AIRBORNE RADAR-MONITORING SYSTEM

INSTRUCTION GUIDE

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Preface

The Instruction Guide includes a complete description of the Airborne Radar-Monitoring System. It is divided into six sections as follows:

Section I . . . . Theory of Operation
Section II. . . . . Operating Instructions and Preflight Tests
Section III . . . . Maintenance Data and Preventative Maintenance
Section IV . . . . Installation Data and Interunit Cabling
Section V . . . . Illustrated Parts Breakdown and Maintenance Parts List
Section VI . . . . Supplementary Data

A ground-based test set and ground-based re-record equipment are used in conjunction with the Airborne Radar-Monitoring System. The airborne equipment is fully described in this Instruction Guide. The test set is described in full, with the exception of the commercial oscilloscope (described in a separate instruction manual). The description of the re-record equipment is confined to a description of the modifications of the commercially available units. (A separate instruction manual covering the original form of the commercial equipment is supplied.)

Section VI, the Supplementary Data Section, contains a description of a test jig which is used for testing the plug-in printed-circuit board of an airborne unit. The Supplementary Data Section also describes an alternate configuration of the airborne equipment.

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AIRBORNE RADAR-MONITORING SYSTEM

SECTION I

THEORY OF OPERATION

1-1. PURPOSE OF THE AIRBORNE RADAR-MONITORING SYSTEM. The purpose of the Airborne Radar-Monitoring System is to provide a continuous recording on magnetic tape of S-band, or X-band radar signals present in the space through which the System-bearing aircraft passes. This recording includes information concerning pulse repetition frequency (prf), amplitude (i.e., signal strength), time of recording and direction of origin (right side, or left side) of the magnetically recorded S-band, or X-band radar signals.

1-2. GENERAL SYSTEM DESCRIPTION. -- See figures 1-1 and 1-2.

1-3. A complete monitoring System consists of a right-side antenna assembly, a left-side antenna assembly, a right-side information amplifier, a left-side information amplifier, an information recorder and a vibrator d-c supply. The right- and left-side information amplifiers, the information recorders and the vibrator d-c supply are identical whether S-band, or X-band transmissions are being monitored. The right- and left-side antenna assemblies however, are both S-band, or both X-band antenna assemblies depending on whether S-band, or X-band transmissions are being monitored.

1-4. Both the S-band and X-band antenna assemblies include a suitable dish for gathering and focusing radar energy, a dipole and reflector arrangement for directing radar energy toward an energy guide, and a crystal detector which receives the radar (microwave) energy from the guide and delivers to the information amplifiers a voltage pulse whose prf, shape and amplitude corresponds to the prf, shape and amplitude of the radar energy originally gathered, or picked-up, by the dish.

1-5. The circuits of the right- and left-side information amplifiers are identical and each performs the same function. Namely, each receives the voltage-pulse output of the corresponding right- or left-side antenna assembly and delivers to the information recorder a pulse whose prf is identical to the prf of the monitored radar signal, whose amplitude is proportional to the amplitude of the monitored radar signal and whose duration is sufficiently long so that an indication of its prf and amplitude may be recorded on magnetic tape. The output of the right-side information amplifier is recorded on one track (i. e., along one strip) of a magnetic tape and the output of the left-side information amplifier is simultaneously recorded on an adjacent, or parallel, track of the magnetic tape.

1-6. The information recorder includes all of the circuits and mechanisms necessary for recording and playing back the signals which provide indication of prf, amplitude and time. As shown in block diagram figure 1-2, these circuits include five time-reference oscillators whose signals may be recorded on a track parallel to the tracks on which the outputs of the right- and left-side information amplifiers were recorded. These oscillators may be keyed on and off at specific times; and, since tape speed is closely regulated, the time during which specific radar signals were recorded can be referenced to specific oscillator signals.

1-7. As the magnetic tape moves from the supply reel to the take-up reel, it first moves past an erase head to insure that the tape is fully demagnetized before it moves on to the record head. Alternating erase current for this purpose is supplied by the bias-and-erase oscillator. Alternating-current bias for the record head also originates from this oscillator. As the magnetic tape continues to move from the supply reel to the takeup reel, it passes next to the record head and then to the playback head where the magnetic energy stored on the three tracks of the magnetic tape during recording is translated to electrical signals. The signals stored on tracks 1, 2, and 3 are then coupled to separate playback amplifiers whose outputs may be re-recorded in any desired form or viewed on a cathode-ray oscilloscope.

1-8. In addition to the airborne components of the system, a ground-based monitor test set and a ground-based, commercially available, re-record equipment is supplied. (See figures 1-3 and 1-4.) The monitor test set is specifically designed to provide the means for checking the performance of the Airborne Radar-Monitoring System, while the commercially available re-record equipment is modified to make it suitable for re-recording the information (track 1, track 2 and track 3 output of the playback amplifiers) obtained by the airborne System.

1-9. Details of the antenna assembly (S-band and X-band), the information amplifier, the information recorder, the vibrator d-c supply, the test set, and the modification of the commercial re-record equipment are described in this instruction guide.

1-10. MAJOR COMPONENTS AND EQUIPMENT ACCESSORIES. Table 1-1 below lists all of the major components and accessories of the Airborne Radar-Monitoring System.

Table 1-1. Airborne Radar-Monitoring System, Major Components and Accessories

Name	Number Supplied Per System
Airborne Equipment:	
Antenna Assembly (S-band or X-band)	2
Information Amplifier	2
Information Recorder	1
Vibrator D-C Supply	1
Set of Interunit Cables	1
Ground-Based Re-Record Equipment:	
Master Amplifier	1
Slave Amplifier	2
Power Supply	3
Low-Speed Playback Transport	1
High-Speed Record Transport	1
Set of Interunit Cables	1
Ground-Based Test Equipment:	
Test Set	1
Set of Test-Set Accessories:	1
S-Band Horn	
X-Band Horn	
Horn-Mounting Tripod	
Measuring Tape	
Test Probe for Commercial Oscilloscope	
Hood for Commercial Oscilloscope	
Crystal Mount	
Headphones	
VTVM	
Associated Cables	
Test Jig for Information-Recorder Printed-Circuit Board	

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1-11. ANTENNA ASSEMBLY.

1-12. GENERAL. The Airborne Radar-Monitoring System may include either two S-band antenna assemblies, or two X-band antenna assemblies. The principal functional elements of these assemblies are the parabolic dish, the feeds and their associated dipoles, and the crystal detector. The S-band antenna assembly is illustrated and its principal functional elements are identified in figure 1-5. Details of its feed are shown in figure 1-6. Corresponding illustrations of the X-band antenna assembly are shown in figures 1-6 and 1-7. The reasons for the particular constructions shown and the differences between the two assemblies are discussed following the functional description which applies equally well to either of these microwave antenna assemblies.

1-13. PURPOSE OF THE ANTENNA ASSEMBLY. The purpose of the antenna assembly, whether S-band, or X-band, is to pick up pulses of microwave electromagnetic transmissions (radar pulses), concentrate and direct these transmissions through the guide or feed; and deliver a voltage pulse to the information amplifier whose prf, shape, and amplitude correspond to the prf, shape, and amplitude of the radar pulses originally picked up by the antenna assembly.

1-14. MICROWAVE ENERGY FLOW TO CRYSTAL DETECTOR. -- See figure 1-8.

1-15. It will be recalled that a voltage is induced and current will flow on a conductor when the conductor lies in the path of a changing, or moving electromagnetic field. Microwave electromagnetic transmissions moving into the parabolic dish of the antenna assembly induce voltages and corresponding surface currents on the metallic surface of the dish. It will also be recalled that all currents have an associated electromagnetic field, so that these surface currents re-radiate, or reflect, an electromagnetic field from the metalic surface of the dish. Since the dish is parabolic, the reflected energy will converge and tend to concentrate at the focal point of the parabola. This is the point at which the driver dipole of the antenna assembly is located.

1-16. The microwave field energy, concentrated at the driver dipole by the parabolic dish, induces a voltage and a corresponding current in the driver-dipole circuit. Here too, a microwave field is associated with this current and the radiation pattern of the dipole is such that microwave energy is directed into the feed and in the opposite direction toward the reflector dipole. The energy radiated away from the dish would be lost if the reflector dipole were not used. The reflector dipole, however, is spaced, and its size is such, as to reflect this energy back toward the driver dipole in such a phase as to reinforce the field at the driver dipole.

1-17. THE DISH STRUCTURES OF THE S-BAND AND THE X-BAND ANTENNA ASSEMBLIES.

1-18. The parabolic dish of both the S-band and X-band antenna assemblies are fabricated by coating the outside surface of several layers of laminated glass cloth with aluminum and then coating the aluminum with a resin coating. This method of fabrication results in a sturdy, lightweight structure in which the aluminum reflecting surface is protected from the elements.

1-19. The diameter of the S-band dish is 11.5 inches and the diameter of the X-band dish is 6.2 inches. In the case of the X-band dish, the diameter was determined by antenna gain and directivity considerations, while in the case of the S-band dish the diameter was determined principally by size and bulk considerations.

1-20. The reason for the dimensions chosen and the difference between them becomes apparent when we consider the effect of dish diameter on the operation of the antenna assembly. As the diameter of a parabolic dish is increased, two things happen. First, the gain of the antenna increases as the square of the diameter;

and second, the antenna becomes more and more directional as described by the expression

$$\text{beamwidth} = \frac{(k)\ \text{wavelength}}{\text{dish diameter}}$$

where k is a constant which depends on the primary feed pattern and feed structure. What this expression tells us is that if the dish is used as a radiator of electromagnetic energy, the electromagnetic energy will be focused into a more narrow beam, or cone, as the diameter of the parabolic dish is increased. This also means that a large diameter dish, used as a receiver, or pick-up, of electromagnetic energy must be pointed at the source of electromagnetic radiations from within a comparatively narrow cone in order to develop usable signal. This is another way of saying that the parabolic dish becomes more directional with an increase in dish diameter. If the dish diameter is increased too far to achieve additional antenna gain, the cone within which the antenna must "look at" the source will become so narrow that the probability of detecting microwave energy is prohibitively low. Thus, the X-band dish diameter represents a compromise between the desirability of a high antenna gain and the necessity for a high probability of signal detection.

1-21. Because the wavelengths of signals in the S-band are about three times greater than the wavelengths of signals in the X-band, the diameter of the S-band dish could have been considerably larger than 11.5 inches for greater antenna gain without a prohibitive decrease in the probability of signal detection. In this case, however, the size of the dish was limited by weight and bulk considerations relative to the space available for the dish on the aircraft bearing the System.

1-22. THE S-BAND FEED AND THE X-BAND FEED.

1-23. As indicated in figure 1-6 the S-band antenna assembly uses a coaxial feed, while the X-band antenna assembly uses a rectangular-waveguide feed. These types of feeds are used to confine the microwave fields and prevent the fields from radiating from the feed and being lost. At S-band frequencies, a coaxial feed serves this purpose very well. At X-band frequencies, however, a coaxial feed of the same dimensions used for S-band is not suitable, because at X-band frequencies a coaxial feed of these dimensions would tend to transmit unwanted modes and reduce the energy transfer to the crystal detector. If the ratio of the inner diameter of the outer conductor to the outer diameter of the inner conductor of the coaxial feed were made larger, the generation of unwanted modes could be avoided. However, if this were done, the weight and bulk of the resulting coaxial feed would exceed the weight and bulk of the rectangular-waveguide feed.

1-24. A waveguide feed is not used at S-band frequencies because the cross-sectional dimensions of a rectangular waveguide must be in the order of one-half wavelength. At X-band frequencies the width of the rectangular-waveguide feed is about one inch. This is a practical dimension in the light of the size and weight specifications for the System. At S-band frequencies, however, the width of a rectangular-waveguide feed would have to be about 3 inches. The added weight and bulk of a feed of this size would be prohibitive for the intended application.

1-25. Tapering the end of the X-band waveguide feed toward the dipoles provides a gradual transition from the impedance of the dipoles to the impedance of the waveguide feed. This reduces the generation of standing waves on the guide. Consequently, reflection losses due to standing waves are reduced, and an optimum power transfer from the dipoles to the crystal detector circuit is effected.

1-26. As indicated in figure 1-6, three things are done to reduce the generation of standing waves in the S-band feed. First, the inner conductor is tapered toward the adapter to affect a gradual transition from the lower impedance of the coaxial guide to the higher impedance of the adapter; second, a quarter-wave transformer is used to provide a closer match between the impedances to the left and to the right of the transformer; and third, a coaxial choke is included on the guide. This choke is about a quarter-wavelength, open-ended section and presents a very high impedance to the standing wave looking into the section from the dipole end of the feed. A set screw is provided for fixing the choke in the best position along the coaxial guide.

1-27. The coax adapter indicated in figure 1-6 provides the means for connecting the S-band crystal holder and detector to the feed, while the UG-135/U waveguide flange-joints serve the same purpose for the X-band antenna assembly. The UG-135/U flange-joint terminating the waveguide feed was modified by cutting away a part of its thickness in order to reduce its weight.

1-28. THE S-BAND CRYSTAL DETECTOR.

1-29. The purpose of the antenna assembly S-band crystal detector is the same as the purpose of a detector circuit at the lower communications frequencies. That is, the S-band crystal detector receives microwave r-f energy and delivers a voltage pulse whose shape corresponds to the modulation envelope (in this case, a pulse modulation envelope) of the r-f energy received. As indicated in figure 1-9a, all of the elements of a typical low-frequency detector circuit are included in the S-band detector circuit. The broken-line capacitance indicated in figure 1-9a represents the stray capacitance of the coaxial feed and the input capacitance of the first stage of the information amplifier. This capacitance serves the same purpose as the actual capacitor which is inserted in a detector circuit at lower frequencies.

1-30. When the microwave electromagnetic field concentrated on the driver dipole generates a signal on the dipole, the coaxial feed confines the field associated with this signal and applies the signal across the input impedance of the information amplifier and the crystal rectifier in series. Electrons then flow from ground and charge the stray capacitance to very nearly the peak value of the positive half of the microwave r-f signal. This charge remains substantially constant for the interval of the pulse of microwave r-f energy because the stray capacitance cannot discharge through the information amplifier input resistance to any appreciable extent before the microwave r-f signal again goes positive.

1-31. THE X-BAND CRYSTAL DETECTOR. The X-band crystal detector serves the same purpose as the S-band crystal detector, and here too, all of the elements of a typical low-frequency detector circuit are included in a familiar circuit arrangement. (See figure 1-9b.) When an X-band signal is picked up by the antenna assembly, a signal develops between one side of the feed and the side opposite. As indicated in figur e 1-9b, this signal is applied across the crystal rectifier to produce envelope detection in the same way as the pulse envelope is detected at S-band frequencies.

1-32. INFORMATION AMPLIFIER.

1-33. PURPOSE OF THE INFORMATION AMPLIFIER. The purpose of the information amplifier is to receive the output pulse of the crystal detector and to deliver to the information recorder an amplified pulse whose amplitude is proportional to the amplitude of the crystal-detector output, whose repetition frequency is the same as the repetition frequency of the crystal-detector output, and whose duration is sufficiently long so that an indication of amplitude and prf may be recorded on magnetic tape. (The following discussion assumes that the duration of all crystal detector output pulses is 0.25 microseconds, or greater).

1-34. BLOCK-DIAGRAM DESCRIPTION OF THE INFORMATION AMPLIFIER.

1-35. As indicated in the information-amplifier portion of block diagram figure 1-2, the information amplifier consists of five functional circuits. These are the four-stage video amplifier, the pulse-width limiter, the pulse stretcher, the stretch limiter and the cathode-follower output. The four-stage video amplifier, the pulse stretcher and the cathode-follower output constitute the main amplifier channel, while the pulse-width limiter and the stretch limiter act as control circuits for the main amplifier channel. These circuits are identified on block diagram figure 1-2 and the circuits corresponding to the blocks of figure 1-2 are identified on schematic figure 1-11. The manner in which these circuits process the pulse output of the crystal detector to produce the output having the characteristics described above is illustrated by the idealized waveforms of time relationships figure 1-10.

1-36. The input to the four-stage video amplifier is indicated by waveform 1 of figure 1-10. This signal is amplified by the four-stage video amplifier and modified by the pulse-width limiter to produce an output waveform (waveform 5) whose leading-edge pulse is always 0.25 microseconds in duration, and whose amplitude is proportional to the amplitude of the input to the four-stage video amplifier.

1-37. The first stage of the four-stage video amplifier amplifies and inverts the positive-pulse input from the crystal detector. The negative-going pulse output (waveform 2) of this stage is coupled to the control grid of the second stage of the four-stage video amplifier and also through a cathode follower to a delay line. (The cathode follower and delay line constitute the pulse-width limiter circuit.) The pulse output of the delay line has the same polarity, amplitude and general waveform as the pulse which couples directly to the grid of the second video amplifier, but the output of the delay line occurs 0.25 microseconds after the pulse is applied to its input.

1-38. The output of the delay line is coupled into the cathode circuit of the second video amplifier and is shown inverted in figure 1-10 in order to represent graphically the manner in which the waveform at the grid and the waveform coupled into the cathode circuit of the second video amplifier combine to produce the effective signal indicated by waveform 4 of figure 1-10. (The effective signal at the grid of a vacuum tube is the difference between the signal at the grid relative to ground and the signal at the cathode relative to ground.) The net effect of the remaining two stages of the four-stage video amplifier is to produce an output having the polarity indicated by waveform 5.

1-39. The output of the four-stage video amplifier is coupled into the pulse-stretcher circuit and into the stretch-limiter circuit. The leading-edge pulse of waveform 5 is the only part of waveform 5 which is actually used in the pulse-stretcher and in the stretch-limiter circuits. This leading-edge pulse charges a capacitor in the pulse-stretcher circuit and triggers a multivibrator in the stretch-limiter circuit. Acting together, these circuits produce an output corresponding to waveform 8.

1-40. The positive-going leading-edge pulse of waveform 5 rapidly charges a capacitor (pulse-stretcher capacitor) in the pulse-stretcher circuit through a low-impedance path which includes a crystal diode. Since all pulse inputs from the crystal detector have been shortened to 0.25 microseconds, charging voltage is applied to the pulse-stretcher capacitor for this interval in all cases, regardless of the duration of the radar pulses being monitored. Thus, the voltage amplitude to which the pulse-stretcher capacitor can charge will be independant of the duration of the pulse inputs from the crystal detector, and will depend on the amplitude of the leading-edge pulse of waveform 5 (i.e., on the amplitude of the radar pulses picked up by the system).

1-41. The rapid charge of the pulse-stretcher capacitor starts the generation of waveform 8. Once this capacitor is charged, it can only discharge very slowly because the pulse-stretcher circuit is arranged so that the circuit to ground is a high impedance. In this way, the voltage across the capacitor will remain substantially constant until a low-impedance discharge path is provided to ground.

1-42. The stretch-limiter circuit generates an output trigger which causes a diode to conduct and provide a low-impedance discharge path to ground for the pulse-stretcher capacitor. This output trigger is generated by triggering a multivibrator whose period is 150 microseconds (indicated by waveform 6) and then differentiating its output The negative-going spike of waveform 7, which occurs at the trailing edge of the multivibrator output pulse, is the stretch-limiter output trigger. This trigger causes the discharge of the pulse-stretcher capacitor and thereby terminates the pulse indicated by waveform 8.

1-43. It should be noted that the output of the information amplifier (waveform 8) occurs at the same pulse repetition frequency as the pulse repetition frequency of the input, and its amplitude is proportional to the amplitude of the input. Thus, the prf and amplitude of the radar pulses which produced the input to the information amplifier are preserved. Further, this output is of sufficient duration so that an indication of prf and amplitude may now be recorded on magnetic tape. The details of the circuits used to achieve this result are discussed in the following paragraphs.

1-44. DETAIL CIRCUITS DESCRIPTION OF THE INFORMATION AMPLIFIER. -- See figure 1-11.

1-45. FOUR-STAGE VIDEO AMPLIFIER.

1-46. Circuits designed to amplify equally well signals whose frequencies range from low values up to several million cycles per second are called video amplifiers. The four-stage video amplifier provides equal amplification for all frequencies up to about three million cycles per second. Equal gain for all these frequencies is necessary to faithfully amplify the 0.25 microsecond pulse which is processed by the four-stage video amplifier.

1-47. The over-all gain of the four-stage video amplifier is about 105. That is, a one-tenth-volt, peak-to-peak pulse input at the grid of V101 will result in a 10.5-volt peak-to-peak pulse output at the cathode of V104. This over-all gain is produced by a stage gain of 6 for V101, a gain of about 3 for V102 and a gain of about 6 from the grid of V103 to the cathode of V104.

1-48. Generally speaking, video amplifiers use comparatively low-impedance plate loads and it will be noticed that the plate loads of V101 and V102 have impedance values less than 6,000 ohms. (The reason for the use of T101 in the plate circuit of V103 will be explained below.)

1-49. With respect to the reason for the use of low-plate impedances in video amplifiers, it should be remembered that the effective impedance of a very large impedance shunted by a smaller impedance is approximately equal to the smaller impedance. In addition, it should be recalled that the gain of an amplifier changes as the impedance of its plate load changes, and that the impedance of the stray capacitance which shunts the plate load goes down as the frequency of the signal we are attempting to amplify goes up. The effective impedance of the plate load will therefore remain very nearly equal to the value of the plate-load resistor connected into the plate circuit so long as the impedance of the stray capacitance is much larger than the value of the plate-load resistor. As long as this is true, the gain of the amplifier remains constant as frequency goes up. With a continuing increase in frequency, however, the impedance of the shunt capacitance goes down and frequencies are reached where the impedance of the stray capacitance is no longer much greater than the resistance of the plate load. When these frequencies are reached, the gain of the amplifier goes down rapidly and equal gain for frequencies above this point is no longer possible. If the resistance of the plate load is low, higher frequencies are reached before the plate-load resistance and the impedance of the shunt capacitance are comparable. Thus, a lower plate-load resistance provides equal gain for a broader range of frequencies; and, although this lower plate-load resistance provides a comparatively lower gain per stage, the desired over-all gain can usually be achieved by adding stages.

1-50. The reason for using pulse transformer T101 in the plate circuit of V103, instead of a low-value resistor, has to do with the fact that the information amplifier is required to process input signals ranging from very low levels to very high levels. Another way of saying this is to say that the information amplifier must have a very wide dynamic range. Specifically, the intended use of the information amplifier requires that it have a dynamic range of about 46 decibels. At the upper limit of the dynamic range, a 150-volt, peak-to-peak signal is required to drive cathode-follower V104. If, for example, a plate-load resistor of 4000 ohms were used in the plate circuit of V103 (in place of T101), a current swing of 37 milliamperes (150 volts/4000 ohms) would be required to develop this 150-volt signal. Since it is necessary that this signal be positive (because of the orientation of crystal diode CR102 in the pulse-stretcher circuit), it would also be necessary, under these conditions, to drive the stage preceding the cathode follower with a negative-going signal; and the quiescent, or no-signal, plate current of V103 would have to be somewhat greater than 37 milliamperes. This is a larger quiescent current than the quiescent current drawn by the entire information amplifier. The use of T101 in the stage preceding the cathode-follower output of the four-stage video amplifier makes it possible to drive this stage with a positive-going signal since the negative-going signal developed in its plate circuit is inverted by T101. Thus, V103 may be biased so that its quiescent plate current is only a few milliamperes and efficiency and reliability are very much better than they would be if a resistive load were used. In addition, the turns ratio of T101 is such that a voltage step up from one to two is provided from its primary to its secondary.

1-51. The last three stages of the four-stage video amplifier are operated at plus 220 volts in order to enable these stages to process high-amplitude signals. All other stages are operated at 110 volts to keep the current drain on the d-c supply to a minimum and achieve a higher efficiency.

1-52. The cathode impedances of the first three stages of the four-stage video amplifier are either un-bypassed, as in the case of the cathode impedance of V101; or partially bypassed, as in the case of the cathode impedances of V102 and V103. This is done to reduce amplitude distortion and frequency distortion, and to provide grid-bias potentials as required.

1-53. Amplitude, or non-linear, distortion results from the fact that the plate current of a vacuum tube does not change in precisely a linear fashion with a changing grid signal. This will result in the generation of a wave shape in the plate circuit which is a somewhat distorted version of the wave shape applied to the grid. In other words, frequencies are generated in the plate circuit which were not applied to the grid. The un-bypassed cathode resistors of the four-stage video amplifier reduce amplitude distortion (i. e., the generation of unwanted frequencies in the plate circuits) by developing signals at these frequencies across these resistors in such a phase as to tend to suppress their generation in the plate circuits. Further, these un-bypassed cathode impedances (R104 and the output impedance of cathode-follower V106 which is common to the cathode circuit of V102) make the operation of the four-stage video amplifier less dependent on changes in tube characteristics, or on tube replacements. For example, if the transconductance of a tube goes down due to tube aging, the amount of feedback, or degenerative signal, coupled to the grid, goes down and the tendency of the stage gain to go down (due to the decreased transconductance) is reduced. However, a decrease in the transconductance of cathode follower V106 will cause the gain of V102 to decrease. This will happen because the output impedance of V106, which is common to the cathode impedance of V102, goes up with a decrease in transconductance so that a larger than normal negative feedback results and reduces the gain of V102.

1-54. Resistor R110 is shunted by a large capacitor so that practically no a-c signal develops across this part of the cathode impedance and the d-c potential which develops across R110 is used to establish grid bias for V102. Grid bias for V103 is established by shunting R117 with a large capacitor, C112. Here, too, the impedance of C112 is so low, even at very low frequencies, that practically no a-c signal can develop across R117 and the d-c potential which does develop is used to provide grid bias for this stage. Capacitor C111, however, is sufficiently small so that, as frequency increases, an a-c signal of diminishing magnitude is developed at the cathode of V103. Thus, less inverse, or degenerative, feedback develops as frequency increases with the result that this frequency-discriminating type of inverse feedback tends to offset the high-frequency attenuation due to stray capacitance and frequency distortion is reduced.

1-55. The fast current changes which occur in each stage of the four-stage video amplifier tend to develop signal across the internal resistance of the vibrator d-c supply. This signal could couple back into the video amplifiers in such a phase as to cause oscillations, waveform distortions, or amplitude distortions. For this reason R102, C101; R108, C103; R122, G109 are used to decouple the four stages from one another and thereby prevent these undesired effects. The resistances provide a high-impedance d-c path between the plate loads of each of the amplifiers; the capacitors shunt to ground, or short circuit, a-c signals which tend to couple between stages through the d-c supply. In addition, these networks serve to decouple hum and noise generated within the d-c supply from the amplifier stages.

1-56. A cathode follower output, V104, is used as the last stage of the four-stage video amplifier to provide a low-impedance source for driving the pulse-stretcher circuit. Grid bias for cathode-follower V104 is obtained at the junction of R 123 and R124, through R118.

1-57. PULSE-WIDTH LIMITER.

1-58. The pulse-width limiter includes V106 and delay line DL101. The amplified and inverted pulse input from the crystal detector is coupled from the plate of V101 through C102 to the grid of cathode follower V106. Cathode follower V106 provides a low impedance source for coupling the amplified negative-going pulse into DL101.

1-59. Resistors R142, R143 and R144 constitute a voltage divider across the plus 110-volts supply to provide operating voltages for V106. Resistor R142 and capacitor C123 serve as a decoupling network. Plate voltage for V106 is obtained at the junction of R142 and R143, while grid voltage is obtained by connecting the junction of R143 and R144 to the grid of V106. The voltage at the junction of R143 and R144 is positive, but the current through V106 produces a more positive voltage at the cathode of V106, thus establishing grid bias.

1-60. Delay line DL101 may be considered to be a coil with a small capacitor connected between each of its turns and ground. (The small capacitors represent the capacitance which actually exists between the turns of the coil and the capacitance between the coil and chassis.) When a signal voltage is applied at one end of the delay line, each of these small capacitors must charge through the inductance of the coil which precedes it. For this reason, there is a delay before the signal voltage applied at one end of the delay line appears at the opposite end. Delay line DL101 is designed so that the signal coupled from cathode follower V106 appears at its output 0.25 microseconds after having been applied to its input. (See waveforms 2 and 3 of figure 1-10.)

1-61. PULSE-STRETCHER.

1-62. The purpose of the pulse-stretcher circuit is to receive the 0.25 microsecond pulse (the positive-going leading-edge pulse of waveform 5) and to deliver a pulse 150 microseconds in duration to the cathode-follower output. The amplitude of the 150-microsecond output must be proportional to the amplitude of the 0.25-microsecond input, and its prf must be the same as the prf of the input.

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1-63. Crystal rectifier CR102 is inserted in series with C116 across the video-amplifier output in such a way that electrons flow from ground and charge C116 positively with respect to ground each time the positive-going leading-edge pulse of the video-amplifier output occurs. (The negative-going trailing-edge pulse of the video-amplifier output has no effect on the charge of C116 because CR102 will not conduct in the opposite direction.) Since CR102 and R129 constitute a low-impedance charge path in one direction, the charge on C116 builds up very rapidly. In the opposite direction, however, CR102 presents a very high back impedance so that the charge accumulated during the 0.25-microsecond interval of the positive-going pulse tends to remain substantially constant for 150 microseconds. When the negative-going trigger output of the stretch limiter occurs at the end of this interval (see waveform 7), diode V111 becomes conductive and electrons flow from ground through V111 and discharge C116. A pulse 125 volts in amplitude at the cathode of V104 will charge C116 to about 10 volts during the 0.25-microsecond pulse interval and will produce a stretched-pulse output at the cathode of V105 about nine volts in amplitude.

1-64. Resistors R127 and R128 constitute a voltage divider across the plus 110 volts supply and provide an operating bias through R126 to the crystal rectifier, CR102. This is done because, in general, silicon diodes do not start to conduct until a voltage of approximately 0.3 volt is applied. If CR102 were not biased in this way, part of the signal applied would be lost.

1-65. Resistor R129 is inserted in series with CR102 to minimize the effects of changes in diode impedance with changes in signal amplitude. These impedance changes are appreciable when compared to the impedance of CR102 and tend to make the amplitude response of the pulse stretcher less linear. The insertion of R129 in series with CR102 effectively adds 3000 ohms to the impedance of this diode so that the impedance changes now constitute a smaller percentage of the effective diode impedance (diode impedance plus 3000 ohms) and the effects of these impedance changes are therefore greatly reduced.

1-66. STRETCH LIMITER.

1-67. The stretch-limiter circuit includes V107, CR103, V108, V109, V110 and V111. The stretch-limiter circuit receives the output of the four-stage video amplifier and generates a trigger which occurs 150 microseconds after the leading edge of the four-stage video-amplifier output. This trigger output causes the discharge of stretcher capacitor, C116.

1-68. The output of the four-stage video amplifier is amplified and inverted by trigger amplifier, V107 and is coupled to crystal diode CR103. Because of the way crystal diode CR103 is inserted in the circuit, the positive-going trailing-edge pulse of the waveform (waveform 5 of figure 1-10, inverted and amplified) which develops at the plate of V107 is eliminated. The remaining negative-going, leading-edge pulse is coupled through C129 and triggers a one-shot cathode-coupled multivibrator consisting of V108 and V109. If the positive-going trailing-edge pulse were not eliminated by CR103, this pulse could trigger the multivibrator back to its original state before it had passed through a complete, one-shot cycle. (R146, C124 and R160, C131 are decoupling networks, having the function described previously.)

1-69. Vacuum tube V109 is the normally conducting half of the multivibrator and V108 is the normally non-conducting half of the multivibrator. Before the multivibrator is triggered, the voltage at the plate of V109 is comparatively low. When the negative-going leading-edge pulse couples through C129 and C130 to the grid of V109, multivibrator action cuts off V109 and starts V108 conducting. This causes the voltage at the plate of V109 to rise rapidly and remain at a high level for a time interval determined by the R-C constant of C130, R157 and R159. The values of C130, R157 and R159 are selected so that V109 remains cut off and V108 continues to conduct for 150 microseconds. At the end of this interval, the multivibrator returns to its initial state with V108 cut off and V109 once more conducting heavily. This is the stable state for the multivibrator and the two halves of the multivibrator remain in this condition until another negative-going pulse couples through CR103 and causes the cycle to repeat. Thus, the leading-edge of each 0.25-microsecond pulse results in the generation of a pulse 150 microseconds in duration at the plate of V109.

1-70. The 150-microsecond pulse generated at the plate of V109 is coupled to a differentiating network consisting of C132, R165 and R166. The time constant of this network is made long enough so that the stretch-limiter output trigger (see waveform 7 of figure 1-10), which develops at the grid of V110 will cut off V110 for about 50 microseconds. Since V110 is normally conducting, the cathode of diode V111 (connected to the cathode of V110) is normally at a high positive potential with respect to its plate, and V111 is therefore normally cut off. When the negative-going spike of waveform 7 develops across R165 and R166, however, V110 cuts off and the voltage at its cathode falls to a low value. Diode V111 can now conduct and electrons therefore find a low-impedance path (through R168 and V111) to discharge stretcher capacitor C116 rapidly. This action generates the trailing edge of the 150-microsecond pulse-stretcher output.

1-71. CATHODE-FOLLOWER OUTPUT.

1-72. The 150-microsecond pulse, which results from the combined action of the pulse stretcher and the stretch limiter, is coupled to the information recorder through cathode follower V105. Cathode-follower coupling between the pulse-stretcher capacitor, C116, and the information recorder is provided to isolate the low impedance of the recording-head coil from the pulse-stretcher capacitor. If this were not done, the pulse-stretcher capacitor would find a low-impedance discharge path through the recording-head coil.

1-73. Resistor R141 is inserted in series with the cathode-follower output stage and the coil of the recording head in order to provide a square-wave of current (corresponding to the 150-microsecond square-wave voltage output of the information amplifier) through the recording-head coil. The resistive impedance of R141 is large in comparison with the inductive reactance of the coil so that the equivalent impedance of the coil and R141 in series is predominantly resistive, and the current through this circuit will therefore be in phase with, or follow closely, the 150 microsecond square-wave voltage pulse which is applied.

1-74. Plate voltage for cathode follower V105 is obtained at the junction of R136 and R137. These resistors constitute a voltage divider across the plus 110-volt supply. (Capacitor C117 provides additional filtering for the plate voltage obtained at this junction.) Grid bias for V105 is obtained by connecting its grid to the junction of R138 and R139 through R133.

1-75. INFORMATION RECORDER.

1-76. GENERAL DESCRIPTION OF THE INFORMATION RECORDER.

1-77. The principal electronic, electrical and mechanical components of the information recorder are indicated in block diagram figure 1-12. Complete electrical and electronic circuit details are indicated in schematic figure 1-13. All functional components identified in block diagram figure 1-12 are correspondingly identified in schematic 1-13.

1-78. Whenever reference is made to track 1 of the magnetic recording tape, the strip along the upper edge (i. e., the edge away from the casting supporting the mechanisms of the information recorder) is being referred to. Whenever reference is made to track 2 of the magnetic tape, the middle strip of the tape is being referred to, and when reference is made to track 3 of the magnetic tape, the strip along the lower edge of the tape is being referred to.

1-79. The outputs of the Wien Bridge oscillators and the 1.0-kc reference oscillator are always recorded on track 1 of the magnetic recording tape. The output of the left-side information amplifier (the information amplifier which receives the output of the antenna assembly mounted on the left side of the system-bearing aircraft as one faces the nose from the cockpit) is always recorded on track 2 of the magnetic recording tape. The output of the right-side information amplifier (the information amplifier which receives the output of the antenna assembly mounted on the right side of the system-bearing aircraft as one faces the nose from the cockpit) is always recorded on track 3 of the magnetic recording tape. These signals are always recorded in this way so that on playback of the original tape, or a tape on which the signals have been re-recorded, it can be determined from which side (right side, or left side) of the aircraft radar signals were received and recorded. (Particular notice should be made of these facts to avoid confusion in interpreting information played back from the recording.)

1-80. If, for example, the oscillator signals were recorded on track 2 of the tape (the middle strip), and if the original tape, or the re-record tape were somehow flipped over in handling, there would be no way of determining whether radar signals were received and recorded from the left side, or from the right side of the system-bearing aircraft. With the method used, however, even if the original tape, or the re-record tape, is flipped over, we know radar signals received from the left side of the aircraft are recorded on the middle strip, and radar signals received from the right side of the aircraft are recorded on the strip along the edge opposite to the edge on which the oscillator signals were recorded. (The Airborne Radar-Monitoring System is wired so that these relationships are established and fixed. Extreme care should be exercised in the installation and maintenance of the system to avoid making any change affecting these relationships. This note is repeated in the operating, maintenance and installation sections of this instruction guide.)

1-81. The main purpose of the information recorder is to receive the outputs of the right- and left-side information amplifiers and record, on separate tracks (track 2, left-side information amplifier; track 3, right-side information amplifier) of a magnetic recording tape, the prf and amplitude information contained in each of these outputs. As previously indicated, an additional track (track 1) on the magnetic tape is used for recording the output signals of the Wien Bridge oscillators and the 1.0-kc reference oscillator.

1-82. The oscillator signals serve three purposes; first, they provide a time reference; second, they provide a means of determining the prf of recorded radar signals; and third, they reference one edge of the magnetic tape as described in the preceding paragraphs. In addition, the 1.0-kc reference oscillator also provides the means for detecting and determining the extent of net changes in record and playback tape speeds. These purposes are discussed in the following paragraphs.

1-83. Any one of the five oscillators may be turned on and off at specific times (the 1-kc oscillator may be keyed for zero or partial output) corresponding to a specific time of the day and, or, some specific event. In this way, an indication of the specific time during which specific information was recorded is provided. For example, assume that at 14:05 o'clock the 2.3-kc oscillator is keyed on for a few seconds and then keyed off. When the playback of this 2.3-kc oscillator signal occurs, a time piece could be set at 14:05 o'clock and all signals occurring thereafter would have been recorded at the time indicated by the time piece. This, of course, assumes that record and playback speeds are constant and that any variations which might occur in these speeds could be detected and measured. (The example given above does not necessarily represent the actual method used. The example is given merely to explain what is meant by "time reference".)

1-84. In order to insure that tape-speed variations (which might occur due to faulty operation of the tape-speed regulating circuits) do not result in false indications of the time during which radar signals were recorded, one of the five oscillators mentioned above is a highly stable 1.0-kc, crystal-controlled oscillator whose chief purpose is to provide an indication of the extent of variations in tape speed. This oscillator is a highly stable, crystal-controlled, transistor oscillator. While this oscillator could be used for the same purpose as the other four oscillators (conventional Wien Bridge oscillators), its chief purpose is to provide a stable frequency standard by means of which net variations of tape speed, occurring during recording and during playback, may be determined and measured. That is, since the frequency of oscillation of the crystal-controlled transistor oscillator is known, and is highly stable, any variations in the frequency of the playback of this oscillator output can be attributed to the net effect of variations in recording and playback speed. This net shift can be measured and the result of the measurement used to calculate the net variation in recording and playback speed. In this way, the time during which specific prf and amplitude information was recorded may be accurately determined even if wide net variations in record and playback speeds do occur. (The effect of playback speed on recorded frequencies are commonly observed when, for example, a commercial disk recorded at 45 rpm is accidentally played back at 78 rpm. When this happens, recorded sounds play back at much higher frequencies than their original recorded values with the result that the playback sounds high-pitched, or "tinny", as well as sounding accelerated.) Further, since this signal derived from the 1.0-kc oscillator is recorded on a track parallel to the track on which the radar signals are recorded, the number of cycles of this signal recorded between radar pips gives indication of the time between pips, or the pulse-repetition frequency of the radar pips.

1-85. In addition to the circuits and mechanisms necessary for recording the outputs of the right- and left-side information amplifiers, and for recording the signals generated by the five oscillators, the information recorder includes a transistor bias and erase oscillator for supplying a bias signal to the record head; a transistor erase-signal source for supplying erase current to the erase head; a three-track playback head; and three playback amplifiers (one for each of the three tracks) whose outputs may be coupled to a ground-based cathode-ray oscilloscope for visual observation, or coupled to a ground-based recorder for re-recording. Details of these circuits and mechanisms are discussed in the following paragraphs.

1-86. DETAIL DESCRIPTION OF THE INFORMATION RECORDER. -- See figure 1-13.

1-87. THE WIEN BRIDGE OSCILLATORS.

1-88. The 1.3-kc oscillator, the 1.7-kc oscillator, the 2.3-kc oscillator and the 3.0-kc oscillator circuits are identical except for the R-C feedback network which determines their frequency of oscillation. These oscillator circuits include the two halves of the oscillator circuit, and an amplifier signal-output stage. (This type of oscillator is given the name Wien Bridge, because the two R-C feedback circuits which it uses are the same as the R-C circuits used in an a-c measuring circuit known as the Wien Bridge.)

1-89. The basic condition necessary to develop oscillations in a vacuum-tube circuit is that a voltage be fed back (from an amplifying and phase inverting circuit) to the grid of a tube in-phase with the initial voltage at this point. Generally speaking, the feedback network selected to perform this function is a frequency discriminating network (one which does not offer the same impedance to all frequencies) designed so that maximum feedback, and zero phase shift occur at the frequency at which oscillations are desired. If we consider the 3.0-kc oscillator as an example, we see that any random signal which develops at the grid of V701B is amplified and inverted (phase-shifted through 180 degrees) by this tube. The amplified and inverted signal is then coupled through C704 to the grid of V701A. This stage again amplifies and inverts the signal (phase-shifts it through an additional 180 degrees) so that the signal which develops at its plate is phase-shifted a total of 360 degrees. In other words, the signal developed at the plate of V701A is in phase with the original random signal disturbance at the grid of V701B. The signal developed at the plate of V701A is coupled back to the grid of V701B through C703 and the network consisting of R702, C701, R701 and C702. This network is a frequency discriminating network and, as indicated in figure 1-14a, the largest fraction (about 1/3) of the voltage developed at the plate of V701B will be fed back at a frequency f_o, where

$$f_o = \frac{1}{2\pi RC}.$$

The R and C in this equation are the values of R702 and C701. In addition, the feedback network produces zero phase shift at this same f_o frequency, so that there is the greatest tendency for the circuit to oscillate at the frequency f_o. The R and C of the equation above are different for each of the four Wien Bridge oscillators, and each combination of this R and C is such as to produce oscillations at the frequency desired.

1-90. Figure 1-14a also indicates that f_o is not sharply defined and that the frequency of oscillations could shift about the point f_o. In order to reduce the frequency range over which oscillations might possibly occur, signal developed at the plate of V701A is also fed back to the cathode of V701B through C703, R705 and R706. In this case, the feedback network is not frequency discriminating since C703 presents practically the same impedance to all frequencies in the range of interest. This means that the same fraction of voltages at all frequencies in the range of interest (a few hundred cycles either side of f_o) are fed back to the cathode of V701B. (See figure 1-14c.) While the voltage fed back from the plate of V701A to the grid of V701B is a positive feedback voltage, the voltage fed back to the cathode of V701B from the same point is a negative feedback voltage, because the voltage fed back to the cathode subtracts from the voltage fed back to the grid. This causes the voltage fed back to be above cutoff for only a narrow range of frequencies around f_o (see figure 1-14d). In this way the range over which oscillation can occur is greatly limited.

1-91. Amplification of the signals generated by the Wien Bridge oscillators is provided by one stage of audio amplification for each oscillator (V702B, V704A, V702A and V704B). These four one-stage amplifiers are identical resistive plate-load audio amplifiers with unbypassed cathode resistors to provide inverse feedback and thereby to reduce amplitude (non-linear) distortion.

1-92. THE 1.0-KC REFERENCE OSCILLATOR.

1-93. The 1.0-kc reference oscillator is a highly stable (± 0.02%) crystal-controlled transistor oscillator whose chief purpose is to provide a stable frequency reference by means of which variations in tape speed may be detected and their magnitude determined.

1-94. As in vacuum-tube oscillator circuits, transistor oscillator circuits provide for amplifying the oscillator signal, shifting its phase through 360 degrees, and feeding the resulting signal back from the output to the input in phase with the original signal. As in vacuum tube circuits also, the signal fed back must be of sufficient amplitude to sustain oscillations. Transistors Q701 and Q702 provide the signal amplification and phase inversion required, while crystal Y701 inserted in the feedback connection produces the frequency stability required. Transistor Q703 provides oscillator signal-output amplification.

1-95. The transistors used in this circuit are NPN-type transistors connected in a common-emitter circuit arrangement. When a signal is applied between base and ground of Q701, electron flow away from the base increases with an increase in signal voltage amplitude. Transistor action causes electron flow away from the collector and through R774 to increase accordingly. The signal voltage developed across R774 as a result of this current change is therefore 180 degrees out of phase with the signal voltage originally applied at the base. Transistor Q702 again inverts the signal voltage developed across R774, with the result that the signal voltage developed across coil L705 is in phase with the signal originally applied at the base. This signal is applied to Y701 and causes it to vibrate and generate a signal at the 1.0-kc frequency for which it was cut.

1-96. The circuit constants of the oscillator are such that the transistors are driven from cutoff to saturation on the positive and negative halves of each cycle so that a square wave at 1.0 kc is generated. The parallel resonant circuit consisting of L705, C732 and C733, however, reduces the gain of the second stage of the transistor oscillator to negligible values for all sine-wave frequency components of the square wave but the 1.0-kc fundamental sine-wave frequency component to which the parallel resonant circuit is tuned.

1-97. The resistor R778 is in series with the comparatively low input impedance of Q703 to prevent the input impedance of Q703 from loading the oscillator and stopping oscillations.

