ZUO ZUO ZUO 1415. Source: Union Observatory, Johannesburg.

MOZAMBIQUE

3350. Lourenco Marques (CRO) (CRL).

(a) HOURS OF TRANSMISSION:

		FREQ.:
1000	(CRO)	7,350, 14,700, 3975., A1.

CHARACTERISTIC SIGNAL: A dot for each second from 59^m55^s to 59^m60^s (a total of 6 dots). The last dot is the time signal.

(b) HOURS OF TRANSMISSION:

		FREQ.:
0757–0800	(CRO)	7,350, 14,700 kc., A1.
	(CRL)	500 kc., A2, 8698 kc., A1.
1857–1900	(CRL)	500 kc., A2, 8698 kc., A1.

REMARKS: New International (MOD. ONOGO) System. (See sec. 301C.) Transmitted automatically from Campos Rodriques Observatory; error never more than a few hundredths of a second. Occasionally the observatory will transmit other time signals, which must not be confused with the above signals. These other signals are similar to the rhythmic signals and consist of several long series of dots.

INDIA

3400. Poona (VWR).

HOURS OF TRANSMISSION:	FREQ.:
0837–0840	6590 kc., A1.

REMARKS: International (ONOGO) System. (See sec. 301B.)

3410. Calcutta (VWC)

HOURS OF TRANSMISSION:	FREQ.:
0827–0830, 1627–1630	153 kc., A1.

REMARKS: International (ONOGO) System. (See sec. 301B). Preparatory signals transmitted by hand as follows: 25^m00^s–27^m00^s "CQ CQ CQ DE VWC VWC VWC Ordinary Time Signals, Wait (•▬•••)." In the event the signal fails, a series of eight or more dots, "Erase", is followed by "signal failed."

CEYLON

3450. Colombo (4PB).

HOURS OF TRANSMISSION: — FREQ.:

0555–0600, 1325–1330 — 500 kc., A2; 8742 kc., A1.

REMARKS: English system (see sec. 301H), transmitted automatically from Colombo Observatory. Preparatory signal of CQ DE 4PB TIME SIGNALS followed by wait signal (•▬▬•••) is sent 02 minutes prior to commencement of the time signal proper.

HONG KONG

3500. Tai Long Head (Hong Kong) (VPS).

HOURS OF TRANSMISSION: — FREQ.:

0200, 1000 — 527.5, 8,566 kc., A1.

PREPARATORY SIGNALS: For 2 minutes before the time signal proper. CQ DE VPS HK TIME WAIT is sent from $53^{m}-00^{s}$ to $54^{m}-00^{s}$ and from $54^{m}-00^{s}$ to $55^{m}-00^{s}$ station remains silent.

CHARACTERISTIC SIGNAL: A dot is sent on every second omitting the 28th, 29th, and 56th to 59th seconds, inclusive.

REMARKS: Source is Royal Observatory, Hong Kong.

NOTE: Ship stations within range are required to maintain silence during the time of signal transmission.

3550. Hong Kong Broadcasting Station (KT) (ZBW) (ZEK).

HOURS OF TRANSMISSION: — FREQ.:

0015 to 2345, at H+15 and H+45 — (KT) 338 kc., A0, A2, A3.
2215 to 1745, at H+15 and H+45 — 8905 kc., A0, A2, A3.
1815 to 2145, at H+15 and H+45 — 5574 kc., A0, A2, A3.

0500, 0515, 1100, 1300, 1500, 2300, 2400	Winter	(ZBW) 860 kc., A3.
0000, 0100, 0500, 0515, 1100, 1300, 1500	Sundays and holidays	(ZBW) 860 kc., A3.
0400, 0415, 1100, 1300, 1400, 2200, 2300	Summer	(ZBW) 860 kc., A3.
0800, 0900, 1300, 1315, 2000, 2200, 2300	Sundays and holidays	(ZBW) 860 kc., A3.
0400, 0500, 1000, 1200, 1400, 2300	Winter	(ZEK) 640 kc. 3940 kc., A3.
0300, 0400, 0900, 1100, 1200, 2200	Summer	(ZEK) 640 kc. 3940 kc., A3.

3570. **Shang-hai (XSG).**

HOURS OF TRANSMISSION:	FREQ.:
0300 0900	458 kc., A1, A2; 8,502 kc., A1.

REMARKS: New International (modified ONOGO) system (see sec. 301C) commences at 03 minutes before the scheduled hours. Supplementary signals consisting of 21 dots are sent from 00^m10^s to 00^m30^s and a long dash from 00^m35^s to 00^m55^s past the scheduled hours. Rhythmic system (see sec. 301D) follows, commencing at 01 minute and a supplementary signal, a long dash, is sent from 06^m10^s to 06^m30^s.

NOTE: Rebroadcast from Zikawei Observatory. Signals may also be transmitted in the 6 and 12 mc. bands.

3575. **T'ien-ching (BPV).**

HOURS OF TRANSMISSION:	FREQ.:
1100 1300 1500	9368 kc.

PREPARATORY SIGNALS: 52^m00^s–55^m00^s, BPV (▬●●● ●▬●▬● ●●●▬) etc., before the scheduled hours.

REMARKS: The English ordinary system (see sec. 301H) commences 5 minutes before scheduled hours. A supplementary signal, long dash is sent from 00^m10^s–00^m30^s past the hour. Rhythmic system (see sec. 301D) commences at 01^m00^s past the hour. A supplementary signal, long dash, is sent from 06^m10^s–06^m30^s past the hour.

NOTE: Rebroadcast from Zikawei Observatory.

JAPAN

361. Time signals controlled from Tokyo Astronomical Observatory are transmitted by means of the Rhythmic System (see sec. 301D) and the Japanese "NDB" System. (See sec. 301F).

Time signals originating at R. R. C. Standard Frequency Station, Koganei, Tokyo, are transmitted by means of the Japanese Ordinary System (see sects. 301G and 950).

3610. **Tokyo (Koganei) (JJY).**

HOURS OF TRANSMISSION:	FREQ.:
0659–2259 -- Continuous, except 29 to 39 minutes of each hour	2,500 kc., A1, A2, A3.
0000–2400 -- Continuous, except 29 to 39 minutes of each hour	5,000, 10,000, 15,000 kc., A1, A2, A3.

REMARKS: Carrier wave is modulated to 1,000 c/s and the time signals are indicated by an interruption of the carrier wave for 0.2 second before each second and for .2 second before each minute. The end of each interruption is the time reference point.

NOTE: See sec. 950 for standard frequency, time announcements, and radio propagation disturbance warnings for Radio Station (JJY).

3620. **Tokyo (JAS).**

HOURS OF TRANSMISSION:	FREQ.:
1225–1230	16,170 kc., A 1.

REMARKS: Preparatory Signal consisting of "JAS22" sent slowly from $12^h20^m00^s$ to $12^h25^m00^s$, English ordinary system (see sec. 301H).

PHILIPPINES

3630. **Manila (DUW)**

HOURS OF TRANSMISSION:		FREQ.:
0955 1455 1955	Weekdays (Philippine Standard Time).	3650 kc.
0955	Sundays and Holidays (Philippine Standard Time).	

3635. **Manila (DUM).**

HOURS OF TRANSMISSION:		FREQ.:
0455 1055 1655 2255	Weekdays (Philippine Standard Time.)	5880 kc., A1, 8920 kc., A1, 15832.5 kc., A1.
1055	Sunday and Holidays (Philippine Standard Time).	

INDONESIA

3640. Djakarta (PKI) (PLC).

HOURS OF TRANSMISSION: — FREQ.:

0057–0100 ---------- 8542, 11440 kc., A1.

PREPARATORY SIGNALS: 55^m00^s to 56^m50^s ---------- Dot (.) every second.
56^m55^s to 57^m00^s ---------- Dash (—).

REMARKS: The New International (modified ONOGO) System. (See sec. 301C.)

AUSTRALIA

3650. Radio Australia (Overseas Service of Australian Broadcasting Commission).

NATURE OF BROADCAST: The time signal consists of a transmission of 6 dots, one for each second from the 55th to the 60th inclusive. The final dot is the time signal. A warning signal consisting of a single dot is transmitted 5 seconds before the first of the series of 6 dots (at 10 seconds before the hour).