1-97A. The output of the 1.0-kc oscillator is connected through pin A of J703 to pin D of J702, and is also connected through pin A of J703 and R786 to pin U of J702. When pin D of J702 is keyed to ground the output of the 1.0-kc oscillator is keyed off completely, and when pin U of J702 is keyed to ground the output of the 1.0-kc oscillator is decreased approximately 8 db.

1-98. THE 20.5-KC BIAS-AND-ERASE OSCILLATOR AND ERASE-SIGNAL SOURCE.

1-99. The purpose of the 20.5-kc bias-and-erase oscillator is to generate the alternating-current signal required to bias the tracks 1, 2 and 3 heads of the record head and to erase magnetic-tape residual noise before the tape passes on to the record head. Alternating current is supplied to the erase head through erase-signal source, Q706.

1-100. Basically, the 20.5-kc bias-and-erase oscillator consists of a resonant circuit (L703, C744 and C745) and a common-emitter transistor amplifier circuit (Q705) to provide the necessary

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360 degrees phase inversion and positive feedback required to sustain oscillations in the resonant circuit.

1-101. The resonant frequency signal developed at the junction of C744 and C745 is applied to the emitter of Q705 and causes electron flow through L703 in such a phase as to sustain oscillations in the resonant circuit.

1-102. A low-impedance oscillator-signal output is provided by Q704. A low-pass filter network consisting of L701, C740 and C741 is inserted at the output of this transistor amplifier to help eliminate sine-wave distortion due to high-frequency harmonics. Inductance L702 is included in the emitter circuit of Q704 to provide a high-impedance alternating-current circuit across which large alternating-current signals can develop; and at the same time, across which negligible direct-current potential drop can occur.

1-103. The sine-wave output from the low-pass filter circuit is applied to the erase head through C749 and Q706 and to the record heads for tracks 1, 2 and 3 through a series resistor and capacitor. Capacitors are included in the circuits coupling to these heads in order to block the d-c component of the bias and erase signal. To reduce loading of the bias-and-erase oscillator by the record heads, R797, R799 and R801 are inserted in series with the coils of these heads. Resistors R798, R803 and R805 are included in the ground return of the record heads to provide an impedance across which a voltage proportional to the current through the heads can develop. Measurement of this voltage therefore gives indication of the current through the heads.

1-104. ERASE HEAD.

1-105. The basic structure of the erase head is schematically indicated in figure 1-13. This type of head structure is commonly referred to as a ring head. The gap between the poles of the erase head is of sufficient length so that tracks 1, 2 and 3 of the magnetic tape (the entire tape) are subjected to the magnetic field generated in the gap by the alternating erase current.

1-106. The tape passes across the erase head first as it moves from the supply reel to the takeup reel. The purpose of the erase head is to remove any magnetization which might have been induced on the tape from stray magnetic fields. This erase process is necessary because the magnetization induced by stray fields would play back with the recorded signals and obscure these signals. This is another way of saying that the erase process provides an improved signal-to-noise ratio for the played-back signals.

1-107. Although magnetic tapes can be erased by means of a direct current, this method of erase leaves the tape strongly magnetized in one direction and variations in the strength of this magnetization constitute noise in themselves. Alternating-current erasing on the other hand reduces magnetization to a value sufficiently close to zero so that the noise due to the small residual magnetization is negligible. Briefly, this method of erasing consists of alternately driving the magnetization of the tape to saturation first in one direction, then in the opposite direction. These alternations are repeated many times as the tape passes through the alternating magnetic field of the erase-head gap. The end result is that the residual magnetization of the tape is reduced to a value substantially close to zero.

1-108. A qualitative description (i.e., a word description) of how and why a-c erase works is extremely complex, but the process may be visualized in concrete terms by imagining a long tray containing many small bar magnets whose orientation is not completely random so that varying magnetization exists along its length. This varying magnetization is analogous to the residual noise magnetization of the tape before a-c erase. Now, if the tray is shifted alternately from right to left about a central position, the orientation of the small magnets in the tray will become more and more random. After the tray has been shifted a number of times, the orientation of the magnets will become more and more random until finally, the varying magnetization which originally existed along the length of the tray is reduced to a value very close to zero. This is the effect which the alternating magnetic field produced by the a-c erase current has on the small particles of magnetic materials which make up the recording elements of the tape.

1-109. RECORD HEAD.

1-110. The record head includes three separate ring-head structures PU702-A, PU702-B and PU702-C. Ring head PU702-A is used to record the oscillator signals on track 1 of the magnetic tape; ring head PU702-B is used to record the signal output of the left-side information amplifier on track 2 of the magnetic tape; and ring head PU702-C is used to record the signal output of the right-side information amplifier on track 3 of the magnetic tape.

1-111. The transfer characteristic of a magnetic recording medium describes the manner in which the magnetization of the medium changes with signal. A typical transfer-characteristic curve of magnetic recording tape is shown in figure 1-15. This curve indicates that the magnetization remaining on the tape (remanent flux) after it has passed the recording head does not change in proportion to the magnetizing current. This means that in the absence of a method for straightening the curve, the signal stored on the tape in the form of a magnetic field will be a poor duplication of the signal current applied to the coil of the recording head.

1-112. Alternating-current biasing of the three ring heads of the recording head causes the transfer characteristic of the magnetic tape to become more linear, in a manner indicated by the dotted line curve of figure 1-15. This method of a-c biasing, or of mixing a high-frequency magnetizing field with the comparatively low-frequency field of the signal current, has been investigated by many specialists in the field of magnetic phenomena and several explanations have been suggested. All are very complex and these will not be repeated here. Suffice it to say, however, that the magnetic field produced on the tape by the signal current is much more nearly proportional to the signal current when a-c biasing is used.

1-113. While d-c biasing may also be used to make the transfer characteristic of the recording medium more linear, this method has the disadvantage of reducing the signal-to-noise ratio of the recording as discussed in paragraph 1-107, above.

1-114. PLAYBACK HEAD.

1-115. The playback head of the information recorder includes three ring heads, PU703-A, PU703-B and PU703-C. As the tape moves past the separate ring gaps of these ring heads, ring head PU703-A generates an electrical signal corresponding to the magnetic field stored on track 1 of the magnetic tape; ring head PU703-B generates an electrical signal corresponding to the magnetic field stored on track 2 of the magnetic tape; and ring head PU703-C generates an electrical signal which corresponds to the magnetic field stored on track 3 of the magnetic tape.

1-116. In the recording process, the ring gap width of the recording ring heads has comparatively small effect on the linear conversion of electrical energy to the magnetic energy stored on the tape during the recording process. This is true because the recording process occurs at the trailing edge of the recording ring-head gaps. It is the definition of this edge rather than the gap width which is of primary importance in the recording process. In the playback process, however, the gap width of the playback head limits the high-frequency response of the signal which plays back. The effect of gap width on the shape of the signal played back is discussed below.

1-117. In the case of the playback of the pure sine-wave oscillator signals recorded on track 1, playback produces an accurate reproduction of the recorded sine-wave shape. This is because the voltage induced in a playback head is proportional to the rate of change of flux coupling through the playback head as the tape passes the gap. In the case of a sine-wave playback, this rate of change is sinusoidal, and the voltage induced on the playback head is therefore also sinusoidal. In the case of the playback of the 150-microsecond pulses recorded on tracks 2 and 3, however, the shape of the signal played back is a highly distorted version of the pulses actually recorded on tracks 2 and 3. This is because the rate of change of flux, in the case of playback of a square wave, does not describe a square wave identical to the recorded square wave. Although the shape of the playback signal is distorted in these cases, the amplitude and prf of the recorded pulses is well preserved, and since we are not interested in the accurate reproduction of these pulses, but rather in the preservation of the prf and amplitude information which they contain, pulse shape distortion is of no consequence.

1-118. EFFECTS OF THE PLAYBACK-HEAD GAP ON PULSE PLAYBACK.

1-119. The length of the playback-head gap largely determines the magnetomotive force which cuts through the playback head from the recording tape. When the length of tape over which one of the frequency components of the signal is recorded is equal to the playback-head gap width, both edges of the playback-head gap are riding on points of equal magnetomotive potential, and as a consequence, no magnetomotive force is generated for this frequency. This is true for all frequencies for which the gap width is an integral multiple of the recorded wavelength (i. e., the length of tape over which one cycle is recorded). The function which describes the playback losses in decibles (gap losses), due to these factors, can be expressed in terms of the length of the playback-head gap and the wavelength of the frequency components of the input pulse, thus,

$$\text{Gap Loss} = -20 \text{ Log} \left| \frac{\text{Sine } \pi \, \delta/\lambda}{\pi \, \delta/\lambda} \right|$$

where δ = playback-head gap length
λ = recorded wavelength

1-120. Figure 1-16a shows the frequency response of an "ideal playback head" of gap length δ. Without the gap losses described by the equation above and its associated plot, the voltage output of an ideal playback head would rise in a linear fashion with frequency (i. e., inversely with wavelength). As shown in figure 1-16b, this type of response rises in a straight line at a rate of 6 db per octave. When the theoretical gap loss curve is subtracted from the ideal straight-line characteristic, the curve of figure 1-16c is obtained. Although this curve is highly idealized, its shape is approached by the shape of the frequency response curves of actual playback heads. For example, the curve of figure 1-16c shows the straight-line segment at the lower frequencies where wavelengths are appreciably greater than the length of the playback-head gap; the curve shows the turnover, or fall in frequency response, as the frequencies increase and wavelengths approach the length of the playback-head gap; and the curve shows the null points which occur at all frequencies whose wavelengths are integral multiples of the gap lengths.

1-121. The effect of playback-head frequency discrimination on the shape of the pulse output is shown graphically in figure 1-17. In this figure, the length of the pulse to be reproduced, the gap length and the resulting output of the playback head are directly related. Since the tape speed is 2.25 inches per second, and the recorded-pulse duration is 150 microseconds, the pulse signals from the right- and left-side information amplifiers are recorded over 0.3×10^{-3} inches of tape. As the section of tape over which the pulse has been recorded enters the playback-head gap, the flux density within the gap, and therefore the flux coupling through the playback head, rises in a linear fashion. This linear rise continues until the length of tape over which the pulse is recorded spans the gap. At this point, the flux density within the gap can no longer increase, and the flux curve of figure 1-17 flattens out. The flux curve remains flat until the trailing edge of the pulse enters the gap. At this time the flux density within the gap decreases, because the length of tape over which the pulse was recorded is leaving the gap, and now the flux coupling through the playback head decreases in a linear fashion. Since the voltage induced on the playback head is proportional to the rate of change of flux, the voltage induced on the playback head ideally has the waveshape indicated in figure 1-17. Actually, however, because of the frequency distortion effects described earlier, the playback-head output takes the general form shown in the referenced figure.

1-122. PLAYBACK AMPLIFIERS FOR TRACK 1, TRACK 2, AND TRACK 3. The playback amplifiers for track 1, track 2, and track 3 receive the signal outputs of the three separate ring heads (PU703-A, PU703-B, PU703-C) of playback head PU703, amplify these signals and provide cathode-follower, low-impedance coupling to the re-record or signal-display equipment. These amplifiers consist of conventional R-C coupled stages whose band-pass characteristics are sufficiently broad to preserve the desired amplitude and prf information. (A plot of prf versus playback amplitude is shown in figure 1-18.) Filter network C755, R815, C754 and R816 is included to reduce the ripple component of the d-c supply voltage and to provide decoupling. This circuit is arranged so that extra filtering and decoupling is provided for the first two stages of the playback amplifiers where the signal is at a comparatively low level.

1-123. MECHANISMS AND TAPE-SPEED CONTROL CIRCUITS OF THE INFORMATION RECORDER.

1-124. The mechanisms and tape-speed control circuits of the information recorder are block diagrammed in figure 1-12. Details of the tape-speed control circuits are shown in figure 1-13.

1-125. The purpose of the mechanisms and tape-speed control circuits of the information recorder is to transport the magnetic recording tape at a regulated speed of 2.25 inches per second, from the supply reel, past the erase head, the record head and the playback head, and thence to the takeup reel.

1-126. In order for the tape speed to remain at a constant value, it is necessary for the speed of the supply-reel drive motor to increase as the tape reels out. Simultaneously, it is necessary for the speed of the takeup-reel drive motor to decrease as it takes up the magnetic tape. This regulated change of drive-motor speeds is necessary because as the supply reel lets out tape, the diameter of the tape remaining on the reel decreases, while the diameter of the tape on the takeup reel increases as the takeup reel takes up the tape. If the drive-motor speeds were constant and not regulated to a suitable rate of change accordingly, the supply reel would reel out less and less tape for each revolution of the supply-reel drive motor, while the takeup reel would take up more and more tape for each revolution of the takeup-reel drive motor. Obviously, this speed relationship would cause the magnetic tape to snap.

1-127. In addition to regulating the speed of the drive motors so that their speed changes at a suitable rate, the capstan-drive motor must be regulated to a fixed speed suited to the desired tape speed. The governed capstan-drive motor pulls the magnetic tape away from the supply reel, while the takeup reel reels up the tape at the constant speed desired. As indicated in figure 1-13, this type of motor (i.e., a governed motor) includes a switch which opens when the speed of the motor increases above the desired regulated speed and closes when the speed of the motor decreases below the desired regulated speed. When the governor switch opens, R832 is inserted in series with the armature of the governed capstan-drive motor. This reduces the armature current and the motor slows down. When the governor switch closes, R832 is shorted out, the armature current increases and the motor speeds up. This action tends to keep the capstan-drive motor speed, and therefore the tape speed, within close limits.

1-128. If the speed of the supply-reel drive motor and the takeup-reel drive motor are not suited to the desired constant tape speed, the force exerted by the tape on the tape-speed control arms causes the arms to move in such a direction as to increase or decrease the motor speeds as required.

1-129. It should be noted that the force exerted on the control arm of the supply-reel drive-motor speed control is such as to decrease the resistance in series with the supply-reel drive-motor armature as the supply reel gives up tape. Correspondingly, the force exerted on the control arm of the takeup-reel drive-motor speed control is such as to increase the resistance in series with the armature of the takeup-reel drive motor. These changes simultaneously speed up the supply-reel drive motor and slow down the takeup-reel drive motor at a rate suited to the speed at which the governed capstan-drive motor pulls the tape away from the supply reel.

1-130. The tape-length capacity of the supply reel and the take-up reel is about 6500 feet. This means recordings may be made continuously for a period of about 9.6 hours.

1-131. The over-all gear ratio of the tape supply and tape take-up mechanisms, from worm gears to reel gears is 1626 to one. This means that 1626 revolutions of the worm gears produce one revolution of the reel gears. As the reels let out and take up magnetic tape, the tape-speed control circuits change the motor speeds between 5,000 and 15,000 revolutions per minute, while the governed capstan-drive motor is regulated to a constant speed of 5500 revolutions per minute. The spring-coupled shaft and fly-wheel arrangement schematically represented in figure 1-12, are used to filter out the high-frequency variations of shaft speed due to governor action. Line filters Z701, Z702 and Z703 are included to prevent electrical noise generated by the motor from coupling into other circuits of the System.

1-132. VIBRATOR D-C SUPPLY. -- See figure 1-19.

1-133. GENERAL.

1-134. The vibrator d-c supply receives 28 volts from the aircraft d-c generator and delivers plus 220 volts and plus 110 volts to the two information-amplifier channels, and plus 220 volts to the information recorder. The vibrator d-c supply consists of four functional elements. These are the vibrator G401, the power transformer T401, the rectifier circuit (CR401, CR402, CR403, CR404) and the filter circuit. Vibrator G401 converts 28 volts dc to an alternating potential so that a voltage step-up through power transformer T401 is possible. The secondary of the power transformer is connected across the rectifier circuit in such a way that the stepped-up alternating voltage developed across the secondary causes a current to flow through the rectifier circuit and into the filter circuit in one direction only. Thus, these functional elements convert 28 volts dc to ac, step up the ac, rectify the ac and filter the resultant to produce plus 220 volts and plus 110 volts at the output of the filter circuit. A detail description of the operation of the functional elements of the vibrator d-c supply is given in the following paragraphs.

1-135. VIBRATOR.

1-136. When 28 volts dc is connected at J401, the vibrator reed is alternately attracted to one pole of a permanent magnet, and then to the opposite pole of the permanent magnet. As the reed vibrates in this way, it alternately connects minus 28 volts to one end of the power transformer, then to the opposite end of the power transformer. If the initial position of the reed is as indicated in figure 1-19, then initially minus 28 volts will be applied to terminal 1 of T401, while plus 28 volts is permanently connected to the center tap of T401. As the current through one half of the primary rises toward the maximum value (determined by the d-c resistance of this part of the primary and the voltage applied), the changing magnetic field associated with the current rise induces a voltage across the other half of the primary by auto-transformer action. The phase of this voltage is such that the potential across the entire primary (between terminals 1 and 3) will be about twice the original voltage applied to half the primary. As indicated in figure 1-19, this voltage is connected across the vibrator coil and causes a current to flow which magnetically polarizes the vibrator reed in such a way that it is attracted to the opposite pole of the permanent magnet (before the current through this half of the primary reaches its maximum value). When this happens, minus 28 volts is connected to the opposite end (terminal 3) of T401 so that the voltage induced between terminals 1 and 3 is opposite in polarity to what it was originally. The magnetic polarity of the vibrator reed therefore reverses so that it is attracted back to the opposite pole of the permanent magnet (its original position) and the cycle described above repeats. This cycle occurs about 400 times per second as determined by the mechanical resonant frequency of the vibrator reed.

1-137. Buffer capacitor C401, connected across the contacts of vibrator G401 and across the primary of T401, serves two purposes. First, C401 serves to short circuit the high potential which develops across the primary of T401 while the reed moves between vibrator contacts 6 and 4; and second, C401 stores a charge and supplies current to T401 during this interval. During the time the reed is moving between contacts, the magnetic field which had been building up when the reed was making contact, collapses very rapidly. This induces a large voltage which would arc across the contacts if C401 were not inserted. The value of capacitors used in this function are generally chosen so as to resonate with the inductance which they parallel (in this case the primary of the power transformer and the vibrator coil).

1-138. If, for example, C401 should become open-circuited, the only discharge path for the high potential would be between vibrator contacts 4 and 6. These contacts would quickly burn under these conditions and cause the reed to stick in one position. Should this happen, the d-c current through one half of the T401 primary would be limited only by the d-c resistance of this part of the primary winding and the resulting current could burn out the power transformer.

1-139. Capacitor C407 and C408 are included to reduce the high frequency components of the voltage which develops across the primary of the power transformer. Inductance L401 is included to decouple the a-c voltages developed in the vibrator circuit from the 28-volts d-c line.

1-140. POWER TRANSFORMER, RECTIFIER AND FILTER CIRCUIT. Vibrator action at the primary of power transformer T401 provides a stepped-up alternating potential of about 350 volts (peak) between terminals 4 and 6 of its secondary. When the potential developed across the secondary of T401 is such that terminal 4 is negative, with respect to terminal 6, then electrons move from terminal 4 to terminal 6 through any uninterrupted circuit path available. When the polarity at the secondary of T401 reverses, electrons move from terminal 6 to terminal 4 through any uninterrupted circuit path available. If we temporarily omit the connection between the center tap (terminal 5) of T401 and the junction of C402 and C403, and if we trace the uninterrupted electron paths for both polarity conditions at the secondary, we will find that the four rectifiers of the rectifier circuit are arranged in the form of a standard bridge-rectifier circuit for the plus 220-volts supply. Filtering for this supply is provided by the combined capacitance of C402 and C403. Now, if we consider the connection between the center tap of T401 and the junction of C402 and C403, we will see that CR401 and CR403 are arranged in the form of a standard full-wave rectifier circuit for the plus 110-volts supply (drawn in with heavy lines on schematic figure 1-19). Filtering for the plus 110-volts supply is provided by C402 which is shared in common with the plus 220-volts filter circuit. It will also be noted that the plus 110-volts supply operates independently of CR402, CR404, C403 and R404 (parts used in the plus 220-volts supply).

1-141. Resistors R401 and R402 are inserted in series with the rectifier circuit to limit the peak current surges through the circuit when power is first applied to the vibrator d-c supply.

1-142. Large capacitors have a large inductive reactance at high frequencies due to the fact that they have a roll, or coil construction. Capacitors C405 and C406 parallel the large filter capacitors (C402 and C403) of the vibrator d-c supply in order to reduce the inductive effect of these large capacitors.

1-143. TEST SET.

1-144. PURPOSE OF THE TEST SET. The test set is used to check the performance and aid in the maintenance of the Airborne Radar-Monitoring System. The test set is shown in figure 1-3.

1-145. BLOCK DIAGRAM DESCRIPTION OF THE TEST SET. As shown in the block diagram (figure 1-20), the test set includes signal-generating circuits, metering circuits, and a commercial oscilloscope. The S-band and X-band outputs are fed to horn radiators when testing or adjusting the airborne equipment of the System. A video test probe is used with the oscilloscope when observing waveforms in the equipment under test. The horn radiators, probe, and other test-set accessories, are listed in table 1-1.

1-146. In addition to the S-band and X-band outputs, which simulate signals normally encountered during actual application of the Airborne Radar-Monitoring System, other test outputs are provided to simulate the signals which appear at points intermediate in the System. Figure 1-21 shows wave shapes and time relationships of test-set signals. The circuits represented by the blocks in figure 1-20 are correspondingly identified on the detailed schematic diagrams, figures 1-22A and 1-22B.

1-147. Test signals appear at the following output jacks:

a. VID. TEST SIG. The video test signal is a pulse train whose repetition rate may be set at 350, 500, 1000, 1500, or 3000 pps. Pulse rise time is 0.15 microseconds. The output amplitude of the video test signal is approximately 60 millivolts. The video test signal may be coupled into the Airborne Radar-Monitoring System's information amplifier to simulate the output of the crystal detector.

b. S-BAND AND X-BAND OUTPUT. Either pulse-modulated or continuous-wave S-band or X-band signals may be selected. Repetition rates of 350, 500, 1000, 1500, or 3000 pps are available. Power output level may be varied approximately 18 db.

c. RECDR. TEST SIG. The recorder test signal is a clipped sine wave derived from an over-driven amplifier. The frequency of the recorder test signal may be set at 350, 500, 1000, 1500, or 3000 cps. This signal will cause sufficient current flow in the recording head to simulate the maximum recording level.

d. CAL. OUT. The commercial oscilloscope contains a calibration signal source as described in the manufacturer's instruction manual. This signal source provides a standard for calibrating the cathode-ray oscilloscope as a voltage-measuring instrument.

1-148. The test set includes the following metering devices:

a. S-Band Wavemeter and X-Band Wavemeter. These meters are provided to measure and check the frequency of the S-band and X-band output signals.

b. Temperature-Compensated Thermistor Bridge. The temperature-compensated thermistor bridge, in conjunction with the R-F WATTS meter, provides a means for checking the continuous-wave r-f power output of the S-band and X-band klystrons.

c. Oscilloscope. The commercial oscilloscope is provided to display signals of the airborne and ground-based equipments.

1-149. The frequency of the Wein Bridge oscillator controls the repetition rate of the test-set output signals described in paragraph 1-147a, b, and c. Waveform 1 of figure 1-21 shows the sine-wave output of the oscillator and its time relationship to other waveforms generated in the test set.

1-150. The output of the Wein Bridge oscillator is coupled to the over-driven amplifier, where the sine wave is amplified and clipped as shown by waveform 2 of figure 1-21.

1-151. The output of the over-driven amplifier is applied to the differentiating network where it is modified to produce the pulse output illustrated by waveform 3. This pulse output initiates the generation of a negative trigger pulse by the thyratron trigger generator and amplifier. The negative trigger-pulse output is indicated by waveform 4.

1-152. The output of the thyratron trigger generator triggers the klystron modulator. The klystron modulator is a one-shot multivibrator, whose period may be varied (by means of a chassis-mounted potentiometer) between 0.5 and 5.0 microseconds. The output of the multivibrator (waveform 5) is applied to the 2K41 and 2K39 klystron repellers, controlling the repetition rate and duration of the pulsed r-f energy generated by the klystrons. The output of each klystron (waveform 6) passes through waveguide and attenuator assemblies to the S-BAND OUT or X-BAND OUT jacks mounted on the front panel of the test set. The outputs are coupled through a coaxial cable to either S-band or X-band horns.

1-153. The power level of the S-band and X-band signals may be measured by means of the temperature-compensated thermistor bridge. The power measurement is performed by connecting the PWR. MON. jack to either the S-BAND OUT jack or the X-BAND OUT jack through a coaxial cable.

1-154. DETAILED CIRCUIT DESCRIPTION OF THE TEST SET. See figures 1-22A and 1-22B.

1-155. WEIN BRIDGE OSCILLATOR.

1-156. The Wein Bridge oscillator, shown schematically in figure 1-22B, generates the basic timing signal which determines the repetition rate of the pulsed X-band and S-band outputs. The output of V601 is coupled through C616 to the grid of V602. An in-phase voltage of correct magnitude is fed back from the output of V602 to the input of V601. REPETITION RATE switch S601 selects one of five pairs of capacitors which, together with resistors R601 and R603, determine the frequency of oscillation. These frequencies are 350, 500, 1000, 1500 and 3000 cps.

1-157. Lamp RT601, in combination with C617 and R604, provides the inverse feed-back to V601 that makes the amplification and phase shift of the oscillator partially independent of supply-voltage and tube-characteristic changes. The output of the oscillator is coupled through C618 and appears across R611.

1-158. Since the output of the Wein Bridge oscillator is a sine wave, it is not suitable for direct application as a basic timing signal. The details of the circuits used to modify this output, and the details of the circuit which this output ultimately controls, are discussed in the paragraphs which follow.

1-159. OVER-DRIVEN AMPLIFIER.

1-160. The peak of the positive half-cycle of the oscillator output causes over-driven-amplifier V603A to draw grid current. When grid current flows, the positive peak of the sine wave is dissipated across series grid-resistor R612. As a result, the waveform at the grid of V603A has its positive peaks limited, or clipped, and the output waveform at the plate of V603A is clipped correspondingly.

1-161. The peak of the negative half-cycle of the oscillator output drives V603A to plate-current cut-off, thus limiting the output of the stage for the corresponding portion of this half-cycle. The resultant output waveform of the over-driven amplifier is an amplified and clipped sine wave.

1-162. The a-c component of this output is coupled through C623 and appears across R617 and R618. Resistors R617 and R618 form a voltage divider to provide a signal which causes a peak-to-peak current of one milliampere to flow through a 2000-ohm recording head. The signal appears at the RECDR, TEST SIG. jack J601.

1-163. DIFFERENTIATING NETWORK. The differentiating networks formed by C626-R619 and C627-R621 modify the output of the over-driven amplifier and produce a waveform (waveform 3) suitable for driving thyratron-trigger-generator V604. Crystal diodes CR601 and CR602 clip the negative pulse outputs of the differentiating networks.

1-164. THYRATRON TRIGGER GENERATOR AND AMPLIFIER.

1-165. The thyratron trigger generator and amplifier generate a negative trigger pulse which is supplied to the klystron modulator. The negative trigger pulse appears at the plate of V603B.

1-166. The thyratron trigger generator is a relaxation oscillator. The combination of grid bias and plate voltage applied to V604 is such that V604 is normally nonconducting. During the time V604 is nonconducting, C628 is charged to the plate-supply voltage of V604. When positive pulses (generated by differentiating the output of the over-driven amplifier) are applied to the grid of V604, the voltage at the grid of V604 is raised sufficiently to fire the tube. When this occurs, C628 discharges through V604 and R623, and the plate voltage of V604 falls rapidly to the level at which V604 extinguishes. Resistors R621 and R623 limit the grid-current and plate-current surge through V604 during the discharge interval. When V604 extinguishes, the low-impedance discharge path for the charge on C628 is open circuited and C628 recharges to the supply voltage. The charge remains fixed on C628 until another trigger pulse is applied to the grid of V604. At this time, the cycle described above is repeated. In-phase feedback is applied from plate to cathode through R626 and C629 to maintain an adequate pulse amplitude.

1-167. The positive trigger pulse (which develops across R623 when V604 fires) is amplified and inverted by V603B, and is coupled through C633 to the klystron-modulator circuit. Coil L601, referred to as a "peaking coil", presents a high impedance to the high-frequency components of the positive trigger, and is included in the grid circuit of V603B to maintain the sharp leading edge of the positive trigger. Coil L601 thus tends to compensate for grid-circuit high-frequency attenuation due to the input capacitance of V603B.

1-168. KLYSTRON MODULATOR.

1-169. The klystron modulator receives the negative-trigger output of V603B and generates a pulse whose duration may be varied from 0.5 to 5.0 microseconds. This pulse is applied to the S-band and X-band klystrons, and is used to modulate their r-f output.

1-170. The klystron modulator is a one-shot multivibrator circuit which includes V605A, normally conducting, and V605B, normally nonconducting. The negative-trigger output of V603B triggers the multivibrator and causes V605A to cut off and V605B to conduct. The time required for each tube to return to its initial condition is determined by the time required for the charge on C636 to flow through R631, L602, and R632. When C636 has discharged sufficiently, the grid of V605A is raised above cut-off and the initial state of each tube is restored. This one-shot-multivibrator action causes the generation of a positive pulse at the plate of V605A and a corresponding negative pulse at the plate of V605B. The duration of these pulses may be adjusted by means of chassis-mounted-potentiometer R632. Pulse durations of from 0.5 to 5.0 microseconds may be obtained.

1-171. The negative pulse generated at the plate of V605B is used to control the operation of the S-band and X-band klystrons. The pulse is applied to both the repellers of the 2K41 and 2K39 klystrons. The pulse also appears at VID. TEST SIG. jack J602. When MODULATION switch S502 is in the CW position, the d-c supply voltage is removed from tubes V601 through V605, and continuous-wave output is obtained from the klystrons.

1-172. 2K41 AND 2K39 KLYSTRONS.

1-173. The reflex velocity-modulated klystrons, V519 and V518, generate the S-band and X-band r-f outputs of the test set.

OUTPUT switch S503 determines which klystron is in operation by applying filament power to either klystron. The S-band and X-band carrier frequencies are determined by the mechanical adjustment of the appropriate klystron. For pulse operation the S-band klystron is electrically tuned for maximum output-pulse amplitude, as indicated on the oscilloscope, by adjustment of R561. For continuous-wave operation the S-band klystron is electrically tuned for maximum power output, as indicated by the power meter, by adjustment of R562. Similarly, for pulse operation the X-band klystron is electrically tuned by the adjustment of R557, and for continuous-wave operation by the adjustment of R558.

1-174. Assemblies W501 and W504, the S-band and X-band waveguides, couple the output of the klystrons to the front-panel coaxial jacks J504, S-BAND OUT, and J503, X-BAND OUT. These waveguides are indicated in the block diagram of figure 1-20, and include the S-band and X-band attenuators and wavemeters. Jacks J504 and J503 may be coupled to the respective S-band and X-band test horns through coaxial cables supplied with the test set.

1-175. S-BAND AND X-BAND WAVEMETERS.

1-176. The S-band wavemeter is a cavity resonating device coupled into the S-band circular waveguide by means of a loop forming a quarter-wavelength stub. The cavity is tuned by a coaxial rod moving parallel to the cavity axis and driven by a micrometer screw. Resonance of the cavity is indicated by a reduction of power, as observed on M501 when J504 is coupled to J502. A calibration curve, with which the micrometer reading at resonance may be related to the output frequency, is supplied with each test set.

1-177. The X-band wavemeter is a cavity resonating device coupled to the narrow side of the X-band rectangular waveguide. The wavemeter is tuned by a spring-loaded micrometer drive screw which changes the resonance of the cavity. Resonance of the cavity is indicated by a reduction of power, as observed on M501 when J503 is coupled to J502. The resonant frequency of the cavity is read directly from the drum-type frequency indicator.

1-178. S-BAND AND X-BAND ATTENUATORS. The central element of the S-band and X-band attenuators consists of a vane which is inserted into a slot in the respective S-band or X-band waveguide. Insertion of the vanes is controlled by shafts which extend through the front panel of the test set. Calibration markings correspond to the position of the vanes, and a calibration chart is provided to interpret the dial reading in terms of attenuation. These controls are labeled S-BAND ATT. and X-BAND ATT. Clockwise rotation of the control knob increases the amount of attenuation by exposing a larger area of the vane to the electric field within the waveguide. The vane absorbs electrical energy and dissipates it as heat, thereby limiting the energy delivered to the output jack.

1-179. TEMPERATURE-COMPENSATED THERMISTOR BRIDGE.

1-180. The temperature-compensated thermistor bridge is used to measure the power output of the S-band and X-band klystrons. D-C power is applied to the bridge when MODULATION switch S502A is in the CW position.

1-181. POWER ZERO SET R526 controls the d-c current through the bridge elements, and is used to set M501 to zero with zero power applied to J502. Klystron power is coupled through a coaxial cable from either J504 or J503 to J502, thermistor RT502 changes resistance and unbalances the bridge in proportion to the input power, and M501 measures the degree of bridge unbalance. Thermistor RT501 compensates for changes in bridge sensitivity due to changes in ambient temperature. Thermistor RT503 compensates for those changes in total bridge current which are due to ambient-temperature changes.

1-182. LOW-VOLTAGE AND BIAS SUPPLIES.

1-183. The low-voltage and bias supplies include a full-wave bridge rectifier, a positive half-wave rectifier, and a negative half-wave rectifier. Each rectifier output is filtered and regulated.

1-184. The full-wave bridge rectifier consists of silicon-junction-diodes CR501, CR502, CR503, CR504, CR506, CR507, CR508, and CR509. The output of this bridge is filtered by the pi-section filter consisting of C501A, C501B, and L501. In turn, the output of the filter is stabilized by the action of voltage-regulators V501 and V502. The filtered and regulated output serves as the 300-volt and 145-volt supplies for V601 through V605.

1-185. The positive half-wave rectifier consists of silicon-junction-diodes CR511 and CR512. The output of the rectifier is filtered by the pi-section filter consisting of C506A, C506B, and R521, and is regulated by the action of voltage-regulator V503. The filtered and regulated output is applied through POWER ZERO SET R526 to the temperature-compensated thermistor bridge.

1-186. The negative half-wave rectifier consists of silicon-junction-diode CR513, whose output is filtered by the pi-section filter consisting of C509, C511, and R528, and is regulated by the action of V504. The filtered and regulated output serves as the 30-volt bias supply for V604 and V605B.

1-187. KLYSTRON POWER SUPPLY.

1-188. The klystron high-voltage supply is obtained by adding the output of a full-wave rectifier to the output of a half-wave rectifier. The positive output of the power supply is grounded, and all output voltages are negative with respect to ground.

1-189. The output of full-wave-rectifier V506-V507 is filtered by the pi-section filter consisting of C514, C516, and L502. The output of the filter is regulated by the action of V508, V509, and V511. Changes in output voltage level are amplifier by V509 and applied to the control grid of V508. An increase in output voltage will cause the control grid of V508 to become more negative, resulting in a decrease of current through V508 and, consequently, a decrease in output voltage. An initial decrease in output voltage will have an opposite effect, but with the same tendency to maintain a nearly constant output. The cathode of V509 is maintained at a constant voltage level with respect to the regulated output by the action of V511. Variable-resistor R542 may be adjusted to set the regulated output level. The output of half-wave rectifier V512 is filtered by capacitor C522, and is regulated by the action of voltage-regulators V513, V514, V516, and V517.

1-190. The klystron power supply provides -1250 volts for the 2K39 and 2K41 cathodes. The 2K39 grid is connected to the 2K39 cathode through L503, and the 2K41 grid is biased approximately 5-volts positive with respect to the 2K41 cathode. In addition, the klystron power supply provides a regulated -1800 volt source which is fed through adjustable taps to the 2K41 or 2K39 repeller for CW or PULSE operation. The klystron shells, which constitute the beam electrodes, are grounded and are thus at the most positive voltage level of the power supply.

1-191. PRIMARY POWER.

1-192. Thermal-relay K501, controlling the coil of K502, provides a time delay to allow klystron-power-supply tube filaments to reach operating temperature before plate voltage is applied. Pilot-lamp DS501 lights when 115-volts ac is applied to the primaries of T501 and T502. The low-voltage and bias supplies and the klystron power supply are protected by 3-ampere fuses, F501 and F502, respectively.

1-193. Input power for the commercial oscilloscope is obtained through J501, the a-c power-input jack, and is controlled by a switch mounted on the oscilloscope front panel.

(Next paragraph: 1-209.)

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Revised:
20 September 56.

1-209. GROUND-BASED RE-RECORD EQUIPMENT.

1-210. GENERAL.

1-211. The ground-based re-record equipment is made up of modified units of commercially available tape-recording equipment. The units of the commercial tape-recording equipment have been modified for use in re-recording the information originally recorded by the Airborne Radar Monitoring System.

1-212. The original recording equipment is described in the accessory manual supplied with the ground-based re-record equipment. Paragraphs 1-209 through 1-230 of this instruction guide describe how and why the original equipment has been modified. Operating instructions for the modified equipment are included in Section II. (The modified equipment is referred to as "re-record equipment" in this instruction guide.)

1-213. A complete re-record equipment (see figure 1-4) includes the following:

a. One low-speed tape-transport mechanism for playback and one high-speed tape-transport mechanism for recording. Each transport is mounted in an individual case. (The transports are referred to as "Mechanical Assemblies" in the accessory manual.)

b. Three amplifier units, mounted in a single rack (referred to as "Electronic Assemblies" in the accessory manual).

c. Three power supplies, mounted in a single case.

A simplified block diagram of the re-record equipment is shown in figure 1-23. (The individual units of the re-record equipment are interconnected as shown in the interunit-cabling diagram of figure 1-24.)

1-214. PURPOSE OF THE RE-RECORD EQUIPMENT. The original tape recording (made by the airborne equipment at 2.25 inches-per-second) is put in more usable form by the ground-based re-record equipment. By re-recording the original information at 7.5 inches-per-second on more durable tape, the information can be played back repeatedly, using a standard playback unit.

1-215. MODIFICATION OF THE ORIGINAL TAPE TRANSPORT TO PRODUCE THE LOW-SPEED PLAYBACK TRANSPORT.

1-216. As shown in figure 1-23, the original data recording is played back on the low-speed playback transport, is amplified, and is re-recorded at 7.5 inches-per-second using the high-speed record transport. The high-speed record transport is an unmodified unit of the commercially available tape-recording equipment described in the accessory manual. The tape-transport control circuit is shown in figure 3 of the accessory manual.

1-217. The low-speed playback transport is similar to the standard transport, except that it has been modified to provide a playback tape speed of 2.25 inches-per-second (the recording speed of the airborne recorder). The modified portion of the tape-transport control circuit is shown schematically in figure 1-25 of this instruction guide. As indicated in the figure, the tape-speed change was effected by replacing the original capstan-drive motor and starting capacitor (B501 and C501) with a lower-speed capstan-drive motor and a new starting capacitor (B1301 and C1301).

1-218. The external appearance of the playback and record transports are identical. However, they can be identified readily by noting the serial numbers appearing on the nameplates. Table 1-2 lists the serial numbers of the playback and record transports supplied on this contract.

Table 1-2

Identification of Playback and Record Tape-Transport Mechanisms

	Equipment Serial Numbers			
Playback Transport (2.25 inches-per-second tape speed)	55E184	55F139	55F140	55F141
Record Transport (7.5 inches-per-second tape speed)	55E185	55F145	55F146	55F185

1-219. MODIFICATION OF THE ORIGINAL AMPLIFIER UNITS FOR USE IN THE RE-RECORD SYSTEM.

1-220. The function of the amplifier units in the standard recording system is described in the accessory manual. Each amplifier contains a playback and a record channel. In the standard recording system, a single tape transport is employed, and the playback channel is used to monitor the information being recorded on the tape. In the re-record equipment described in this instruction guide, two tape transports are used. As shown in figure 1-23, the information derived from the low-speed playback transport is amplified by one stage in the playback channel, further amplified in the record channel, and finally re-recorded using the high-speed record transport. In order to incorporate the original amplifier units into the re-record system, two types of modifications were necessary: (1) circuit changes to provide simultaneous playback and record, and (2) circuit changes to provide uniform pulse-reproduction characteristics. The circuit changes were incorporated into the amplifiers using two toggle switches to establish the additional signal paths. By turning the switches off and interconnecting the units differently, the recording equipment may be operated in the conventional manner described in the accessory manual.

1-221. It will be seen in figure 1-23 that the re-record system employs three tape tracks and three amplifiers to process the data recorded on the original tape. The amplifier complement consists of a "master" and two "slave" amplifier units. Except for biasing and primary power requirements, the three amplifier circuits are identical. Therefore, only a single signal path will be discussed in this instruction guide.

1-222. MODIFICATION OF THE ORIGINAL AMPLIFIER UNITS TO PROVIDE SIMULTANEOUS PLAYBACK AND RECORDING.

1-223. Line voltage for the tape transports and for the slave amplifier units is supplied through the master amplifier unit (see figure 1 of the accessory manual). The fuse in this circuit, F402, has been changed from a three-ampere fuse to a five-ampere fuse. The larger fuse is used because both the low-speed playback transport and the high-speed record transport draw current through this fuse when the re-record system is in operation. To supply line voltage to the second tape transport, a standard power inter-connecting cable (5759-1) was modified to include W1301. The modified cable is shown in figure 1-24.

1-224. The amplifier units (5701R3-1 and 5701R3-3), shown schematically in figures 1 and 12 of the accessory manual, have been modified as shown in figure 1-26 of this instruction guide. The original components of the amplifier units are designated by the 400 series of call-outs (C401, R401, etc), while the components added to the amplifier by the modification are designated by the 1300 series of call-outs (C1301, R1301, etc.). In a modified amplifier unit, the signal derived from a playback head of the low-speed playback transport appears across the primary of T404 (see figure 1-26). The signal developed across the secondary of T404 is amplified by V405, and is applied to PLAYBACK LEVEL potentiometer R438. In the modified amplifier unit, the signal is also applied to voltage divider R1301-R1302, where it is attenuated, and is then applied to the grid of V401 through S1301. The signal is amplified, and is finally fed to the corresponding record head of the high-speed record transport, where re-recording is accomplished at a tape speed of 7.5 inches-per-second.

1-225. MODIFICATION OF THE ORIGINAL AMPLIFIER UNITS TO PROVIDE UNIFORM PULSE-REPRODUCTION CHARACTERISTICS.

1-226. If a recording system is to reproduce information faithfully, all of the frequency components contained in the original information must be amplified or attenuated by the same amount. Furthermore, all of the frequency components must be delayed by the same time interval, in order to maintain their relative phase. Stated in the usual way: the frequency-response curve must be "flat" and the phase-vs-frequency curve must be "linear". To achieve a flat frequency-response curve in a magnetic-recording system, compensation must be made for basic limitations of the system (paragraphs 1-119 and 1-120). The over-all system is made flat by emphasizing certain frequencies in the recording and playback amplifiers. Frequency compensation effected in the recording amplifier is called "pre-emphasis", while frequency compensation introduced by the playback amplifier is called "post-emphasis".

1-227. The reproduction of pulse information requires a system capable of reproducing the frequency represented by the pulse repetition frequency (1st harmonic), as well as reproducing multiples of the basic frequency (higher-order harmonics). In addition, the phase relationship of the harmonics must be maintained for accurate pulse reproduction. Using an ideal system (one having flat frequency-response and linear phase-vs-frequency characteristics over an unlimited frequency range), the pulse distortion described in paragraph 1-121 could be corrected by employing suitable integrating circuits. However, since there is a limit to the frequency range of a practical tape-recording system, the reproduction of high-frequency pulses may be poor, even though low-frequency pulses are reproduced adequately. The compromise in pulse reproduction characteristics, dictated by the limitations of a practical recording system, require further deviations from the compensation curves which would produce the flatest frequency response curve. Therefore, the airborne information recorder and the ground-based re-record equipment employs pre-emphasis and post-emphasis curves which do not match the curves of figure 1-16.

1-228. It is the ultimate objective of the airborne and ground-based equipment to reproduce the relative amplitudes of intercepted signals, regardless of the pulse repetition frequencies involved. This end result is achieved within the prf range of 300 to 3000 pps, but some pulse distortion is introduced. Although pulse distortion varies with prf, the peak output voltage is nearly constant. This faithful reproduction of pulse amplitudes is achieved by compensating for the deficiencies of the recording and playback processes. The compensation sequence is as follows:

a. The original pulse data is recorded on the tape using an amplifier having the frequency-response characteristic shown in figure 1-27(a).

b The original data recording is then played back on the low-speed playback transport, using an amplifier with the response characteristics shown in figure 1-27(b). This response curve was obtained by modifying the input stage (V405) of the amplifier-unit playback channel. The modification is described in paragraph 1-230.

c. Next, the data is re-recorded using the pre-emphasis curve available when the EQUALIZATION switch is in the LOW SPEED position. The response curve, shown in figure 1-27(c), is the curve of the unmodified recording channel.

d. The re-recorded data is finally played back using the post-emphasis curve selected when the EQUALIZATION switch is in the HIGH SPEED position. The response curve, shown in figure 1-27(d), is available in the playback channel of unmodified amplifier units. In practice, the PLAYBACK EQUALIZER potentiometer is adjusted for uniform pulse reproduction, thus modifying the curve shown in figure 6 of the accessory manual. The post-emphasis circuit is described in paragraph 1-229.

e. The net result of the pre- and post-emphasis circuits is shown in the frequency-response curve of figure 1-27(e). This frequency-response correction, combined with the frequency-response characteristics of the record and playback processes, results in a faithful reproduction of the original radar-pulse amplitudes and repetition frequencies.

1-229. The post-emphasis curve (d) is obtained when the re-recorded data is finally played back at 7.5 inches-per-second with the EQUALIZATION switch in the HIGH SPEED position. This post-emphasis curve may be duplicated using the standard equipment described in the accessory manual, or using the modified equipment described in this instruction guide. The unmodified equipment, shown schematically in figures 1 and 12 of the accessory manual, will be described here. Post-emphasis is accomplished in the first stage of the playback channel, V405. When the EQUALIZATION switch is in the HIGH SPEED position, high-frequency components of the voltage appearing at the plate of V405 are applied across the grid-return resistor (R430) through PLAYBACK EQUALIZER potentiometer R435 and blocking capacitor C417. The signal fed back to the grid-return resistor is predominantly high in frequency because the reactance of C417 is small at these higher frequencies. Because the feed-back voltage is 180° out of phase with the signal acting at the grid of V405, the over-all gain of V405 is reduced at the higher frequencies.

1-230. The pre-emphasis curves have not been changed by the modifications incorporated into the amplifier units. Also, the post-emphasis curve of the modified amplifier is similar to the one used in the original equipment when the EQUALIZATION switch is in the HIGH SPEED position. However, the feed-back circuit of V405 is changed when the EQUALIZATION switch is in the LOW SPEED position, thus providing post-emphasis curve (b). To effect the necessary change in the feed-back circuit, EQUALIZATION switch S402 was replaced by S1303. As shown in figure 1-26, when S1303 is in the LOW SPEED position the signal voltage appearing at the plate of V405 is applied across the grid-return resistor (R430) through R1303, S1303, S1302, and C1302. Because the reactance of C1302 is low, even at the lower frequencies, the gain of the stage is reduced uniformly throughout the usable audio range. However, the bypassing action of C1303 reduces the magnitude of the negative feed-back voltage at the higher frequencies.

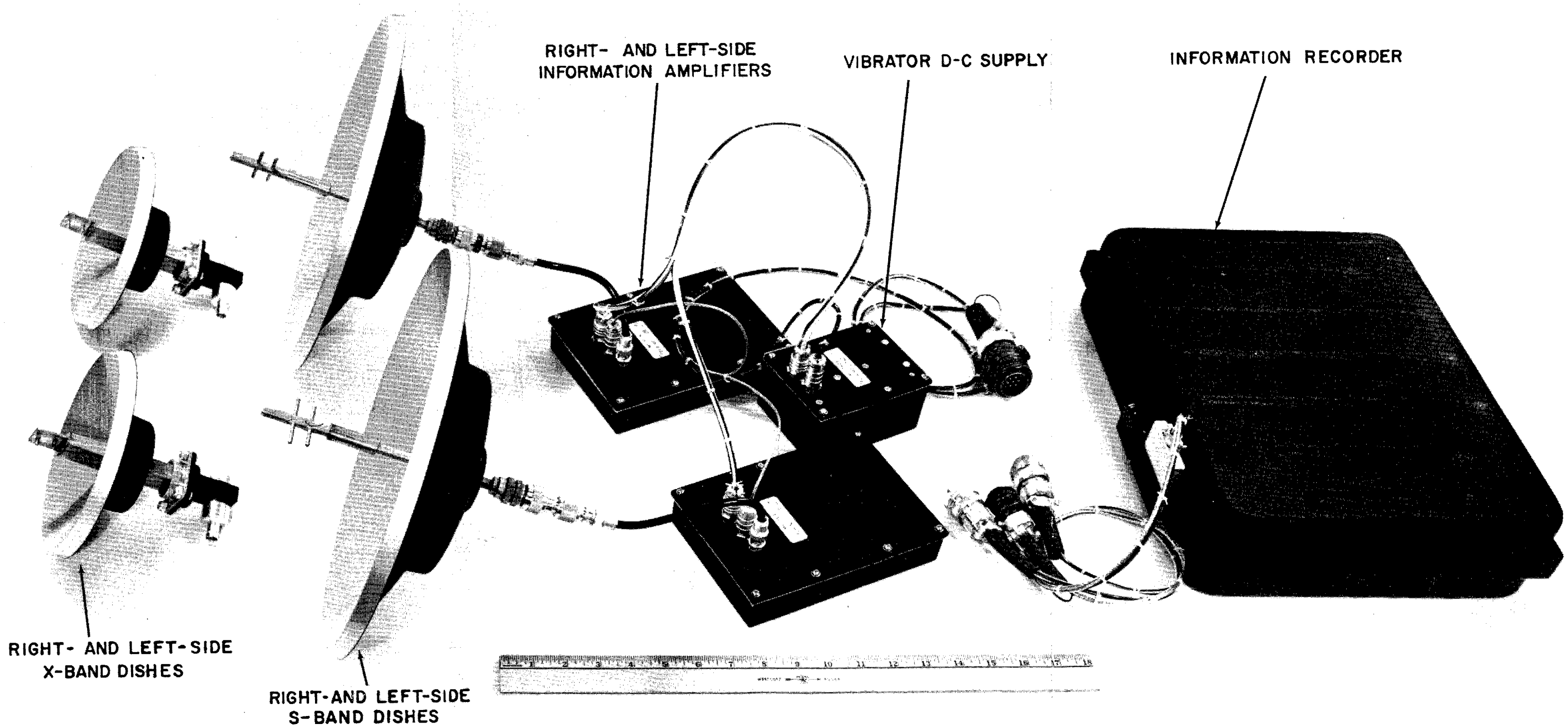

Figure 1-1. Airborne Radar-Monitoring System, Components

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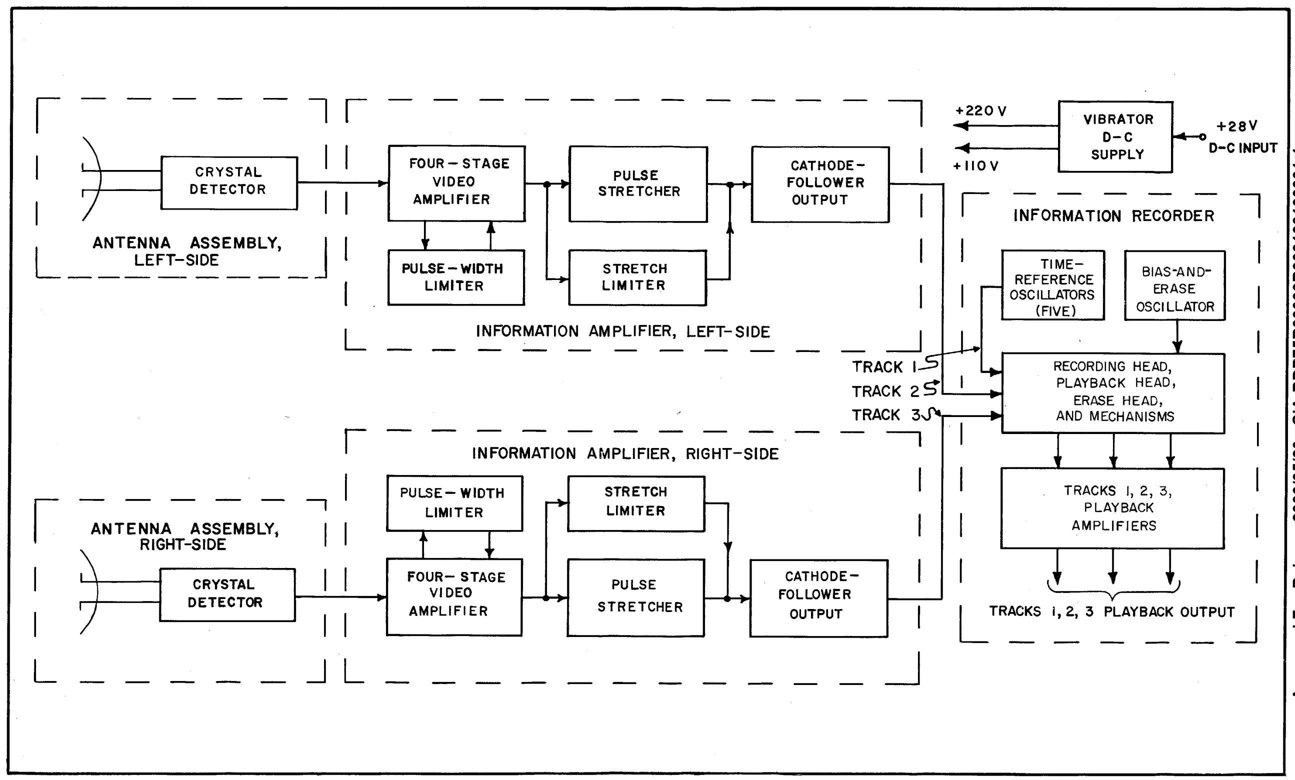

Figure 1-2. Airborne Radar-Monitoring System, Block Diagram

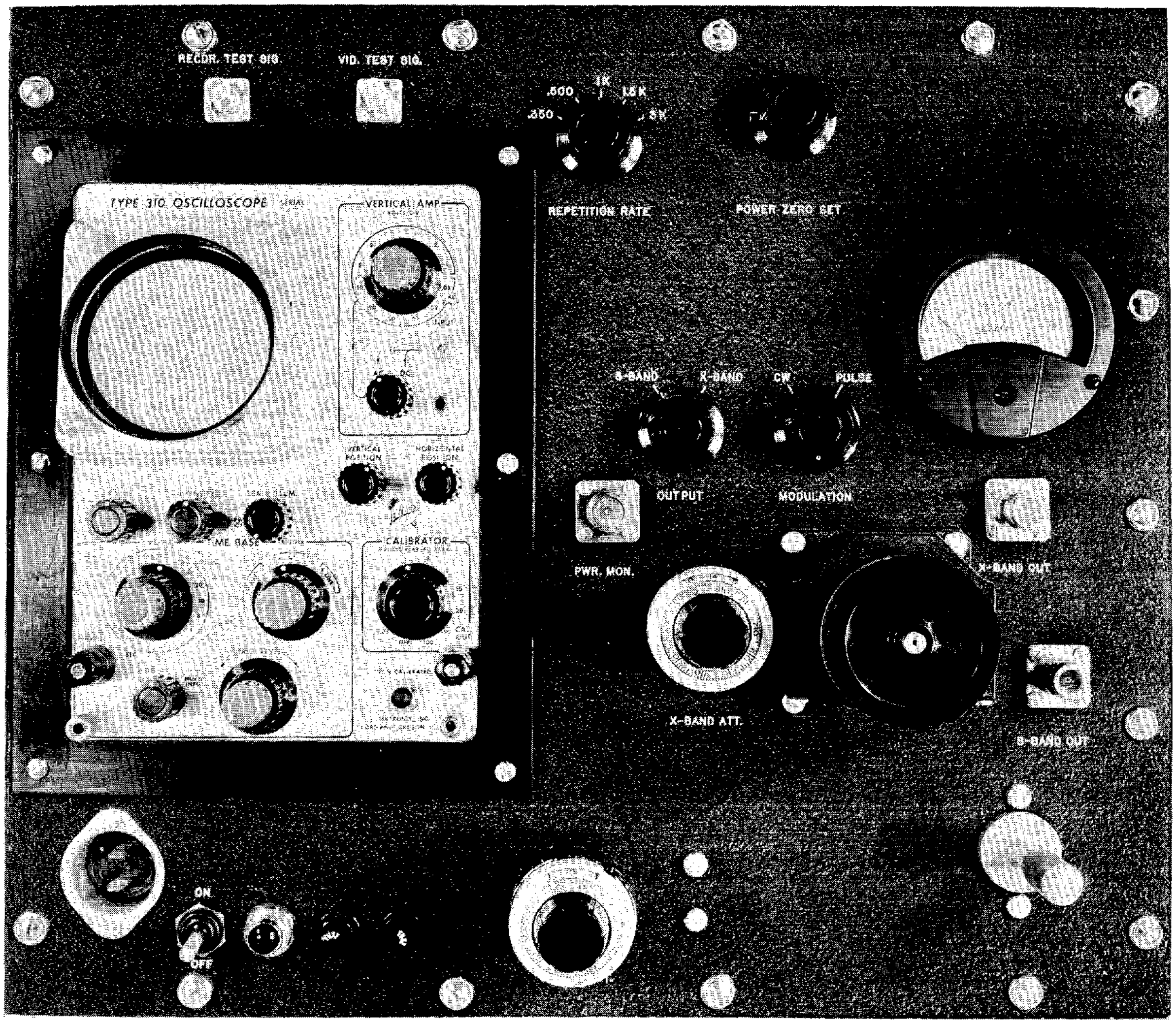

Figure 1-3. Ground-Based Test Set

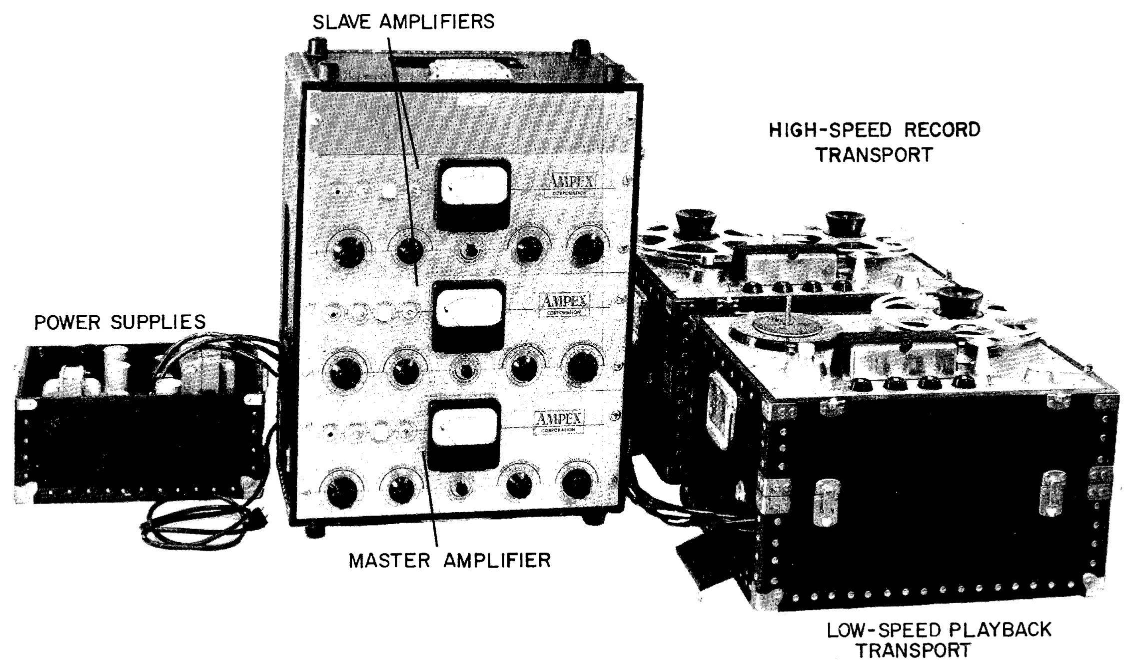

Figure 1-4. Ground-Based Re-Record Equipment and Accessories

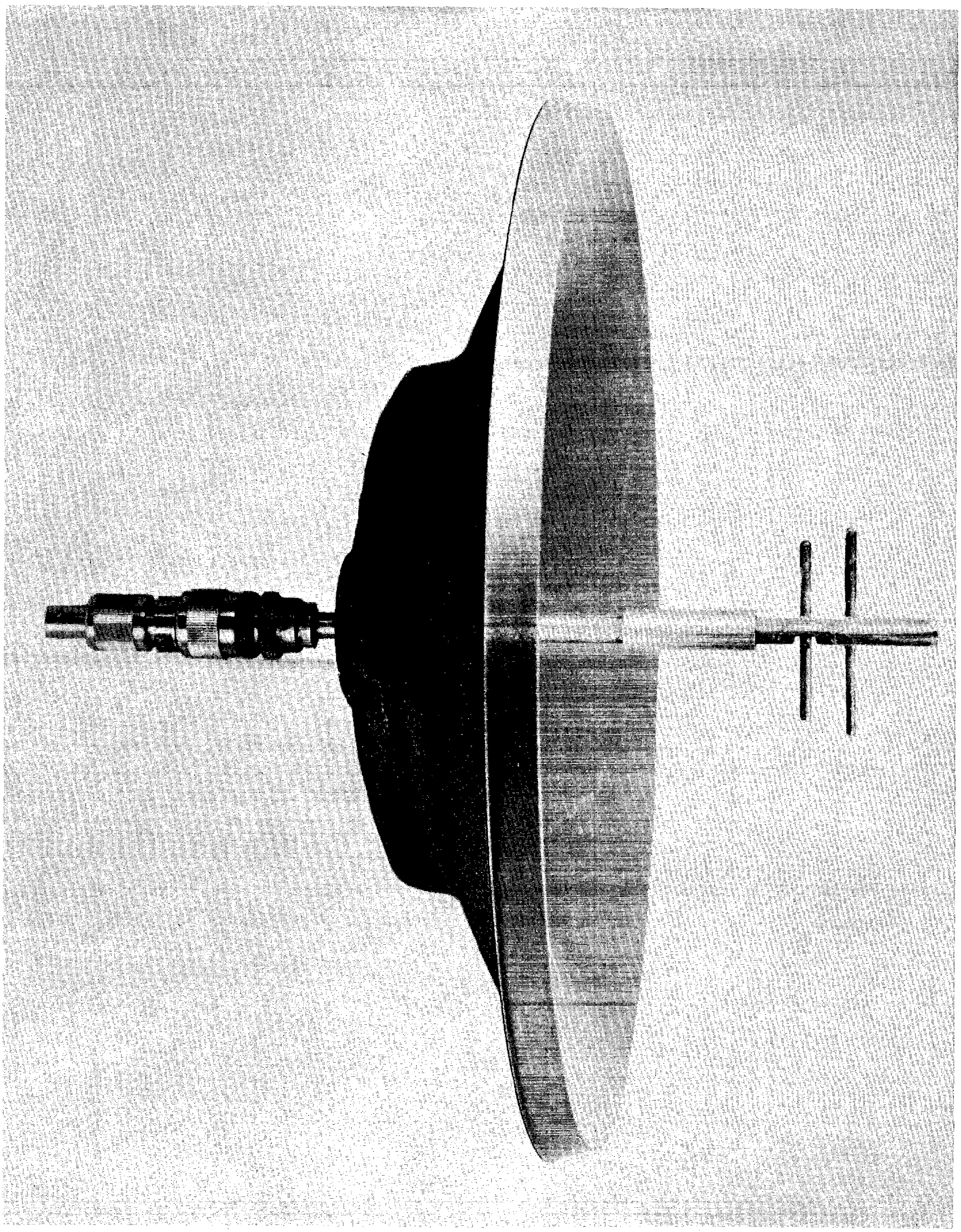

Figure 1-5. S-Band Antenna Assembly

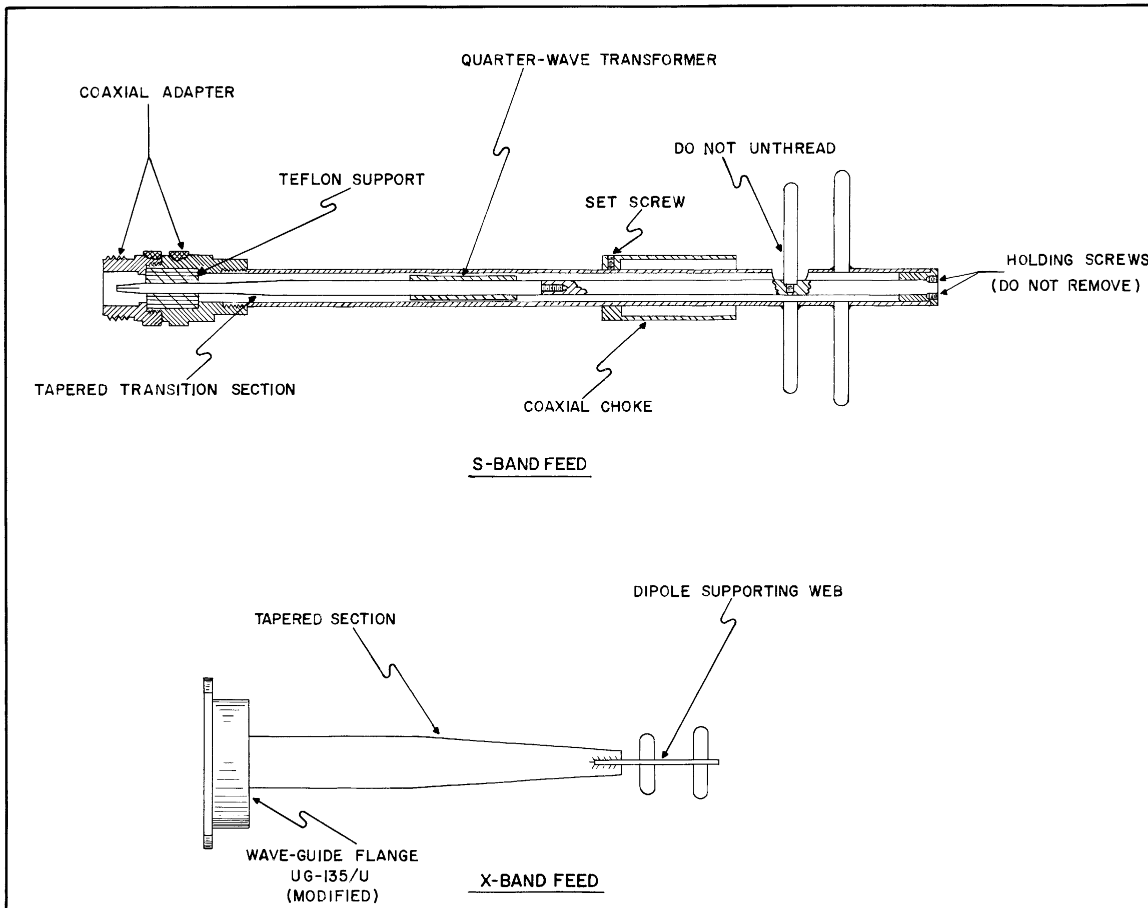

Figure 1-6. S-Band Feed and X-Band Feed, Detail

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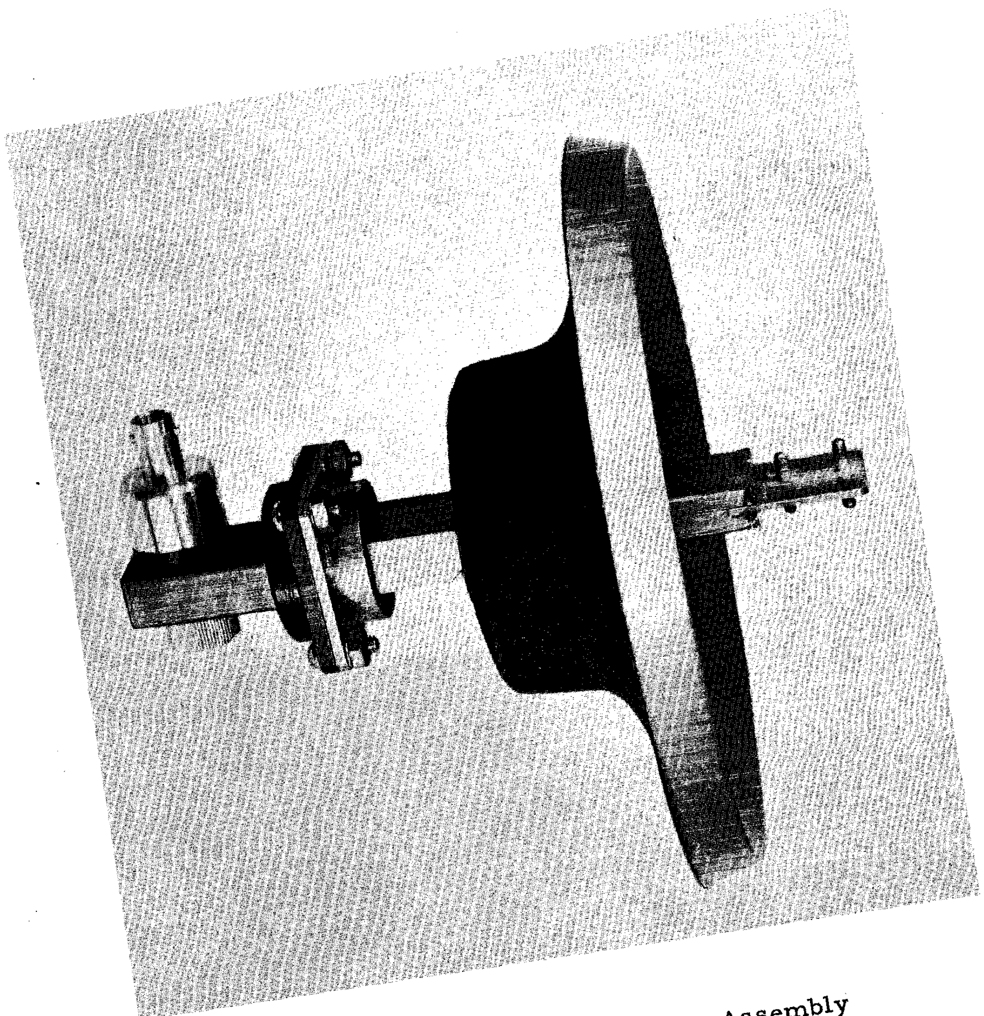

Figure 1-7. X-Band Antenna Assembly

SECRET

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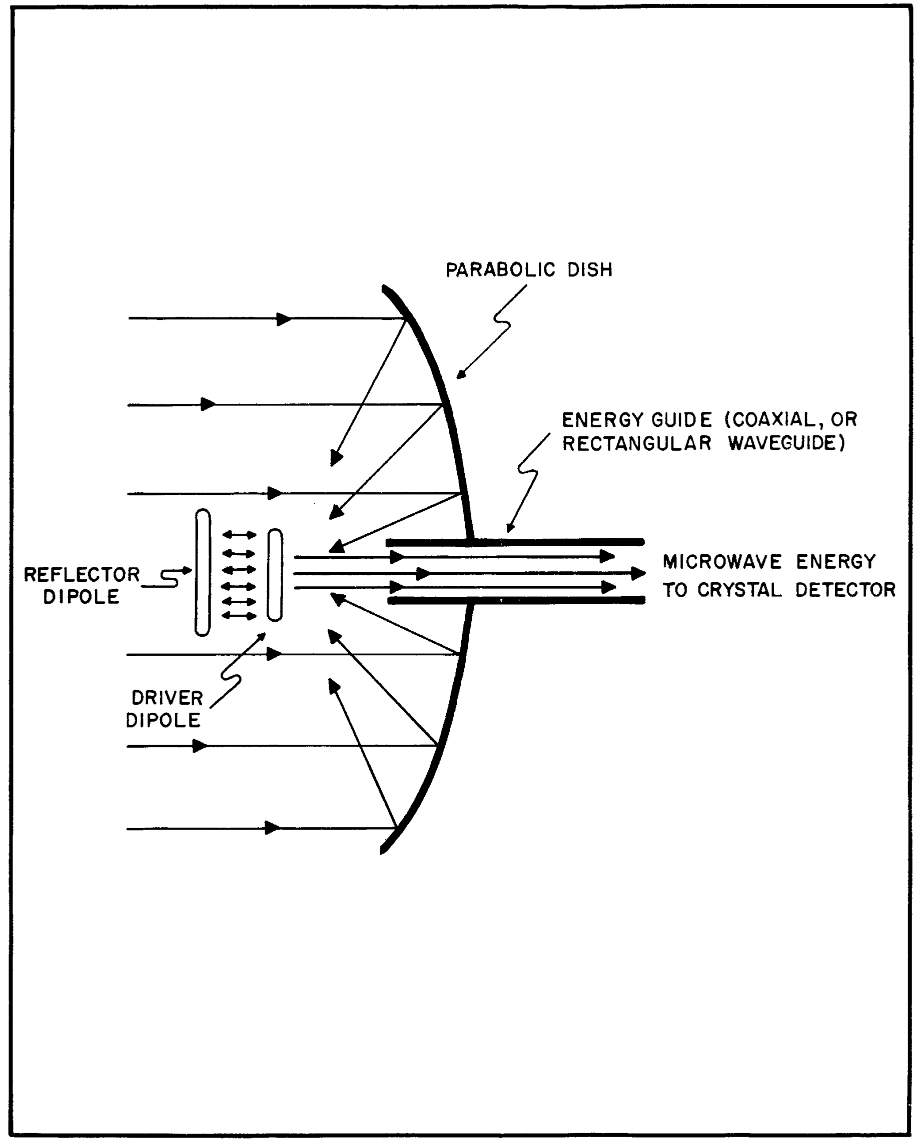

Figure 1-8. Microwave Energy Flow to Crystal Detector

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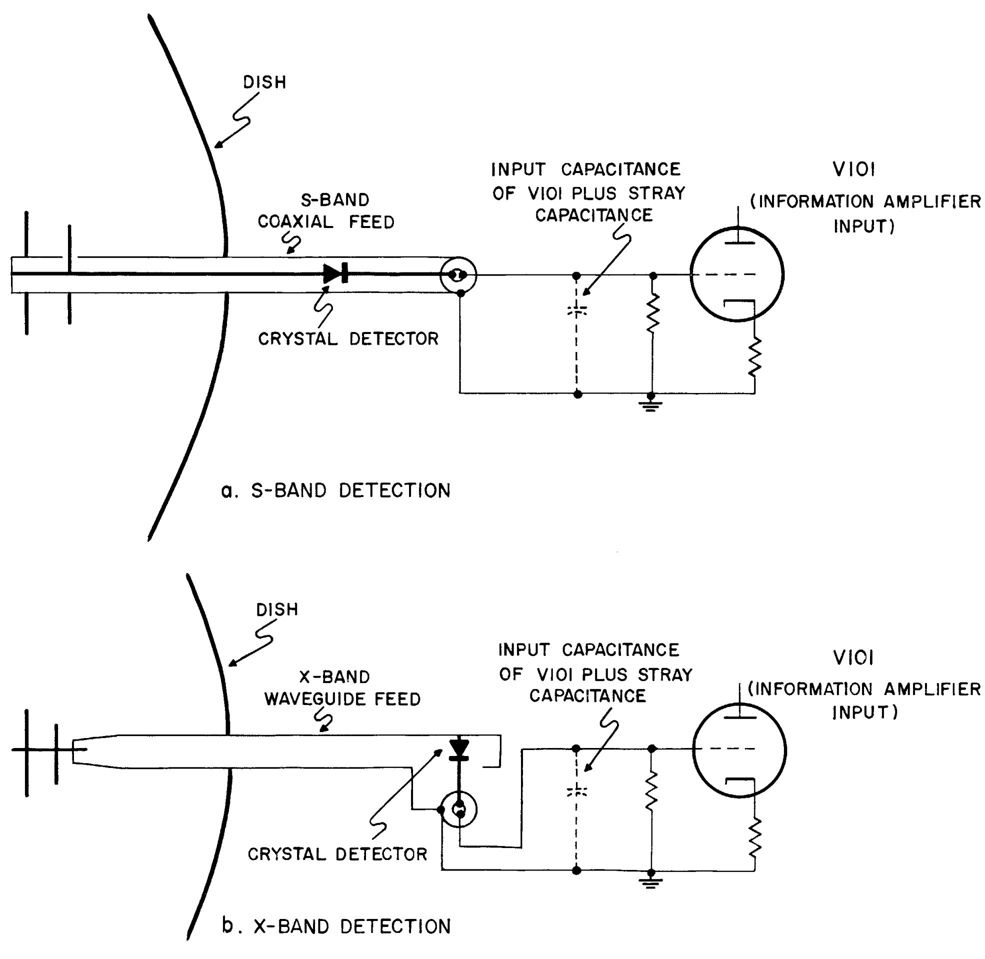

Figure 1-9. S-Band and X-Band Detection, Simplified Schematic

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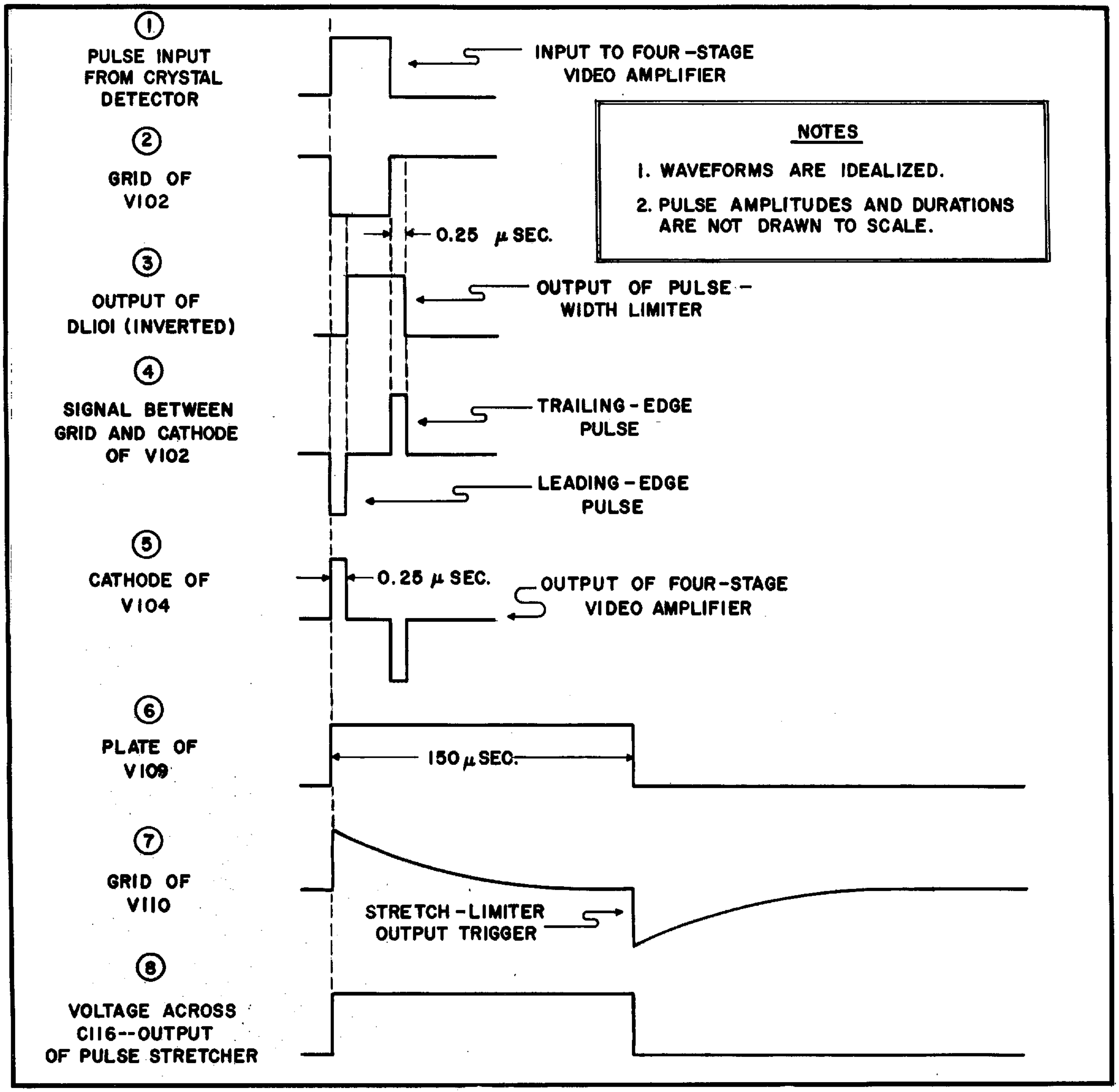

Figure 1-10. Information Amplifier, Time Relationship of Waveforms

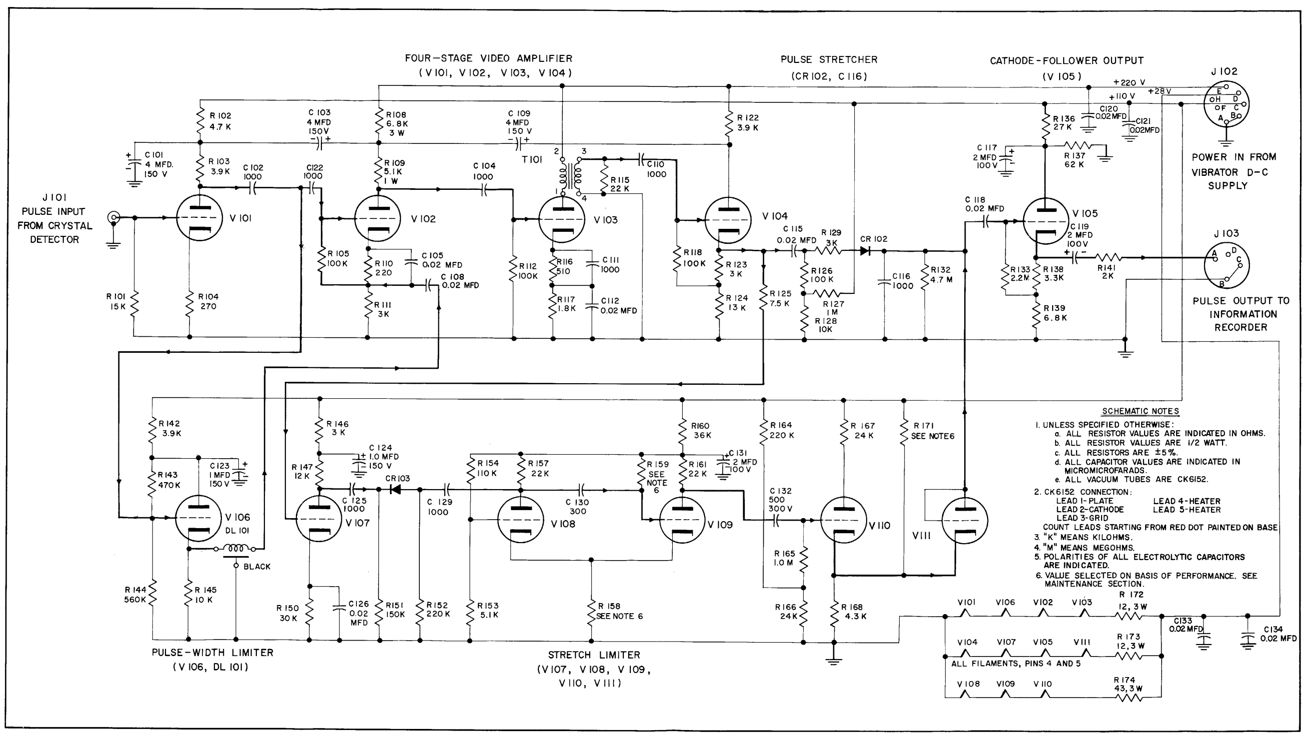

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Figure 1-11. Information Amplifier, Schematic

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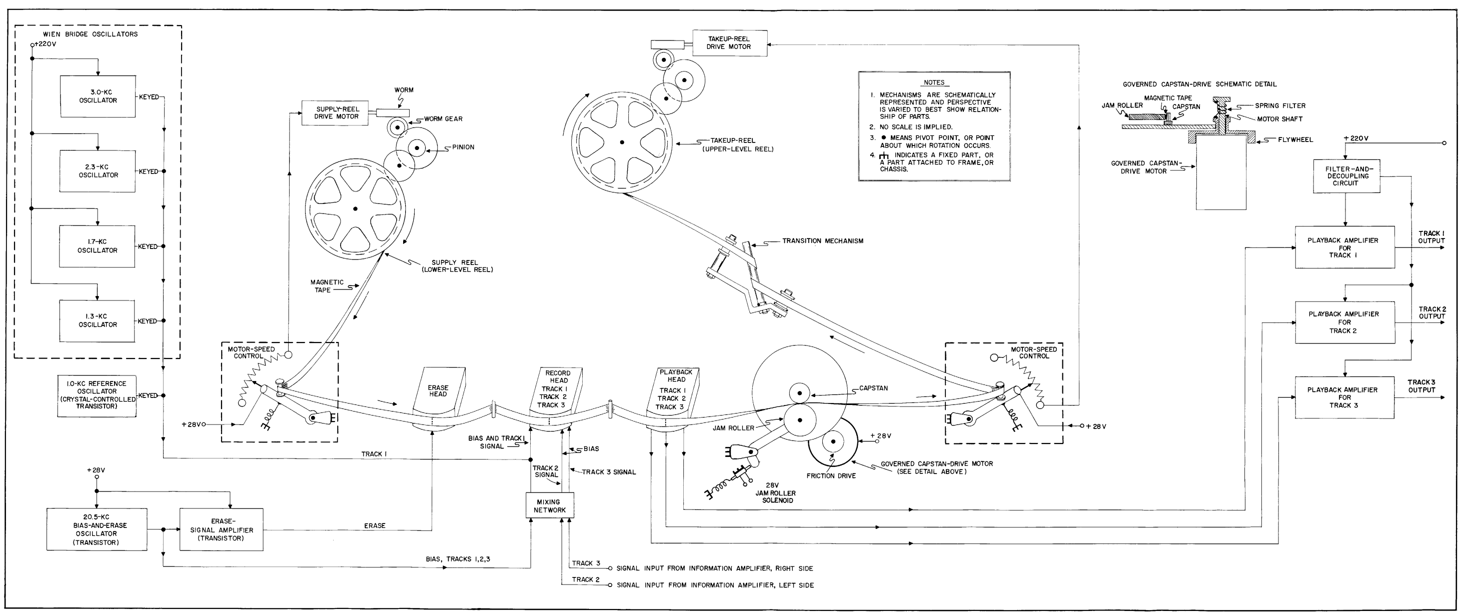

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Figure 1-12. Information Recorder, Electronics and Mechanisms Block Diagram

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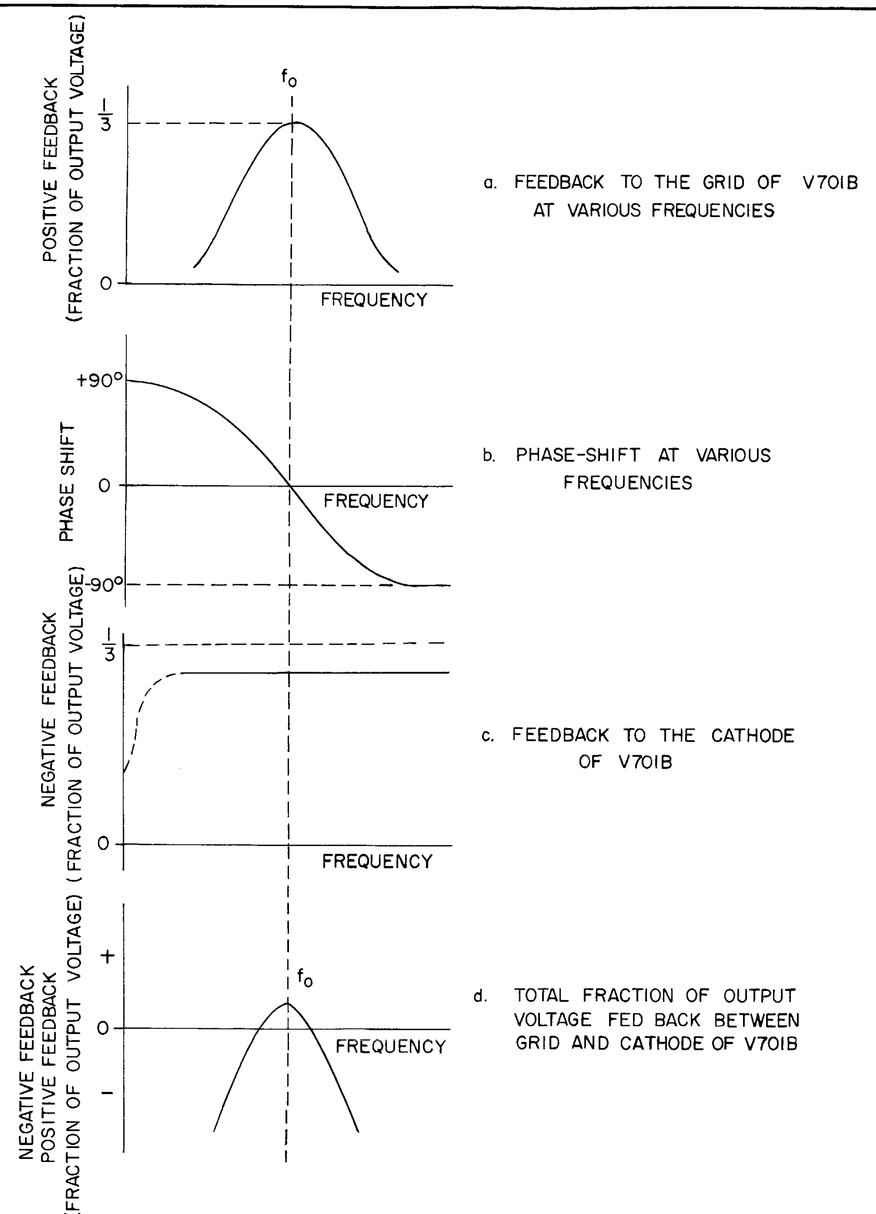