ERROR: Accurate to ± 0.05 second.

HOURS OF TRANSMISSION:	FREQUENCY:	PROGRAM:	DIRECTED TO:
0000	25,735, 21,540, 15,210	English	S.E. Asia
	21,680	French	S. Pacific
	17,840, 15,330	French	S.E. Asia
0100	25,735, 21,540, 17,840	English	S.E. Asia
	17,715, 15,180	French	Mid Pacific
0200	25,735, 21,540, 17,840	English	S.E. Asia
0300–0400	25,735, 21,600, 21,540, 17,840	English	S.E. Asia
	25,735, 21,600, 21,540, 17,840	English	Mid Pacific
0500	25,735, 21,600, 21,540, 17,840	English	S.E. Asia
	21,680	English	Africa
	21,600	English	Mid Pacific
	21,680	English	Africa
0600–0700	25,735, 21,600, 15,180	English	S.E. Asia
	21,540, 17,840	Indonesian	S.E. Asia
	11,710 (from 26.3.1961)	English	Europe, S. Pacific
	21,600	English	Mid Pacific
0800–0900	25,735, 21,540, 15,180	English	S.E. Asia
	11,810	English	East Asia
	7,190	English	Mid Pacific
	11,710	English	Europe, S. Pacific
1000	11,740, 7,220	Indonesian	S.E. Asia
	25,735, 15,180, 9,570	English	S.E. Asia
	11,810, 9,580	Japanese	E. Asia
	7,190	English	Mid Pacific
1100–1200	11,740, 7,220	Chinese	S.E. Asia
	25,735, 15,180, 9,570	English	S.E. Asia
	9,580, 11,810	English	S.E. Asia
	7,190	English	Mid Pacific
1300	25,735, 15,180, 11,740	English	S.E. Asia
	9,570, 7,220	English	S.E. Asia
	9,580	English	E. Asia
	11,710	English	North America
1400	11,760, 7,220	Thai	S.E. Asia
	11,740, 9,570	English	S.E. Asia
	9,580	English	S. Asia
1500	11,760, 11,740, 9,570	English	S. & S.E. Asia
	7,220	English	S. & S.E. Asia
1600	11,760, 9,570, 7,220	English	S. & S.E. Asia
	11,710	English	North America
1700	11,760, 9,570, 7,220	English	S. & S.E. Asia
2000	15,315	English	Mid Pacific
	11,840	English	S. Pacific
2100–2200	15,315	English	Mid Pacific
	11,840	English	S. Pacific
	15,240	English	E. Asia
2300	25,735, 21,540, 15,210	English	S.E. Asia
	15,240	English	E. Asia
	17,840, 15,330	Indonesian	S.E. Asia

REMARKS: At 0000 Sunday (English), 0100 weekdays (English) and 0100 daily (French), the time signal is broadcast faintly in the background without interrupting the program.

3655. Sydney (VIS).

HOURS OF TRANSMISSION: — FREQ.:

0257 }
1057 } 500 kc., A2.

CHARACTERISTIC SIGNAL:

	Seconds
First minute:	
Series X (▬ ● ● ▬) every 10 seconds	50
Silent	5
Series dashes (▬▬) every second	5
Second minute:	
Series N (▬ ●) every 10 seconds	50
Silent	5
Series dashes (▬▬) every second	5
Third minute:	
Series G (▬ ▬ ●) every 10 seconds	50
Silent	5
Series dashes (▬▬) every second	5

REMARKS: The beginning of the final dash following the third minute is the time signal.

3660. Sydney (VIX).

NOTE: Canberra (Belconnen) (VHP) (3665) and Sydney (VIX) share the same frequencies. (VIX) transmits from 0001 to 0200, (VHP) from 0200 to 0400 and similarly for each ensuing 4 hours.

3665. Canberra (Belconnen) (VHP).

HOURS OF TRANSMISSION: — FREQ.:

0025–0030 — 44*, 6428.5, 8478, 12907.5, 17256.8, 22485 kc., A1.
0755–0800 — 44, 4286, 6428.5, 8478, 12907.5, 17256.8, 22485 kc., A1.
1355–1400 }
1955–2000 } 44, 4286, 6428.5, 8478, 12907.5, 17256.8 kc., A1.

* Not on Tuesdays and Thursdays.

REMARKS: United States System (see sec. 301A). Source is Commonwealth Observatory, Mt. Stromlo. Most closely controlled signals are on 8478 kc. Signals transmitted on other frequencies tend to have systematic differences of about one millisecond, except for the signals on 44 kc. which will begin about 15 milliseconds late.

NOTE: Canberra (Belconnen)(VHP) and Sydney (VIX) share the above frequencies. (VIX) transmits from 0001 to 0200, (VHP) from 0200 to 0400 and similarly for each ensuing 4 hours.

3670. Melbourne (VIM).

HOURS OF TRANSMISSION: — FREQ.:

0157–0200 }
1357–1400 } 500 kc., A2.

REMARKS: New International System. (See sec. 301C.)

3680. Adelaide (VIA).

HOURS OF TRANSMISSION: — FREQ.:

0027–0030 }
1227–1230 } 500 kc., A2.

REMARKS: International System. (See sec. 301B.) Except that the first minute consists of a series of the letter X (▬ ● ● ▬) commencing at the 5th and finishing at the 50th second, followed by O (▬ ▬ ▬) each dash commencing at the 55th, 57th, and 59th seconds. Automatic transmission; source is Adelaide Observatory.

3690. Perth (VIP).

HOURS OF TRANSMISSION: — FREQ.:

0057–0100 }
1257–1300 } 500 kc., A2.

REMARKS: International System. (See sec. 301B.). Source is Perth Observatory.

NEW ZEALAND

3700. Wellington (ZLW) (ZMO).

HOURS OF TRANSMISSION:	FREQ.:
2255–2300	417.5 kc., A2 after preliminary call on 500 kc.

REMARKS: English System. (See sec. 301H.). Automatic transmission from standard clock of the New Zealand Time Service, Wellington (ZMO). A preparatory signal of "Attention" (▬•▬•▬) transmitted at 2254 and ZMO(▬▬••▬ ▬▬ ▬•▬▬), repeated four times, transmitted from 22h. 54m. 10s. to 22h. 54m. 40s., precedes the time signal. Error does not exceed 0.05 seconds.

3710. Wellington Broadcasting Station (ZLYA) (ZLYZ).

HOURS OF TRANSMISSION:	FREQ.:
0030	570 kc., A3.
0400	
0630	
0700	
0900 (except Sunday)	
1000	
1100	
1700	
1800	
1900	
2000	
2100	
2258	
2259	
2300	

REMARKS: Each time signal consists of 6 dots, separated by 1 second intervals, with the last dot representing the exact minute. Error rarely exceeds .1 second.

GUAM ISLAND

3800. Guam (NPN).

HOURS OF TRANSMISSION:	FREQ.:
0555–0600	484 kc., 4955 kc., 8150 kc., 13530 kc., 17530 kc., 21760 kc., A1.
1155–1200	
1755–1800	
2355–2400	

REMARKS: Station uses United States System. (See sec. 301A.) Rebroadcast of Washington time signal by automatic relay; error normally less than 0.5 second.

HAWAIIAN ISLANDS

3900. Honolulu, Oahu (NPM).

HOURS OF TRANSMISSION:	FREQ.:
0555–0600	131.05, 4525, 9050, 13655. 17122.4, 22593 kcs., A1.
1155–1200	
1755–1800	
2355–2400	

REMARKS: Second-order time signals; normally correct to less than 0.5 second, having generally a constant lag.

BYE-3997-62

APPENDIX G

INSTRUCTIONS FOR MAINTAING THE OPERATOR'S LOG

A. GENERAL: It is important that an accurate log be maintained for each satellite and pass tasked by the ALERT message. Detailed below are instructions for keeping the operator's log.

B. PREPARATION AND DISPOSITION OF LOGS: Logs will be completed in duplicate. The orginal logs will be forwarded with the tape recording of the satellites and orbits to which they pertain. The copy will be retained on file at the operations site for a period of one year. If the site has not received instructions to the contrary, the duplicate copies may be destroyed at the end of the one year period. The logs may be destroyed in accordance with normal security procedures, and no report of destruction will be required.