Figure 1-14. Wien Bridge Oscillator, Feedback Relationships

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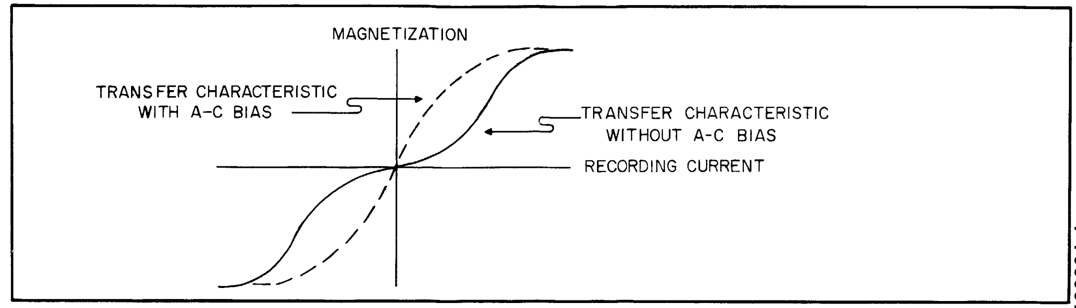

Figure 1-15. Effect of A-C Bias On the Transfer Characteristic of a Magnetic Recording Medium

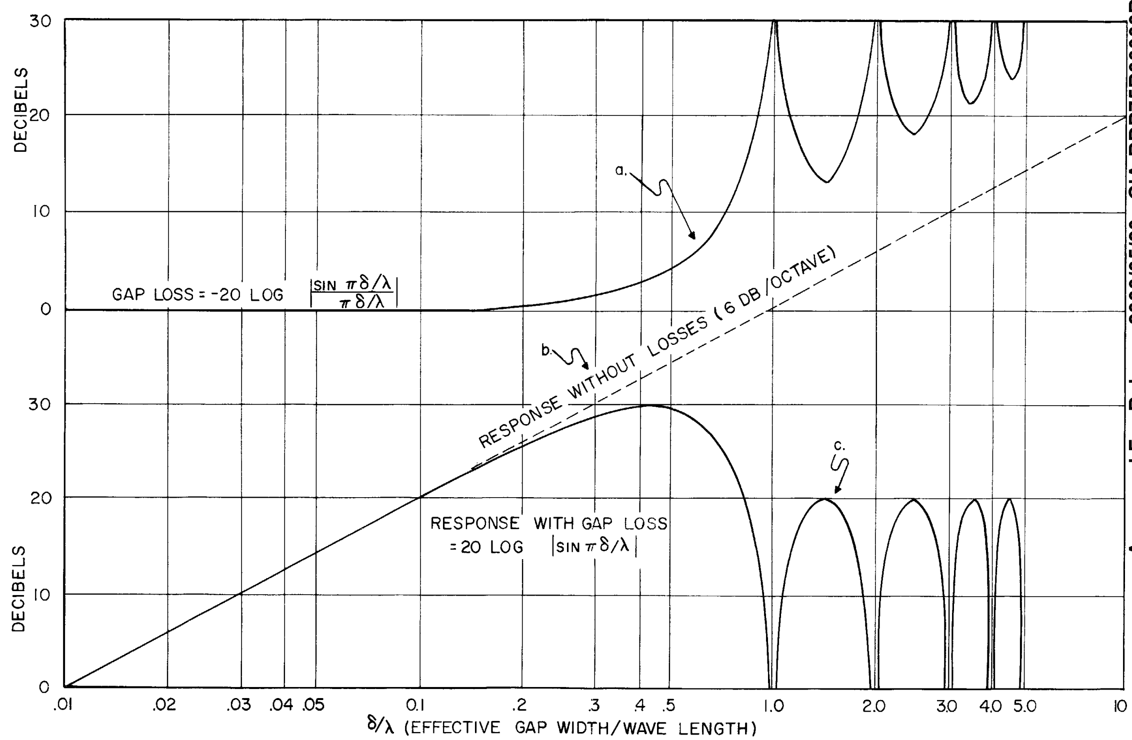

Figure 1-16. Frequency Response of a Playback Head of Gap Width δ

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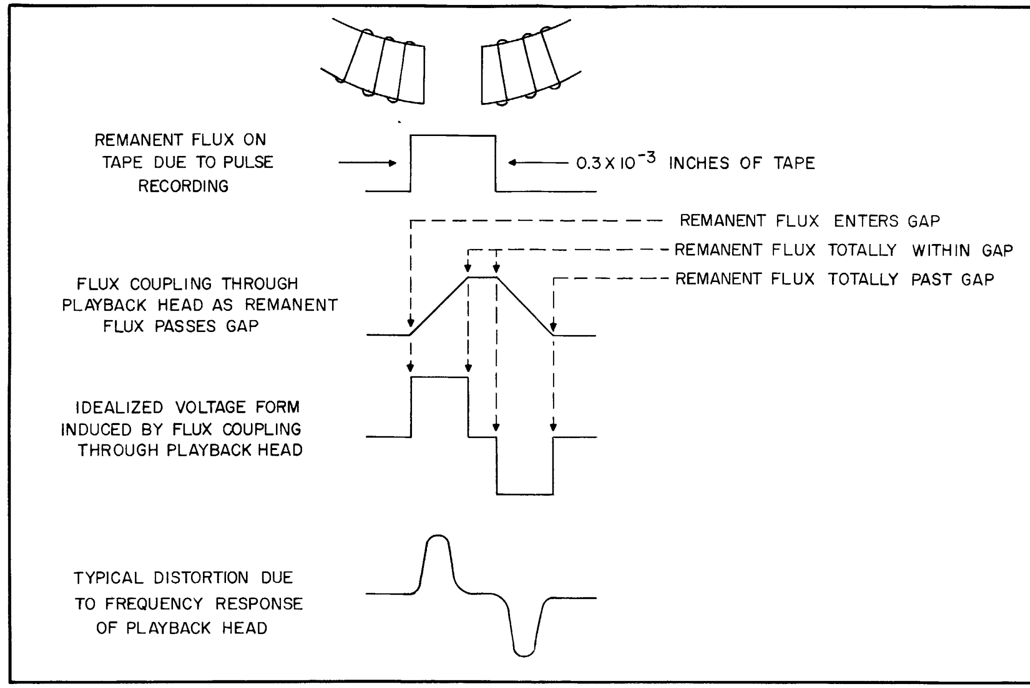

Figure 1-17. Gap Width, Pulse Width and Playback Pulse Related

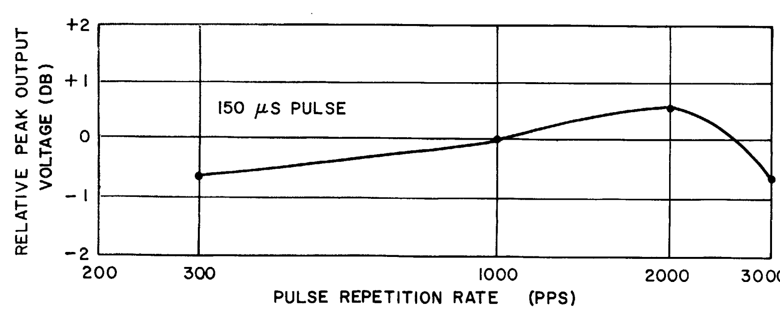

Figure 1-18. A Plot of Playback Voltage Output Versus PRF

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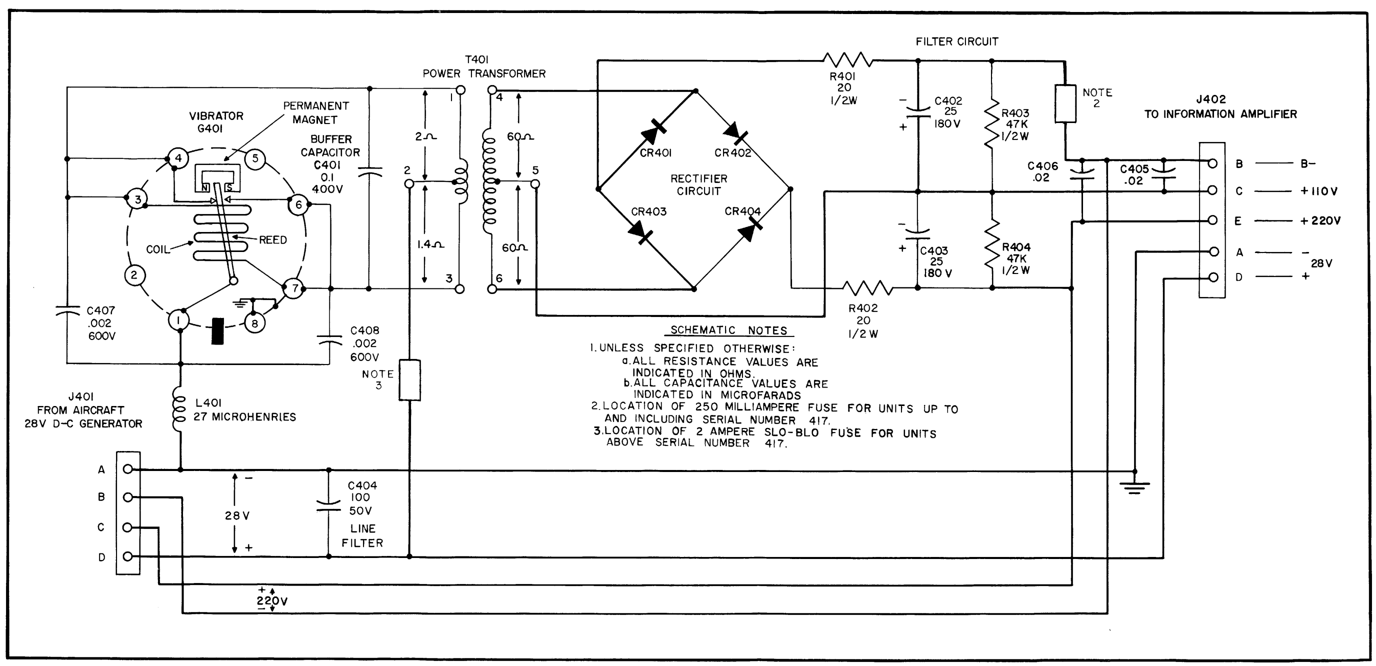

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1 November 56.

Figure 1-19. Vibrator D-C Supply, Schematic

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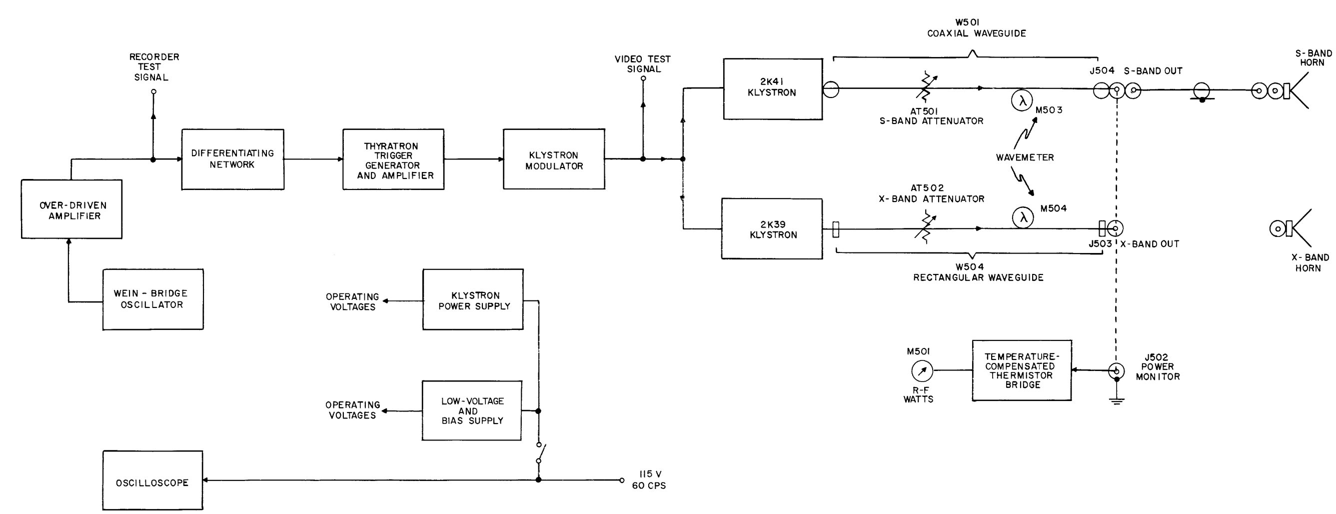

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Figure 1-20. Test Set, Block Diagram

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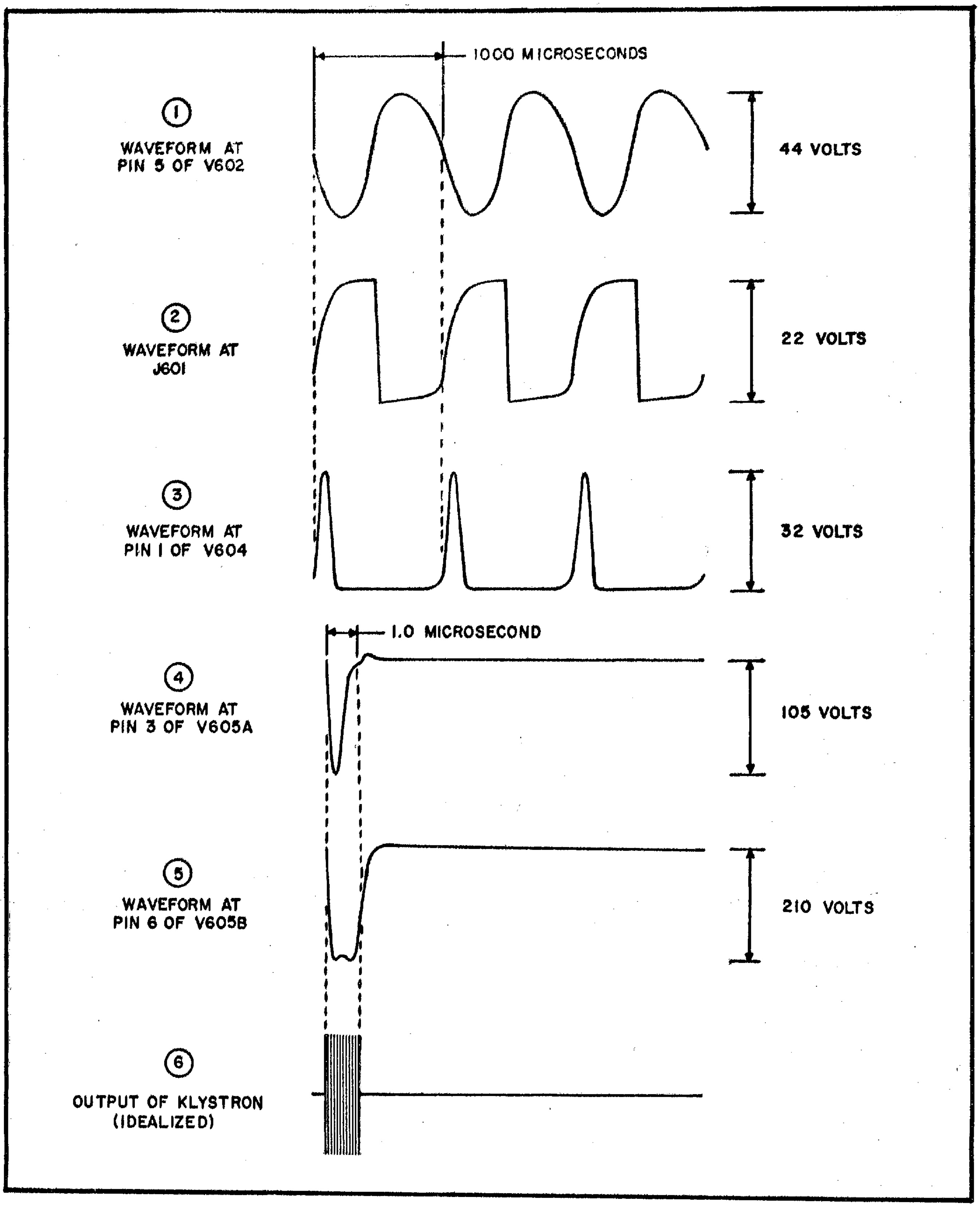
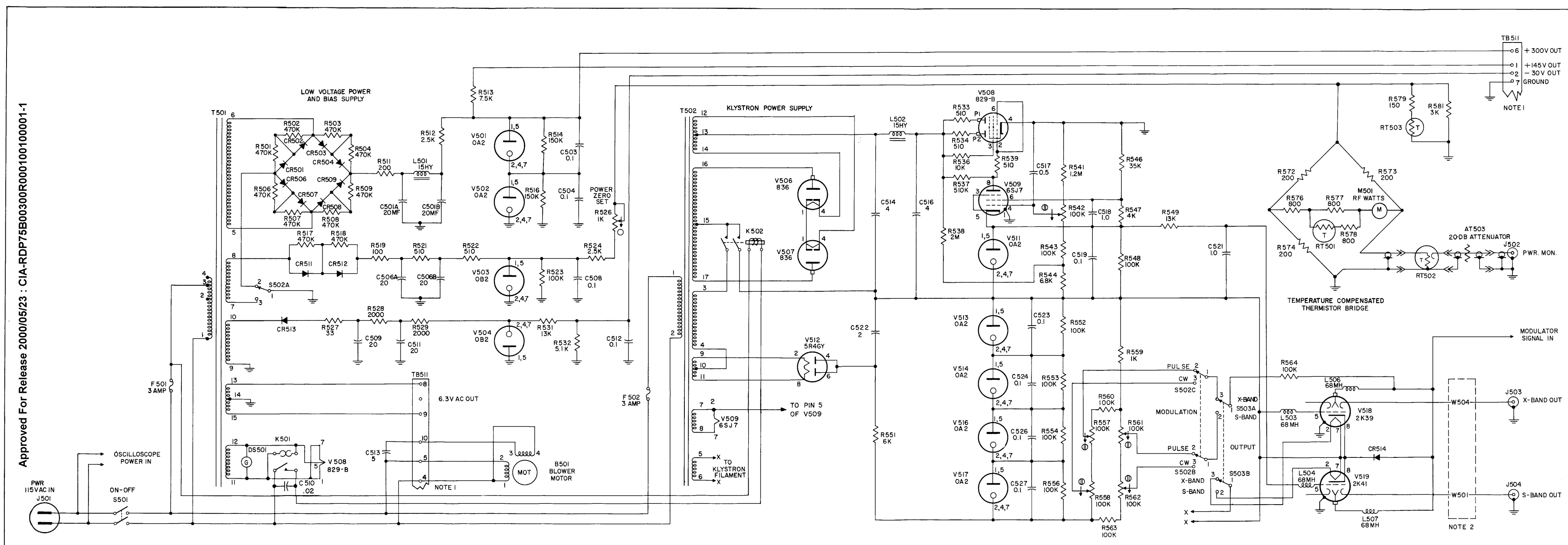


Figure 1-21. Test Set, Time Relationships of Waveforms



SCHEMATIC NOTES

1. CORRESPONDING TERMINALS SHOWN IN FIGURE 1-22B.
2. S-BAND AND X-BAND WAVEGUIDE ASSEMBLIES (W501 AND W504) ARE INDICATED ON BLOCK DIAGRAM FIGURE 1-20.
3. UNLESS SPECIFIED OTHERWISE:
   a. ALL RESISTANCE VALUES ARE INDICATED IN OHMS. "K" MEANS KILOHMS. "M" MEANS MEGOHMS.
   b. ALL CAPACITANCE VALUES ARE IN MICROFARADS. "MMF" MEANS MICROMICROFARADS.
   c. ALL INDUCTANCE VALUES ARE IN MILLIHENRIES. "MH" MEANS MICROHENRIES. "HY" MEANS HENRIES.
4. ○ INDICATES FRONT PANEL CONTROL.
5. ⊕ INDICATES SCREWDRIVER ADJUSTMENT.
6. ↑ INDICATES CLOCKWISE ROTATION OF ADJUSTMENT OR CONTROL SHAFT.

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Figure 1-22A. Test Set, Partial Schematic

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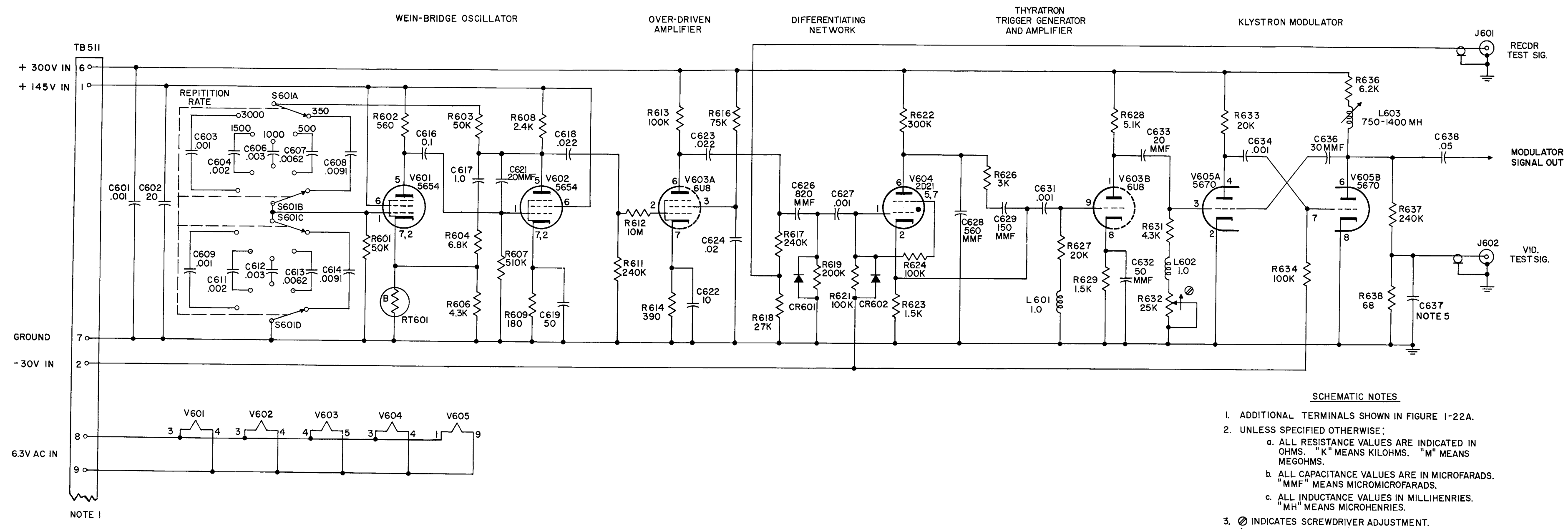

SCHEMATIC NOTES

1. ADDITIONAL TERMINALS SHOWN IN FIGURE 1-22A.
2. UNLESS SPECIFIED OTHERWISE:
   a. ALL RESISTANCE VALUES ARE INDICATED IN OHMS. "K" MEANS KILOHMS. "M" MEANS MEGOHMS.
   b. ALL CAPACITANCE VALUES ARE IN MICROFARADS. "MMF" MEANS MICROMICROFARADS.
   c. ALL INDUCTANCE VALUES IN MILLIHENRIES. "MH" MEANS MICROHENRIES.
3. ⊘ INDICATES SCREWDRIVER ADJUSTMENT.
4. ↑ INDICATES CLOCKWISE ROTATION OF ADJUSTMENT SHAFT
5. VALUE SELECTED TO OBTAIN OPTIMUM WAVEFORM AT J602.

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Figure 1-22B. Test Set, Partial Schematic

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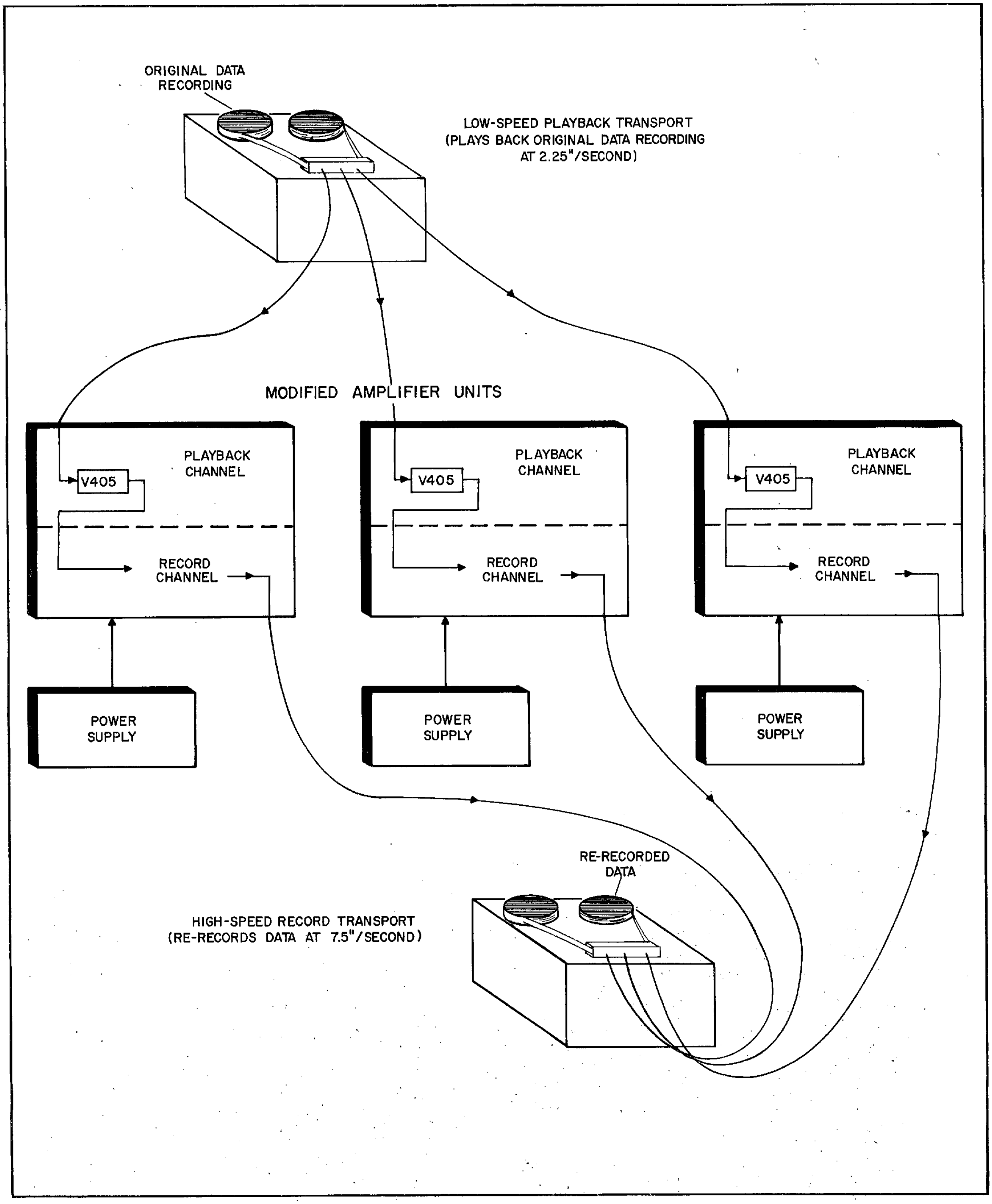

Figure 1-23. Re-Record Equipment, Simplified

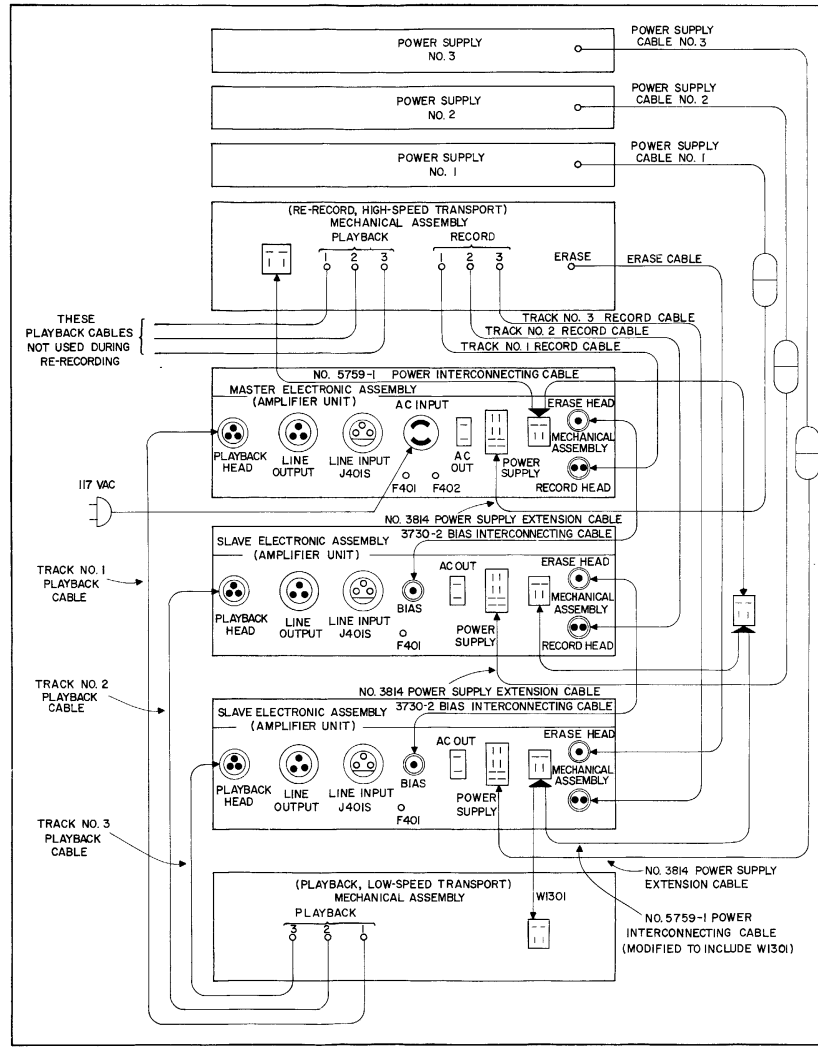

Figure 1-24. Re-Record Equipment, Interunit Cabling Diagram

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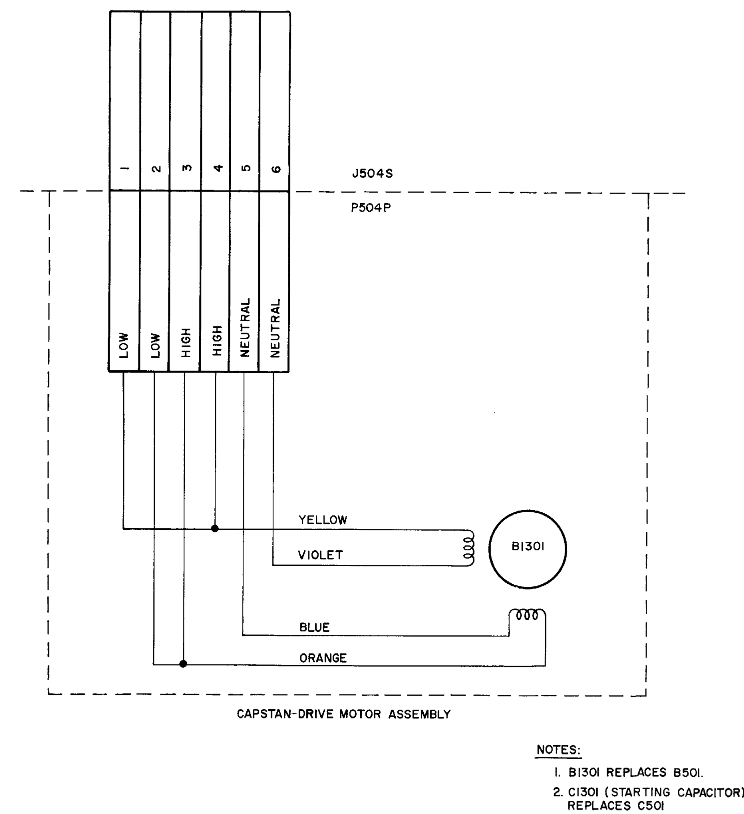

Figure 1-25. Circuit Connections of B1301, Schematic Diagram

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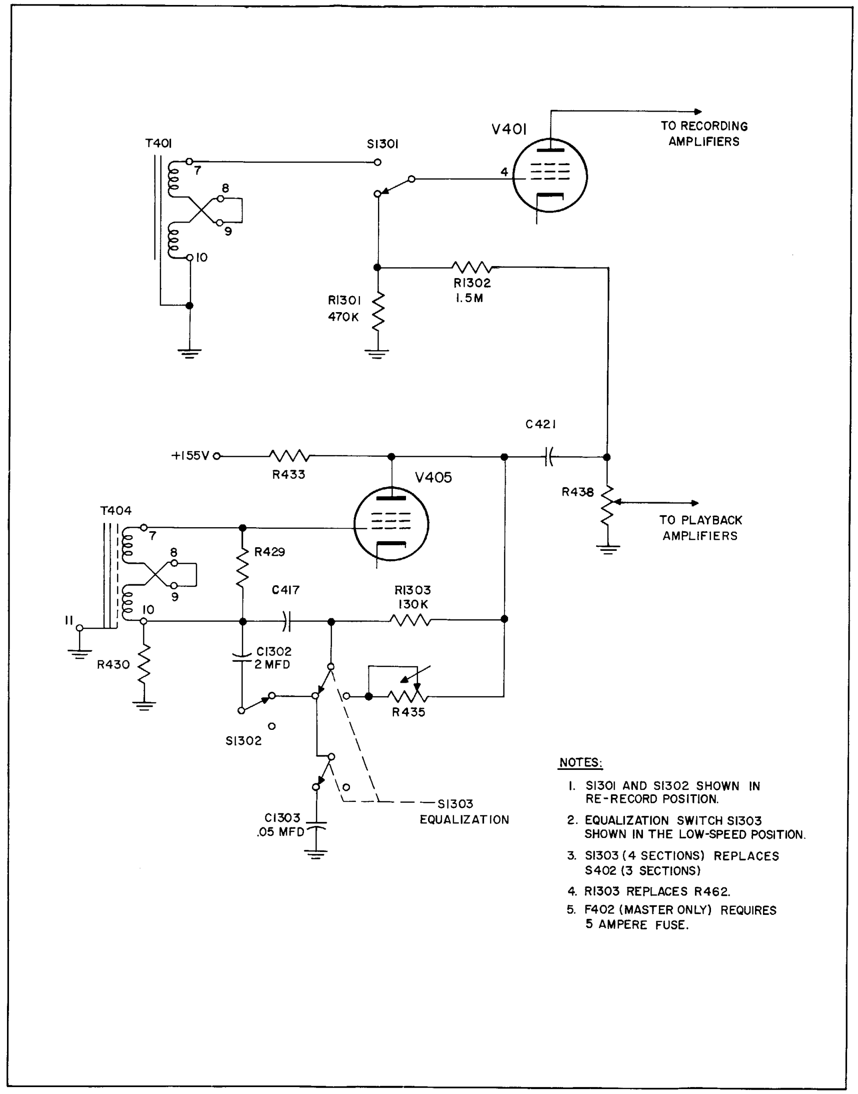

Figure 1-26. Modified Amplifier Unit, Partial Schematic Diagram

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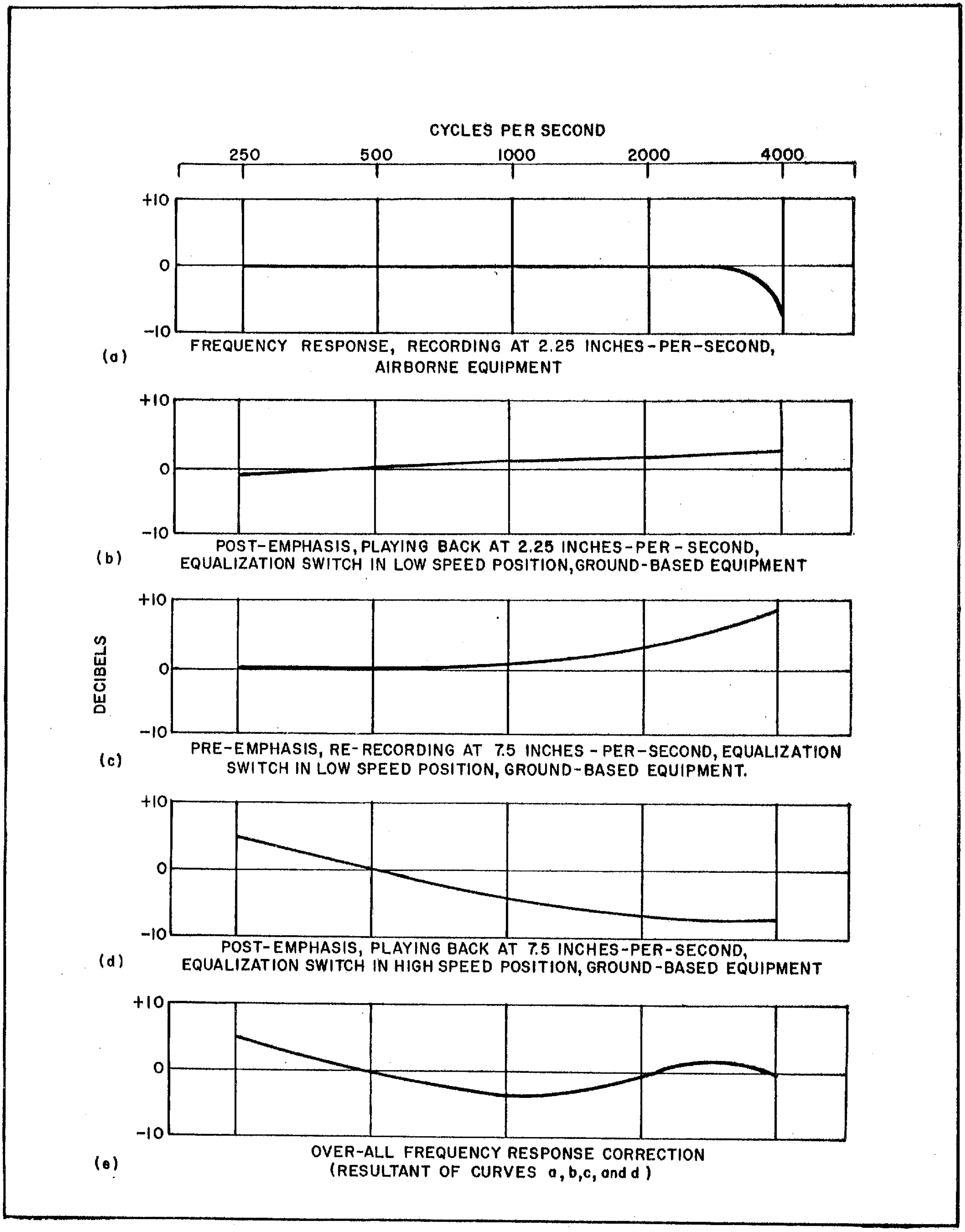

Figure 1-27. The Re-Record and Playback Processes, Amplifier Response Characteristics

AIRBORNE RADAR-MONITORING SYSTEM

SECTION II

OPERATING INSTRUCTIONS AND PREFLIGHT TESTS

2-1. GENERAL. Supporting equipment for the Airborne Radar-Monitoring System includes the ground-based test set and ground-based re-record equipment. This section of the instruction guide contains instructions applicable to the general use of the test set as well as specific instructions for using the test set in testing and calibrating the airborne equipment before flight. Although the in-flight operation of the airborne equipment is beyond the scope of this manual, sufficient detailed information is provided to enable the technician to prepare the equipment for flight. Also, the method of transferring the in-flight data recording to a more usable medium is outlined in the paragraphs covering the re-recording procedures.

2-2. TYPES OF PREFLIGHT TESTS.

2-3. In preparing the equipment for flight, two types of preflight tests are required: (1) "preflight bench procedures" involving the information recorder, and (2) "preflight ramp tests" involving the entire airborne system.

2-4. In the case of the preflight bench procedures, the information recorder is removed from the aircraft, inspected and cleaned, loaded with magnetic tape, and the tape-handling operation is checked.

2-5. After the preflight bench procedures have been performed, the information recorder is reinstalled in the aircraft. The preflight ramp tests are performed shortly before take-off. In performing the ramp tests, the test set is used to test and calibrate the airborne equipment.

2-6. PURPOSE OF PREFLIGHT BENCH PROCEDURES AND RAMP TESTS. When coordinated with flight information, the data recorded by the Airborne Radar-Monitoring System can be put to strategic use. The preflight bench procedures and ramp tests are performed to insure the reliability and accuracy of the in-flight data recording.

2-7. SAMPLE FORM FOR NOTING THE RESULTS OF THE PREFLIGHT BENCH PROCEDURES AND RAMP TESTS. The results of the preflight procedures and tests must be entered on a form similar to the one shown in Table 2-1.

Table 2-1. Sample Form for Preflight Test Data

(1) PREFLIGHT BENCH PROCEDURES.

Information recorder (serial number):__________.

Preflight bench procedures performed (see paragraph 2-11): tape-handling surfaces cleaned____, heads cleaned_______, heads demagnetized_____, recorder loaded with tape number: ______, mechanical operation checked_______, desiccant replaced _______.

Operating time: ______.

(2) PREFLIGHT RAMP TESTS.

Information recorder installed in aircraft number: __________.

______S-band
______X-band antennas (serial numbers):_______ (right) and _________ (left).

Information amplifiers (serial numbers):_______ (right) and _______ (left).

Vibrator D-C supply (serial number): _______________.

(a) SYSTEM TURNED OFF.
(1000 pps signal simulated by test set (see paragraph 2-20). All voltages measured peak-to-peak.)

Output of test set adjusted for (S) 4.6 / (X) 17.7 milliwatts/square-meter at right-side antenna. Antenna sensitivity measured at P101-RIGHT:_____volts (limits: .090 to .175 volts).

Output of test set adjusted for (S) 4.6 / (X) 17.7 milliwatts/square-meter at left-side antenna. Antenna sensitivity measured at P101-LEFT:_____volts (limits: .090 to .175 volts).

Table 2-1. Sample Form for Preflight Test Data (Continued)

(b) SYSTEM TURNED ON.
(1000 pps signal simulated by test set (see paragraph 2-20). All voltages measured peak-to-peak at test points indicated.)

(S) 4.6
(X) 17.7 milliwatts/square-meter applied to right-side antenna. With recording-bias source disabled, R804 adjusted for 12.5 millivolts at TP4. __________ (see paragraph 2-30).

(S) 4.6
(X) 17.7 milliwatts/square-meter applied to left-side antenna. With recording-bias source disabled, R802 adjusted for 12.5 millivolts at TP1. __________ (see paragraph 2-30).

(c) SYSTEM TURNED ON.
(All voltages measured peak-to-peak across 2000 ohm headphones. See paragraph 2-31).

Output of tone channels: 1-kc tone: ________volts.
1.3-kc tone: ________volts.
1.7-kc tone: ________volts.
2.3-kc tone: ________volts.
3-kc tone: ________volts.
(Limits: .140 to .280 volts.)

(S) 4.6
(X) 17.7 milliwatts/square-meter (1000 pps) applied to right-side antenna for one minute as reference signal level. Output of right-side monitor channel: ________volts (limits: .140 to .280 volts). Signal pulse modulated at 350 pps for 1/2 minute as indexing signal. (See paragraph 2-31.)

Signal pulse modulated at 1500 pps for 1/2 minute, and applied to left-side antenna as indexing signal.
(S) 4.6
(X) 17.7 milliwatts/square-meter (1000 pps) applied to left-side antenna for one minute as reference signal level. Output of left-side monitor channel: ________volts (limits: .140 to .280 volts). (See paragraph 2-31.)

System turned off until take off.
Visual inspection of installation ________.

Operating time: ________.

(3) FLIGHT INFORMATION.

Mission number: ____________. Date: ____________.
Take off time: ____________.
Landing time: ____________.

Operating time: ________.

Operator ____________.

Since the test results are very important in interpreting the recording made by the airborne equipment, extreme care must be taken to insure that accurate and legible entries are made on the Preflight Test-Data Form. If voltage measurements fall outside the limits specified in the table, the airborne equipment is unsuited for flight, and requires replacement or repair (see Section III).

2-8. EQUIPMENT NECESSARY FOR PREFLIGHT TESTS.

2-9. The equipment used in performing the series of preflight procedures and tests is listed in Table 2-2.

Table 2-2. Equipment Used in Performing Preflight Procedures and Tests

Quantity	Description of Equipment
1	Airborne Radar-Monitoring System, installed in the aircraft, and including:
(2)	Antenna Assemblies (S-band or X-band, depending upon the band to be monitored).
(2)	Information Amplifiers.
(1)	Information Recorder.
(1)	Vibrator D-C Supply.
(1)	Set of Interconnecting Cables (W1201 through W1205).
1	Set of Accessories, not supplied on this contract, but contained in the aircraft.
1	Ground-Based Test Set, used to simulate intercepted signals.
1	Set of Accessories including:
(1)	S-Band Horn — Only one used, depending upon the system installed in the aircraft under test.
(1)	X-Band Horn
(1)	W510, Horn-feed cable, RG-9/U coaxial, six feet long, fitted with type N connectors.
(1)	Horn-mounting tripod.
(1)	VTVM.
(1)	Headphones.
(1)	W511, extension cable for W1205, multi-conductor, three feet long, fitted with AN connectors.
(1)	W512, information-recorder monitoring cable, multi-conductor, six feet long, fitted with miniature connector and terminal box.
(1)	W513, information-amplifier monitoring cable, multi-conductor, 20 feet long, fitted with miniature connector on one end, other end of cable unterminated.
(1)	W507, primary-power cable, two conductor, four feet long, fitted with a-c connectors.
(1)	6 foot steel measuring tape.

2-10. Power supply sources are required for the equipment listed in Table 2-2. The airborne equipment is powered by means of a 28V-dc power source. The test equipment requires a 115V-ac 60-cycle source of power.

2-11. PERFORMING THE PREFLIGHT BENCH PROCEDURES.

2-12. GENERAL. Paragraph 2-6 describes the purpose of the preflight bench procedures. Paragraphs 2-13 through 2-19 contain step-by-step instructions for completing the preflight bench procedures. It is assumed that the airborne equipment has been installed in the aircraft in accordance with the installation and interunit-cabling instructions of Section IV.

2-13. PREPARING THE INFORMATION RECORDER FOR THE BENCH PROCEDURES. The information recorder must be removed from the aircraft, and must be partially disassembled to gain access to the tape-handling components. Proceed as follows:

a. Disconnect P702 from J702 of the information-recorder unit, and remove the unit from the aircraft.

b. Place the recorder in a horizontal position, with the pins of the jacks pointing downward. Remove the cover from the case by removing the six 6-32 machine screws.

c. Push each of the four reel guides away from the reel rim, and depress the friction pin to hold the guide in place.

d. Disengage the upper and lower driving gears from the tape reels by pushing the driving gears away from the rim of the tape reels. The driving-gear assemblies will lock in an alternate position, away from the rim of the tape reels, as shown in figure 2-1.

e. Lift off the reel-retaining cap.

f. The tape reels may now be removed from the information recorder by lifting them off the reel-support shaft.

g. Lift off the upper reel.

h. Lift off the flanged bushing.

i. Lift off the lower reel.

j. To avoid mislaying the flanged bushing and reel-retaining cap, place them on the reel-support shaft.

The tape-handling components will now be accessible, and the routine maintenance procedures can be performed. Note the serial number of the information recorder in the space provided on the Preflight Test-Data Form.

2-14. PERFORMING ROUTINE MAINTENANCE. Perform a general inspection of the information recorder to detect signs of rust, corrosion, or wear. Cover vulnerable surfaces with a thin coating of instrument oil (MP 10156). Use a soft brush or a blower to remove dust from the interior of the unit. Use a lintless cloth (MP10219), moistened with alcohol (MP 10228), to clean all of the surfaces over which the magnetic tape passes (see figure 2-1). Cleaning the tape-handling surfaces is accomplished by proceeding as follows:

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1 November 56.

a. Clean the five teflon tape guides.

b. Clean the jam roller and capstan.

CAUTION

Do not use carbon tetrachloride or acetone for cleaning the erase, record, or playback heads. These cleaning agents tend to dissolve the plastic parts of the heads.

c. Open the head cover by pulling the plunger up, turning the control level counterclockwise, and releasing the plunger. The head cover will thus be locked open.

d. Use a lintless cloth, moistened with alcohol, to clean the heads and tape-guide pins. Avoid undue pressure on the heads, and avoid scratching the head surfaces. For proper operation, the tape surfaces must come into intimate contact with the heads. Therefore, all red-oxide deposits must be removed by the cleaning operation.

e. Energize the head demagnetizer (MP10143), and demagnetize the erase, record, and playback heads. With the gap of the head demagnetizer aligned with the gap of the head to be demagnetized, place the demagnetizer near the head, but do not let the demagnetizer come into contact with the head. To demagnetize the head, draw the energized head demagnetizer slowly away from the head.

f. Complete the appropriate blanks of the Preflight Test-Data Form.

2-15. LOADING THE INFORMATION RECORDER WITH MAGNETIC TAPE. Since it is important to be able to identify the supply and take-up reels of the information recorder, it will be necessary to mark the reels "SUPPLY" and "TAKE-UP", respectively. A red crayon or grease pencil is suitable for marking the reels. Next, it will be necessary to use the re-record tape-transport mechanism to wind tape onto the SUPPLY reel. To wind tape onto the SUPPLY reel proceed as follows:

a. Place the SUPPLY reel, gear-side down, on the right-hand spindle of the re-record tape transport.

b. Place a reel of magnetic tape (MP 10145) on the left-hand spindle of the re-record equipment.

c. The tape is to be wound onto the SUPPLY reel with the smooth side of the tape toward the outside of the reel. It is important to use the tape guides of the re-record equipment to obtain uniform winding. See the accessory manual for the procedure to be used in operating the ground-based re-record equipment. Note that the re-record equipment is used simply as a tape-handling device in this operation, and nothing is to be recorded on the tape.

d. The amount of tape to be wound onto the reel is determined by the recording-time requirements of the particular mission. The time scale on the airborne reel can be used to estimate the amount of tape required for a specific recording period.

CAUTION

The magnetic tape used with the airborne equipment is fragile, and every precaution should be taken to prevent breakage. However, if the tape becomes broken, mend it with special splicing tape. After completing the splice, be sure that no adhesive material is exposed. Use the special splicing tape ONLY; do NOT use ordinary cellophane tape for splicing.

e. After winding the required amount of tape onto the SUPPLY reel, install the reel on the reel-support shaft of the information recorder, positioning the reel with the gear surface downward.

f. Thread the tape through the machine as shown in figure 2-1, leaving about 10 inches of free tape after passing the transition guide.

g. Place the flanged bushing on the reel-support shaft, and place the TAKE-UP reel over the bushing, positioning the reel with the gear surface upward.

h. Insert the free end of the tape into the slot in the hub of the reel, and turn the reel by hand until there is no slack in the tape loop.

i. Place the reel-retaining cap on top of the TAKE-UP reel.

j. Inspect the threading of the tape to be sure that it is threaded as shown in figure 2-1. The smooth side of the tape must be on the outside of the reels, and must be oriented away from the heads. If threaded correctly, there will be no twists in the tape, and it will be centered in the guide pins and guide rollers.

k. Gently engage the lower driving gear by pressing point A (figure 2-1) while holding the driving gear away from the driven reel gear.

l. Position loop arm No. 1 midway between the two stops, and slowly turn the TAKE-UP reel until there is no slack left in the tape.

m. Pull the plunger upward, turn the control lever clockwise, and release the plunger. The head cover will now be locked closed.

n. Position loop arm No. 2 midway between the two stops, and slowly turn the TAKE-UP reel until there is no slack left in the tape.

o. Engage the upper driving gear by pressing Point C.

p. Push each of the four reel guides away from the reel (to release the spring-loaded friction pin), and allow the reel guide to return to the engaged position.

q. Complete the appropriate blanks of the Preflight Test-Data Form.

2-16. CHECKING THE OPERATION OF THE INFORMATION RECORDER.

2-17. After the information recorder has been prepared for flight and loaded with tape, the preflight bench procedures are completed by checking the mechanical operation of the unit. Ground the frame of the information recorder, and apply 28-volts dc to terminals A (positive) and B (negative) of J702.

2-18. With the information recorder operating, check the following tape-handling and tape-alignment characteristics:

a. The tape must pass between the flanges of the teflon guide rollers without bending.

b. The tape must pass between the flanges of the reels without touching the flanges.

c. The tape must pass between the guide pins of the head assembly without bending.

d. With the head cover open, observe the tape contacting surfaces of the erase, record and playback heads. The surfaces must be completely hidden by the tape.

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e. The tape must pass between the jam roller and tape capstan without tending to "ride up" or "ride down" from its normal position.

f. After some initial oscillation, the loop arms must come to rest between the stops. A slight oscillation will be observed, but no large tape loops will appear if the equipment is operating normally.

g. Start and stop the information recorder several times by removing and restoring the 28-volt supply. The jam roller must engage or disengage each time the 28-volt supply is restored or removed. If the equipment is operating normally, no large tape loops will form. Repeat the stop-start cycle several times, and perform the operational checks listed in the previous sub-paragraphs.

h. Mount the information recorder in a vertical position, and repeat the above checks.

i. Remove the 28-volt d-c supply from the equipment.

j. Replace the information-recorder cover.

k. Complete the appropriate blanks of the Preflight Test-Data Form.

2-19. RENEWING THE DESICCANT. Reactivate or replace the desiccant by proceeding as follows:

a. Place the recorder in a horizontal position with the pins of the jacks pointing downward.

b. Remove the cover from the case by removing six 6-32 machine screws.

c. Invert the information-recorder cover to gain access to the desiccant container.

d. Remove the cover from the desiccant container by removing the two hexagonal nuts.

e. Reactivate or replace the desiccant (MP 10212).

f. Reassemble the desiccant container, and re-install the cover on the information recorder.

g. Complete the appropriate blanks of the Preflight Test-Data Form.

2-20. PERFORMING THE PREFLIGHT RAMP TESTS.

2-21. GENERAL.

2-22. Paragraph 2-6 describes the purpose of the preflight ramp tests. Paragraphs 2-25 through 2-36 contain step-by-step instructions for performing the tests. These paragraphs assume that the preflight bench procedures have been accomplished and the information recorder is ready to be re-installed in the aircraft. Furthermore, it is assumed that the remainder of the airborne equipment has been installed in the aircraft in accordance with the installation and interunit-cabling instructions of Section IV.

2-23. Before re-installing the information recorder, and before interconnecting the airborne system with the test set and test-set accessories for the preflight ramp tests, the technician must become thoroughly familiar with the test set. The theory of operation is described in paragraphs 1-143 through 1-193. Paragraphs 2-52 through 2-63 describe the test-set operating procedures for maintenance tests, as well as for preflight tests.

2-24. OBJECTIVES OF THE PREFLIGHT RAMP TESTS. The steps outlined in paragraphs 2-25 through 2-36 are directed toward the following objectives:

a. The test set is used to establish known signal levels at the antennas of the Airborne Radar-Monitoring System. The signal levels (in microwatts/square-meter) are established by adjusting the power output of the test set for standard power levels.

b. The sensitivity of the antenna assemblies is determined by measuring the antenna-output voltage with known signal levels applied to the antennas. The sensitivity is noted on the Preflight Test-Data Form.

c. With the known signal levels applied to the antennas, the recording currents of the two channels are made equal.

d. Tones are recorded on the three tracks, and the recording is monitored, thus providing an over-all system check.

e. Finally, the sensitivity of the Airborne Radar-Monitoring System is calibrated by recording known signal levels. To provide orientation reference, signals of different repetition rates are recorded by the right-side and left-side tape tracks. The pulse repetition frequencies of these "indexing" signals are noted on the Preflight Test-Data Form. Recording the calibrating and indexing signals completes the preflight testing and calibration of the system.

2-25. SETTING UP THE EQUIPMENT.

2-26. The power switch supplying the airborne equipment must be pre-set to the OFF position. Place the information recorder in the aircraft, but do not connect the interunit cables until some of the preflight tests have been performed.

2-27. Assemble the test set and accessory equipment near the aircraft. Set up the equipment by proceeding as follows:

a. Locate the test set beneath the aircraft. To facilitate measurements, the test set should be so oriented that the face of the cathode-ray tube is shielded from ambient light. The test set must not be located in strong magnetic fields, or false measurements will be obtained.

b. Locate the horn-mounting tripod near the window containing the right-side antenna assembly.

c. Mount the S-band (or X-band) horn on the tripod.

d. Adjust the tripod height and position until the axes of the horn and reflector are aligned.

e. Adjust the distance between the horn and receiving antenna to five feet for the S band or X band. The distance is measured from the driven element in the horn to the driven element of the dish.

f. Orient the horn so that it radiates waves which are polarized in the same plane as the receiving antenna.

Note

The right-hand and left-hand sides of the aircraft are defined when facing the nose of the aircraft from the pilot's position.

2-28. ESTABLISHING KNOWN SIGNAL LEVELS AT THE ANTENNA. After the equipment has been set up in the manner described, apply power to the test set and proceed as follows:

a. Connect W510 between the S-BAND OUT (or X-BAND OUT) jack and the PWR. MON. jack.

b. Adjust the S-band power (as measured at the end of W510) to 16 milliwatts. For an antenna-to-horn spacing of five feet, this represents a power of 4.6 milliwatts-per-square-meter at the antenna. (Adjust the X-band power to 60 milliwatts. For an antenna-to-horn spacing of five feet, this represents a power of 17.7 milliwatts-per-square-meter.)

c. Pulse modulate the r-f output signal at 1000 pps.

d. Disconnect W510 from the PWR MON jack, and connect the cable to the S-band (or X-band) horn.

Note

The accuracy of the power level applied to the airborne antennas depends upon accurate positioning and orientation of the test horn, as well as upon accurate power measurements.

2-29. TESTING THE SENSITIVITY OF THE ANTENNA ASSEMBLIES. With the known signal level applied to the horn, test the sensitivity of the antennas by proceeding as follows:

a. Disconnect P101 from J101 of the right-side information amplifier.

b. Use the test-set oscilloscope to measure the peak-to-peak voltage appearing at P101. If the sensitivity of the antenna assembly is normal, the voltage will be .125 volts, peak-to-peak, plus or minus three db (.090 to .175 volts). If the voltage is outside the specified range, the antenna crystal should be replaced, and the test repeated.

c. Perform the test on the left-side antenna assembly.

d. Record the data in (2a) of the Preflight Test-Data Form.

2-30. EQUALIZING THE SENSITIVITY OF THE RIGHT-SIDE AND LEFT-SIDE INFORMATION CHANNELS. After establishing a known signal level at the right-side antenna, P101 is reconnected to J101, and the recording current for track number three is adjusted. The current is measured and the adjustment is made with the recording-bias source disabled. The recording current for the left-side channel (track number two) is adjusted in a similar manner. To perform these tests and adjustments, proceed as follows:

a. Place the information recorder in a horizontal position with the pins of the jacks pointing upward. Remove the information recorder cover to gain access to TP1, TP4, R802, R804, and L703.

b. Disable the bias voltage by connecting a short clip lead across L703.

c. Connect W511 between W1205 and the information recorder.

d. Apply power to the Airborne Radar-Monitoring System, and wait approximately two minutes before proceeding.

e. Apply a signal level of 4.6 milliwatts/square-meter to the right-side S-band antenna (17.7 milliwatts/square-meter for the X-band).

WARNING

Voltages employed in this equipment are dangerous. Proceed with caution when operating the equipment with the cover plates removed.

f. Use the oscilloscope to measure the peak-to-peak level of the track-three recording current. To accomplish this, measure the voltage between TP4 and ground; the voltage at TP4 is the IR drop across a 100-ohm resistor.

g. Adjust R804 for a peak-to-peak voltage reading of 12.5 millivolts. This voltage represents a recording current of 0.125 milliamperes.

h. Repeat the above procedure for the left-side information channel. In the case of the left-side channel, the peak-to-peak level of the track-two recording current is measured at TP1. The current is adjusted by means of R802.

i. After the gain of the two channels has been equalized, complete sub-paragraph (2b) of the Preflight Test-Data Form, turn the Airborne Radar-Monitoring System off, remove the clip lead, and replace the cover of the information recorder.

2-31. TESTING THE INFORMATION RECORDER.

2-32. To test the three tracks of the information recorder, proceed as follows:

a. Connect the information-recorder monitoring cable (W512) to J701.

b. Connect the headphones to the junction box of W512.

c. Connect the oscilloscope to the terminals of the W512 junction box.

d. The information recorded by the right-side, left-side, and tone channels may now be monitored by turning the junction-box switch to the appropriate position. The peak-to-peak output voltage may be measured on the oscilloscope.

2-33. Test recorder-track number one by proceeding as follows:

a. Apply power to the airborne equipment.

b. Turn the tone oscillators ("event markers") off by means of the auxiliary control system contained in the aircraft.

c. Turn the markers on individually, monitoring the tones in the headphones.

d. Use the oscilloscope to measure the level of the 1-kc, 1.3-kc, 1.7-kc, 2.3-kc, and 3-kc signals. If the equipment is operating satisfactorily, the peak-to-peak voltage will be .2 volts, plus or minus 3 db (.140 to .280 volts).

e. Enter the voltage readings in the blanks provided in subparagraph (2c) of the Preflight Test-Data Form.

2-34. With power applied to the airborne equipment, record a standard signal level on the tape, test record-track number three, and record an indexing signal on the tape by proceeding as follows:

a. Adjust the test set to provide a signal level of 4.6 milliwatts/square-meter at the right-side S-band antenna. (17.7 milliwatts/square-meter for the X-band.)

b. Pulse modulate the signal at a frequency of 1000 pps.

c. Thus, the sensitivity of the right-side channel of the airborne system is established by a known signal on the tape. Apply the signal for one minute.

d. Simultaneously, monitor the right-side information channel with the headphones and oscilloscope.

e. Enter the monitor-voltage level in the appropriate space on the Preflight Test-Data Form.

f. Pulse modulate the input signal at a frequency of 350 pps. This is an indexing signal which identifies the right-side information channel. Apply the signal for 30 seconds.

2-35. Set up the test-horn radiator and tripod assembly on the left-hand side of the aircraft. With power applied to the airborne equipment, record an indexing signal on the tape, record a standard signal level on the tape, and test record-track number two by proceeding as follows:

a. Adjust the test set to provide a signal level of 4.6 milliwatts/square-meter at the left-side S-band antenna. (17.7 milliwatts/square-meter for the X-band.)

b. Pulse modulate the signal at a frequency of 1500 pps. This is an indexing signal which identifies the left-side information channel. Apply the signal for 30 seconds.

c. Pulse modulate the signal at a frequency of 1000 pps.

d. Thus the sensitivity of the left-side channel of the airborne system is established by a known signal on the tape. Apply the signal for one minute.

e. Simultaneously, monitor the left-side information channel with the headphones and oscilloscope.

f. Enter the monitor-voltage level in the appropriate space on the Preflight Test-Data Form.

2-36. PREPARING THE AIRBORNE EQUIPMENT FOR FLIGHT. After completing the above tests, turn off the power to the airborne equipment, and remove the test equipment and accessories from the vicinity of the aircraft. Install the information recorder in its mounting rack and connect P702 to J702. Perform a thorough visual check of the airborne installation. Be sure that all equipment covers are installed, and that all mounting bolts are firmly in place. Check the mechanical condition of the equipment and interconnecting cables. Check the mechanical mating of all connectors to be sure that they will not become disconnected due to vibration in flight.

2-37. RE-RECORDING PROCEDURE.

2-38. EQUIPMENT REQUIRED FOR RE-RECORDING. The equipment required for re-recording monitored signals at 7.5 inches-per-second is listed in Table 2-3. A 60-cycle a-c power source of 115 volts is required to operate the re-record equipment.

Table 2-3. Units Comprising The Ground-Based Re-Record System

Equipment Designation Used In This Instruction Guide	Equipment Designation Used On Equipment Nameplate	Equipment Designation Used In Equipment Manual	Number of Units
Power Supplies	Magnetic Tape Recorder Model 350-3P	Power Supply 3741	3
Modified Master-Amplifier Unit	Magnetic Tape Recorder Model 350-3P	(Modified) Master Electronic Assembly 5701R3-1	1
Modified Slave-Amplifier Units		(Modified) Slave Electronic Assembly 5701R3-3	2
High-Speed Record Transport	Magnetic Tape Recorder Model 350-3R Serial Numbers: 55E185 55F145 55F185 55F146	Mechanical Assembly 5700	1
Low-Speed Playback Transport	Magnetic Tape Recorder Model 350-3R Serial Numbers: 55E184 55F139 55F141 55F140	(Modified) Mechanical Assembly 5700	1
Set of Interconnecting Cables:			1
a. Three Power-Supply Extension Cables		3814	
b. Two Bias-Interconnecting Cables		3730-2	
c. One Erase Cable (Part of Record Transport)			
d. One Power-Interconnecting Cable		5759-1	
e. One Power-Interconnecting Cable (5759-1 modified to include W1301)			
f. One Primary-Power Cable			

2-39. SETTING UP THE RE-RECORD EQUIPMENT.

2-40. Set up the re-recording equipment in a convenient working area, observing the following:

a. Place the portable case containing the power-supply units below the work table or bench.

b. Place the rack containing the amplifier units on top of the work table. Orient the rack and cases so that the controls are readily accessible from the operating position.

c. Place the portable cases containing the tape-transport mechanisms on top of the work table.

2-41. Preset the amplifier-unit controls as follows:

a. POWER: OFF.

b. RECORD LEVEL: 0.

c. METER AND OUTPUT SWITCH: RECORD LEVEL.

d. The setting of the PLAYBACK LEVEL controls is unimportant.

2-42. Preset the low-speed tape-transport (playback) controls as follows:

a. REEL SIZE: SMALL.

b. TAPE SPEED: LOW.

2-43. Preset the high-speed tape-transport (re-record) controls as follows:

a. REEL SIZE: LARGE.

b. TAPE SPEED: HIGH.

2-44. Interconnect the units as shown in figure 1-24, and connect the primary power cable to the a-c mains. The playback cables from the high-speed (record) tape-transport mechanism are not used.

Note

Be careful to interconnect the record and playback cables in the correct order, so that the data from track No. 1 is transferred to track No. 1 of the new recording.

2-45. REMOVING THE MAGNETIC-RECORDING TAPE FROM THE INFORMATION RECORDER. Remove the magnetic-recording tape from the information recorder by proceeding as follows:

a. Disconnect P702 from J702 of the information recorder, and remove the recorder from the aircraft.

b. Place the recorder in a horizontal position, with the pins of the jacks pointing downward.

c. Remove the cover from the case by removing the six 6-32 machine screws.

d. Push each of the four reel guides away from the reel rim, and depress the friction pin to hold the guide in place.

e. Disengage the upper and lower driving gears from the tape reels by pushing the driving gears away from the rim of the tape reels.

f. Open the head cover by pulling the plunger up, turning the head-cover control lever counterclockwise, and releasing the plunger.

g. Rotate the upper reel counterclockwise to provide sufficient slack for removing the tape from the tape guides, loop arms, etc.

h. Remove the reel-retaining cap.

i. Remove the tape reels, being careful not to break the tape. To avoid misplacing the flanged bushing and reel-retaining cap, place them on the reel-support shaft.

Note

When handling magnetic tape, keep the reels away from strong magnetic fields, and do not expose the reels to high temperatures. Strong magnetic fields may contaminate recorded data. High temperatures may cause the tape to be distorted physically, thereby distorting recorded data.

2-46. RE-RECORDING THE DATA.

2-47. Before beginning the re-recording process, it is necessary to rewind the original data recording. Proceed as follows:

a. Place the tape reel marked TAKE-UP on the right-hand spindle of the low-speed (playback) tape transport.

b. Place the tape reel marked SUPPLY on the left-hand spindle.

c. Thread the tape through the guides on the playback tape transport as described in Section III of the accessory manual.

d. Rewind the data recording onto the SUPPLY reel.

2-48. Place a full reel of magnetic recording tape (MP 10146) on the left-hand spindle of the high-speed (record) tape-transport mechanism. Place an empty reel on the right-hand spindle. Thread the tape in the manner described in the accessory manual.

2-49. Adjust the RECORD LEVEL controls by proceeding as follows:

a. Turn the POWER switches ON. Allow five minutes of warm-up time before proceeding with the re-recording operation.

b. Press the PLAY button on the high-speed tape-transport mechanism.

c. Wait one second, and press any one of the RECORD buttons on the amplifier units.

d. Press the PLAY button on the low-speed tape-transport mechanism.

e. Monitor the tone channel (track one). With the event-marking tones (1-kc, 1.3-kc, 1.7-kc, 2.3-kc, or 3-kc) being played back, adjust the track-one RECORD LEVEL control for a reading of -12 on the volume indicator.

f. Monitor the right-side information channel (track three). When the 1000-cps calibrating signal is heard, adjust the track-three RECORD LEVEL control for a reading of -20 on the volume indicator. The right-side calibrating signal will be followed by a 350-cps indexing signal.

g. Monitor the left-side information channel (track two). A 1500-cps indexing signal will be heard. Following this, a 1000-cps calibrating signal will be heard. When the 1000-cps signal is heard, adjust the track-two RECORD LEVEL control for a reading of -20 on the volume indicator.

h. After adjusting the RECORD LEVEL controls for the appropriate channels, stop the tape-transport mechanisms by pressing the STOP buttons.

i. Re-wind the tapes using the procedure described in the accessory manual.

2-50. Begin the re-recording process by following the procedures of the preceeding paragraph, steps b through d.

Note

After the RECORD LEVEL controls have been adjusted for the correct recording level, and after the re-recording process has been started, do not touch the equipment controls until the re-recording process is complete. Adjusting the RECORD LEVEL controls will disturb the relationships between the calibrate-signal level and monitored-signal levels. Independently stopping or starting either of the machines will invalidate the data by causing discontinuities in the time relationships of the event-marking signals.

If data representing over one-and-one-half hours of monitoring time is to be re-recorded, it will be necessary to interrupt the recording process for the purpose of changing tape reels. Be sure to stop both the playback and re-record machines simultaneously. Use the procedures of the preceding paragraphs when re-starting the machines, but do not reset the RECORD LEVEL controls.

2-51. When re-recording is complete, stop the machines by pressing the STOP buttons. Re-wind the tapes, turn the equipment OFF, and remove the tapes from the machines. Mark the date, aircraft number, mission number, and tape number on the reels of tape containing the re-recorded data. Store the re-recorded data with the corresponding Preflight Test-Data Form.

2-52. <u>OPERATING THE TEST SET.</u>

2-53. GENERAL. The operating instructions contained in these paragraphs must be followed closely. If the results specified are not obtained, the test set may be defective. Correct any equipment faults before using the test set for preflight or maintenance checks.

2-54. FUNCTIONS OF TEST-SET JACKS. Table 2-4 lists the jacks mounted on the front panel of the equipment, and describes their output or monitoring function. The functions of jacks mounted on the front panel of the oscilloscope are described in the instruction manual supplied with the oscilloscope.

Table 2-4. Functions of Test-Set Jacks

Panel Designation	Function
Output Jacks:	
RECDR. TEST SIG.	Provides trapezoidal waveform at a frequency of 350, 500, 1000, 1500 or 3000 cps. The signal is applied to the input of the information recorder when that unit is tested independently.
S-BAND OUT	Provides adjustable levels of S-band energy, either pulse modulated or continuous wave. The signal is applied to the S-band horn radiator when testing the airborne system.
X-BAND OUT	Provides adjustable levels of X-band energy, either pulse modulated or continuous wave. The signal is applied to the X-band horn radiator when testing the airborne system.
VID. TEST SIG.	Provides short pulses at a repetition rate of 350, 500, 1000, 1500 or 3000 pps. The signal is applied to the information amplifiers when these units are tested independently.
Monitoring Jack:	
PWR. MON.	The S-band or X-band energy is applied to this jack, and the power level is read on the front-panel r-f wattmeter with the MODULATION switch in the CW position.

2-55. TEST-SET OPERATING CONTROLS. Before attempting to use the test set, study table 2-5 in order to become familiar with the operating controls and their function. Also, refer to the instruction manual supplied with the oscilloscope.

Table 2-5. Test-Set Operating Controls

Panel Designation	Function	Preset Position
Output Controls:		
REPETITION RATE	Selects output pulse rates of 350, 500, 1000, 1500, or 3000 pps.	1000
ON-OFF	Applies power to the test set.	OFF
S-BAND ATT.	Controls output of S-band klystron.	Mid-Range
X-BAND ATT.	Controls output of X-band klystron.	Mid-Range
OUTPUT	Supplies filament voltage to either S-band or X-band klystron.	As Required
MODULATION	Selects either pulsed or continuous-wave klystron output.	PULSE
Monitoring Controls:		
S-WAVEMETER	Controls frequency of calibrated absorption wavemeter. Used to measure frequency of S-band energy.	Mid-Range
X-WAVEMETER	Controls frequency of calibrated absorption wavemeter. Used to measure frequency of X-band energy.	Mid-Range
POWER ZERO SET	Calibrates r-f wattmeter with zero power applied.	Mid-Range

WARNING

Potentials as high as 1800 volts are employed in the test set. Voltages of this magnitude are dangerous, and every precaution should be taken to avoid bodily contact. The equipment is not dangerous when completely enclosed in its cabinet. Do not operate the test set with the cabinet removed.

2-56. ENERGIZING THE TEST SET. Before energizing the test set, be sure that the fuse holders contain 3-amp fuses. To energize the test set, proceed as follows:

a. Preset the controls to the positions indicated in table 2-5.

b. Connect one end of the a-c power cable to the front-panel jack and connect the other end of the cable to a 115-volt, 60-cycle, a-c source.

c. Place the ON-OFF switch in the ON position. The panel lamp will light as soon as power is applied. Wait one minute before proceeding.

2-57. OBTAINING TRAPEZOIDAL OR PULSE OUTPUT FROM THE TEST SET. When the MODULATION switch is in the PULSE position, a trapezoidal output signal is available at the RECDR. TEST SIG. jack and a pulse output signal is available at the VID. TEST SIG. jack. The output frequency is selected by setting the REPETITION RATE control. Normal peak-to-peak voltage at the RECDR. TEST SIG. jack is 20 volts. Normal peak-to-peak voltage at the VID. TEST SIG. jack is 60 millivolts.

2-58. OBTAINING PULSED S-BAND OR PULSED X-BAND OUTPUT FROM THE TEST SET. The procedure for obtaining a signal of known power level, frequency, and repetition rate is based on the four steps listed below:

1. Calibration of the r-f wattmeter with zero r-f power applied.
2. Adjustment of the klystron output power to the desired level.
3. Frequency check.
4. Selection of pulse-modulation rate.

2-59. To calibrate the r-f wattmeter proceed as follows:

a. Preset the test-set controls as in table 2-5, but with the MODULATION switch in the CW position.

b. Set the OUTPUT switch to either S-BAND or X-BAND.

c. Apply a-c power to the test set and allow about five minutes for the equipment to warm up.

d. With no power applied to the PWR. MON. jack, adjust the POWER ZERO SET control to obtain a reading of zero on the R-F WATTS meter.

2-60. To adjust the klystron output power continue the procedure as follows:

a. Connect the PWR. MON. jack to the output jack (S-BAND OUT, X-BAND OUT) which corresponds to the position of the OUTPUT switch.

b. Adjust the attenuator (S-BAND ATT., X-BAND ATT.) for the desired reading on the r-f wattmeter.

Note

> To check the pulsed output of the klystron, connect the crystal detector to the output jack, and connect the oscilloscope VERTICAL AMP. INPUT to the output of the crystal detector. With the MODULATION switch in the PULSE position, the detected output pulse of the klystron may be observed.

2-61. The frequency of the S-band signal should be 2850 mc $\pm$25 mc, and the frequency of the X-band signal should be 9000 mc $\pm$25 mc. To check the frequency of the output signal continue the procedure as follows:

a. With the MODULATION switch in the CW position, adjust the wavemeter for a dip in the reading of the r-f wattmeter using the S-band wavemeter, the frequency can be determined from a graph supplied with the test set. Using the X-band wavemeter, the frequency can be read directly from the calibrated dial.

b. With the MODULATION switch in the PULSE position, adjust the wavemeter for a dip in pulse amplitude as noted on the oscilloscope.

c. After determining the operating frequency, detune the wavemeter so that maximum power can be obtained from the klystron.

If the frequency of the input signal is incorrect, the test set must be removed from its case, and the klystrons must be tuned mechanically. After tuning a klystron, its repeller voltage must be adjusted for maximum PULSE and CW output.

2-62. To select the pulse-modulation rate, place the MODULATION switch in the PULSE position, and set the REPETITION RATE control for the desired pulse rate.

2-63. OPERATING THE OSCILLOSCOPE. The oscilloscope instruction manual describes in detail the operating procedures for the instrument.

(Next page: 2-36)

MISSING PAGE

ORIGINAL DOCUMENT MISSING PAGE(S):

p 2-31 thru 2-35
(SEE p. 2-31)

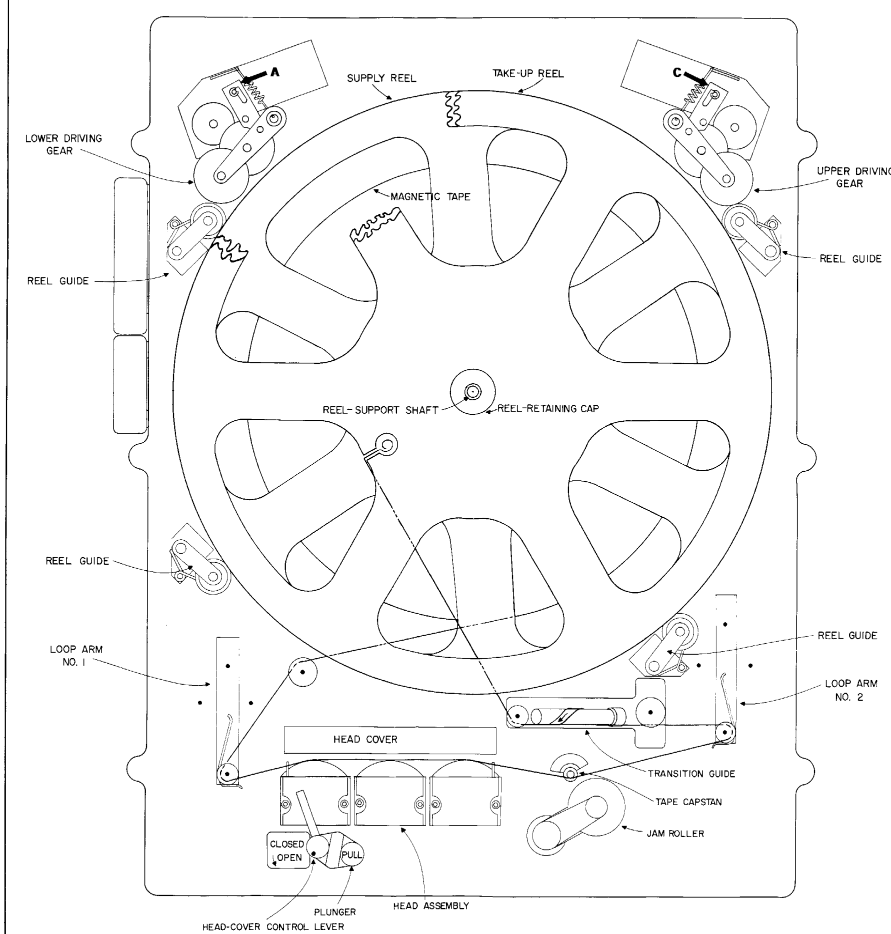

Figure 2-1. Information Recorder, Details of Tape-Loading Procedure

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AIRBORNE RADAR-MONITORING SYSTEM

SECTION III

MAINTENANCE DATA AND PREVENTATIVE MAINTENANCE

3-1. GENERAL.

3-2. This section of the instruction guide contains trouble-isolation procedures, specific instructions for the replacement and adjustment of electrical and mechanical components, and preventative maintenance data. The general maintenance procedures apply to the ground-based test set and ground-based re-record equipment, as well as to the airborne equipment.

3-3. Before attempting to isolate and correct trouble in the equipment, a technician must become thoroughly familiar with the theory of operation (Section I of this instruction guide).

3-4. DETECTING TROUBLE IN THE AIRBORNE OR GROUND-BASED RE-RECORD EQUIPMENT. Any malfunction of the airborne or ground-based units will be observed in one or more of the following ways:

a. During the preflight bench procedures.

b. During the preflight ramp tests.

c. During the re-recording process.

d. During the comprehensive 50-hour bench tests.

3-5. DETECTING TROUBLE DURING THE PREFLIGHT BENCH PROCEDURES. These procedures will detect mechanical or electro-mechanical defects in the information recorder. In general, troubles can be analyzed by close visual observation of the operating sequence. Once the faulty component has been isolated, it should be replaced or adjusted, following the procedures outlined in paragraph 3-29.

3-6. DETECTING TROUBLE DURING THE PREFLIGHT RAMP TESTS. These tests will detect electronic defects in the antennas, information amplifiers, information recorder, and associated cables. Performing the preflight tests in the sequence indicated in Section II will assist in isolating the defective unit. Subsequent bench tests will isolate the stage, and finally the component.

3-7. DETECTING TROUBLE DURING THE RE-RECORD PROCESS. While re-recording the original data, the technician should monitor the information to determine that it is continuous. Intermittent operation of the airborne or ground-based equipment may only be revealed by discontinuities of the final re-recorded data.

3-8. DETECTING TROUBLE DURING THE COMPREHENSIVE 50-HOUR BENCH TESTS. These tests will detect marginal performance characteristics which may not be revealed by the preflight or re-recording procedures.

3-9. GENERAL PROCEDURE FOR ISOLATING TROUBLE.

3-10. TYPES OF TROUBLE. There are three basic types of equipment troubles:

a. Equipment inoperative.

b. Intermittent operation.

c. Marginal performance.

These three types of trouble require slightly different isolation techniques. The techniques used in isolating the basic types of trouble apply to the airborne equipment, ground-based re-record equipment, and ground-based test set.

3-11. EQUIPMENT INOPERATIVE. In cases where the equipment is found to be inoperative, isolate the trouble by proceeding as follows:

a. Visual inspection. Be sure that all connectors are mated, and that all components are in place. With power applied to the equipment, be sure that the filaments of all tubes are lit.

b. Power-supply test. Measure all power supply voltages, including the primary-power source. Where full-load voltages are tabulated, defects in related units can influence the voltages significantly.

c. Signal tracing. Apply a standard signal level to the input of the system or unit, and compare the results of stage-by-stage tests with tabulated performance data. The stage failing to yield the proper output signal is assumed to be defective. At this point, it is especially important to have a thorough understanding of the theory of operation of the equipment, since circuits external to the suspected stage may be responsible for malfunction of the stage.

d. Component isolation. Measure the operating potentials of the defective stage, and compare the results with the tabulated data. By correlating this information with the schematic diagram of the unit, it is possible to determine which group of components may be defective. With the equipment turned off, measure the resistance of the components, and compare the results with the tabulated data. In general, if the voltage appearing at the electrode of a tube or transistor is abnormal, but the resistance measurement is correct, the tube or transistor should be replaced. If other components are suspected, they may have to be disconnected from the circuit to be tested.

3-12. INTERMITTENT OPERATION. In cases where the airborne equipment has failed in flight, but operates satisfactorily using the bench-test equipment, the interunit cabling system should be removed from the aircraft and employed in the bench-test set-up. Occasionally, an intermittent cable defect, which had caused equipment failure in the aircraft, will not occur on the bench. Intermittent cables and intermittent components are difficult to isolate. The basic technique for locating intermittencies involves the procedures outlined in paragraph 3-11. However, the trouble must first be precipitated by physically manipulating cables and components while observing the output of the equipment on an oscilloscope. For maximum probability of trouble detection, adjust the horizontal sweep of the oscilloscope for a slow writing speed (10 cps). The technique of isolating intermittent operation of the airborne equipment also applies to the ground-based equipment.

3-13. MARGINAL PERFORMANCE. In cases where the performance of the equipment is marginal (low sensitivity, hum, noise, poor frequency response, distortion, limited dynamic range), more precise measurements must be made. The tests designed to evaluate the performance of the equipment, along with a tabulation of the normal-performance characteristics, are contained in the paragraphs covering routine maintenance. The procedures of paragraph 3-11 are followed in isolating the defective stage or component.

3-14. EQUIPMENT REQUIRED FOR PERFORMING TESTS AND ISOLATING TROUBLE.

3-15. The tabulated waveforms and performance characteristics can be duplicated using Unit-Essential Equipment. The Unit-Essential Equipment includes all of the equipment necessary to operate, repair, and maintain the Airborne Radar-Monitoring System. Unit-Essential Equipment necessary for preflight bench procedures, preflight ramp tests, and routine operation is listed in Section II of this instruction guide. Unit-Essential Equipment necessary for isolating trouble, performing extensive maintenance tests, and adjusting the airborne equipment is listed in Table 3-1.

Table 3-1. Unit-Essential Equipment Used in Maintaining the Airborne Radar-Monitoring System

Equipment	MP Number
Flutter meter. Ranges: 0 - 0.5, 0 - 2%.	MP10194
Portable frequency meter. Range: 56-64 cps.	MP10208
0-3 oz. scale.	MP10207
0-30 oz. scale.	MP10165
Audio oscillator. Range: 5 cps - 600 kc. Output: 20 Volts (no load). Internal impedance: 600 ohms.	MP10206
Oscilloscope. Driven sweep to 0.1 microsecond per cm. (Requires plug-in preamplifier.)	MP10218
Plug-in preamplifier. High gain. Sensitivity: 5 mv./cm. Frequency response to 9 mc.	MP10148
Plug-in preamplifier. Dual trace. Sensitivity: 0.05 v./cm. Frequency response to 8.5 mc.	MP10230
Attenuator probe.	MP10187
Stroboscopic (tachometer) lamp.	MP10188
Tool kit, electronic technician.	MP10190
Tool kit, laboratory.	MP10192
Vacuum-tube voltmeter. Frequency response: 20 cps-700 mc. Range: 0 - 300 volts ac and dc. Input resistance and capacitance: 10 megohms, 1.5 micromicrofarads.	MP10213
Jig for testing electronics board of information recorder	MP10225

3-16. In addition to Unit-Essential Equipment, the base testing facility must be equipped with suitable interconnecting cables for the airborne equipment, a 28-volt d-c source of power for the airborne equipment, and a 115-volt a-c 60-cycle source of power for the test equipment.

WARNING

Voltages employed in this equipment are dangerous to life. Proceed with caution when operating the equipment with the cover plates removed.

3-17. ISOLATING TROUBLE IN THE SYSTEM BY MEANS OF WAVEFORM DATA. Tables 3-2 through 3-5 contain waveform data which may be used to determine whether a system fault originates in the airborne equipment or in the ground-based re-record equipment. Although the waveform data includes a rather limited number of test conditions, the waveforms are representative of conditions involving maximum and minimum pulse-repetition rates, and maximum and minimum pulse amplitudes.

3-18. The waveforms in tables 3-2 through 3-5 are to be observed under the conditions described in the tables.

Table 3-2. Waveform Data for Over-All System Tests, High-Amplitude 500-pps Input

Apply input signal as follows: 1-microsecond pulse (rise time less than .07 microseconds), 500 pulses-per-second, 1 volt peak-to-peak, to J101 of left-side information amplifier.

Set oscilloscope as follows: 20-millivolts/vertical-division, 500-microseconds/horizontal-division.

Observe waveform at TP1.

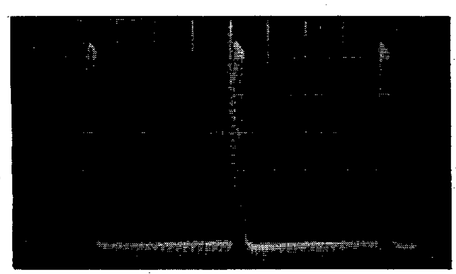
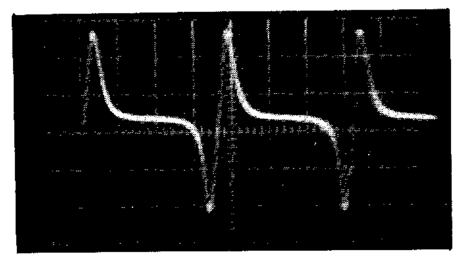


Table 3-2. Waveform Data for Over-All System Tests, High-Amplitude 500-pps Input (Continued)

After recording the signal on the tape, place the tape on the low-speed playback transport, and re-record the signal at 7.5 inches-per-second. On the re-record amplifier unit for track number two, set the controls as follows: EQUALIZATION SWITCH in LOW SPEED position, RECORD LEVEL set for reading of -3 on VU meter (for previously recorded 1000-pps 1-volt peak-to-peak signal), LINE TERM in ON position, PLAYBACK LEVEL set for reading of 0 on VU meter (at 1000 pps).

Set oscilloscope as follows: 5-volts/vertical-division, 500-microseconds/horizontal-division.

Observe waveform at MONITOR AMPLIFIER jack.



After re-recording the signal at 7.5 inches-per-second, playback the re-recorded tape by proceeding as follows: connect the playback head of the high-speed re-record transport to the PLAYBACK HEAD jack of the track-two amplifier, set the EQUALIZATION SWITCH in HIGH SPEED position, place the LINE TERM switch in the ON position, and set the PLAYBACK LEVEL control for a reading of 0 on the VU meter (for previously recorded 1000-pps 1-volt peak-to-peak signal).

Set oscilloscope as follows: 5-volts/vertical-division, 500-microseconds/horizontal-division.

Observe waveform at MONITOR AMPLIFIER jack.

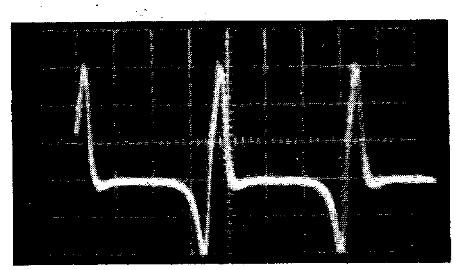
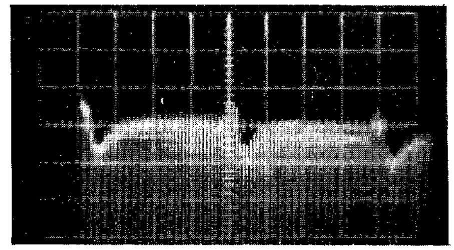


Table 3-3. Waveform Data for Over-All System Tests, Low-Amplitude 500-pps Input

Apply input signal as follows: 1-microsecond pulse (rise time less than .07 microseconds), 500 pulses-per-second, 8 millivolts peak-to-peak, to J101 of left-side information amplifier.

Set oscilloscope as follows: 1-millivolt/vertical-division, 500-microseconds/horizontal-division.