C. LOG ENTRIES: The log shall be completed as follows:

1. Block 1 - SECURITY CLASSIFICATION. Stamp with a security classification of SECRET HANDLE VIA THE BYEMAN CONTROL SYSTEM Project EARPOP.

2. Block 2 - SITE. Enter the U. S. site number (Example: [redacted] etc.).

3. Block 3 - DATE. Enter the date that the first signal (from the satellite to which the log pertains) is acquired.

4. Block 4 - PREDICTED SIGNAL ACQUISITION. Enter the time and azimuth at which it is predicted that the satellite will be acquired, as computed in accordance with Section III of this SOP.

5. Block 5 - DTG of ALERT MSG. Enter the date/time group of the message activating the participation of the site in the operation of this satellite orbit.

6. Block 6 - SOURCE. Enter the satellite mission number and corresponding orbit number.

7. Block 7 - HUT. Enter the reference designation (PRIMARY or SECONDARY) of the hut in which the intercept operation against this satellite orbit is carried out. (Determined by Officer-in-Charge).

8. Block 8 - RECORDER. Enter the recording function (LOCAL or REMOTE) of the hut in which the intercept operation against this satellite orbit is carried out. (Determined by Officer-in-Charge).

9. Block 9 - TIME CODE GENERATOR SYCHRONIZATION. Enter information on the latest synchronization of the TIME CODE GENERATOR used in the intercept operation. Enter the date and time the generator was synchronized, the call sign and frequency of the Observatory Time Broadcast used in the synchronization, and the rate and direction of drift. (Obtained from the TIME CODE GENERATOR LOG see APPENDIX M).

10. Columns 10 through 13 - TIME, FREQ, BEAR, REMARKS. In these columns, a chronological history of the pass shall be maintained. List the GMT (from the TIME CODE GENERATOR Display) of each change or observation in Column 10. List the frequencies (in kilocycles) to which the various receivers are tuned in Column 11. State the bearing from which the strongest signal is obtained in Column 12. Enter remarks on frequency and bearing drift, changes in signal strength or characteristics, control setting changes, and any other information that might assist analysis personnel in processing the data in Column 13. Note particularly any unusual DATA CHANNEL signals in this column.

11. Block 14 - COMMENTS. Enter the following information in Block 14 of the OPERATORS LOG:

a. All non-operative equipment associated with System POPPY and the number of days each has been inoperative.

b. All deviations from the normal recorder channel assignment as outlined in APPENDIX B.

c. Other information pertaining to the intercept operation as a whole which might assist analysis personnel in processing the data. Operators are encouraged to use this block freely in recording their observations.

12. Block 15 - APPROVED. The Project Officer of the intercept operation shall sign his name in this block, thereby certifying as to the completness and correctness of the log.

13. Insure that all of the logs associated with the intercept operation contain the same information in Blocks 1, 2, 3, 5, 9, and 14.

D. LOG FORM SAMPLE: A log form sample will be found on the next page. Log forms are to be reproduced locally as required.

~~SECRET~~ EARPOP

BYE-3997-62

CONFIDENTIAL - RECLASSIFY WHEN FILLED IN

1. Security Classification	2. Site	3. Date

4. Predicted Signal Acquisition	5. DTG of ALERT MSG	6. SOURCE

7. Hut	8 Recorder	9. Time Code Generator Synchronization / Z at Kcs Per hour

10. Time	11. Freq	12. Bear	13. Remarks

14. Comments

15. Approved	1. Security Classification

ORIGINAL

~~SECRET~~ EARPOP

APPENDIX H

LABELING THE TAPE

A. GENERAL: Tape labels are to be filled out in accordance with the instructions given below and attached to all tape reels. Tapes submitted for processing are to be in an unrewound condition, and the label shall be attached in such a manner as to allow playback of the tape without removing the label. A sample tape label form will be found at the end of this Appendix, and is to be reproduced locally as required.

B. LABEL ENTRIES: The tape label shall be filled out as follows:

1. SITE: Enter the U. S. site number (Example: etc.).

2. SOURCE: Enter the complete satellite mission number and orbit applicable to each satellite intercepted (obtained from ALERT message).

3. TIME UP: Enter the ZULU Time that each satellite was first intercepted on a DATA CHANNEL beside the appropriate entry in column 2. (Obtained from OPERATOR'S LOG).

4. TIME DOWN: Enter the ZULU Time that each satellite was last heard on a DATA CHANNEL beside the appropriate entry in column 2. (Obtained from OPERATOR'S LOG).

5. CHANNEL ASSIGNMENT: If the recorder channel assignment is as specified in APPENDIX B, the word NORMAL shall be entered in this space. If the recorder channel assignment deviates from that specified in APPENDIX B, the word ABNORMAL shall be entered, and a full description of the situation given in Block 14 of the OPERATOR'S LOG (APPENDIX G).

6. REEL NUMBER: Enter the number of the reel and the total number of reels, e.g. 1 of 1, 1 of 2, etc.

7. CLASSIFICATION: Enter the Classification SECRET/HANDLE VIA THE BYEMAN CONTROL SYSTEM/PROJECT EARPOP.

C. LABELING THE TAPE BOX: Write the complete satellite mission number and corresponding orbit for each satellite recorded in the intercept operation on the exposed portion of the inner folder of the tape box, in such a manner that it will be readily visible on one end of the box.

CONFIDENTIAL - RECLASSIFIY WHEN FILLED IN

7. Classfication		1. Site
2. Source	3. Time Up	4. Time Down
5. Channel Assignment		6. Reel No. OF
7. Classification		

BYE-3997-62

REPORT THE FAILURE OF ONLY ONE PART OR TUBE ON THIS FORM

1. REPORT NO.	2. REPORTING ACTIVITY	3. REPAIRED OR REPORTED BY (NAME)	4. DATE OF FAILURE
5. EQUIPMENT INSTALLED IN (TYPE AND NO.)	6. TIME METER READING OR INSTALLATION LOG TIME	7. WAS MISSION ABORTED? ☐ YES ☐ NO	8. OPERATIONAL CONDITION

EQUIPMENT	9. MODEL DESIGNATION AND MOD. NO.	10. SERIAL NO.	11. CONTRACTOR	12. CONTRACT OR ORDER NO.
COMPONENT (MAJOR UNIT)	13. MODEL DESIGNATION AND MOD. NO.	14. SERIAL NO.	15. CONTRACTOR	16. CONTRACT OR ORDER NO.
ASSEMBLY OR SUBASSEMBLY	17. ASSEMBLY AND MOD. NO.	18. SERIAL NO.	19. MANUFACTURER	20. (LEAVE BLANK)

PART DATA				
	21. PART NAME OR TUBE TYPE	22. STOCK NO. (FAILED ITEM)	23. PART REF. DESIG. (V-101, R-101, ETC.)	24. REPAIR TIME (MAN-HOURS)
	25. HOURS IN SERVICE	26. MANUFACTURER OF FAILED PART	27. SERIAL NO.	28. WAS REPLACEMENT PART AVAILABLE LOCALLY ☐ YES ☐ NO

29. FIRST INDICATION OF TROUBLE

1	INOPERATIVE
2	INTERMITTENT
3	LOW PERFORMANCE
4	NOISY
5	OFF FREQUENCY
6	OUT OF ADJUSTMENT
7	OVERHEATING
8	UNSTABLE
9	OTHER

30. CHECK TYPE(S) OF TUBE OR PART FAILURE

007	☐	ARCING	001	☐	GASSY	790	☐ OUT OF ADJUST.
710	☐	BEARING FAILURE	300	☐	GROUNDED	006	☐ SHORTED
780	☐	BENT	380	☐	LEAKAGE	770	☐ SLIP RING OR COMMUTATOR FAILURE
040	☐	BINDING	730	☐	LOOSE		
070	☐	BROKEN	004	☐	LOW GM OR EMISSION	018	☐ TESTED OK DID NOT WORK
720	☐	BRUSH FAILURE	750	☐	MISSING		
080	☐	BURNED OUT	008	☐	NOISY	020	☐ WORN EXCESSIVELY
130	☐	CHANGED VALUE	450	☐	OPEN		☐ SEE INSIDE FLAP FOR ADDITIONAL CODES
170	☐	CORRODED	099	☐	OTHER		

31. CAUSE OF FAILURE

2	FAULTY PACKAGING
5	MISHANDLING
6	INSPECTION OR TEST
1	NORMAL OPERATION
3	STORAGE
7	ASSOCIATED FAILURE-EXPLAIN
4	OTHER

32. WAS THE PART REPLACED DURING PREVENTIVE MAINTENANCE? ☐ YES ☐ NO

33. REMARKS *(Continue on reverse side if necessary)*

DD (1 AUG 54) **787** ELECTRONIC FAILURE REPORT

ELECTRONIC FAILURE REPORT FORMS (DD Form 787)

APPENDIX I
I-1

ORIGINAL

APPENDIX J

ALERT REPORT MESSAGE FORMAT
(SEE NOTE 1)

PRECEDENCE (PRIORITY)

DATE/TIME GROUP

FM

TO DIRNAVSECGRU

INFO DIRNSA [redacted]

CLASSIFICATION/NOFORN /HANDLE VIA COMINT CHANNELS ONLY

THIS IS A [redacted] ALERT REPORT MESSAGE (NOTE 1)

ALFA: (Abbreviated satellite designation/s and orbit number/s as in ALERT message.

BRAVO: (Tasked CHANNELS not heard. If any, identify satellite and CHANNEL/s; if none, omit this item)

CHARLIE: (CHANNELS not tasked but heard. If any, identify satellite and CHANNEL/s; if none, omit this item)

DELTA: (Equipment failures or repairs effected since last ALERT report message, and any resulting requirement (e.g., spare parts, technical assistance) - if none, omit this item.

ECHO: (Remarks - if none,omit this item).

NOTE 1: Ensure ALERT Report Messages are worded such that no reference or inference is made to satellite operations. To identify a specific satellite and corresponding orbit, use the term "task" followed by the abbreviated satellite mission number and corresponding orbit number. e.g. "task 1A1234." Alert Report messages will be forwarded outside of the BYEMAN Control System and flagged "This is a [redacted] Alert Report Message."

EXAMPLE:

PRIORITY/ROUTINE

012345Z JUL 64

FM

TO DIRNAVSECGRU

INFO DIRNSA [redacted]

SECRET - NOFORN - HANDLE VIA COMINT CHANNELS ONLY

THIS IS A [redacted] ALERT REPORT

ALFA: 3A/B 2525B/C, 3B/C 2526B

BRAVO: 3B 2525C, 3C 2526B

CHARLIE: 3C 2526C

DELTA: REQ following parts ASAP: ONE EACH POWER TRANSFORMER, ETC.

ECHO: IN RECEIPT YOUR DTG'S 040404Z JUN.

APPENDIX K

RECEIVING SYSTEM SENSITIVITY CHECK

A. INTRODUCTION

1. This procedure is to be carefully followed whenever a quantitative sensitivity check of the equipment is made. Ordinarily, the following conditions will generate a need for this sensitivity check:

a. During the initial set-up of the System POPPY equipment.

b. Whenever repairs have been made which could affect the sensitivity of the receiving system (change of RF, IF, or oscillator tubes, or other components).

c. Immediately prior to the commencement of a series of ALERTS.

d. Whenever the system fails the RAPID SENSITIVITY CHECK.

e. Once each week if the station is operating at the rate of one or more orbits per week.

f. At intervals as required to insure the system is capable of operation on short notice, i.e., two hours after the receipt of an ALERT message, when there is a period of more than one week between orbits.

2. In order to accomplish the check, an AN/URM-44 or similar signal generator having a calibrated output control will be required. The generator must be able to cover the VHF frequency spectrum, and have a calibrated output of from 0 DBM to 120 DBM. If the Signal Generator being used has the output calibrated in Microvolts rather than in DBM the MICROVOLT/DBM CONVERSION NOMOGRAPH, Figure K-1 may be used to convert settings of the Signal Generator to DBM.

Microvolts	DBM	Microvolts	DBM	Microvolts	DBM	Microvolts	DBM
100	-67	250	-59	600	-51	1200	-45
120	-65	300	-58	700	-50	1400	-44
140	-64	350	-56	800	-49	1600	-43
160	-63	400	-55	900	-48	1800	-42
180	-62	450	-54	1000	-47	2000	-41
200	-61	500	-53				

MICROVOLT/DBM CONVERSION NOMOGRAPH
Figure K - 1

3. All equipment, including the Signal Generator, shall be allowed to warm up for a period of one hour prior to commencement of sensitivity checks, with the frequency band selection switch of the signal generator set in the appropriate position for the check.

B. RECEIVER SENSITIVITY MEASUREMENT

1. CHANNEL A SYSTEM

a. Place the "3-4" converter switch in position No. 3.

b. Disconnect the antenna cable at the transition located near the bottom of the mast.

c. Calibrate the receiver frequency in accordance with instructions contained in the receiver instruction manual.

d. Set the receiver controls as follows:

LINE METER Switch	+10
LINE GAIN	Optional
ANT TRIM	To be adjusted
AGC	Fast
LIMITER	Off
BANDWIDTH	16 kc
BFO	0
AUDIO RESPONSE	Wide
BREAK IN	Off
FUNCTION	MGC
BFO	Off
LOCAL GAIN	10
RF GAIN	To be adjusted
MEGACYCLE CHANGE	Assigned Frequency
KILOCYCLE CHANGE	Assigned Frequency

e. Plug a pair of headphones in the PHONES jack.

f. Connect the output of the signal generator to the "3-4" TEST POINT jack on the Converter Control Panel. Output of the signal generator will be applied to the converter through a directional coupler. (The directional coupler has a coupling loss of 70 db. All readings of the signal generator must be increased by 70 db to obtain the absolute sensitivity.)

g. Set the signal generator as follows:

RF	Approximate calibration frequency for CHANNEL A
Modulation	400 cycles at 30%
Output	Approximately -40 dbm

h. Adjust the SIGNAL GENERATOR frequency until the output of the receiver is maximum when the receiver is set to the assigned frequency for the system under test.

i. Reduce the output of the Signal Generator to minimum.

j. Adjust the RF GAIN control of the receiver until the LINE LEVEL meter reads between -5 VU and 0 VU. The LINE LEVEL meter is reading system noise.

k. Carefully adjust the ANT TRIM control for maximum reading of the LINE LEVEL meter. Reduce the RF GAIN control as necessary to keep the LINE LEVEL meter on scale.

l. Determine System Saturation level: Slowly increase the RF GAIN control, reducing the LINE LEVEL control as necessary to keep the LINE LEVEL meter on scale, until the LINE LEVEL meter reads maximum and begins to decrease for further advances of the RF GAIN control. The point at which the LINE LEVEL meter peaks is the saturation level of the system. This condition occurs as a result of saturation of the fourth IF stage of the receiver and indicates that there is ample gain in the receiving system. Reduce the RF GAIN until the LINE LEVEL meter reads 1 VU less than the value indicated at saturation. THIS SETTING WILL BE USED AS A REFERENCE LEVEL FOR FUTURE ADJUSTMENTS.

m. Adjust RF GAIN control to saturation reference level as determined in paragraph k. above. Reduce the RF GAIN control until the LINE LEVEL meter reads 15 VU below the saturation reference level. The LINE GAIN control may be used to adjust the LINE LEVEL meter to a convenient reference point prior to making this adjustment.

n. Advance the attenuator control of the Signal Generator to a setting of approximately -40 dbm. Carefully adjust the Signal Generator frequency until maximum is indicated on the LINE LEVEL meter of the receiver. DO NOT ADJUST THE RECEIVER RF GAIN CONTROL. If the Receiver approaches saturation, reduce the output of the Signal Generator as required to maintain the Receiver below the saturation level.

o. When exactly in tune recheck the reference output setting and percentage of modulation of the Signal Generator.

p. Carefully readjust the Signal Generator attenuator until the LINE LEVEL meter is exactly 5 VU below the saturation reference level of the receiver. Read the Signal Generator attenuator setting in dbm. Add -70 db to the reading of the Signal Generator to compensate for the loss inserted by the directional coupler. THIS FIGURE IS THE SENSITIVITY OF THE SYSTEM FOR AN APPROXIMATELY 3:1 SIGNAL/NOISE RATIO. The sensitivity figure should not be less than -105 dbm. Log the sensitivity figure obtained. If subsequent sensitivity measurements show a decrease of 5 db or more in the system sensitivity, the system should be checked for trouble.

q. Place the "3-4" converter switch in position No. 4. Readjust the signal generator attenuator until the LINE LEVEL meter is exactly 5 VU below the saturation level of the receiver, as was done in paragraph p. above. Read the Signal Generator attenuator setting in dbm. Add the -70 db loss of the directional coupler. Compare the sensitivity figure thus obtained with the sensitivity figure obtained in paragraph p. above. If the two figures are within 5 db, the converters can be considered to be operating satisfactorily. If the two readings differ by more than 5 db, the low reading converter should be checked for defects.

r. This completes the sensitivity check of the CHANNEL A system. Disconnect the Signal Generator. RECONNECT THE ANTENNA CABLE. Switch the "3-4" converter switch to position 3, to deenergize the coaxial relays.