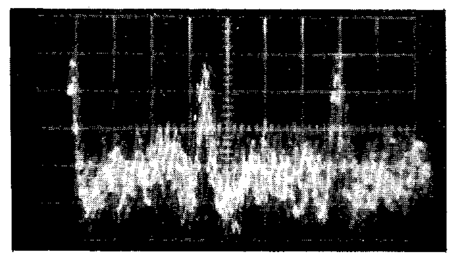
Observe waveform at TP1.



After recording the signal on the tape, place the tape on the low-speed playback transport, and re-record the signal at 7.5 inches-per-second. On the re-record amplifier unit for track number two, set the controls as follows: EQUALIZATION SWITCH in LOW SPEED position, RECORD LEVEL set for reading of -3 on VU meter (for previously recorded 1000-pps 1-volt peak-to-peak signal), LINE TERM in ON position, PLAYBACK LEVEL set for reading of 0 on VU meter (at 1000 pps).

Set oscilloscope as follows: 100-millivolts/vertical-division, 500-microseconds/horizontal-division.

Observe waveform at MONITOR AMPLIFIER jack.



After re-recording the signal at 7.5 inches-per-second, playback the re-recorded tape by proceeding as follows: connect the playback head of the high-speed re-record transport to the PLAYBACK HEAD jack of the track-two amplifier, set the EQUALIZATION SWITCH in HIGH SPEED position, place the LINE TERM switch in the ON position, and set the PLAYBACK LEVEL control for a reading of 0 on the VU meter (for previously recorded 1000-pps 1-volt peak-to-peak signal).

Set oscilloscope as follows: 100-millivolts/vertical-division, 500-microseconds/horizontal-division.

Observe waveform at MONITOR AMPLIFIER jack.

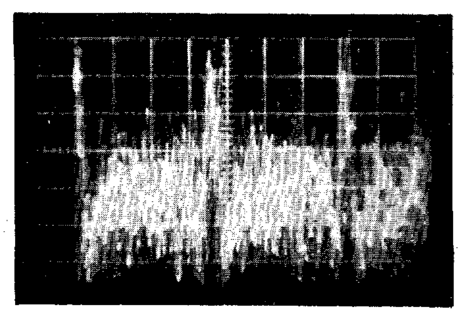


Table 3-4. Waveform Data for Over-All System Tests, High-Amplitude 4000-pps Input

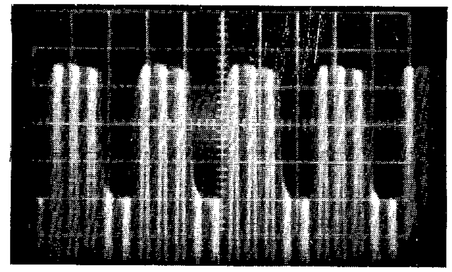
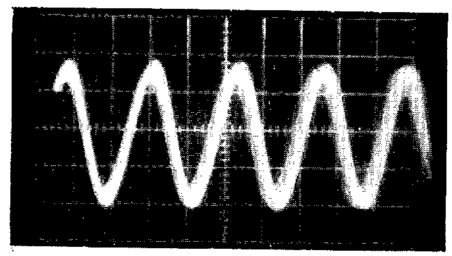
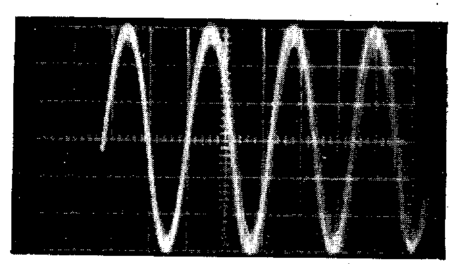
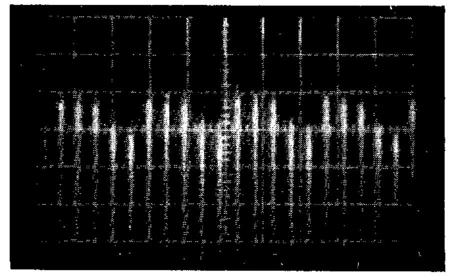
Apply input signal as follows: 1-microsecond pulse (rise time less than .07 microseconds), 4000 pulses-per-second, 1-volt peak-to-peak, to J101 of left-side information amplifier. Set oscilloscope as follows: 20-millivolts/vertical division, 100-microseconds/horizontal-division. Observe waveform at TP1.	
After recording the signal on the tape, place the tape on the low-speed playback transport, and re-record the signal at 7.5 inches-per-second. On the re-record amplifier unit for track number two, set the controls as follows: EQUALIZATION SWITCH in LOW SPEED position, RECORD LEVEL set for reading of -3 on VU meter (for previously recorded 1000-pps 1-volt peak-to-peak signal), LINE TERM in ON position, PLAYBACK LEVEL set for reading of 0 on VU meter (at 1000 pps). Set oscilloscope as follows: 5-volts/vertical-division, 100-microseconds/horizontal-division. Observe waveform at MONITOR AMPLIFIER jack.	
After re-recording the signal at 7.5 inches-per-second, playback the re-recorded tape by proceeding as follows: connect the playback head of the high-speed re-record transport to the PLAYBACK HEAD jack of the track-two amplifier, set the EQUALIZATION SWITCH in HIGH SPEED position, place the LINE TERM switch in the ON position, and set the PLAYBACK LEVEL control for a reading of 0 on the VU meter (for previously recorded 1000-pps 1-volt peak-to-peak signal). Set oscilloscope as follows: 5-volts/vertical-division, 100-microseconds/horizontal-division. Observe waveform at MONITOR AMPLIFIER jack.	

Table 3-5. Waveform Data for Over-All System Tests, Low-Amplitude 4000-pps Input

Apply input signal as follows: 1-microsecond pulse (rise time less than .07 microseconds), 4000 pulses-per-second, 8 millivolts peak-to-peak, to J101 of left-side information amplifier.

Set oscilloscope as follows: 1-millivolt/vertical-division, 100-microseconds/horizontal-division.

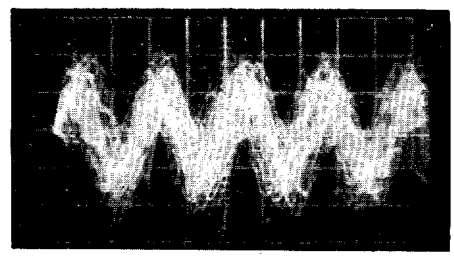
Observe waveform at TP1.



After recording the signal on the tape, place the tape on the low-speed playback transport, and re-record the signal at 7.5 inches-per-second. On the re-record amplifier unit for track number two, set the controls as follows: EQUALIZATION SWITCH in LOW SPEED position, RECORD LEVEL set for reading of -3 on VU meter (for previously recorded 1000-pps 1-volt peak-to-peak signal), LINE TERM in ON position, PLAYBACK LEVEL set for reading of 0 on VU meter (at 1000 pps).

Set oscilloscope as follows: 100-millivolts/vertical-division, 100-microseconds/horizontal-division.

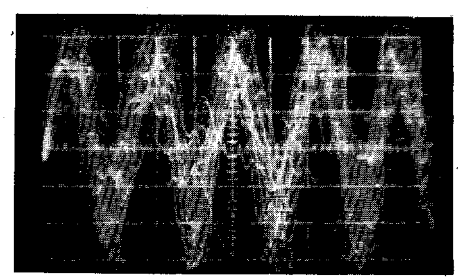
Observe waveform at MONITOR AMPLIFIER jack.



After re-recording the signal at 7.5 inches-per-second, playback the re-recorded tape by proceeding as follows: connect the playback head of the high-speed re-record transport to the PLAYBACK HEAD jack of the track-two amplifier, set the EQUALIZATION SWITCH in HIGH SPEED position, place the LINE TERM switch in the ON position, and set the PLAYBACK LEVEL control for a reading of 0 on the VU meter (for previously recorded 1000-pps 1-volt peak-to-peak signal).

Set oscilloscope as follows: 100-millivolts/vertical-division, 100-microseconds/horizontal-division.

Observe waveform at MONITOR AMPLIFIER jack.



3-19. ISOLATING TROUBLE IN THE AIRBORNE EQUIPMENT.

3-20. GENERAL.

3-21. Performing the preflight tests in the sequence indicated in Section II will automatically isolate a defective antenna diode. If other units of the system do not perform satisfactorily, units of known performance may be substituted for defective units. Replacement of antenna diodes and substitution of units are the only types of trouble isolation and correction that should be effected at advanced field locations.

3-22. As described in paragraph 3-11, the procedure for isolating trouble in the airborne equipment involves signal tracing, voltage measurements, and resistance measurements. The measurements obtained using a standard bench test set-up are then compared with waveforms, voltages, and resistances for a normal equipment.

3-23. To isolate trouble in the airborne equipment, remove the units from the aircraft, interconnect the units, apply power, and proceed as follows:

a. Measure power-supply output voltage.

b. Apply a standard signal to the input of the information amplifier.

c. Check waveforms, and perform voltage and resistance measurements as required in the information amplifier.

d. Check waveforms, and perform voltage and resistance measurements as required in the information recorder.

3-24. NORMAL PERFORMANCE CHARACTERISTICS OF THE VIBRATOR D-C SUPPLY. Table 3-6 contains voltage data which may be noted for the purpose of evaluating the performance of the vibrator D-C supply. The voltage measurements are to be made under the conditions described in the table.

Table 3-6. Performance Data, Vibrator D-C Supply

The data in this table to be taken with the equipment units interconnected for normal airborne operation. Voltages measured to ground.	
Primary Supply Voltage	
Measured at pin D of J102	Maximum: 29.5 volts Minimum: 27.5 volts
Output of Vibrator D-C Supply	
Measured at pin E of J102	Maximum: 230 volts Minimum: 215 volts Maximum level of hum and noise: 2 volts (peak-to-peak)
Measured at pin C of J102	Maximum: 120 volts Minimum: 105 volts Maximum level of hum and noise: 1 volt (peak-to-peak).

3-25. INFORMATION-AMPLIFIER WAVEFORM DATA. Table 3-7 contains waveforms which may be observed for the purpose of isolating a defective stage in the information amplifier. The waveforms are to be observed under the conditions described in the table.

Table 3-7. Typical Waveforms, Information Amplifier

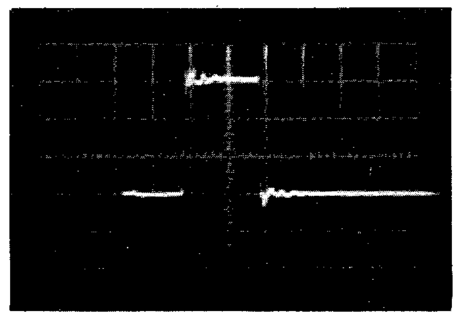
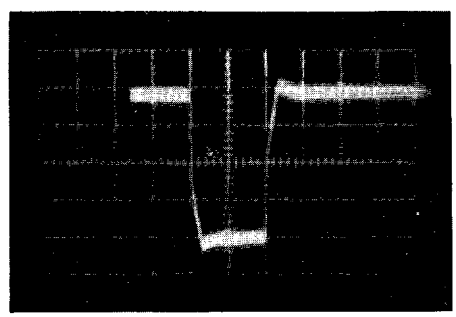
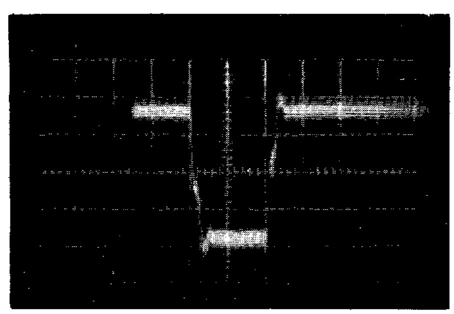
Apply input signal as follows: 2-microsecond pulses (rise time less than .07 microseconds), 1000 pulses-per-second, 150 millivolts peak-to-peak, to J101.	
Set oscilloscope as follows: 50-millivolts/vertical-division, 1-microsecond/horizontal-division. Observe waveform at: grid (pin 3) of V101.	
Set oscilloscope as follows: 200-millivolts/vertical-division, 1-microsecond/horizontal-division. Observe waveform at: grid (pin 3) of V102.	
Set oscilloscope as follows: 200-millivolts/vertical-division, 1-microsecond/horizontal-division. Observe waveform at cathode (pin 2) of V106.	

Table 3-7. Typical Waveforms, Information Amplifier (Continued)

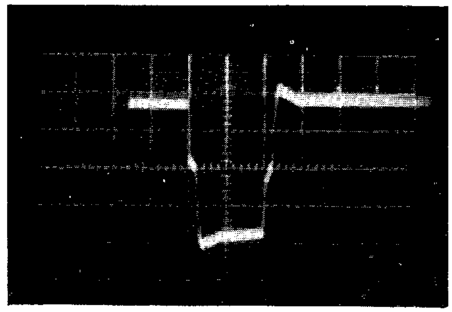
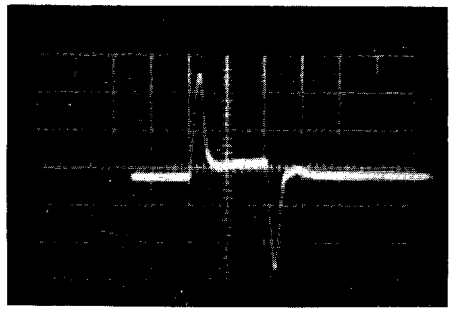
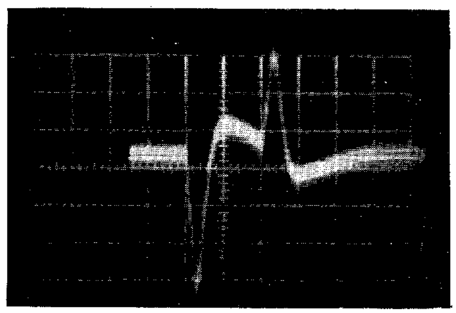
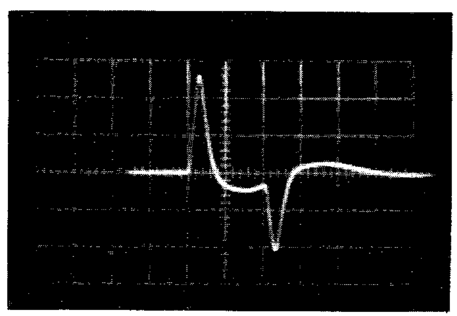
Set oscilloscope as follows: 200-millivolts/vertical-division, 1-microsecond/horizontal-division. Observe waveform at: cathode (pin 2) of V102.	
Set oscilloscope as follows: 1-volt/vertical-division, 1-microsecond/horizontal-division. Observe waveform at: plate (pin 1) of V102.	
Set oscilloscope as follows: 2-volts/vertical-division, 1-microsecond/horizontal-division. Observe waveform at: plate (pin 1) of V103.	
Set oscilloscope as follows: 5-volts/vertical-division, 1-microsecond/horizontal-division. Observe waveform at: grid (pin 3) of V104.	

Table 3-7. Typical Waveforms, Information Amplifier (Continued)

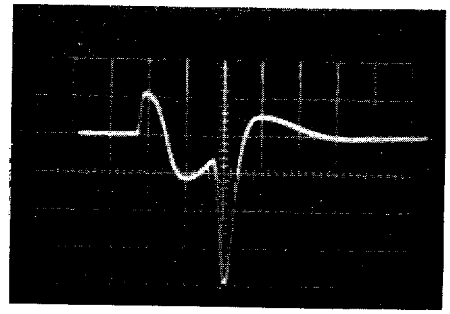
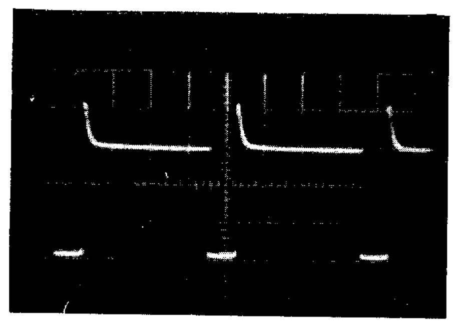
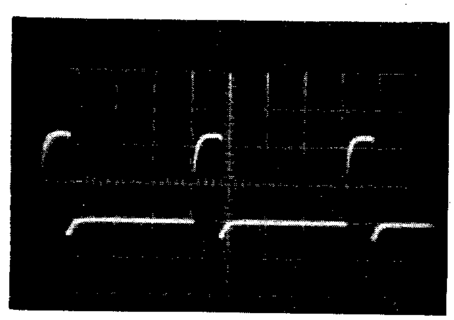
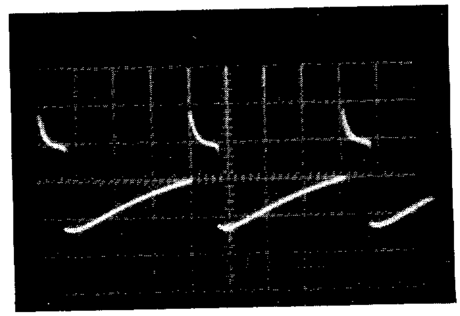
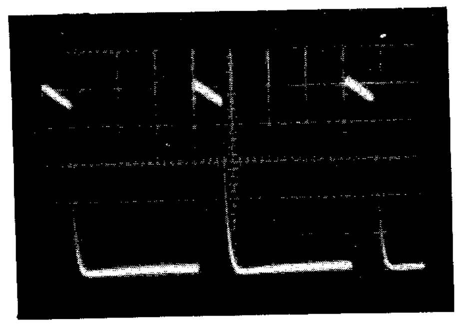
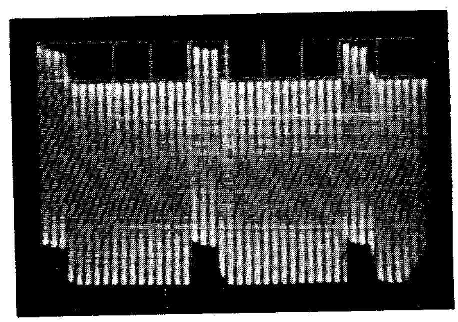
Set oscilloscope as follows: 2-volts/vertical-division, 1-microsecond/horizontal-division. Observe waveform at: grid (pin 3) of V107.	
Set oscilloscope as follows: 5-volts/vertical-division, 200-microseconds/horizontal-division. Observe waveform at: plate (pin 1) of V108.	
Set oscilloscope as follows: 1-volt/vertical-division, 200-microseconds/horizontal-division. Observe waveform at: cathode (pin 2) of V108.	
Set oscilloscope as follows: 10-volts/vertical-division, 200-microseconds/horizontal-division. Observe waveform at: plate (pin 1) of V109.	

Table 3-7. Typical Waveforms, Information Amplifier (Continued)

Set oscilloscope as follows: 5-volts/vertical-division, 200-microseconds/horizontal-division. Observe waveform at: cathode (pin 2) of V110.	
Set oscilloscope as follows: 200-millivolts/vertical-division, 200-microseconds/horizontal-division. Observe waveform at: grid (pin 3) of V105.	
Set oscilloscope as follows: 500-millivolts/vertical-division, 200-microseconds/horizontal-division. Observe waveform at: pin A of J103.	

3-26. INFORMATION-AMPLIFIER VOLTAGE AND RESISTANCE DATA. Table 3-8 contains voltage and resistance data which may be noted for the purpose of isolating a defective component in the information amplifier. The voltage and resistance measurements are to be made under the conditions described in the table.

Table 3-8. Typical Voltage and Resistance Data, Information Amplifier

The VOLTAGE DATA in this table to be taken under the following conditions:

1. All airborne units (except antennas) interconnected for normal operation.
2. No signal applied to system.
3. Primary power: 28-volts dc.
4. Unless otherwise specified, measurements made with a 20,000 ohm/volt multimeter.
5. Where (*) specified, measurements made with a VTVM having an input impedance of 10 megohms.
6. Filament voltage is measured between pins 4 and 5. All other voltages are measured to ground.

The RESISTANCE DATA in this table to be taken under the following conditions:

1. Information amplifier not interconnected with other units.
2. No signal applied to system.
3. Primary power turned off.
4. Unless otherwise specified, measurements made with a multimeter, with negative meter lead grounded.
5. Where (*) specified, measurements made with a VTVM.
6. Filament resistance is measured between pins 4 and 5. All other resistances are measured to ground.

Component		Terminal Number			
		1	2	3	4 and 5
V101	volts	62	*1.53	*0	6.2
	ohms	37K	260	17K	4.2
V102	volts	108	34.5	24.5	6.5
	ohms	*75M	3.4K	108K	4.3

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1 November 56.

Table 3-8. Typical Voltage and Resistance Data, Information Amplifier (Continued)

Component		Terminal Number			
		1	2	3	4 and 5
V103	volts	240	12.5	*0	6.2
	ohms	*75M	2.4K	108K	4.2
V104	volts	225	52	33.2	6.4
	ohms	*75M	17K	118K	4.4
V105	volts	59	10.7	4.5	6.4
	ohms	35K	11K	*2.6M	4.2
V106	volts	95	51	43	6.4
	ohms	33K	11K	280K	4.2
V107	volts	86	52.5	52	6.4
	ohms	45K	32K	25K	4.3
V108	volts	51	6.8	*1.25	6.3
	ohms	71K	6K	5.1K	4.4
V109	volts	28	6.8	6.7	6.4
	ohms	71K	6K	*5M	4.4
V110	volts	47	13	10.5	6.4
	ohms	55K	4.3K	*1.15M	4.5
V111	volts	*.77	13	*.77	6.2
	ohms	*1M	4.3K	*1M	4.2

3-27. INFORMATION-RECORDER WAVEFORM DATA. Table 3-9 contains waveforms which may be observed for the purpose of isolating a defective stage in the information recorder. The waveforms are to be observed under the conditions described in the table.

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1 November 56.

Table 3-9. Typical Waveforms, Information Recorder

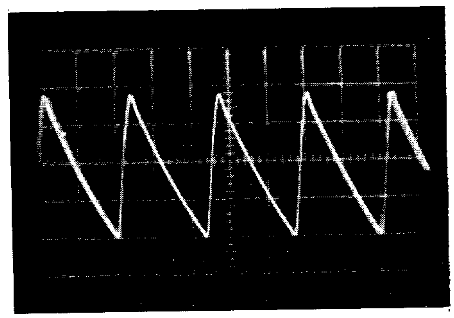
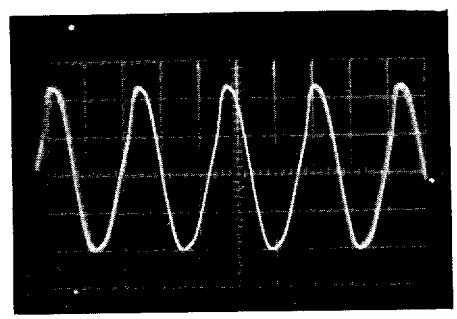
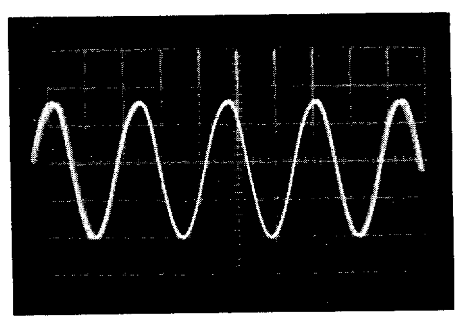
To observe waveforms generated in the bias and erase circuits, proceed as follows: interconnect the equipment for normal operation; short K1, K2, K3, K4, and K5 to ground; and apply power.	
Set oscilloscope as follows: 100-millivolts/vertical-division, 20-microseconds/horizontal-division. Observe waveform at: base of Q705.	
Set oscilloscope as follows: 10-volts/vertical-division, 20-microseconds/horizontal-division. Observe waveform at: base of Q704.	
Set oscilloscope as follows: 10-volts/vertical-division, 20-microseconds/horizontal-division. Observe waveform at: base of Q706.	

Table 3-9. Typical Waveforms, Information Recorder (Continued)

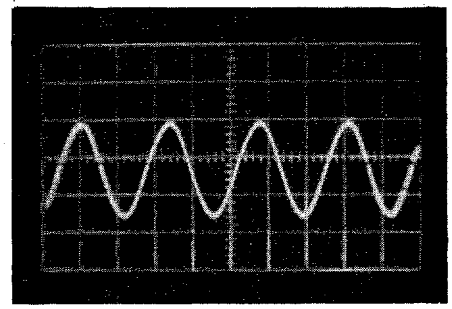
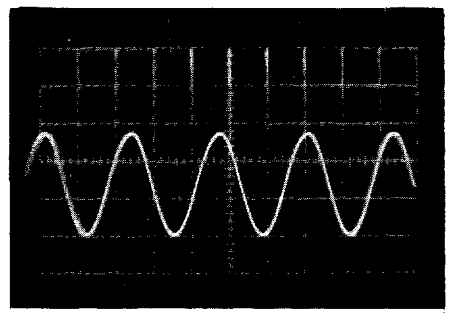
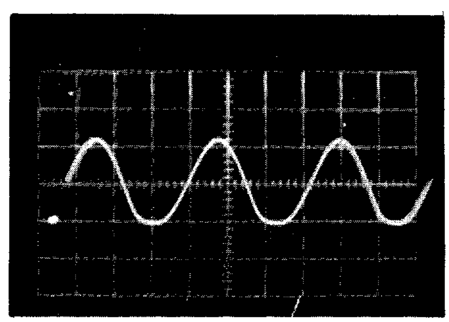
Set oscilloscope as follows: 100-millivolts/vertical-division, 20-microseconds/horizontal-division. Observe waveform at: TP3.	
Set oscilloscope as follows: 100-millivolts/vertical-division, 20-microseconds/horizontal-division. Observe waveform at: TP1, TP4, TP6.	
To observe waveforms generated in the 1.3-kc, 1.7-kc, 2.3-kc, and 3.0-kc tone-oscillator circuits, proceed as follows: interconnect the equipment for normal operation; short K1, K2, K3, and K4 to ground; and apply power. Only the stage-by-stage waveforms of the 3.0-kc oscillator are shown, but these waveforms are typical of the 1.3-kc, 1.7-kc, and 2.3-kc oscillators also.	
Set oscilloscope as follows: 500-millivolts/vertical-division, 100-microseconds/horizontal-division. Observe waveform at: cathode (pin 5) of V701B.	

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Table 3-9. Typical Waveforms, Information Recorder (Continued)

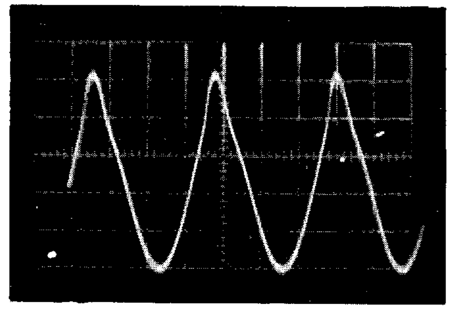
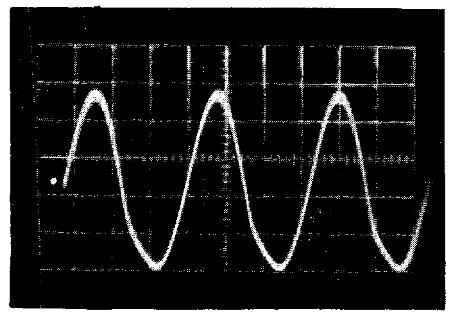
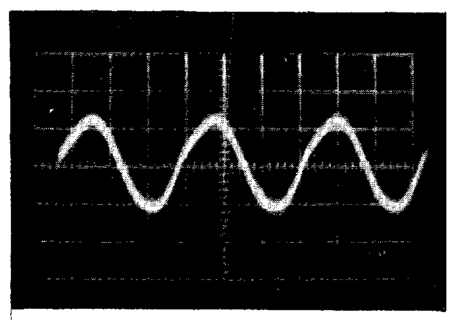
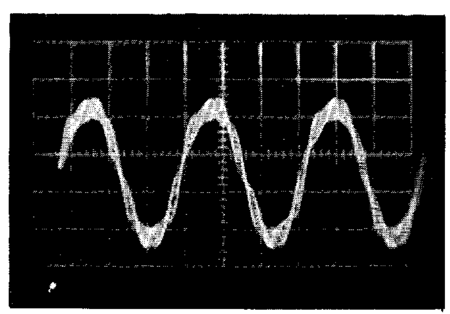
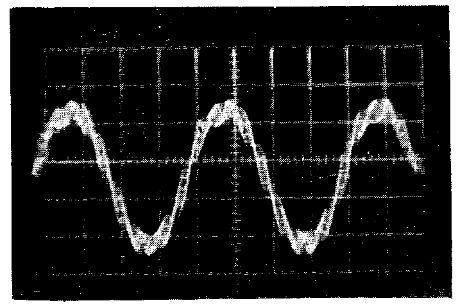
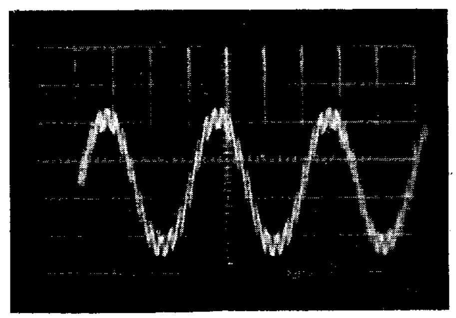
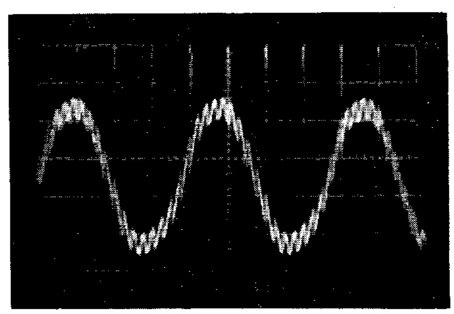
Set oscilloscope as follows: 2-volts/vertical-division, 100-microseconds/horizontal-division. Observe waveform at: grid (pin 2) of V701A.	
Set oscilloscope as follows: 1-volt/vertical-division, 100-microseconds/horizontal-division. Observe waveform at: grid (pin 2) of V702A.	
Set oscilloscope as follows: 10-volts/vertical-division, 100-microseconds/horizontal-division. Observe waveform at: TP3000.	
Set oscilloscope as follows: 1-volt/vertical-division, 100-microseconds/horizontal-division. Observe waveform at: K5, or pin E of J703.	

Table 3-9. Typical Waveforms, Information Recorder (Continued)

Short K1, K2, K3 and K5 to ground. Set oscilloscope as follows: 1-volt/vertical-division, 100-microseconds/horizontal-division. Observe waveform at: K4, or pin D of J703	
Short K1, K2, K4 and K5 to ground. Set oscilloscope as follows: 1-volt/vertical-division, 200-microseconds/horizontal-division. Observe waveform at: K3, or pin C of J703.	
Short K1, K3, K4 and K5 to ground. Set oscilloscope as follows: 1-volt/vertical-division, 200-microseconds/horizontal-division. Observe waveform at: K2, or pin B of J703.	

To observe waveforms generated in the 1-kc oscillator circuits, proceed as follows: interconnect the equipment for normal operation; short K2, K3, K4, and K5 to ground; and apply power.

Table 3-9. Typical Waveforms, Information Recorder (Continued)

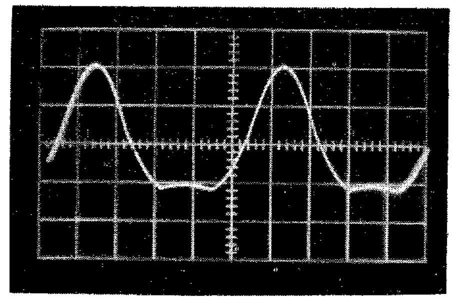
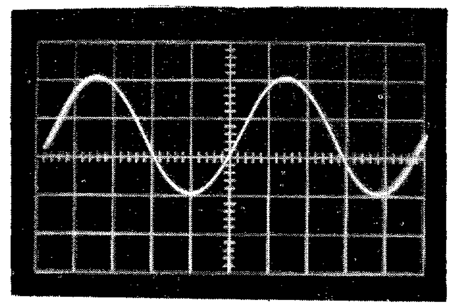
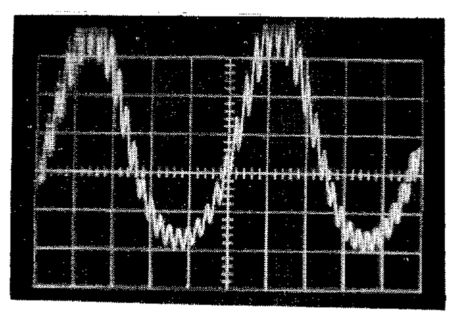
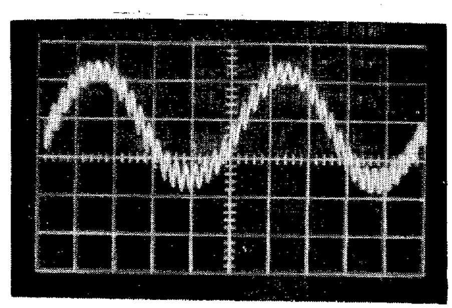
Set oscilloscope as follows: 1-volt/vertical-division, 200-microseconds/horizontal-division. Observe waveform at: base of Q702.	
Set oscilloscope as follows: 5-volts/vertical-division, 200-microseconds/horizontal-division. Observe waveform at: collector of Q702.	
Set oscilloscope as follows: 10-millivolts/vertical-division, 200-microseconds/horizontal-division. Observe waveform at: base of Q703.	
Set oscilloscope as follows: 2-volts/vertical-division, 200-microseconds/horizontal-division. Observe waveform at: TP1000.	

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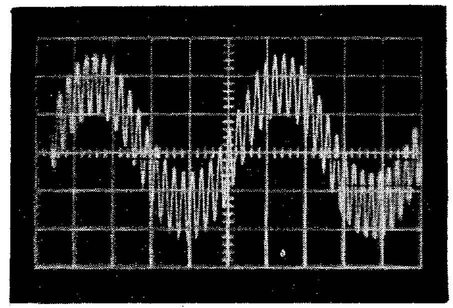
Table 3-9. Typical Waveforms, Information Recorder (Continued)

Set oscilloscope as follows:
1-volt/vertical-division,
200-microseconds/horizontal-division.

Observe waveform at:
K1, or pin A of J703.

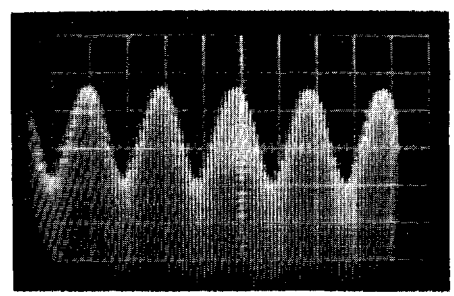


To observe waveforms in the recording-head circuits, proceed as follows: interconnect the equipment for normal operation, and apply power.

Short K2, K3, K4, and K5 to ground.

Set oscilloscope as follows:
5-millivolts/vertical-division,
1000-microseconds/horizontal-division.

Observe waveform at:
TP6.



Short K1, K3, K4 and K5 to ground.

Set oscilloscope as follows:
5-millivolts/vertical-division,
500-microseconds/horizontal-division.

Observe waveform at:
TP6.

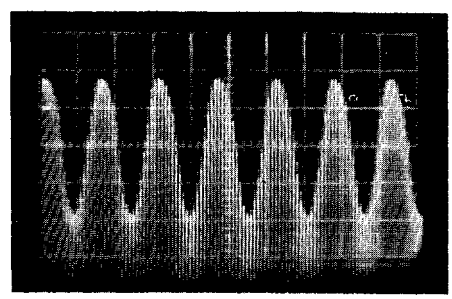


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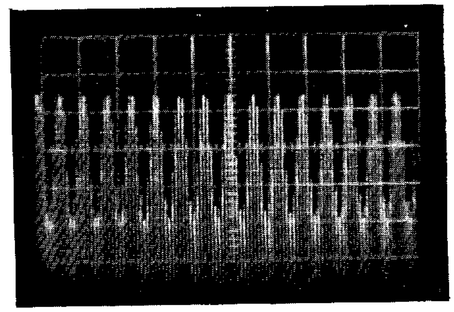
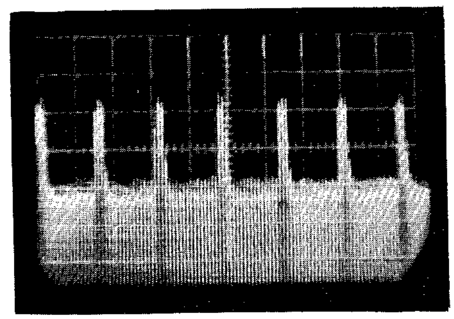
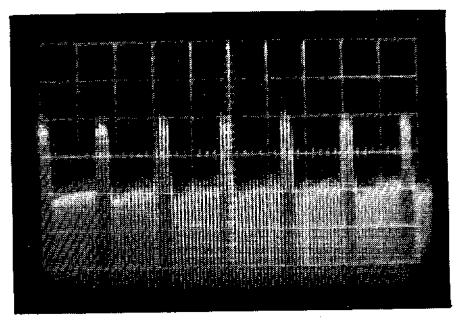
Table 3-9. Typical Waveforms, Information Recorder (Continued)

Short K1, K2, K3, and K4 to ground. Set oscilloscope as follows: 5-millivolts/vertical-division, 500-microseconds/horizontal-division. Observe waveform at: TP6.	
Apply input signal as follows: 2-microsecond pulses (rise time less than .07 microseconds), 1000 pulses-per-second, 150 millivolts peak-to-peak, to J101-LEFT. Set oscilloscope as follows: 5-millivolts/vertical-division, 500-microseconds/horizontal-division. Observe waveform at: TP1.	
Apply input signal as follows: 2-microsecond pulses (rise time less than .07 microseconds), 1000 pulses-per-second, 150 millivolts peak-to-peak, to J101-RIGHT. Set oscilloscope as follows: 5-millivolts/vertical-division, 500-microseconds/horizontal-division. Observe waveform at: TP4.	

To observe waveforms in the playback and monitoring circuits, proceed as follows: interconnect the equipment for normal operation; short K1, K3, K4, and K5 to ground; apply an input signal consisting of 2-microsecond pulses (rise time less than .07 microseconds), 1000 pulses-per-second, 150 millivolts peak-to-peak, to J101-RIGHT; connect pin E to pin H of J701 to apply heater voltage to the monitor-amplifier stage; and apply power.

Table 3-9. Typical Waveforms, Information Recorder
(Continued)

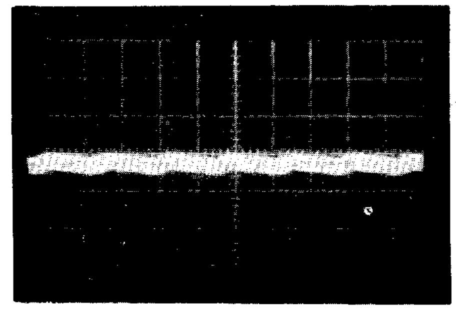
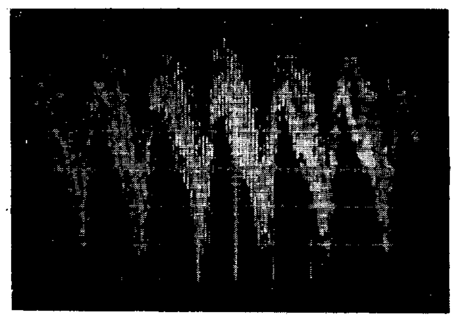
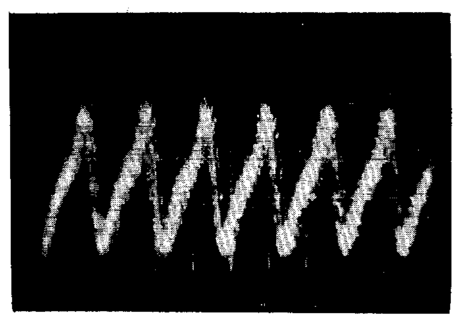
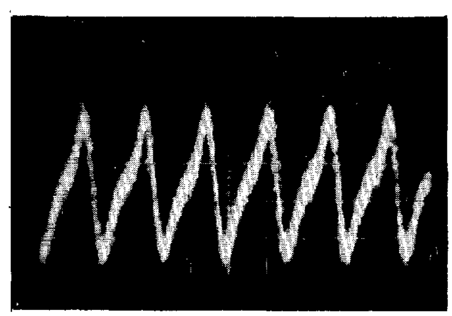
Set oscilloscope as follows: 1-millivolt/vertical-division, 500-microseconds/horizontal-division. Observe waveform at: P709.	
Set oscilloscope as follows: 1-millivolt/vertical-division, 500-microseconds/horizontal-division. Observe waveform at: plate (pin 8) of V711B.	
Set oscilloscope as follows: 50-millivolts/vertical-division, 500-microseconds/horizontal-division. Observe waveform at: plate (pin 8) of V714B.	
Set oscilloscope as follows: 50-millivolts/vertical-division, 500-microseconds/horizontal-division. Observe waveform at: pin R of J703.	

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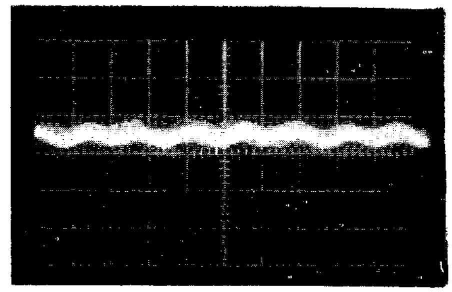
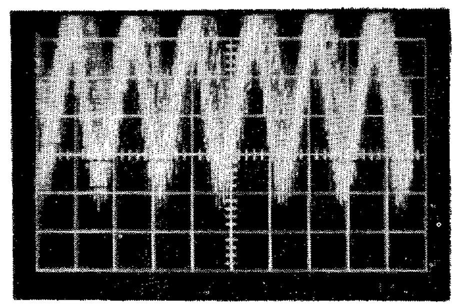
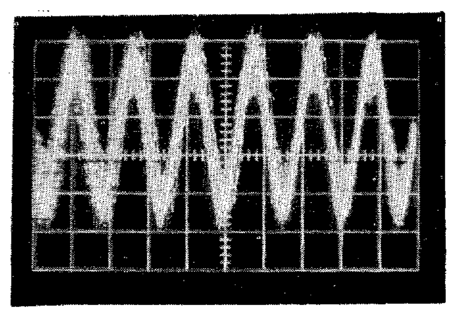
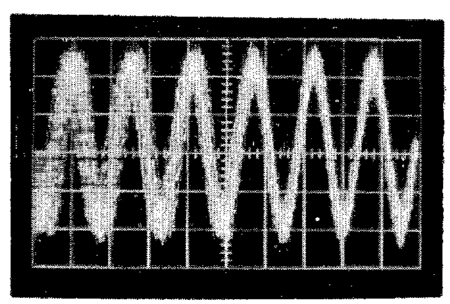
Table 3-9. Typical Waveforms, Information Recorder (Continued)

Set oscilloscope as follows: 1-millivolt/vertical-division, 500 to 1200-microseconds/ horizontal-division. Observe waveform at: P701.	
Set oscilloscope as follows: 2-millivolts/vertical-division, 500-microseconds/horizontal-division. Observe waveform at: plate (pin 8) of V709B.	
Set oscilloscope as follows: 50-millivolts/vertical-division, 500-microseconds/horizontal-division. Observe waveform at: plate (pin 8) of V712B.	
Set oscilloscope as follows: 50-millivolts/vertical-division, 500-microseconds/horizontal-division. Observe waveform at: pin N of J703.	

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3-28. INFORMATION-RECORDER VOLTAGE AND RESISTANCE DATA. Table 3-10 contains voltage and resistance data which may be noted for the purpose of isolating a defective component in the information recorder. The voltage and resistance measurements are to be made under the conditions described in the table.

Table 3-10. Typical Voltage and Resistance Data, Information Recorder

The VOLTAGE DATA in this table to be taken under the following conditions:	1. All airborne units (except antennas) interconnected for normal operation. 2. No signal applied to system. 3. Primary power: 28-volts dc. 4. Measurements made with 20,000 ohm/volt multimeter. 5. All voltage measured to ground.
The RESISTANCE DATA in this table to be taken under the following conditions:	1. Printed-circuit board assembly disconnected from information recorder. 2. No signal applied to system. 3. Primary power turned off. 4. Measurements made with a multimeter. 5. Unless otherwise specified, all resistance measured to ground. 6. Where (*) specified, resistance measured to pin T of J703.

CAUTION

Meter current may damage transistors. Do not perform resistance measurements which will cause current to flow through the transistors.