2. DATA CHANNEL SYSTEM

a. Place the "1-2" converter switch in position No. 1.

b. Disconnect the lower antenna cable at the transition located near the bottom of the mast.

c. Calibrate the frequency of both DATA CHANNEL receivers in accordance with instructions contained in the receiver instruction manual.

d. Set the Receiver controls as specified in paragraph B-1-d for the CHANNEL A System.

e. Plug a pair of headphones in the PHONES jack of one of the receivers.

f. Connect the output of the signal generator to TEST POINT "1-2" on the Converter Control Panel. Output of the signal generator will be applied to the converter through a directional coupler (Identical to that of CHANNEL A).

g. Set the Signal Generator as follows:

RF frequency	Approximate calibration frequency for DATA CHANNELS.
Modulation	400 cycles at 30%
Output	Approximately -40dbm

h. Repeat steps "h" through "l", as specified for the CHANNEL A system, for the CHANNEL B and CHANNEL C receivers.

i. Adjust RF FAIN control to saturation reference level as determined in step "k" of the CHANNEL A procedure, above. Reduce the RF GAIN controluntil the LINE LEVEL meter reads 10 VU below the saturation reference level. Switch the LINE METER Switch to the "0" position, and again reduce the RF GAIN controluntil the LINE LEVEL meter reads 10 VU below the reference level on the meter. Switch the LINE METER to the "-10" position, and reduce the RF GAIN control as before. The LINE GAIN control may be used to adjust the LINE LEVEL meter to a convenient level during this adjustment. The receiver gain is now set 30 db below the saturation reference level established in step "l".

j. Repeat steps "n" through "p", as specified for the CHANNEL A System, for the CHANNEL B and CHANNEL C receivers.

k. Place the "1 - 2" converter switch in position No. 2. Compare the sensitivity figures of the two converters as was done in step B-1-q for CHANNEL A, using either DATA CHANNEL receiver.

l. This completes the sensitivity check of the DATA CHANNEL system. Disconnect the Signal Generator. RECONNECT THE ANTENNA CABLE. Switch the "1-2" converter switch to 1, to deenergize the coaxial relays.

3. CHANNEL D SYSTEM

a. The CHANNEL D Receiver is used for the reception of TIME SIGNALS in the HF spectrum. These signals are within the tuning range of the receiver; no converter is required. Sensitivity checks on the CHANNEL D System are to be made at the frequencies on which TIME SIGNALS will be received by the station.

b. Calibrate the CHANNEL D Receiver frequency dial in accordance with instructions contained in the receiver instruction manual.

c. Set Receiver controls as specified in paragraph B-1-d for CHANNEL A System, except set Mc and Kc CHANGE to the frequency of the time signals to be received.

d. Plug a pair of headphones in the PHONES jack.

e. Disconnect the CHANNEL D Receiver input at jack IA on the Entry Terminal Panel. Connect the output of the Signal Generator to the transmission line going to the CHANNEL D Receiver. (There is no directional coupler in the CHANNEL D System. Therefore, there will not be a 70 db coupler loss in this system.)

f. Set the Signal Generator as follows:

RF Frequency	Approximate Frequency of TIME SIGNALS
Modulation	400 cycles at 30%
Output	Approximately -110 dbm

g. Adjust the SIGNAL GENERATOR frequency until the output of the receiver is maximum when the receiver is set to the approximate frequency of the Observatory Time Broadcast.

h. Reduce the output of the Signal Generator to minimum.

i. Adjust the RF GAIN control of the receiver until the LINE LEVEL meter reads between -5 VU and 0 VU. The LINE LEVEL meter is reading system noise.

j. Carefully adjust the ANT TRIM control for maximum reading of the LINE LEVEL Meter. Reduce the RF GAIN control as necessary to keep the LINE LEVEL meter on scale.

k. Determine System Saturation Level: Slowly increase the RF GAIN control, reducing the LINE GAIN control as necessary to keep the LINE LEVEL meter on scale, until the LINE LEVEL meter reads maximum and begins to decrease for further advances of the RF GAIN control. The point at which the LINE LEVEL meter peaks is the saturation level of the system. This condition occurs as a result of saturation of the fourth IF stage of the receiver, and indicates that there is ample gain in the receiving system. Reduce the RF GAIN until the LINE LEVEL meter reads 1 VU less than the value indicated at saturation. THIS SETTING WILL BE USED AS A REFERENCE LEVEL FOR FUTURE ADJUSTMENTS.

l. Adjust RF GAIN control to saturation reference level as determined in paragraph k. above. Reduce the RF GAIN control until the LINE LEVEL meter reads 15 VU below the saturation reference level. The LINE GAIN control may be used to adjust the LINE LEVEL meter to a convenient reference point prior to making this adjustment.

m. Advance the attenuator control of the Signal Generator to a setting of approximately -110 dbm. Carefully adjust the Signal Generator frequency until maximum is indicated on the LINE LEVEL meter of the receiver. DO NOT ADJUST THE RECEIVER RF GAIN CONTROL. If the Receiver approaches saturation, reduce the output of the Signal Generator as required to maintain the Receiver below the saturation level.

n. When exactly in tune, recheck the reference output setting and percentage of modulation of the Signal Generator.

o. Carefully readjust the Signal Generator attenuator until the LINE LEVEL meter is exactly 5 VU below the saturation reference level of the receiver. Read the Signal Generator attenuator setting in dbm. THIS FIGURE IS THE SENSITIVITY OF THE SYSTEM FOR AN APPROXIMATELY 3:1 SIGNAL/NOISE RATIO. (Note that because there is no directional coupler in the CHANNEL D System, the system sensitivity is read directly from the calibrated output of the Signal Generator. The 70 db loss of the directional coupler is not added to this reading.) The sensitivity figure should not be less than -105 dbm. Log the sensitivity figure obtained. If subsequent sensitivity measurements show a decrease of 5 db or more in the system sensitivity, the system should be checked for trouble.

p. This completes the sensitivity check of the CHANNEL D System. Disconnect the Signal Generator. RECONNECT THE RECEIVER INPUT TO JACK 1A ON THE ENTRY TERMINATION PANEL.

APPENDIX L

TIMING SYSTEM ADJUSTMENTS

A. CALIBRATION INTERVALS: The TIME CODE GENERATOR is to be calibrated with an Observatory Time Broadcast at least once during each twenty-four hour period if the station is tasked with one or more intercept operations per day, and during the pre-operational check if the station is operating less frequently. The ASTRODATA TIME CODE GENERATOR is equipped with a battery pack which keeps the internal clock running during power interruptions. Time code and visual outputs are disabled, however. The battery is trickle charged while power is applied, and when power fails, the oscillator and counter sections are automatically switched to the battery. It is therefore unnecessary to resynchronize the ASTRODATA TIME CODE GENERATOR after power outages of less than six hours. If power has not been restored at the end of six hours, the ASTRODATA TIME CODE GENERATOR must be turned off, and resynchronized when power is restored.

B. TIME CODE GENERATOR LOG: A log is to be maintained on the TIME CODE GENERATOR for the purpose of providing information on the accuracy of the instrument. This log should include:

1. Date and time of synchronization.

2. Frequency and call sign of Observatory Time Broadcast used.

3. Time difference between Observatory Time Broadcast and each TIME CODE GENERATOR before resynchronization.

4. Amount and direction of TIME CODE GENERATOR drift for each instrument. (Time difference between Observatory Time Broadcast and TIME CODE GENERATOR after last synchronization, subtracted algebraically from time difference between Observatory Time Broadcast and TIME CODE GENERATOR before resynchronization.)

5. Drift rate per hour and direction of drift for each instrument. (Amount of drift as determined in paragraph B-4 above divided by number of hours since last measurement, normally about twenty-four hours.) Indicate whether the TIME CODE GENERATOR is running fast by plus (+) or slow by minus (-).

6. Amount of error after resynchronization. (Accuracy goal is within $\pm$ 10 milliseconds. Note that measurements can be most conveniently made if the TIME CODE GENERATOR is synchronized a few milliseconds ahead of the Observatory Time Broadcast.)

7. Remarks. Enter any information pertinent to the history of the TIME CODE GENERATOR.

C. CALIBRATION PROCEDURE: The following is a recommended procedure for the synchronization of the TIME CODE GENERATOR with a Time Standard Broadcast.

1. Warm-up period: Normally the TIME CODE GENERATOR should be allowed to warm up two hours for every hour it has been off before attempting calibration. The ASTRODATA TIME CODE GENERATOR should be warmed up in the STANDBY mode.

2. Synchronization of the ASTRODATA TIME CODE GENERATOR:

a. Lower the front cover of the TIME CODE GENERATOR. Tune in a Standard Time Broadcast from one of the Observatory Stations listed in APPENDIX E, "Time Check Observatory Designation List". Note that this list is provided for guidance only, and that the station is at liberty to use any Observatory Time Broadcast that can be conveniently received at the site. Standard Time broadcasts are also transmitted in the VLF spectrum. While the huts are not equipped to receive in the VLF spectrum, the individual sites are encouraged to use a VLF receiver, if available, for the reception of VLF Standard Time Broadcasts for the purpose of synchronizing the TIME CODE GENERATOR. VLF Standard Time Broadcasts are transmitted on the following frequencies.

FREQUENCY	CALL SIGN	TRANSMITTER LOCATION
15.5 kcs	NSS	Annapolis, Maryland
16.0 kcs	GBR	Rugby, England
18.0 kcs	NBA	Balboa, Canal Zone
18.6 kcs	NPG	Jim Creek, Washington
19.8 kcs	NPM	Lualualei, Hawaii

b. Move the STANDBY switch to the down position. If the display is running, press the STOP button. Press the RESET button.

c. Starting at the right, set up the display with the ADVANCE COUNT buttons to the time at which the TIME CODE GENERATOR is to be started. Seconds indicators should be left on "00".

d. At the instant that the time indicated on the ASTRODATA TIME CODE GENERATOR is signaled by the observatory broadcast, push the start button. In the case of WWV, the even minute is indicated by the start of the steady tone (not by the GMT code signal transmitted between the voice announcements).

e. Connect the 1 PPS output of the TIME CODE GENERATOR to the EXT. TRIG connection on the OSCILLOSCOPE. This may be done at the Signal Panel. Set the SLOPE switch on the positive position and adjust the TRIG LEVEL control to allow the 1 PPS signal to trigger the display.

f. Connect the observatory time broadcast, appearing at the TIME STANDARD jack on the Signal Panel, to a vertical input of the OSCILLOSCOPE, and adjust the TIME/DIV and VOLTS/DIV controls to obtain a display of the "time tick" on the OSCILLOSCOPE.

g. Observe the location of the "time tick". Count the number of milliseconds between the initiation of the trace and the "tick". The interval will be either more or less than 500 milliseconds. If the duration is more than 500 milliseconds, turn the RATE MS/S switch on the TIME CODE GENERATOR to the FAST position and hold down the ADVANCE button until the "time tick" appears near the left edge of the trace.

h. Manipulating the RETARD button, the RATE MS/S switch, and the TIME/CM control, move the "tick" nearer in time to the initiation of the sweep. If the "tick" should disappear to the left of the trace, press the ADVANCE button momentarily.

i. When the TIME/DIV control is set at 1 millisecond per centimeter and the "tick" is centered on the OSCILLOSCOPE display, the ASTRODATA TIME CODE GENERATOR is synchronized with real time. To check synchronization, wait until the next time announcement and verify that the correct time of day is indicated.

j. If the observatory broadcast employed in the synchronization transmits other than Greenwich Mean (ZULU) time, it will be necessary to add or subtract a certain number of hours from the transmitted time to set the TIME CODE GENERATOR. Both the TIME CODE GENERATOR and the clocks shall be set to Greenwich Mean (ZULU) time.

k. If the TIME CODE GENERATOR is reading incorrectly but is synchronized with the observatory broadcast (i.e., an integral number of hours, minutes and seconds fast or slow), the correct time may be set while the generator is running by operating the ADVANCE COUNT buttons (not to be confused with the ADVANCE button).

l. This completes the synchronization of the ASTRODATA TIME CODE GENERATOR.

D. TIME CODE CHECKS:

1. Frequency of Check: The Time Code Check is to be performed at the following times:

a. During the initial set-up of the equipment.

b. Immediately prior to the commencement of a series of ALERTS.

c. Once each week if the station is operating at the rate of one or more orbits per week.

d. At intervals as required to insure that the system is capable of operation on short notice, i.e., two hours after the receipt of an ALERT message, when there is a period of more than one week between orbits.

e. Whenever maintenance of any kind is performed on the TIME CODE GENERATOR.

f. Whenever the TIME CODE GENERATOR is turned OFF for any reason.

2. Preliminary Remarks: It occasionally happens that a TIME CODE GENERATOR puts out incorrect time code, although the display may be giving normal indications in all respects. This condition is usually brought about by the failure of a diode in the code matrix, and is detectable by reading the code on a suitable readout unit, or by viewing each pulse of the 20 pulse train individually to determine whether or not it is widening and narrowing with time as it should. Lacking a readout unit such as the EECO ZA-843, each site should use an oscilloscope to check the time code pulses from the generator for correct width variations with time.

3. ASTRODATA Code Check Technique:

a. Tape a small rectangular box over the START, STOP and RESET buttons to preclude inadvertent operation of these buttons.

b. Connect 1 PPS from the Signal Panel to the EXT TRIG connection on the OSCILLOSCOPE. Adjust the TRIG LEVEL control to provide a trace.

c. Set the TIME/CM control to 50 milliseconds per centimeter and turn the VARIABLE TIME/CM control counterclockwise to the stop. Slowly turn the control clockwise until one sweep <u>just</u> occurs every second.

d. Connect the vertical input of the OSCILLOSCOPE to the CHANNEL <u>6</u> Recorder Input on the Signal Panel. Time code should appear on the display as a series of pulses.

e. With the HORIZONTAL POSITIONING control, center the last pulse of the train on the OSCILLOSCOPE screen, and pull the VARIABLE TIME/CM control to the X5 position. If the last pulse has shifted, or is not visible on the screen of the OSCILLOSCOPE, refer to the OSCILLOSCOPE alignment procedure to correct this condition.

f. Observe the last pulse in the center of the expanded time base. It should be widening on odd seconds and narrowing on even seconds. If the last pulse appears to be satisfactory, return the time base to normal by pressing in the VARIABLE TIME/CM control. Move the HORIZONTAL POSITIONING control to center the second pulse on the screen, and again expand the trace. This pulse should be wide on seconds 2, 3, 6 and 7, and narrow at other times. Continue this procedure for the third through the seventh pulses from the end of the train. The indications to be expected are summarized below.