Table 3-10. Typical Voltage and Resistance Data, Information Recorder (Continued)

Component		Terminal Number							
		1	2	3	4	5	6	7	8
V701	volts	160	0	13.3	2.9	1.1	19.5	.01	111
	ohms	∞	230K	5.9	5200	1150	8.5	4900	∞
V702	volts	190	0	13.3	1.35	1.62	6.7	0	183
	ohms	∞	240K	5.9	1100	1050	3.1	230K	∞
V703	volts	110	.01	19.5	1.15	2.6	13	0	165
	ohms	∞	6200	8.6	1200	5300	5.9	240K	∞
V704	volts	175	0	6.5	1.86	1.83	13	0	177
	ohms	∞	230K	3.1	1050	1100	5.9	240K	∞
V705	volts	108	.01	0	1.25	2.8	6.7	0	156
	ohms	∞	9100	0	1250	5000	3.1	230K	∞
V706	volts	165	0	6.5	2.6	1.17	0	.01	115
	ohms	∞	230K	3.1	5100	1250	0	12K	∞
V709	volts	n.c.	n.c.	15	n.c.	.3	8.7	0	24
	ohms	n.c.	n.c.	*5.8	n.c.	1100	*8.5	∞	∞
V710	volts	n.c.	n.c.	28	n.c.	.31	21.7	0	24
	ohms	n.c.	n.c.	*0	n.c.	1050	*3	∞	∞
V711	volts	n.c.	n.c.	15	n.c.	.26	21.3	0	24.5
	ohms	n.c.	n.c.	*5.9	n.c.	1100	*3	∞	∞
V712	volts	135	32	21.7	34	0	15	-.32	32
	ohms	∞	∞	*3	24K	0	*5.8	500K	∞
V713	volts	135	30.5	21.3	32.5	0	28	-.35	30.5
	ohms	∞	∞	*3	24K	0	*0	480K	∞
V714	volts	135	32.5	8.5	35	0	15	-.42	32.5
	ohms	∞	∞	*8.6	23K	0	*5.9	490K	∞

Table 3-10. Typical Voltage and Resistance Data, Information Recorder (Continued)

Transistors (voltage measurements only, volts dc).			
Transistor	Emitter	Base	Collector
Q701	0	.55	4.8
Q702	.47	.66	11.5
Q703	0	.65	8.8
Q704	.42	-.11	27.0
Q705	2.70	2.40	27.0
Q706	.26	.04	28.0

3-29. REPAIRING THE AIRBORNE EQUIPMENT.

3-30. GENERAL.

3-31. As described in paragraph 3-21, replacement of antenna diodes and substitution of units are the only types of repairs that should be attempted at advanced field locations.

3-32. If spare units are not available, the equipment must be removed from the aircraft and must be bench tested to isolate trouble. These bench tests must be performed at base facilities where Unit-Essential Equipment is available.

3-33. If repairs cannot be accomplished at a base facility, replacement units should be requisitioned, and the defective units should be returned to the supply depot.

3-34. REPLACING PARTS.

3-35. After determining that an electronic part must be replaced, obtain a replacement part which is identical physically, as well as electrically. All of the replaceable electrical and mechanical parts are listed by "MP" (maintenance part) numbers in Section V of this instruction guide.

3-36. When replacing electronic parts, observe the following:

a. Mount the replacement part in the same position as the original part.

b. Make the length of the replacement-part leads equal to the length of the leads on the original part.

c. When soldering replacement parts in place, use long-nose pliers to hold the leads of the part. The pliers will conduct heat away from the part.

d. After repairs have been effected, test the electrical performance of the unit.

3-37. When replacing mechanical parts, mechanical alignment and operation must be checked in accordance with paragraph 3-44.

3-38. In general, the equipment can be repaired by any maintenance technician skilled in the repair of airborne equipment. Therefore, only procedures and precautions which apply exclusively to the units of the Airborne Radar-Monitoring System are outlined in these paragraphs.

3-39. REPAIRING THE ANTENNA ASSEMBLIES.

a. If a diode is suspected to be faulty, do not use an ohmmeter to test the diode, but substitute a new one. Because relatively low voltages will damage the diodes, special handling precautions are necessary. When handling a diode, always grasp both terminals simultaneously. Do not touch the ceramic body of the diode, because moisture will cause leakage at high frequencies. When placing a diode into a crystal holder, maintain zero potential across the diode terminals by holding a finger on the crystal holder while inserting the diode.

b. Occasionally a faulty crystal holder may be responsible for improper operation of the detector section of the antenna assembly.

In the case of the S-band antenna, be sure that the insulating sleeve is in good condition, and be sure that the retaining spring is not permanently compressed.

c. If either W1201 or W1204 is faulty, the high frequency response or sensitivity of the airborne equipment may be affected. Disconnect both ends of the cables, and measure the resistance between the center conductors and ground. The resistance should be greater than 10 megohms.

3-40. REPAIRING THE INFORMATION AMPLIFIERS.

a. All of the electrical components are mounted on a single printed board. The tubes may be removed without removing the board from the information-amplifier coverplate. When it is necessary to work with components mounted on the underside of the board, remove the four screws holding the board to the cover, and lay the board back in the direction of the connectors. Avoid causing tension in the leads between the connectors and the printed board.

b. After replacing components, perform the comprehensive series of tests outlined in the paragraphs covering preventative maintenance procedures. Adjust gain-compensation potentiometers R802 and R804 using the procedures described in the preflight ramp tests.

c. Select the value of R171 (300K to 390K) on the basis of negative overshoot at the output of the information amplifier. At J101, apply a peak-to-peak signal level 30 to 36 db below 1 volt. Observe the waveform of the output pulse appearing at J103. The negative overshoot must be less than 15%.

d. Select the value of R159 (3.3M to 4.7M) on the basis of pulse width at the output of the information amplifier. At J101, apply a peak-to-peak signal level of 150 millivolts, pulse width from 0.25 microseconds to 10 microseconds. Observe the waveform of the output pulse appearing at J103. The width of the output pulse must be 150 microseconds, plus 20 microseconds, or minus 10 microseconds.

e. Select the value of R158 (5.6K to 6.1K) on the basis of the threshold firing level of the multivibrator. At J101, apply a peak-to-peak signal 36 db below 1 volt. Observe the waveform of the output pulse appearing at J103. The multivibrator must stop firing at input-signal levels below -36 db.

3-41. REPAIRING THE VIBRATOR D-C SUPPLY. With the exception of rectifiers CR401, CR402, CR403, and CR404, any of the components may be replaced without removing the major board assembly from the power-supply cover plate.

a. When replacing CR401, CR402, CR403 or CR404, remove the three screws mounting the major board assembly, and lay the board back in the direction of the connectors. Avoid causing tension in the interconnecting wires.

b. Special precautions must be taken in replacing C404. It is extremely important to observe the polarity of the capacitor terminals when replacing this capacitor.

3-42. REPAIRING THE INFORMATION RECORDER, GENERAL.

3-43. This unit contains a large number of mechanical as well as electrical parts. The subassemblies and a few electronic parts are shown in the top and bottom views of the information recorder (figure 5-7). Figures 5-8 through 5-13A may be used to locate and identify those mechanical and electronic parts which are not called out in the top and bottom views of the recorder.

3-44. Only those parts considered replaceable in the field are called out in the figures of Section V. The mechanical parts may be replaced as subassemblies, or individual parts of a subassembly may be replaced. The paragraphs which follow contain information pertinent to the replacement of electronic and mechanical parts. When certain electronic parts are replaced, performance tests and adjustments are necessary. When a tape-handling part is replaced, the new part must be adjusted to insure correct alignment of the magnetic tape. If more than one tape-handling part is replaced, or if performance indicates that the tape alignment is unsatisfactory, the complete tape-alignment procedure should be followed.

3-45. REPAIRING THE INFORMATION RECORDER, INSTALLATION OF ELECTRONIC PARTS.

3-46. Most of the electronic parts are mounted on a single printed-circuit board (figure 5-6). Approximately one half of the components can be removed without removing the board from the recorder. The remainder of the components can only be removed after the board has been dismounted. To dismount the board, proceed as follows:

a. Remove the six screws which hold the board to the housing frame.

b. Unplug the board from the printed-circuit connector, and lay the board back over the flywheel.

c. To remove the entire board, remove the cable from the three cable clamps, and disconnect the six miniature connectors.

3-46A. Select the values of R706, R724, R742, R760 (4.7K to 6.8K) on the basis of the peak-to-peak output voltage of the 3-kc, 2.3-kc, 1.7-kc, 1.3-kc oscillators. Measure the output of these oscillators at K5, K4, K3, K2, respectively. The oscillator output voltages must be 3 volts peak-to-peak, plus or minus 3 db.

3-46B. Select the value of R778 on the basis of the peak-to-peak output voltage of the 1-kc oscillator. Measure the output of the oscillator at K1. The oscillator output voltage must be 3 volts peak-to-peak, plus or minus 3 db. The output should be obtainable with a value of R778 which is equal to at least 130K. If a resistor of lower value must be used to obtain the required output, transistor trouble is indicated.

3-46C. Select the value of R701 and R702 on the basis of the output frequency of the 3-kc oscillator. Use either 4.7K or 5.1K resistors to obtain an output frequency of 3.0 kc.

3-46D. Select the value of R719 and R720 on the basis of the output frequency of the 2.3-kc oscillator. Use either 6.2K or 6.8K resistors to obtain an output frequency of 2.3 kc.

3-46E. Select the value of R797, R799, and R801 to obtain a 20.5-kc bias-signal of 300 millivolts peak-to-peak, plus or minus ten per cent, across R798, R803, and R805, respectively.

3-46F. Adjust R802 and R804 for a resistance of 3.9K. This resistance corresponds to the setting for a recording current of 0.125 milliamperes as described in paragraph 2-30g.

3-47. REPAIRING THE INFORMATION RECORDER, ADJUSTMENT OF MECHANICAL PARTS.

3-47A. After replacing a capstan motor, mechanical filter, or motor-support bracket, use a 30-ounce scale (MP 10165) to check the contact force between the flywheel of the capstan-motor and flywheel assembly (MP 10048) and the drive-wheel of the capstan-drive assembly (MP 10050). Refer to figure 5-11A, and proceed as follows:

a. Place the 30-ounce scale against the motor housing at a point three-fourths of an inch from the cable end of the motor.

b. Apply pressure at this point until the flywheel and the drive-wheel break contact.

c. If the tension of the motor-support spring assembly (MP 10155) is adjusted correctly, the scale should indicate between seven and nine ounces when the surfaces break contact.

d. If the scale reading is outside this range, adjust the set screw (MP 10110) located on the motor-support bracket (MP 10648) until the tension of the spring produces the specified scale reading.

3-47B. After replacing a jam-roller assembly, adjust the position of the three locknuts on the plunger-linkage lead screw. Refer to figure 5-11, and proceed as follows:

CAUTION

While adjusting the locknuts, keep the plunger linkage from rotating by holding the flatted end of the lead screw (MP 10728). Holding the linkage at the sleeve (MP 10286) may result in permanent deformation of the spring (MP 10756) inside the linkage sleeve.

a. With the solenoid energized, position the locknut nearest the flatted end of the lead-screw for a jam-roller (MP 10065) force of 34 to 38 ounces on the surface of the shaft of the capstan-drive assembly (MP 10050).

b. Position the middle locknut about one turn from the lever assembly (MP 10354).

c. Position the third locknut about two turns from the linkage sleeve.

d. With the solenoid de-energized, position the stop-screw on the lever-arm assembly to provide a clearance of from .05 to .07 inches between the jam roller and the shaft of the capstan-drive assembly.

3-47C. If an ohmmeter is used in measuring the continuity of the erase, record, or playback heads, demagnetize the heads before attempting to use the recorder. The heads must also be demagnetized if a tool comes in contact with the head assembly.

3-47D. If the erase, record, or playback heads are replaced, mechanical alignment of the head(s) and associated guides is required. (See figure 5-10.) Preliminary alignment is performed by observing the relationship between the heads and the magnetic tape, and final alignment is based upon the use of standard alignment tape to optimize frequency-response characteristics.

3-47E. The following are preliminary head-alignment conditions and procedures:

a. With the tape-guide bracket assemblies (MP 10034 and MP 10035) aligned correctly, and with the head cover open, align each head by sight so that the tape-contacting surface is parallel with the teflon sleeves of the guide-pin assembly (MP 10670). Preliminary alignment is satisfactory if the full width of the tape is in contact with the head gaps, and if the gaps are completely covered by the tape.

b. The above conditions may be fulfilled by adjusting the two head-alignment screws provided for each head. The screws are accessible from the underside of the head and head-cover assembly.

CAUTION

When adjusting the head-alignment screws, avoid scratching or denting the elastic surface of the capstan-drive wheel.

3-47F. The final head-alignment procedure involves the orientation of the head gaps so that they are at right angles to the direction of tape travel. In the case of the record and playback heads, correct head orientation provides optimum high-frequency response characteristics. In the case of the erase head, correct head orientation provides maximum signal-to-noise ratio. Refer to figure 5-10, and proceed as follows:

a. Disable the source of bias and erase signals by removing the printed-circuit board from the recorder.

b. Demagnetize the heads.

c. Load the recorder with standard alignment tape (MP 10144).

d. Observe the output on a high-gain oscilloscope connected to the playback head. Adjust the orientation of the gap of the playback head (MP 10020) for optimum high-frequency output from the three channels. The adjusting screw is located on the tape-capstan side of the head, and is accessible from the top of the recorder.

e. Remove the standard alignment tape, and load the recorder with operational tape.

f. Replace the printed-circuit board.

g. Adjust the orientation of the gap of the record head (MP 10038) for optimum high-frequency recording level on the three channels.

h. Adjust the orientation of the gap of the erase head (MP 10040) for minimum residual signal on the three channels. Note that adjusting the erase head also re-positions the tape-guide bracket assembly (MP 10035) mounted on the side of the head. After adjusting the erase head, re-position the tape-guide bracket assembly.

3-47G. After replacing a reel-drive assembly (MP 10184 or MP 10168), adjust the degree of mesh between the reel-drive gear and reel-rim gear. Refer to figure 5-8, and proceed as follows:

a. Rotate the adjustment screw located on the adjusting-screw mounting bracket (MP 10169 or MP 10175), until the idler gear (MP 10794) and reel gear are fully meshed.

b. Disengage the idler gear and reel gear about 25% by turning the adjustment screw one-half turn.

c. Cement the adjustment screw in place.

3-47H. After replacing one of the tape-guide rollers or assemblies (MP 10013 of figure 5-7, MP 10113 of figure 5-9, MP 10095 or MP 10101 of figure 5-12), check the position of the tape in relation to the roller flanges. The tape must pass across the center of the roller without being bent by the flanges. If the roller flanges bend the tape, the height of the roller must be changed. Place .002-inch shims on either end of the roller until the tape is centered midway between the roller flanges. This alignment must be checked with the tape in motion.

3-47I. After replacing one of the tape-guide bracket assemblies (MP 10034 or MP 10035 of figure 5-10), check the position of the tape in relation to the bracket guide pins. The pins must be perpendicular to the plane of the tape, and the tape must pass between the pins without being bent. If one of the pins bends the tape, loosen the support screws and adjust the assembly until the tape enters and leaves the head and head-cover assembly without being bent. This adjustment must be checked with the head cover open, and with the tape in motion.

3-47J. After replacing a loop-arm assembly, use a three-ounce scale (MP 10207) to check the tension of the lopp arm. Refer to figure 5-9, and proceed as follows:

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a. Connect the scale to the shaft (MP 10126) of the tape-guide roller (MP 10113), and deflect the loop arm (MP 10115) through its entire arc. While the arm is in motion, the tension must be between two and two and one-half ounces. If the tension of the loop arm is outside the range specified, proceed with steps b through d.

b. Release the counterbalance spring by turning the small-gear lock screw counterclockwise. (The screw is located on the upper side of base-plate MP 10127.)

c. Using a screwdriver to turn the shaft of the large-gear assembly (MP 10117), adjust the tension of the counter-balance spring until the tension of the loop arm is within the specified range.

d. While holding the large gear in position, turn the small-gear lock screw clockwise until it engages the teeth of the small gear.

3-47K. The loop-arm commutator assembly (MP 10129 of figure 5-9) must be adjusted for static balance before the contact and leaf-spring assembly (MP 10125) and brush (MP 10043) are assembled. Static balance is achieved by adjusting the counterweight screw. After completing the assembly, bend the leaf spring to provide a pressure of one to one and one-fourth ounces on the contact strip (MP 10123).

3-48. REPAIRING THE INFORMATION RECORDER, COMPLETE TAPE-ALIGNMENT PROCEDURE.

3-48A. When replacing a single mechanical assembly it may be necessary only to make the alignment adjustments for the individual assembly as described in paragraph 3-47. However, if several parts or assemblies are replaced, it may be necessary to repeat the initial sequence of tape-alignment adjustments described in the paragraphs which follow.

3-48B. Before installing the tape reels the following checks and adjustments should be performed:

a. Check the flywheel force on the capstan drive-wheel. Adjust the force as in paragraph 3-47A.

b. Check the jam-roller force on the shaft of the capstan-drive assembly. Adjust the force as in paragraph 3-47B.

c. Check the preliminary alignment of the playback, record, and erase heads. Adjust the alignment of the heads as in paragraphs 3-47D and 3-47E.

d. Remove the guide roller of the tape-guide assembly (MP 10013 of figure 5-7) and the lower-transition guide roller (MP 10101 of figure 5-12).

e. Check the reel-guide rollers for ability to turn freely.

3-48C. After loading the supply reel with tape, install the supply and takeup reels, engage the reel-guide rollers, and thread the tape as shown in figure 2-1. With the head cover open continue as follows:

a. Engage the reel-drive gears. Check the degree of mesh. Adjust the degree of mesh as in paragraph 3-47G.

b. Manually apply tension to the tape and adjust the elevation of the supply-reel loop-arm guide roller so that the tape is centered when leaving the supply reel. Adjust the guide-roller elevation as in paragraph 3-47H.

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c. Manually apply tension to the tape and align the tape-guide bracket assemblies on the head assembly so that the pins are perpendicular to the plane of the tape and the tape passes between the pins without being bent. Adjust the bracket assemblies as in paragraph 3-47I.

d. Manually apply tension to the tape and adjust the elevation of the takeup-reel loop-arm guide roller so that the tape is centered when entering the takeup reel. Adjust the guide-roller elevation as in paragraph 3-47H.

3-48D. Close the head cover, place the tape in motion and continue as follows:

a. Manually hold the jam roller away from the capstan and maintain the tape in motion by holding the supply-reel loop-arm in the center of its travel. Check the elevation of the guide rollers and guide brackets.

b. Allow the jam roller to engage, while checking for any tendency of the tape to be bent by either the upper or lower pin on the tape-guide bracket assembly (MP 10034). Bending by the upper pin may be counter-acted by increasing the elevation of the takeup-reel loop-arm guide roller. Conversely, bending by the lower pin may be counter-acted by decreasing the elevation of the takeup-reel loop-arm guide roller. Readjust the guide-bracket-assembly elevation if the tape continues to be bent after changing the elevation of the takeup-reel guide roller. Minor bending tendencies on either the upper or lower guide pin may be eliminated by slight readjustment of the forward or backward tilt of the playback head.

3-48E. Open the head cover, place the tape in motion, and continue as follows:

a. Adjust the elevation of the playback, record, and erase heads so that the tape centers on the three tracks of each head.

Maintain the existing attitude of each head while adjusting the elevation.

b. Replace the guide rollers removed in paragraph 3-44Bd. Use the tape elevation as a reference for establishing the guide-roller elevation.

c. Recheck the elevation of the guide roller preceding the takeup reel to insure the tape will continue winding on the center of the reel.

3-48F. Perform the final head-alignment procedures of paragraph 3-47F.

3-48G. PREVENTATIVE MAINTENANCE. The preventative maintenance for the Airborne Radar-Monitoring System includes: (1) Routine maintenance of the airborne equipment, and (2) Periodic evaluation of system performance. These paragraphs contain detailed instructions pertaining to over-all system tests and specific instructions for periodic maintenance of the airborne equipment.

3-48H. ROUTINE MAINTENANCE OF THE AIRBORNE EQUIPMENT. The following maitenance notes are supplementary to the preflight bench procedures described in Section II:

a. When units are removed from the aircraft, they should be thoroughly cleaned, and should be inspected for signs of corrosion or wear.

b. Periodic lubrication is not required.

c. Personnel responsible for maintenance of the equipment must keep a record of operating time. The record is based upon the operating-time entries on the Preflight Test-Data Form.

3-48I. The capstan-drive-motor commutator must be cleaned every 15 hours of operation to avoid motor failure due to an accumulation of carbon dust from the brushes. At the same time, new brushes should be added if required. To clean the capstan-motor commutator proceed as follows:

a. Remove the two screws securing the top motor shield and remove the shield.

b. Depress the two spring clips and remove the motor end caps. Remove the retaining ring from the motor shaft. Remove the two washers and the spring from the motor shaft.

c. Using tweezers, withdraw the two springs holding the brushes against the commutator. Withdraw the two brushes from the brush holders, while being careful not to fray the brush pigtails.

d. Examine the brushes for wear, pitting, or frayed pigtails and replace the brushes if required. When replacing the brushes, do not let excessive solder run through the pigtail strands. The solder stiffens the brush leads and prevents the brush from engaging the commutator surface.

e. Pry the commutator assembly off the slotted motor shaft. Remove any carbon dust from the commutator assembly with an alcohol bath. Also, clean the commutator segments with an alcohol-soaked cloth. Lightly burnish the surface of the commutator segments with very fine sandpaper. Use great care in burnishing to avoid shorting commutator segments.

f. Replace the commutator assembly on the motor shaft; insert the brushes, and reposition the brush-holder springs; replace the two washers, spring and retaining ring; replace the end caps and top motor shield. Complete the assembly by replacing the two screws to secure the top motor shield.

3-49. PERIODIC EVALUATION OF SYSTEM PERFORMANCE. Extensive performance tests are to be performed at 50-hour intervals. (The 50-hour period is based upon airborne-equipment operating time.) These tests are designed to reveal marginal equipment performance which may not be revealed by the preflight and re-recording procedures. The following performance characteristics are to be evaluated during the comprehensive 50-hour tests.

a. Vibrator D-C supply: voltage levels, hum and noise levels.

b. Information amplifier: hum and noise, frequency response, pulse control, gain, and dynamic range characteristics.

c. Information recorder: tape speed, flutter and wow, tone outputs, bias levels, erase levels, record-current levels, and head alignment.

d. Re-record equipment. A recording made on the information recorder is played back at 2.25 inches-per-second on the low-speed transport of the re-record equipment. The monitor output voltage is noted and compared with typical characteristic curves. During this test, the signal is re-recorded at 7.5 inches-per-second. Finally, the re-recorded signal is played back on the high-speed transport of the re-record equipment. The monitor output voltage is noted and compared with typical characteristic curves.

All of the airborne equipment, except the antennas, must be removed from the aircraft for these tests. To perform the tests, set up the equipment in a convenient working area, remove the covers from the units, and interconnect the equipment using a cabling system similar to the one installed in the aircraft.

3-50. NORMAL-PERFORMANCE CHARACTERISTICS OF THE VIBRATOR D-C SUPPLY. The normal-performance characteristics of the vibrator D-C supply are indicated in table 3-6.

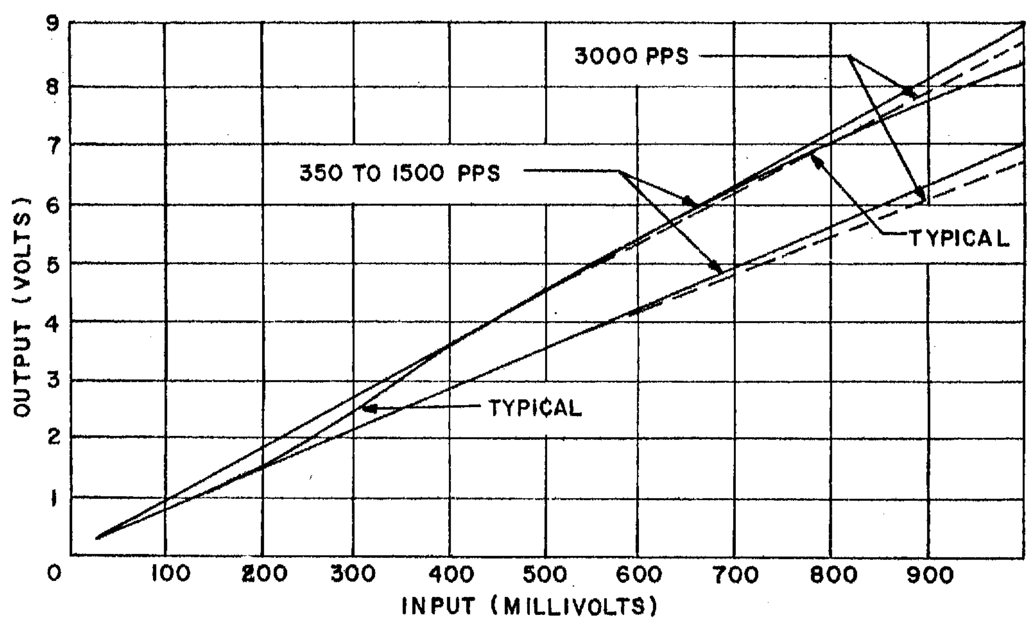
3-51. NORMAL-PERFORMANCE CHARACTERISTICS OF THE INFORMATION AMPLIFIER. The normal-performance characteristics of the information amplifier are listed in table 3-11.

Table 3-11. Performance Data, Information Amplifier

HUM AND NOISE	With the input and output circuits of the information amplifier unterminated, the peak-to-peak voltage of residual hum and noise must be less than 25 millivolts.
FREQUENCY RESPONSE	With a peak-to-peak input-signal level of 150 millivolts, the peak-to-peak open-circuit voltage measured at pin A of J103 must be as follows: 1 microsecond pulses: — Output voltage (± 1 db): 100 pps — 1 250 pps — 1 500 pps — 1 1000 pps — 1 2000 pps — 1 3000 pps — 1 4000 pps — .95 5000 pps — .9
PULSE CONTROL	To test pulse control, input pulses having the following characteristics are applied to the input of the information amplifier: pulse width, from .25 to 10 microseconds; pulse-repetition rate, 1000 pps; pulse amplitude, 150 millivolts peak-to-peak. The output pulses (measured at pin A of J103) must be 160 microseconds, ± 25 microseconds

Table 3-11. Performance Data, Information Amplifier
(Continued)

GAIN AND DYNAMIC RANGE	The graph indicates the normal open-circuit output voltage (measured at pin A of J103) for input-signal levels between 25 millivolts and 1 volt. (All voltages measured peak-to-peak; input pulse width: 1 microsecond.)



3-52. NORMAL-PERFORMANCE CHARACTERISTICS OF THE INFORMATION RECORDER. The normal-performance characteristics of the information recorder are listed in Table 3-12.

Table 3-12. Performance Data, Information Recorder

TAPE SPEED	Two requirements must be fulfilled by the tape-transport mechanism: (1) the average speed of the capstan-drive wheel must be 6.51 R.P.S. (+2%, -4%), and (2) the instantaneous deviation (flutter or wow) must be no greater than 1.5%. (1) The speed of the tape is checked by means of the tape-drive capstan, using a stroboscopic lamp in conjunction with the pattern on the capstan. If the speed is 2% high or 4% low, adjustment is required. Adjust for correct speed by turning off the information recorder, removing the end cap from the capstan drive motor, and adjusting the governor screw. Note that the capstan pattern will appear stationary for speeds that are related to the correct speed. Also, although the pattern can be made to appear stationary with a stroboscopic lamp energized by a 60-cycle source of power, special considerations are required if the stroboscopic lamp is operated from power sources which are not 60 cycles-per-second. The exact frequency of the line voltage must be determined, and compensating adjustments indicated in the lamp manual must be made. (2) The instantaneous variation of tape speed is checked by recording a 3000-cps tone on the information recorder, and by playing back the recording into a flutter meter, using the ground-based re-record equipment as the playback device. If the flutter is greater than 1.5%, adjustment is required. Flutter can result from damaged or worn bearings and surfaces associated with the capstan drive motor, mechanical filter, capstan-drive wheel, or jam roller.

Table 3-12. Performance Data, Information Recorder (Continued)

1.0-KC, 1.3-KC, 1.7-KC, 2.3-KC, AND 3.0-KC OSCILLATORS	The oscillators must have the following output characteristics (as measured at key-points K5, K4, K3, K2, and K1, respectively):
Level:	3 volts, peak-to-peak, plus or minus 3 db.
Distortion:	less than 10%.
Hum and Noise:	20 db below signal.
Frequency Deviation:	plus or minus 5% for 1.3-kc, 1.7-kc, 2.3-kc and 3.0-kc oscillators. Plus or minus 0.02% for 1-kc oscillator.
RECORDING BIAS	The following are the normal operating characteristics of the recording-bias circuits:
Level:	310 millivolts (plus or minus 10%) peak-to-peak across the 100-ohm metering resistor.
Distortion:	5% maximum.
Hum and Noise:	.5 millivolts peak-to-peak across the 100-ohm metering resistor.
Frequency:	20.5 kc, plus or minus 5%.
ERASE CURRENT	The following are the normal operating characteristics of the erase circuit:
Level:	300 millivolts (plus or minus 10%) peak-to-peak across the 10-ohm metering resistor.
Distortion:	5% maximum.
Hum and Noise:	30 millivolts peak-to-peak across the 10-ohm metering resistor.
MONITOR AMPLIFIER	The normal operating characteristics of the monitor amplifier circuits are listed below. The following characteristics are measured by applying a 10-millivolt signal, at 1000

Table 3-12. Performance Data, Information Recorder (Continued)

MONITOR AMPLIFIER (Continued)	cps, from a 50-ohm source, to the input of the amplifier (with the playback head disconnected).
Gain:	60 db, plus or minus 3 db.
Distortion:	5% maximum.
Frequency Response:	plus or minus 1 db 350 to 4000 cps.
	The following characteristics are measured with the playback head connected, and with the entire system in operation.
Hum and Noise:	5 millivolts maximum at J701.
HEAD ALIGNMENT	Two characteristics of playback-head alignment are checked. The electronics-board assembly is removed, and standard alignment tape is threaded through the machine. A high-gain oscilloscope is connected to the playback heads.
	(1) The output voltages derived from the three playback heads must be within a three-db range.
	(2) The playback heads are also aligned for maximum response to the highest readable frequency recorded on the standard alignment tape.
	The two standards outlined above are also used in checking the alignment of the record heads. To perform this test, the standard alignment tape is removed from the machine, is replaced by the tape normally used in the information recorder, and a 3000-pps signal is recorded. The record head is aligned for maximum signal at the playback head.

Table 3-12. Performance Data, Information Recorder
(Continued)

RECORD CURRENT	The graphs which follow indicate the normal record current for different pulse repetition rates and different pulse amplitudes. The "record current" is noted as the peak-to-peak signal voltage which appears across the 100-ohm metering resistor in series with the record head. In the case of right-side information channel, the signal voltage representing record current is measured at TP4. The signal voltage for the left-side information channel is measured at TP1. The graph below represents the normal record current for peak-to-peak pulse-input levels ranging from 8 millivolts to 8 volts, at a pulse repetition rate of 1000 pps (applied to the input of the information amplifier). The output-signal levels should be within ± 3 db of the curves shown below.

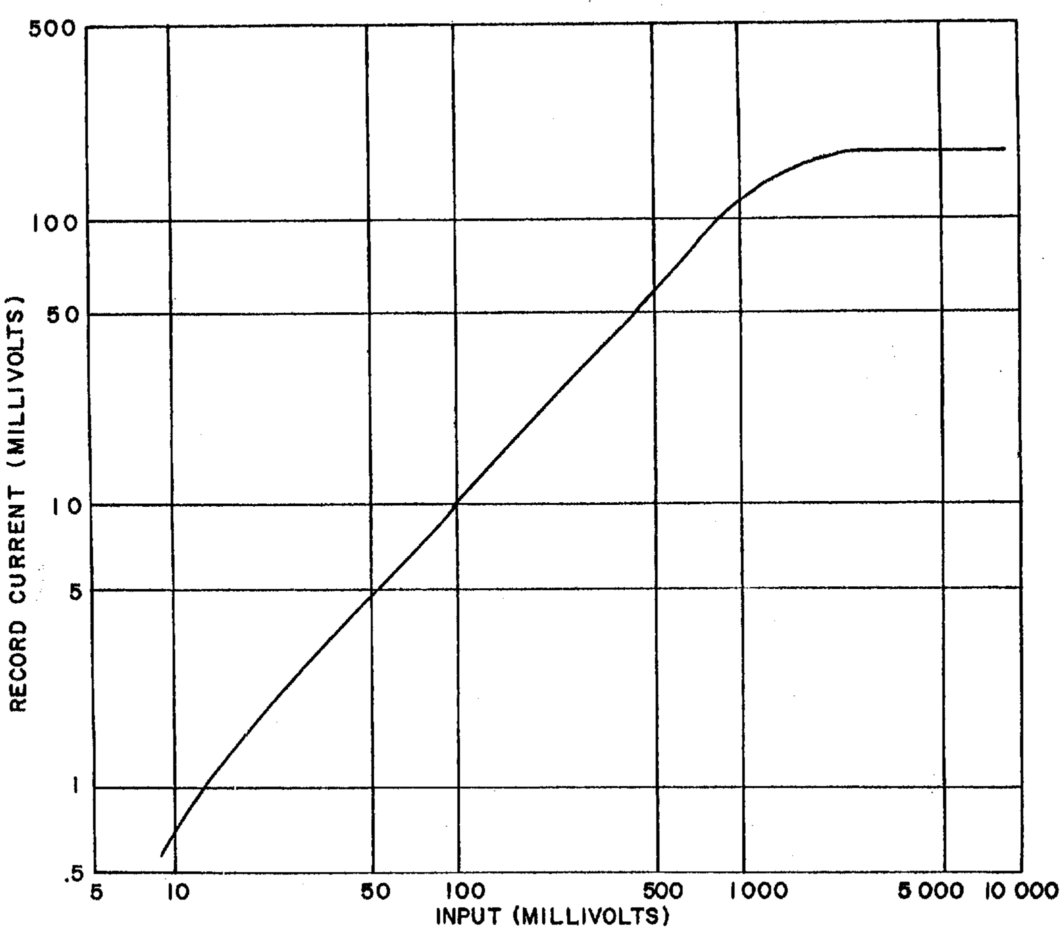
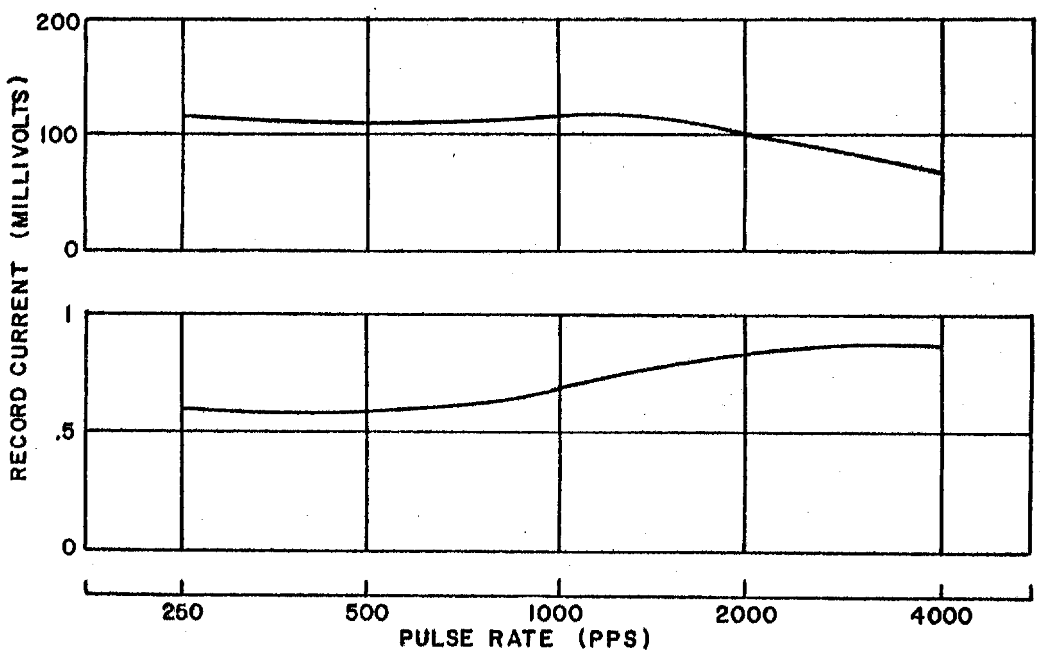


Table 3-12. Performance Data, Information Recorder
(Continued)

The graphs below represent the normal record current for pulse repetition rates between 250 and 4000 pps, and for pulse-input levels of 8 millivolts and 1 volt (applied to the input of the information amplifier). The output-signal levels should be within ± 1.5 db of the curves shown below.



3-53. NORMAL-PERFORMANCE CHARACTERISTICS OF THE RE-RECORD EQUIPMENT. The normal-performance characteristics of the re-record equipment are listed in Table 3-13.

Table 3-13. Performance Data, Re-Record Equipment

PLAYBACK OF TEST RECORDING	The graphs which follow indicate the playback levels of the test signals recorded on the information recorder during the RECORD CURRENT test described in Table 3-12. After recording the signals on the tape, place the tape on the low-speed playback transport, and re-record the signal at 7.5 inches-per-second. On the re-record amplifier unit for the track involved, set the controls as follows: EQUALIZATION SWITCH in LOW SPEED position, RECORD LEVEL set for a reading of -3 on the VU meter (for 1000-pps 1-volt peak-to-peak signal), LINE TERM in ON position, PLAYBACK LEVEL set for reading of 0 on VU meter (at 1000 pps). Connect an oscilloscope across the MONITOR AMPLIFIER jack, and measure the peak-to-peak voltage of the output signal. The output-signal levels should be within plus or minus 3 db of the curves shown below.

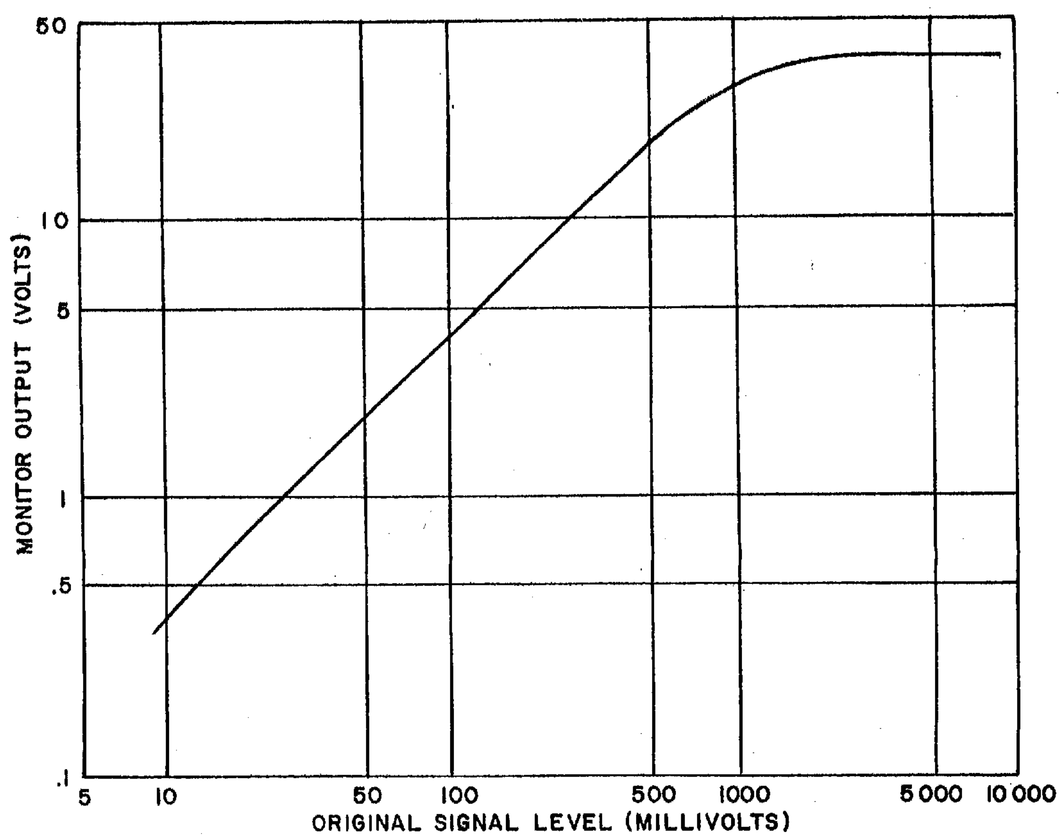
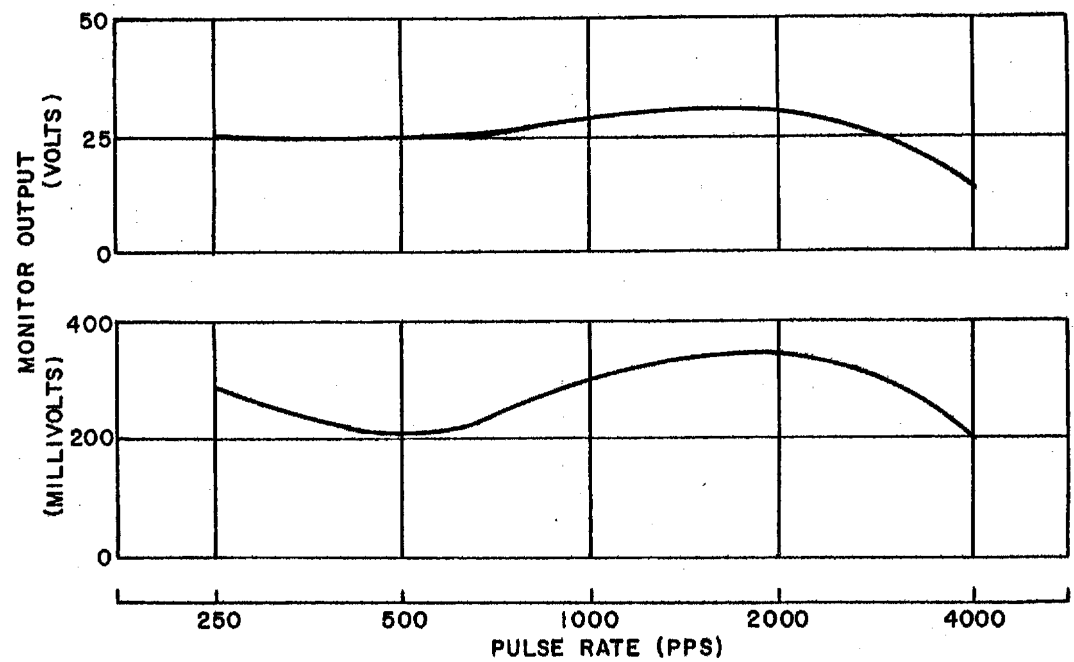
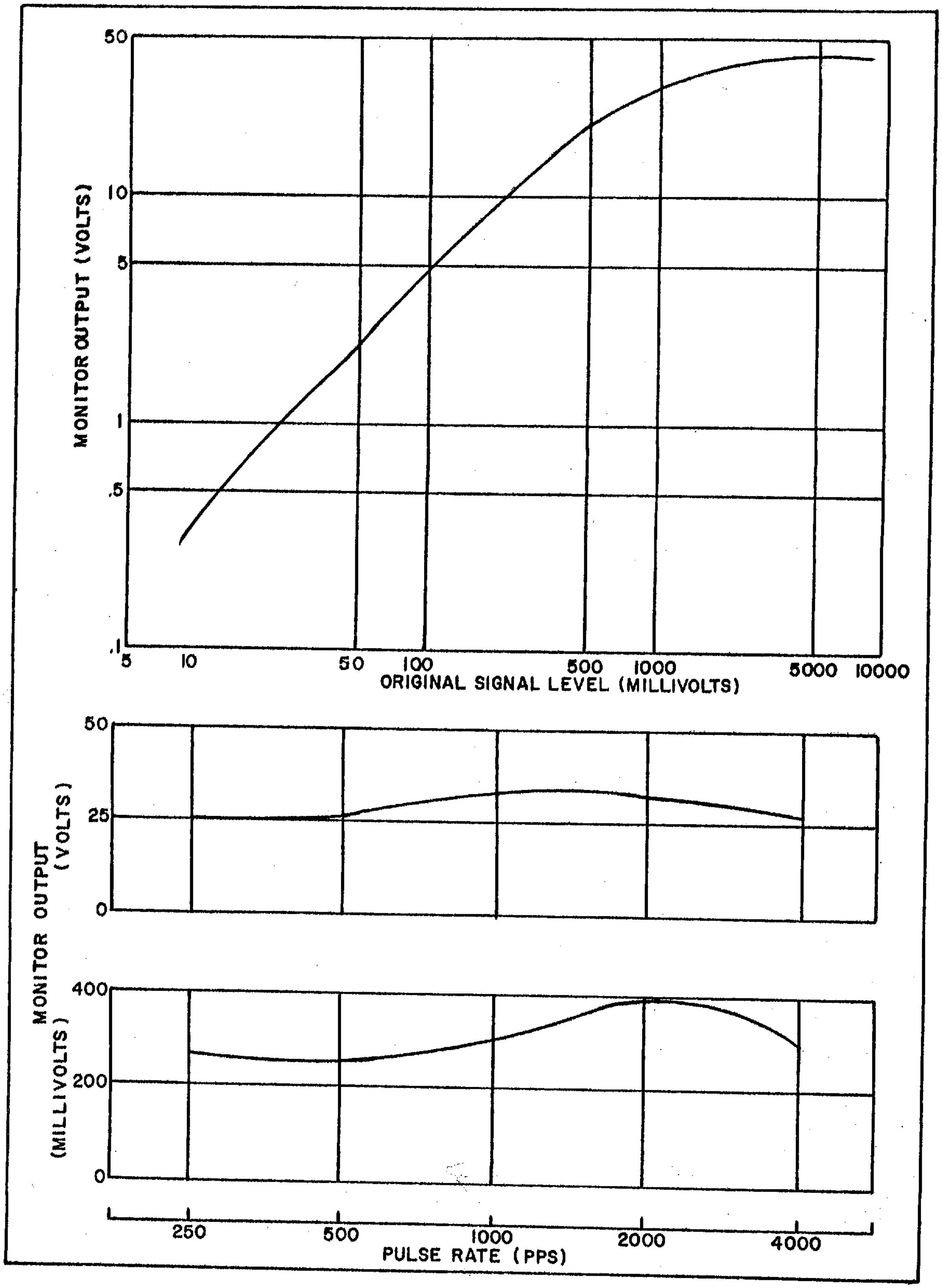


Table 3-13. Performance Data, Re-Record Equipment (Continued)



PLAYBACK OF RE-RECORDED TEST SIGNALS	The graphs which follow indicate the playback levels of the test signals re-recorded at 7.5 inches-per-second. After re-recording the signals at 7.5 inches-per-second, playback the re-recorded tape by proceeding as follows: connect the playback head of the high-speed re-record transport to the PLAYBACK HEAD jack of the amplifier for the track involved, set the EQUALIZATION SWITCH in HIGH SPEED position, place the LINE TERM switch in the ON position, and set the PLAYBACK LEVEL control for a reading of 0 on the VU meter (for 1000-pps 1-volt peak-to-peak signal). Connect an oscilloscope across the MONITOR AMPLIFIER jack, and measure the peak-to-peak voltage of the output signal. The output-signal levels should be within plus or minus 3 db of the curves shown below.