NUMBER OF PULSE FROM END OF TRAIN	WIDE PULSE	NARROW PULSE
	UNIT SECONDS	UNIT SECONDS
1	1, 3, 5, 7, 9	0, 2, 4, 6, 8
2	2, 3, 6, 7	0, 1, 4, 5, 8, 9
3	4 - 7	0 - 3, 8, 9
4	8, 9	0 - 7
	TEN SECONDS	TEN SECONDS
5	10, 30, 50	00, 20, 40
6	20, 30	00, 10, 40, 50
7	40, 50	00 - 30

g. Since the pulses indicating hours and minutes require an excessive amount of time to widen and narrow normally, it will be necessary to advance the time artificially by manipulating the ADVANCE COUNT buttons on the TIME CODE GENERATOR. Observe the remainder of the pulses in the train on an individual basis as before. Move the HORIZONTAL POSITIONING control slowly to retain identification of the pulses between sweeps. While observing a pulse, press the ADVANCE COUNT button appropriate to that pulse enough times to make sure that the pulse width is changing. The button associated with each of the remaining pulses is given below.

NUMBER OF PULSE FROM END OF TRAIN	APPROPRIATE ADVANCE COUNT BUTTON
8	Unit of Minutes
9	"
10	"
11	"
12	Tens of Minutes
13	"
14	"
15	Unit of Hours
16	"
17	"
18	"
19	Tens of Hours
20	"

h. Reset the ASTRODATA for the correct display.

i. This completes the ASTRODATA Time Code Check.

APPENDIX M

EPHEMERAL DATA MESSAGE FORMAT

CLASSIFICATION BYEMAN CHANNELS

PRECEDENCE

FM DIRNAVSECGRU

TO

CLASSIFICATION BYEMAN CHANNELS

1. This is ephemeral data for mission/s (complete satellite mission number/s).

2. Read six columns:

ONE	TWO	THREE	FOUR	FIVE	SIX
(NOTE 1)	(NOTE 2)	(NOTE 3)	(NOTE 4)	(NOTE 5)	(NOTE 6)

NOTE 1: Orbit number applicable to all POPPY missions included in one launch.

NOTE 2: Date applicable to all POPPY missions included in one launch. Date will be given as day of year (Julian day) e.g., 1 is 1 JAN, 84 is 25 MAR.

NOTE 3: Time (GMT) of equator crossing for ALFA mission.

NOTE 4: Longitude of equator crossing for ALFA mission in degrees West.

NOTE 5: Time (GMT) of equator crossing for BRAVO mission.

NOTE 6: Longitude of equator crossing for BRAVO mission in degrees West.

ABOVE FORMAT PROVIDES EPHEMERAL DATA FOR TWO SATELLITES ONLY.

APPENDIX N

WEEKLY EQUIPMENT MAINTENANCE CHECKS

AND REPORTS

A. INTRODUCTION

1. This appendix contains instructions for performing certain equipment checks on a weekly basis and for forwarding the results to NRL, Code 5435. These instructions are an addendum to appropriate foregoing chapters and appendices pertaining to general and specific instructions for equipment maintenance adjustments and calibrations. They are intended to ensure optimum performance of the system and provide NRL with a continuing record as to the operational status of the equipment.

2. Step by step procedures for weekly equipment checks:

a. Antenna pattern measurements. These measurements will be conducted with the channel A and data channel antennas, designated A and B respectively.

(1) Equipment required. A test transmitter having the same general transmitting frequency as the converters, or an antenna fed from a VHF signal generator calibrated in the hut, is required for pattern measurements. The transmitter or transmitting antenna should be 100 to 200 feet away and elevated if possible. If neither of these equipments is available, orient the two hut antennas visually so they are pointing directly at each other. Connect the VHF signal generator to the antenna in the primary hut and transmit to the antenna in the secondary hut. Connect the output of the receiver in the secondary hut to an oscilloscope and adjust the signal generator to a convenient reference level, making certain that the receiver is not in saturation. Care must be used as measurements in the near field tend to broaden the patterns and make the nulls less distinct. In addition, due to the proximity of metal objects to the transmitting antenna, multipath reception may occur with resulting cancelling or adding effects. These effects will change as the receiving antenna is moved, due to the different distances of metallic obstructions.

(2) Pattern measurement procedures. Ascertain that the alidade scale is aligned to zero degrees against true north preceding the antenna pattern measurements and carry out the following steps:

(a) Note and record signal reference level used in subparagraph 2a(1) above.

(b) Increase the power output of the signal generator 3 db and rotate the receiving antenna until signal returns to the original reference level on the oscilloscope. Record the alidade scale setting. Rotate the antenna in the opposite direction until the signal again returns to the original reference level and record the alidade scale setting.

(c) Increase the level on the signal generator by 3 db for a total of 6 db and repeat step (b) above.

(d) Increase the signal by 4 db for a total of 10 db and repeat step (b) above.

(e) Connect VHF signal generator in the secondary hut and transmit to the antenna in the primary hut. Repeat steps (a) through (d) above.

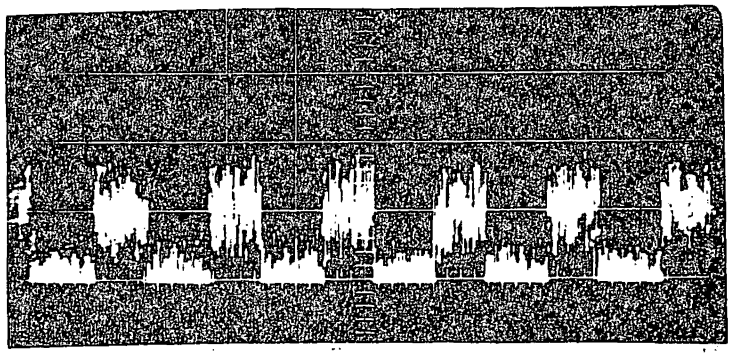
b. Tangential sensitivity measurements of channel ALFA and DATA channel converters.

(1) Adjust system equipment controls for normal intercept operations.

(2) Tune the H. P. Model 608 signal generator to the channel ALFA converter frequency.

(3) Set the modulation switch in the pulse position and modulate the signal generator with the calibrator output of the oscilloscope.

(4) Adjust the RF level of the signal generator until the signal plus receiver noise just "sits" on the noise as viewed on the oscilloscope and shown in figure #1.



#1 - A tangential signal as viewed on the scope when a Hewlett-Packard 608 is pulsed with a scope calibrate out.

(5) Record the output level (in db) from the signal generator.

(6) Disconnect the output of the signal generator from the input to the converter, measure and record the receiver output noise level in millivolts peak-to-peak.

(7) Measure the converter local oscillator frequency by connecting the H. P. counter plug-in (#5253) to the converter oscillator BNC out (the plug located immediately below the meter on the left of the converter). Record this frequency.

(8) Repeat steps b(1) through b(7) for all converters.

c. Tape recorder/reproduce adjustments. Unless otherwise noted check and align the recorder/reproduce according to applicable portions of the GR-2800 instruction manual.

(1) AM electronics. Use the procedures outlined in sections 2-23 through 2-27. When adjustments of the AM record/reproduce amplifiers are completed, increase the gain of channel 4 record amplifier to maximum so that the microphone can be used without a pre-amplifier.

(2) FM electronics. Use the procedures outlined in sections 2-31 through 2-37.

(3) Tension adjustments. Use procedures outlined in sections 3-50 through 3-54. Make all adjustments at 30 inches per second.

(4) Make the following additional checks:

(a) Measure the capstan power amplifier frequency across terminals D8 and D9 on the main terminal board. This should be 60 CPS when the capstan power amplifier is in the PREC FREQ position.

(b) Measure and record the frequency of the 50 KC oscillator.

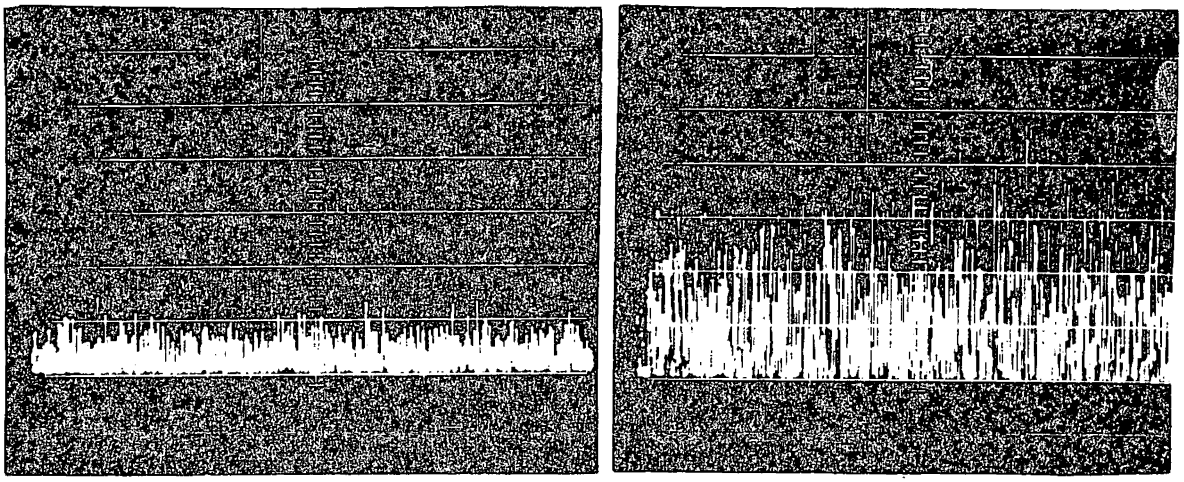
(c) Using the 50 KC test tape provided by NSA or NRL, measure and record the frequency and note the range variation from readout to readout for a five minute portion of the tape.

(d) ADU. The ADU should be set up according to the maintenance manual procedures. The diodes should be checked and an overall evaluation noted on the check sheet.

(e) Time Code Generator. The time code generator should be checked to make certain time code is coming out and that the voltage peak-to-peak ratio between bits and carrier is 1 to 0.12 volts. The bits level should be between 1 and 3 volts peak-to-peak (2.8 volts peak-to-peak preferably).

Also, the drift rate of time code generator should be checked daily and the average value for the week recorded.

(f) Noise. A check should be made by swinging the antenna through 360 degrees. The noise should be given a bearing reading (or range of bearings), an amplitude reading (volts peak-to-peak from scope observations) as compared to the quiet part of the horizon and a rough description of its character. (See figures #2 and #3)



#2 and #3 - The left photo shows approximately 100 millivolts peak-to-peak of noise at a bearing of 280 degrees (quiet part of the sky) and the right photo shows approximately 400 millivolts of noise at 90 degrees for a ratio of 4 to 1. The noise is random.

3. Using check sheets shown on pages N6 and N7 record the information derived during weekly equipment checkout and forward to:

NAVAL RESEARCH LABORATORY
WASHINGTON, D.C.
ATTN: CODE 5435

4. These check sheets may be reproduced locally.

5. When recording local oscillator frequency of the converters on the check sheet ascertain the number of megacycles is omitted. Indicate frequency in kilocycles only. For example: If the local oscillator frequency of converter primary #1 is 136.800 MCS, omit 136 MCS and record .800 KCS.

6. These procedures for maintenance checks are designed primarily for collection stations which operate exclusively in hilo huts, but may be modified as required for those stations whose equipment has been permanently located inside buildings.

7. The information contained in check sheets, and forwarded to NRL, will be unclassified. Field stations will ascertain that classified information is not included in these reports. Any amplifying substantive information pertaining to these reports should be properly classified and forwarded separately through appropriate channels to Director, Naval Security Group.

Date_____

Site_____

(PRIMARY CHECK SHEET. TO BE SENT TO NRL CODE 5435)

1. Antennas: Primary A pattern 3 db points____°. 6 db points____°. 10 db points____o 0 line. Primary B pattern 3 db points____°. 6 db points____°. 10 db points____°.

2. Converters: Sensitivity - Primary #1____dbm. #2____dbm. #3____dbm. #4____dbm.
Frequency - Primary #1____kcs. #2____kcs. #3____kcs. #4____kcs.
Receiver noise output - Primary converter #1____mv p-p.
#2____mv p-p. #3____mv p-p. #4____mv p-p.

3. Recorders: FM Electronics____aligned____ok. AM Electronics____aligned____ok.
Tape Tensions - run____oz. Wind____oz. Rewind____oz.
Internal 50kc oscillator frequency____cps.
Playback of 50kc off tape____cps.
Range of variation of tape playback____cps.
Power amplifier frequency____cps.

4. ADU: Diodes____ok.____replaced. Chopping____ok.____adjusted
Overall operation____satisfactory or____unsatisfactory.

5. Time Code Generator: Code ratio of bits to carrier____volts p-p.
Average drift rate per day____.

6. Noise: Bearing____Characteristics____Amplitude____

Bearing____Characteristics____Amplitude____

Bearing____Characteristics____Amplitude____

Bearing____Characteristics____Amplitude____

Bearing____Characteristics____Amplitude____

7. Description of Noise: (i.e., Ignition, Diathermy, Voice, Communications, Flourescent lighting and cyclic rates of each).

_____

_____

_____

Date_____

Site_____

(SECONDARY CHECK SHEET. TO BE SENT TO NRL CODE 5435)

1. Antennas: Secondary A pattern 3 db points____°. 6 db points____°. 10 db points____°. Secondary B pattern 3 db points____°. 6 db points____°. 10 db points____°.

2. Converters: Sensitivity - Secondary #1____dbm. #2____dbm. #3____dbm. #4____dbm.
Frequency - Secondary #1____kcs. #2____kcs. #3____kcs. #4____kcs.
Receiver noise output - Secondary converter #1____mv p-p.
#2____mv p-p.
#3____mv p-p.
#4____mv p-p.

3. Recorders: FM Electronics____aligned____ok. AM Electronics____aligned____ok.
Tape Tensions - run____oz. Wind____oz. Rewind____oz.
Internal 50kc oscillator frequency____cps.
Playback of 50kc off tape____cps.
Range of variation of tape playback____cps.
Power amplifier frequency____cps.

4. ADU: Diodes____ok.____replaced. Chopping____ok.____adjusted
Overall operation____satisfactory or____unsatisfactory.

5. Time Code Generator: Code ratio of bits to carrier____volts p-p.
Average drift rate per day____.

6. Noise: Bearing_____Characteristics_____Amplitude_____

Bearing_____Characteristics_____Amplitude_____

Bearing_____Characteristics_____Amplitude_____

Bearing_____Characteristics_____Amplitude_____

Bearing_____Characteristics_____Amplitude_____

7. Description of Noise: (i.e., Ignition, Diathermy, Voice, Communications, Flourescent lighting and cyclic rates of each).

_____

_____

_____

APPENDIX O

DATA RECORDING CHANNEL ASSIGNMENTS

1. The following instructions for data recording channel assignments are applicable to missions 7101, 7103, 7104 and all future payloads successfully placed in orbit.

a. [redacted] tasked payloads from one mission or two different numbered missions will be recorded on tracks one/three and five/seven in alphabetical sequence. Examples of channel assignment for payloads presently in operational status:

Mission (s) Tasked	Channel assignment
7104A/B, 7104A/C or 7104A/D	Alfa on 1/3, Bravo, Charlie or Delta on 5/7.
7104B/C or 7104B/D	Bravo on 1/3, Charlie or Delta on 5/7.
7104C/D	Charlie on 1/3, Delta on 5/7.
7101A/B	Alfa on 1/3, Bravo on 5/7.
7103A/B or 7103A/C	Alfa on 1/3, Bravo or Charlie on 5/7.
7103B/C	Bravo on 1/3, Charlie on 5/7
7103A and 7104B	03 Alfa on 1/3, 04 Bravo on 5/7.

2. When [redacted] of different mission payloads with the same letter designation is tasked, they will be recorded in numerical sequence as follows:

7103A and 7104A	03 Alfa on 1/3, 04 Alfa on 5/7.

3. The above instructions for recording POPPY data in alphabetical or numerical sequence applicable only when [redacted] payloads is within the collection site's intercept range [redacted] during any or all portions of a tasked orbit, and both can be recorded on one tape (or two tapes if required due to separation of payloads).

4. Whenever separation of payloads from any mission is such that only one of two tasked payloads is within the collection site's intercept range, data from each will be recorded on tracks 1/3 only.

5. Since NSA processors will program all manual and machine processing equipment to above recorder channel assignments for POPPY data, compliance with above instructions mandatory.