Table 3-13. Performance Data, Re-Record Equipment (Continued)



3-54. <u>SERVICING THE GROUND-BASED TEST SET.</u> The general principles of isolating trouble, outlined in the first paragraphs of this section, are applicable to the test set. The test set is shown schematically in figures 1-22A and 1-22B. The test-set oscilloscope is described in the instruction manual included with the equipment.

3-55. ISOLATING TROUBLE.

3-56. Before attempting to isolate trouble in the test set, the maintenance technician must become thoroughly familiar with the theory of operation (paragraphs 1-143 through 1-193).

3-57. The waveforms shown in figure 1-21 may be used to isolate a defective stage. Before observing the waveforms, the test-set controls must be preset as follows:

a. ON-OFF switch -- ON

b. MODULATION switch -- PULSE

c. REPETITION RATE control -- 1 K

The waveforms are observed using the oscilloscope probe, with the negative lead of the probe connected to the test-set chassis.

3-58. Table 3-14 contains typical voltage and resistance data which may be used for the purpose of isolating defective components in the test set. The voltage and resistance measurements are to be made under the conditions described in the table.

Note

> Table 3-14 contains nominal voltage and resistance data, while the Inspection Data Sheets (included with each test set) contain specific data. Changes in component values are also noted on the Inspection Data Sheets.

Table 3-14. Typical Voltage and Resistance Data, Ground-Based Test Set

The VOLTAGE DATA in this table to be taken under the following conditions:	1. Primary power: 117 volts ac. 2. All measurements made with a 20,000 ohm/volt multimeter. 3. All voltage measured to ground. 4. Where (*) specified, measurements made at plate caps of V508. 5. "H" indicates heater terminals.
WARNING Dangerously high voltages are used in the test set. Use a high-voltage probe when taking measurements.	
The RESISTANCE DATA in this table to be taken under the following conditions:	1. Primary power turned off. 2. Measurements made with a vacuum-tube voltmeter. 3. All resistance measured to ground with negative meter lead grounded. 4. Where (*) specified, measurements made at plate caps of V508.
Set the test-set controls as follows: OUTPUT switch -- X-BAND MODULATION switch -- CW POWER ZERO SET control -- Zero reading on r-f wattmeter.	

Table 3-14, Typical Voltage and Resistance Data,
Ground-Based Test Set
(Continued)

Component		Terminal Number*							
		1	2	3	4	5	6	7	8
V503	volts	110	0	NC	0	110	NC	0	--
	ohms	3.2K	0	NC	0	3.2K	NC	0	--
V504	volts	0	-105	NC	-105	0	NC	-105	--
	ohms	0	7.5K	NC	7.5K	0	NC	7.5K	--
V506	volts	535	NC	NC	535	--	--	--	--
	ohms	2.1M	NC	NC	2.1M	--	--	--	--
V507	volts	535	NC	NC	535	--	--	--	--
	ohms	2.1M	NC	NC	2.1M	--	--	--	--
V508	volts	H	-45	415	0	H	-45	H	490*
	ohms	∞	2.5M	2.2M	0	∞	2.5M	∞	2.1M*
V509	volts	0	-1100	-1100	-1105	-1100	-1000	-1100	-45
	ohms	0	40K	40K	255K	40K	36K	40K	2.4M
V511	volts	-1100	-1250	NC	-1250	-1100	NC	-1250	--
	ohms	40K	135K	NC	135K	40K	NC	135K	--
V512	volts	NC	H	NC	-1960	NC	-1960	NC	H
	ohms	NC	∞	NC	250K	NC	250K	NC	∞
V513	volts	-1250	-1400	NC	-1400	-1250	NC	-1400	--
	ohms	135K	220K	NC	220K	135K	NC	220K	--
V514	volts	-1400	-1550	NC	-1550	-1400	NC	-1550	--
	ohms	220K	270K	NC	270K	220K	NC	270K	--
V516	volts	-1550	-1700	NC	-1700	-1550	NC	-1700	--
	ohms	270K	275K	NC	275K	270K	NC	275K	--
V517	volts	-1700	-1850	NC	-1850	-1700	NC	-1850	--
	ohms	275K	245K	NC	245K	275K	NC	245K	--
V518	volts	NC	-1250	NC	NC	-1250	NC	-1250	-1250
	ohms	NC	134K	NC	NC	134K	NC	134K	134K
Place the OUTPUT switch in the S-BAND position.									
V519	volts	NC	-1250	NC	NC	-1275	NC	-1250	-1250
	ohms	NC	134K	NC	NC	55K	NC	134K	134K

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20 September 56.

Table 3-14. Typical Voltage and Resistance Data, Ground-Based Test Set (Continued)

To measure the repeller voltages of the klystrons, connect the voltmeter to contact number 1 of S503A, and set the test-set controls as follows:

OUTPUT -- X-BAND; MODULATION -- CW
V518 repeller voltage: -1750 volts

MODULATION -- PULSE; REPETITION RATE -- 1 K
V518 repeller voltage: -1540 volts

OUTPUT -- S-BAND; MODULATION -- CW
V519 repeller voltage: -1525 volts

MODULATION -- PULSE; REPETITION RATE -- 1 K
V519 repeller voltage: -1300 volts

Set the test-set controls as follows:

OUTPUT switch -- S-BAND or X-BAND
MODULATION switch -- PULSE

Connect a jumper between pin 1 of V601 and ground to disable the Wein Bridge oscillator.

Component		Terminal Number							
		1	2	3	4	5	6	7	8
V501	volts	295	145	NC	145	295	NC	145	--
	ohms	100K	100K	NC	100K	100K	NC	100K	--
V502	volts	145	0	NC	0	145	NC	0	--
	ohms	100K	0	NC	0	100K	NC	0	--
V601	volts	0	3.8	H	H	135	138	3.8	--
	ohms	52K	270	0.1	0.1	110K	110K	270	--
V602	volts	0	2.5	H	H	115	138	2.5	--
	ohms	535K	190	0.1	0.1	120K	110K	190	--
V603	volts	260	0	110	H	H	15	2.3	7.7
	ohms	105K	10M	190K	0.1	0.1	220K	410	1.5K
V604	volts	-30	0	H	H	-30	285	-30	--
	ohms	90K	1.5K	0.1	0.1	190K	420K	190K	--
V605	volts	H	0	0	100	NC	280	-30	0
	ohms	0.1	0	10K	120K	NC	110K	110K	0
Term 9 V603	volts	0	Term 9 V605	volts	H				
	ohms	20K		ohms	0.1				

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3-59. Replacing components in the test set may be accomplished without using special procedures. However, after replacing a component which might affect the frequency or amplitude characteristics of test-set output, tests must be performed to insure proper operation. Test-set adjustments (other than those performed in the course of normal operation) are described in the paragraphs which follow.

3-60. PERFORMING ADJUSTMENTS.

3-61. The following test-set adjustments may be made:

a. The width of the output pulse is controlled by R632.

b. The shape of the output pulse is controlled by L603.

c. The output voltage of the klystron power supply is controlled by R542.

d. For CW operation, S-band output power and frequency are controlled by R562 and by the mechanical adjustment of V519. For PULSE operation, S-band output power and frequency are controlled by R561 and by the mechanical adjustment of V519.

e. For CW operation, X-band output power and frequency are controlled by R558, and by the mechanical adjustment of V518 and the double-tuned stub. For PULSE operation, the X-band output power and frequency are controlled by R557, and by the mechanical adjustment of V518 and the double-tuned stub.

Detailed procedures for adjusting the above components are given in the paragraphs which follow.

3-62. To adjust the width of the output pulse, proceed as follows:

a. Place the REPETITION RATE control in the 1K position.

b. Place the MODULATION switch in the PULSE position.

c. Connect the oscilloscope input to J602.

d. Adjust R632 for a pulse width of 1.0 microsecond.

3-63. To adjust the shape of the output pulse proceed as follows:

a. Place the REPETITION RATE control in the 1K position.

b. Place the MODULATION switch in the PULSE position.

c. Connect the oscilloscope input to J602.

d. Adjust L603 for minimum pulse rise time without ringing.

3-64. To adjust the output voltage of the klystron power supply proceed as follows:

a. Connect a 20,000 ohm/volt multimeter between pin 2 of V511 and ground.

b. Adjust R542 for a meter reading of -1250 volts.

3-65. To adjust the S-band output power and frequency for CW operation proceed as follows:

a. Place the OUTPUT switch in the S-BAND position.

b. Place the MODULATION switch in the CW position.

c. With zero power applied to the PWR. MON. jack, adjust the POWER ZERO SET control for a reading of zero on the r-f wattmeter.

d. Connect the S-BAND OUT jack to the PWR. MON. jack.

e. Adjust R562 for maximum output as read on the r-f wattmeter. The klystron output will rise and fall through several peak values as the repeller voltage is changed by adjusting R562. (The first peak observed will not necessarily represent maximum output.)

f. Adjust the S-BAND ATT. control as required to maintain on-scale meter readings.

g. Measure the klystron output frequency by adjusting the S-band wavemeter for a dip in output power.

Note

To make maximum output power available at the OUTPUT jack, it is necessary to detune the wavemeter after each frequency measurement.

h. If the measured frequency falls outside the range of 2850 megacycles $\pm$25 megacycles, adjust the mechanical tuning of V519. Re-adjust R562 for maximum output power and re-measure the output frequency. It may be necessary to repeat these steps several times to obtain the required output frequency.

3-66. To adjust the S-band output power for PULSE operation proceed as follows:

a. Place the MODULATION switch in the PULSE position.

b. Place the REPETITION RATE control in the 1K position.

c. Connect the accessory crystal mount and crystal to the S-BAND OUT jack. Connect the oscilloscope input to the crystal output.

d. Adjust R561 for maximum pulse amplitude as observed on the oscilloscope.

3-67. To adjust the X-band output power and frequency for CW operation proceed as follows:

a. Place the OUTPUT switch in the X-BAND position.

b. Place the MODULATION switch in the CW position.

c. With zero power applied to the PWR. MON. jack, adjust the POWER ZERO SET control for a reading of zero on the r-f wattmeter.

d. Connect the X-BAND OUT jack to the PWR. MON. jack.

e. Adjust R558 for maximum output (refer to paragraph 3-65e) as read on the r-f wattmeter.

f. Adjust the X-band double-stub tuner (located between the 2K39 and the rectangular waveguide) for maximum output.

g. Adjust the X-BAND ATT. control as required to maintain on-scale meter readings.

h. Measure the klystron output frequency by adjusting the X-band wavemeter for a dip in output power. Detune the wavemeter as noted under paragraph 3-65G.

i. If the measured frequency falls outside the range of 9000 megacycles ± 25 megacycles, adjust the mechanical tuning of V518. Re-adjust R558 for maximum output power, re-adjust the double-stub tuner for maximum output, and re-measure the output frequency. Repeat these steps as required to obtain the specified output frequency.

3-68. To adjust the X-band output power for PULSE operation proceed as follows:

a. Place the MODULATION switch in the PULSE position.

b. Place the REPETITION RATE control in the 1K position.

c. Connect the accessory crystal mount and crystal to the X-BAND OUT jack. Connect the oscilloscope input to the crystal output.

d. Adjust R557 for maximum pulse amplitude as observed on the oscilloscope.

3-69. SERVICING THE GROUND-BASED RE-RECORD EQUIPMENT.

3-70. Normal-performance data for the re-record equipment is shown in table 3-13. Because the data in the table involves the processing of recorded pulse information, the data is not directly indicative of the sine-wave frequency response of the amplifiers used in the re-record equipment. The paragraphs which follow describe the test set-up and procedure to be followed when testing the frequency response of the re-record amplifiers.

3-71. TESTING THE FREQUENCY-RESPONSE CHARACTERISTICS OF THE RE-RECORD AMPLIFIERS.

3-72. The original amplifiers (which were modified for use in the re-record equipment) are described in the accessory manual supplied with the re-record equipment. Modification details are described in Section I of this instruction guide, with the modified frequency-response characteristics shown in figure 1-27. If the modified amplifiers are performing satisfactorily, the frequency-response curves of figure 1-27(b), 1-27(c), and 1-27(d) may be duplicated.

3-73. Prepare to perform the tests by proceeding as follows:

a. Set up the re-record equipment, and interconnect the cables for normal operation.

b. Remove the erase-head, record-head, and playback-head plugs from the amplifier to be tested.

c. When testing a slave amplifier, remove the bias-input plug.

d. When testing a master amplifier, remove the bias-oscillator tube.

3-74. Frequency-response curves for the amplifiers are obtained by applying a voltage of known frequency to the input terminals of the amplifier under test, and measuring the input level necessary to maintain a given output level. In each case, the voltage is fed through an attenuator to establish the input level, and the output of the amplifier is terminated in a normal load impedance.

3-75. To facilitate comparison of the frequency-response measurements with the normal response curves, input adjustments made to increase the output level are given a negative sign, and input adjustments made to decrease the output level are given a positive sign.

3-76. EQUIPMENT SET-UP AND PROCEDURE FOR MEASURING POST-EMPHASIS RESPONSE AT 2.25 INCHES-PER-SECOND.

3-77. The normal post-emphasis frequency response at 2.25 inches per second is shown in (b) of figure 1-27. The test set-up is shown as TEST SET-UP 2 of figure 3-1. Set the LINE TERM switch (S404) in the OFF position.

3-78. Set the front-panel controls of the amplifier as follows:

a. RECORD LEVEL - 0

b. EQUALIZATION - LOW SPEED

c. INPUT TRANSFER SWITCH - MICROPHONE

d. METER AND OUTPUT SWITCH - PLAYBACK LEVEL

e. PLAYBACK LEVEL - as required

3-79. Turn on the amplifier and test equipment and allow a five-minute warm-up period. Adjust the oscillator for a one-volt output at 500 cycles. Adjust the PLAYBACK LEVEL control to provide 0.78 volts across the 600-ohm terminating resistor. Adjust the frequency of the oscillator from 250 to 4000 cycles-per-second and note the adjustment of oscillator-output level necessary to maintain a constant amplifier-output level of 0.78 volts.

3-80. EQUIPMENT SET-UP AND PROCEDURE FOR MEASURING POST-EMPHASIS RESPONSE AT 7.5 INCHES-PER-SECOND.

3-81. The normal post-emphasis frequency response at 7.5 inches-per-second is shown in (d) of figure 1-27. The test set-up is shown as TEST SET-UP 2 of figure 3-1. Set the LINE TERM switch (S404) in the OFF position.

3-82. Set the front-panel controls of the amplifier as follows:

a. RECORD LEVEL - 0

b. EQUALIZATION - HIGH SPEED

c. INPUT TRANSFER SWITCH - MICROPHONE

d. METER AND OUTPUT SWITCH - PLAYBACK LEVEL

e. PLAYBACK LEVEL - as required

3-83. Turn on the amplifier and test equipment and allow a five-minute warm-up period. Adjust the oscillator for a one-volt output at 500 cycles. Adjust the PLAYBACK LEVEL control to provide 0.78 volts across the 600-ohm terminating resistor. Adjust the frequency of the oscillator from 250 to 4000 cycles-per-second and note the adjustment of oscillator-output level necessary to maintain a constant amplifier-output level of 0.78 volts.

3-84. EQUIPMENT SET-UP AND PROCEDURE FOR MEASURING PRE-EMPHASIS RESPONSE AT 7.5 INCHES-PER-SECOND.

3-85. The normal pre-emphasis frequency response at 7.5 inches-per-second is shown in (c) of figure 1-27. The test set-up is shown as TEST SET-UP 1 of figure 3-1. Set the LINE TERM switch (S404) in the OFF position.

3-86. Set the front-panel controls of the amplifier as follows:

a. PLAYBACK LEVEL - 0

b. EQUALIZATION - LOW SPEED

c. INPUT TRANSFER SWITCH - MICROPHONE

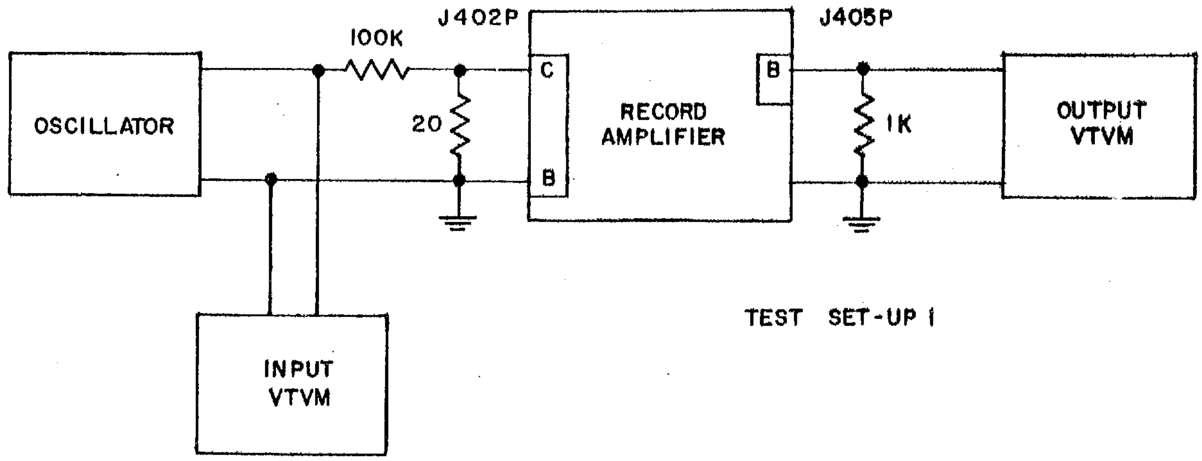
d. METER OUTPUT SWITCH - RECORD LEVEL

e. RECORD LEVEL - as required

3-87. Turn on the amplifier and test equipment and allow a five-minute warm-up period. Adjust the oscillator for a one-volt output at 500 cycles. Adjust the RECORD LEVEL control to provide 0.78 volts across the 1K resistor. Adjust the frequency of the oscillator from 250 to 4000 cycles-per-second and note the adjustment of oscillator-output level necessary to maintain a constant amplifier-output level of 0.78 volts.

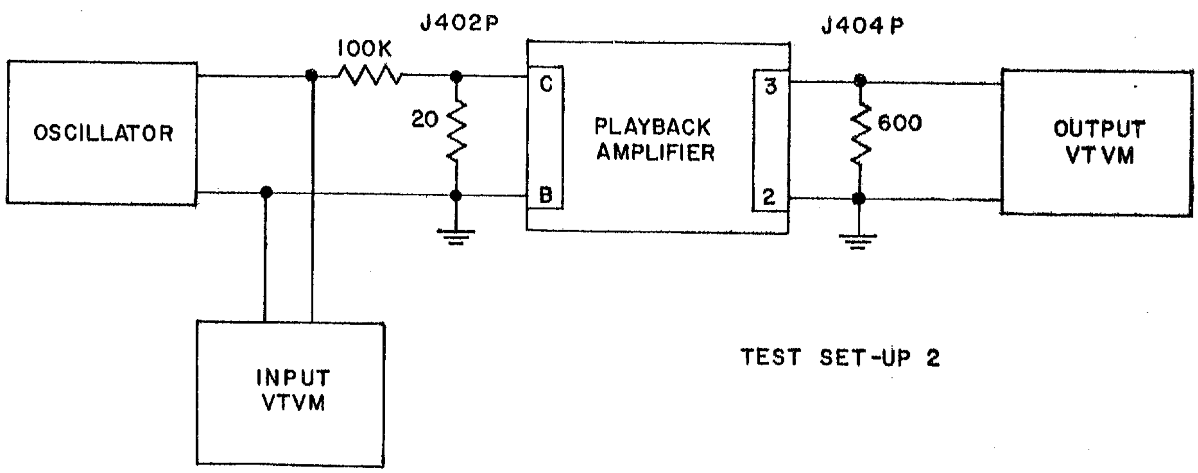
3-88. MAINTAINING THE RE-RECORD EQUIPMENT. The accessory manual, supplied with the ground-based re-record equipment, describes the procedures to be followed in maintaining the ground-based re-record equipment. The details of the modifications incorporated in the commercially available units are described in Section I of this instruction guide. Figures 1-24, 1-25, and 1-26 show the modifications of circuits and interunit cabling. The components involved in the modifications can be identified by referring to the illustrated parts breakdown of Section V.

1. MEASUREMENT PROCEDURE FOR DUPLICATING CURVE (c) OF FIGURE 1-27 (DISABLE BIAS AND ERASE CIRCUITS)



FREQUENCY RESPONSE IS NOTED AS INPUT LEVEL REQUIRED TO MAINTAIN CONSTANT OUTPUT

2. MEASUREMENT PROCEDURE FOR DUPLICATING CURVES (b) AND (d) OF FIGURE 1-27



FREQUENCY RESPONSE IS NOTED AS INPUT LEVEL REQUIRED TO MAINTAIN CONSTANT OUTPUT

Figure 3-1. Test Set-Up for Measuring Frequency Response of Record and Playback Amplifiers

SECTION IV

INSTALLATION DATA AND INTERUNIT CABLING

4-1. GENERAL. Detailed installation information involving a specific type of aircraft is beyond the scope of the instruction guide. However, weights and critical dimensions of the equipment are tabulated. Given this information, a competent installation technician will be able to install the airborne system in the aircraft. Details of interunit cabling are also provided in this section of the instruction guide.

4-2. EQUIPMENT NECESSARY FOR COMPLETE INSTALLATION. The components of the airborne system supplied under this contract are shown in figure 1-1. The units are listed in table 4-1. The table lists the weight, current requirements, and outline-drawing figure number of each unit.

Table 4-1. Equipment Supplied

Unit	Weight	Current at 28 Volts D-C	Figure No. of Outline Dwg.
S-Band Antenna Assembly	0 lb. 10 oz.		4-2
X-Band Antenna Assembly	0 lb. 7 oz.		4-3
Information Amplifier	1 lb. 0 oz.	1.2 amps	4-4
Vibrator D-C Supply	1 lb. 8 oz.	1.0 amps	4-5
Information Recorder	10 lb. 15 oz.	2.2 amps	4-6
Interconnecting Cables (Interunit Cabling Diagram, Figure 4-1)			
W1201 or W1204	0 lb. 2 oz.	(7 in. long)	
W1202	0 lb. 3 oz.	(24 in. long)	
W1203	0 lb. 7 oz.	(60 in. long)	
W1205	0 lb. 8 oz.	(30 in. long)	

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In addition to the equipment listed in Table 4-1, auxiliary equipment is required to complete the installation. The auxiliary equipment is not furnished under this contract, but is contained in the aircraft.

4-3. INSTALLING THE EQUIPMENT IN THE AIRCRAFT.

4-4. GENERAL. The location of the information amplifiers is determined by the location of the antenna assemblies and by the length of coaxial cables W1201 and W1204. These cables must not be under tension, and should be provided with a bend radius of about two inches. The other units of the system may be installed in any location which is free of strong magnetic fields. If the remaining interconnecting cables supplied with the equipment (W1202, W1203, and W1205) are used, the units of the airborne system should be located in positions which will allow sufficient cable slack for plug removal. (See the interunit-cabling diagram of figure 4-1.) If other factors dictate greater separation of the airborne units, longer versions of W1202, W1203, or W1205 can be fabricated. After the location of the units has been determined, proceed with the installation as described in paragraphs 4-5 through 4-10. When installing the equipment, observe the following general precautions:

a. Use lock-washers with all machine screws.

b. Be sure that the units make good electrical contact with the surface on which they are mounted. It may be necessary to scrape the paint from the bottom of the information amplifiers and power supply to insure good electrical contact.

4-5. INSTALLING THE S-BAND ANTENNA ASSEMBLIES. An outline drawing of the S-band antenna assembly is shown in figure 4-2. Four drilled-fillister-head 10-24 machine screws, 1/2" long, are required to install the antennas. The antennas are installed on the brackets mounted in the aircraft. In installing the S-band antenna assemblies, the dipole rods in front of the dish must be in a vertical position (vertical polarization). After the four mounting screws have been installed, they must be safety-wired in place.

4-6. INSTALLING THE X-BAND ANTENNA ASSEMBLIES. An outline drawing of the X-band antenna assembly is shown in figure 4-3. Four drilled-fillister-head 10-24 machine screws, 1/2" long, are required to install the antennas. The antennas are installed on the brackets mounted in the aircraft. In installing the X-band antenna assemblies, the dipole rods in front of the dish are oriented at an angle of 45° with the vertical (45° polarization). After the four mounting screws have been installed, they must be safety-wired in place.

4-7. CHANGING ANTENNAS. Note that the antenna mounting brackets hold the dishes in the following manner: The plane of the dish periphery is parallel to the centerline of the aircraft, but is oriented downward at an angle of approximately four degrees. Do not attempt to "straighten" the brackets to obtain perfectly vertical orientation of the dishes. Note also that different antenna-mounting brackets are used in mounting the antennas for the different bands. If it is necessary to install antennas for a different band, a different set of brackets will have to be installed. The new brackets must be installed by a competent airframe mechanic.

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4-8. INSTALLING THE INFORMATION AMPLIFIERS. An outline drawing of the information-amplifier assembly is shown in figure 4-4. Four 6-32 machine screws, 3/8" long, are required to install the information amplifiers on sub-plates. The sub-plate may be fabricated in accordance with the requirements of the particular installation, but must be large enough to accommodate the bolts used in fastening the sub-plates to the aircraft. Four 10-24 machine screws are sufficient for mounting a sub-plate to the aircraft. The information amplifiers may be mounted in any position which will permit the coaxial cables to be connected to the antennas. Care must be taken to prevent damaging the connectors located on the top of the information amplifiers.

4-9. INSTALLING THE VIBRATOR D-C SUPPLY. An outline drawing of the power-supply assembly is shown in figure 4-5. As in the case of the information amplifiers, sub-plate installation is used. Four 6-32 machine screws, 1/2" long, are required to install the power supply on the sub-plate. The power supply may be mounted in any convenient position. Again, care must be taken to prevent damaging the connectors located on the top of the power supply.

4-10. INSTALLING THE INFORMATION RECORDER. An outline drawing of the information recorder is shown in figure 4-6. The information recorder is installed in the special rack mounted in the aircraft; no screws are required. The unit is oriented so that the jacks are above the center-line of the unit, and so that the pins of the jacks point toward the inside of the aircraft. Before the information recorder is installed in its special mounting rack, scrape some of the paint from the surface around the hole designated in figure 4-6. Use a nut, bolt, lock washer, and bonding strap to ground the recorder chassis to the aircraft.

4-11. INTERCONNECTING THE UNITS. Interconnect the units of the airborne equipment with the equipment installed in the aircraft in accordance with the interunit-cabling diagram of figure 4-1. Note that the left-side antenna, information amplifier, etc., are defined from the pilot's position, facing toward the front of the aircraft. Route the cables in a manner which will keep them from being damaged by other objects. Allow sufficient slack in the cables so that there is no tension when the connectors are in place. Clamp cables in position (except the coaxial cables) using nylon-lined cable clamps. Lock the cable plugs in place using the facilities provided on the plugs or units.

CAUTION

> Do not apply power to the system until it has been determined that the polarity of the power supply voltage is correct. Test the polarity of the voltages appearing on the junction-box jack which mates with P1201. Pin F must have a potential of +28 volts with respect to pin E. Applying voltage of reversed polarity will damage the capacitors in the vibrator d-c supply.

4-12. Table 4-2 lists the terminations of the interunit cables. The list of terminations serves as a reference in identifying interunit connections.

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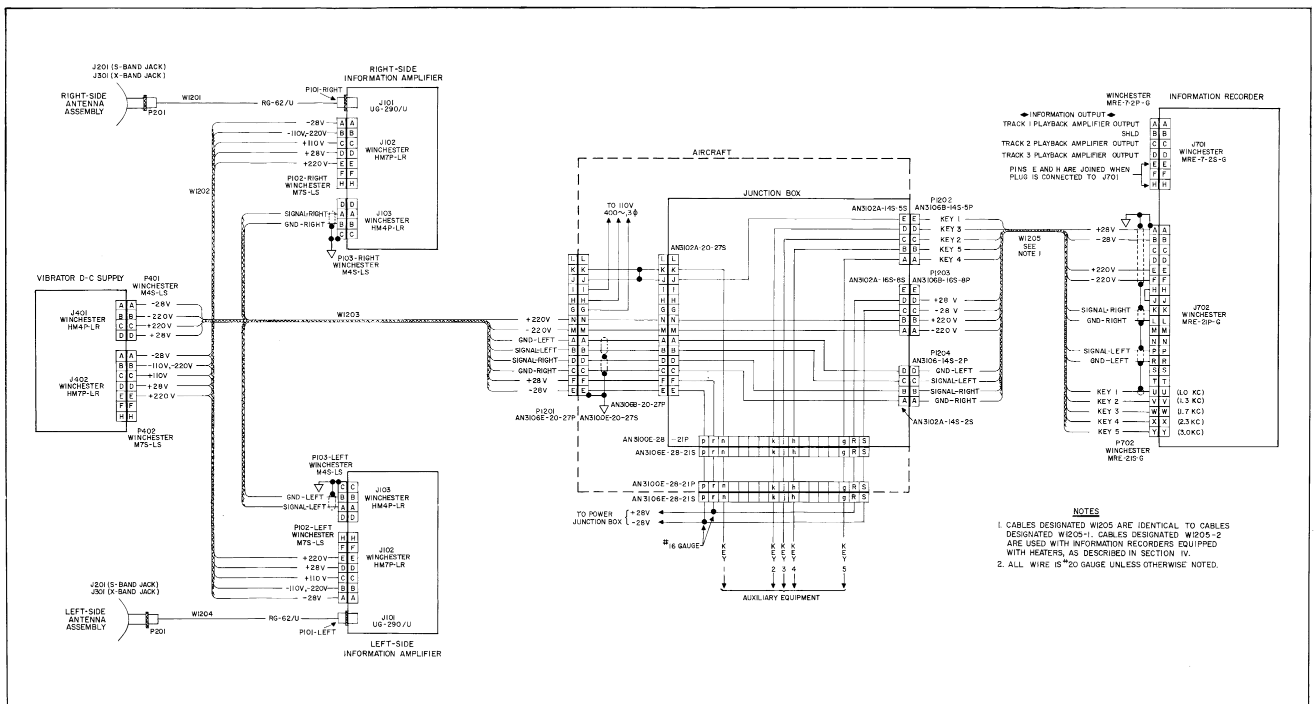

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Figure 4-1. Airborne Equipment, Interunit Cabling Diagram

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Table 4-2. Terminations of Interunit Cables

Cable W1201

From	To
P1201	P101 Right

Cable W1202

From	To
P402A	P102A*
P402B	P102B*
P402C	P102C*
P402D	P102D*
P402E	P102E*

Cable W1203

From	To
P1201A	P103B Right
P1201B	P103A Right
P1201C	P103B Left
P1201D	P103A Left
P1201E	P401A
P1201F	P401D
P1201M	P401B
P1201N	P401C

Cable W1204

From	To
P201	P101 Left

Cable W1205

From	To
P702A	P1203D
P702B	P1203C
P702E	P1203B
P702F	P1203A
P702K	P1204B
P702L	P1204A
P702P	P1204C
P702R	P1204D
P702U	P1202E
P702V	P1202C
P702W	P1202D
P702X	P1202A
P702Y	P1202B
P702H	P702J

*Right and Left

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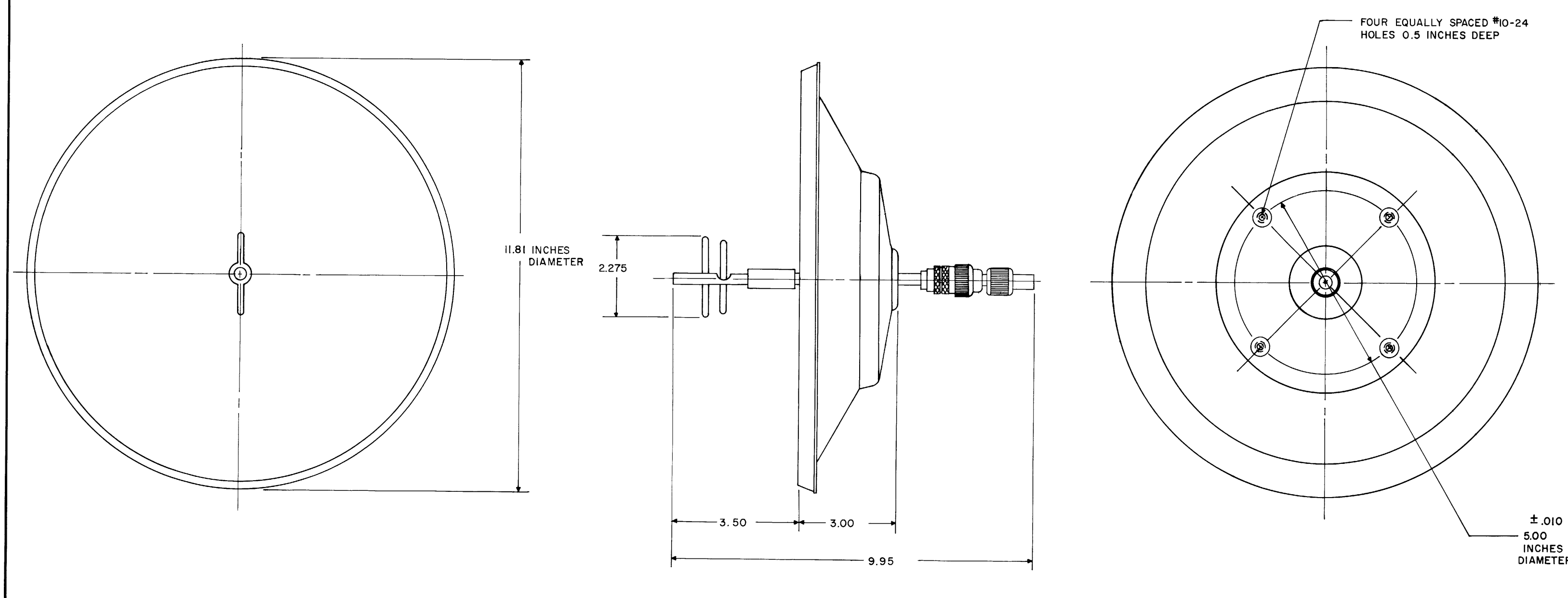

Figure 4-2. S-Band Antenna Assembly, Installation Dimensions

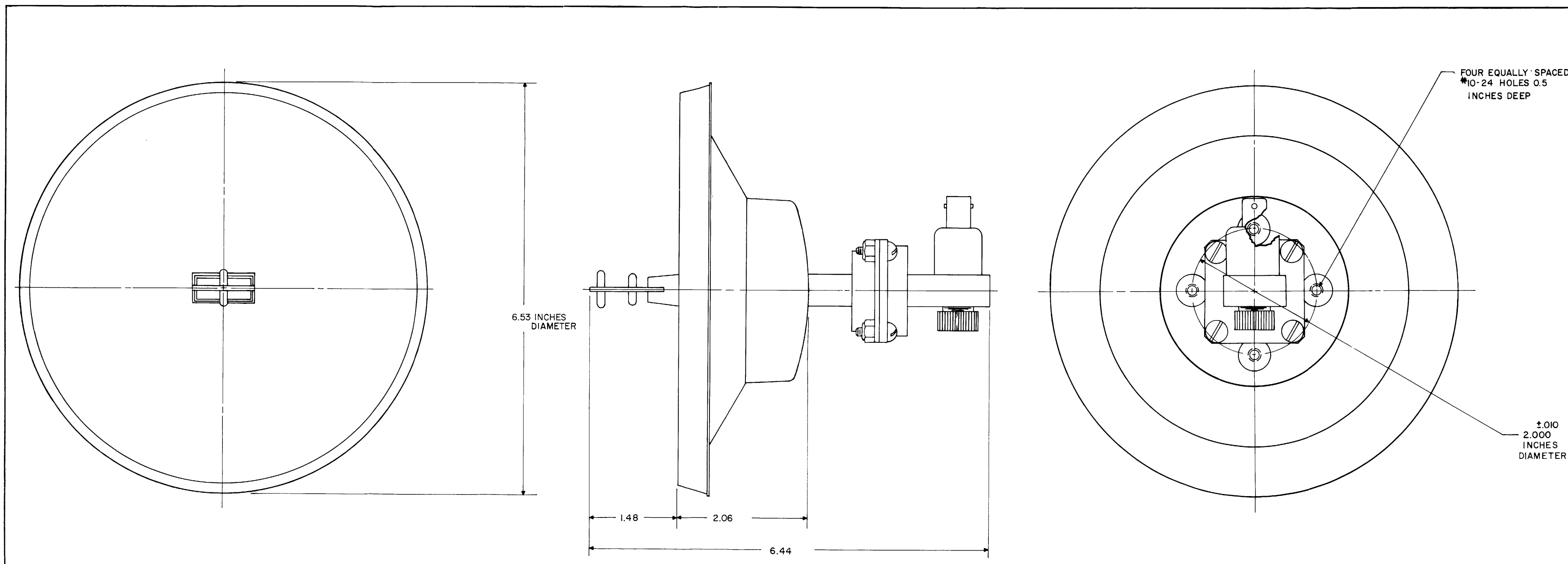

Figure 4-3. X-Band Antenna Assembly Installation Dimensions

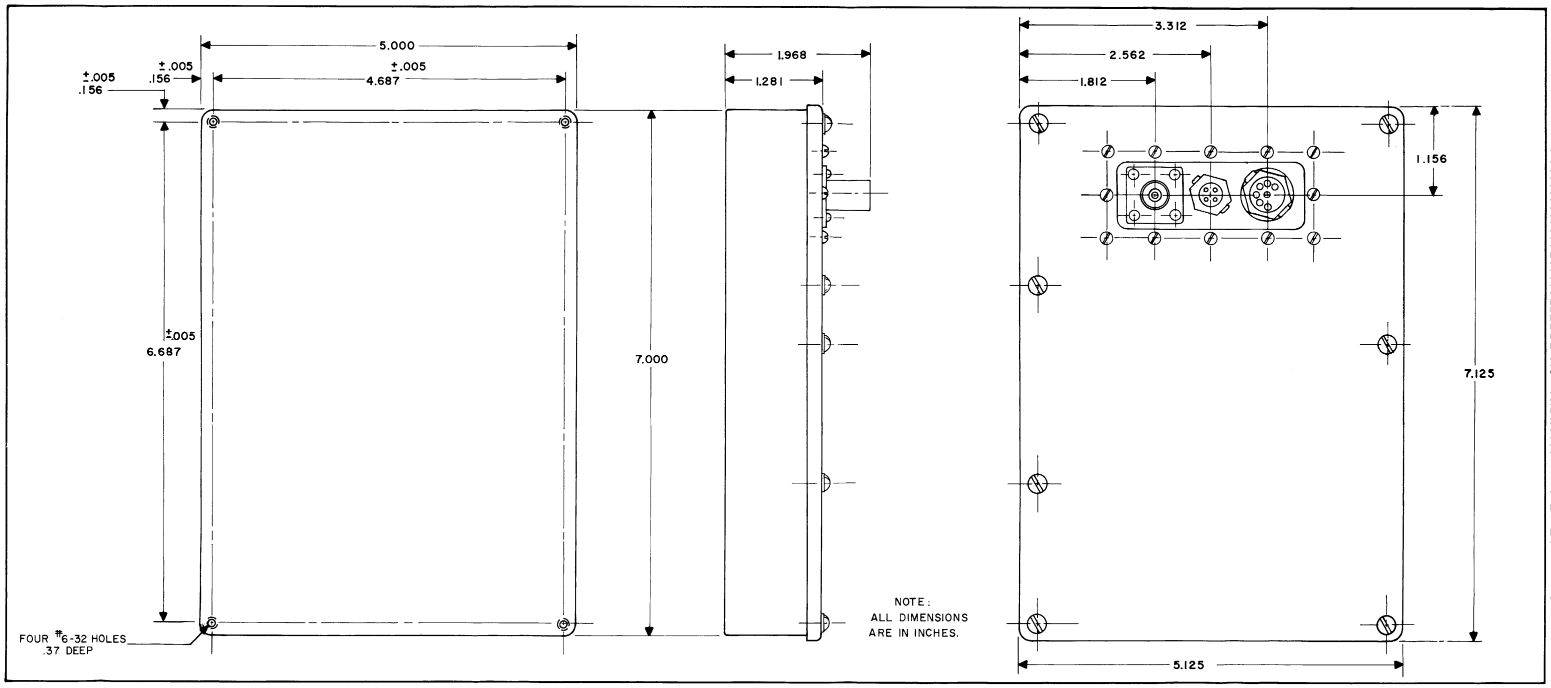

Figure 4-4. Information Amplifier, Installation Dimensions

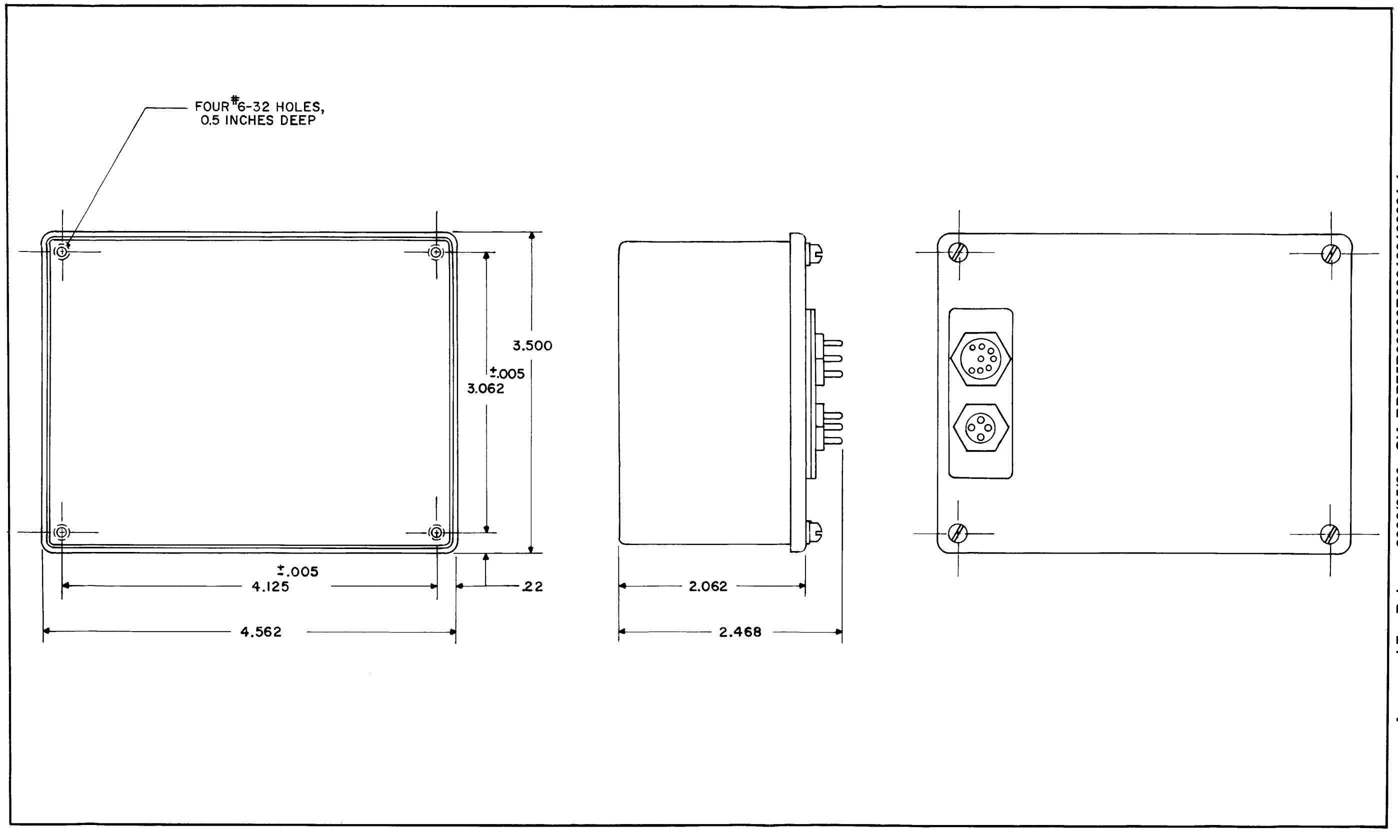

Figure 4-5. Vibrator D-C Supply, Installation Dimensions

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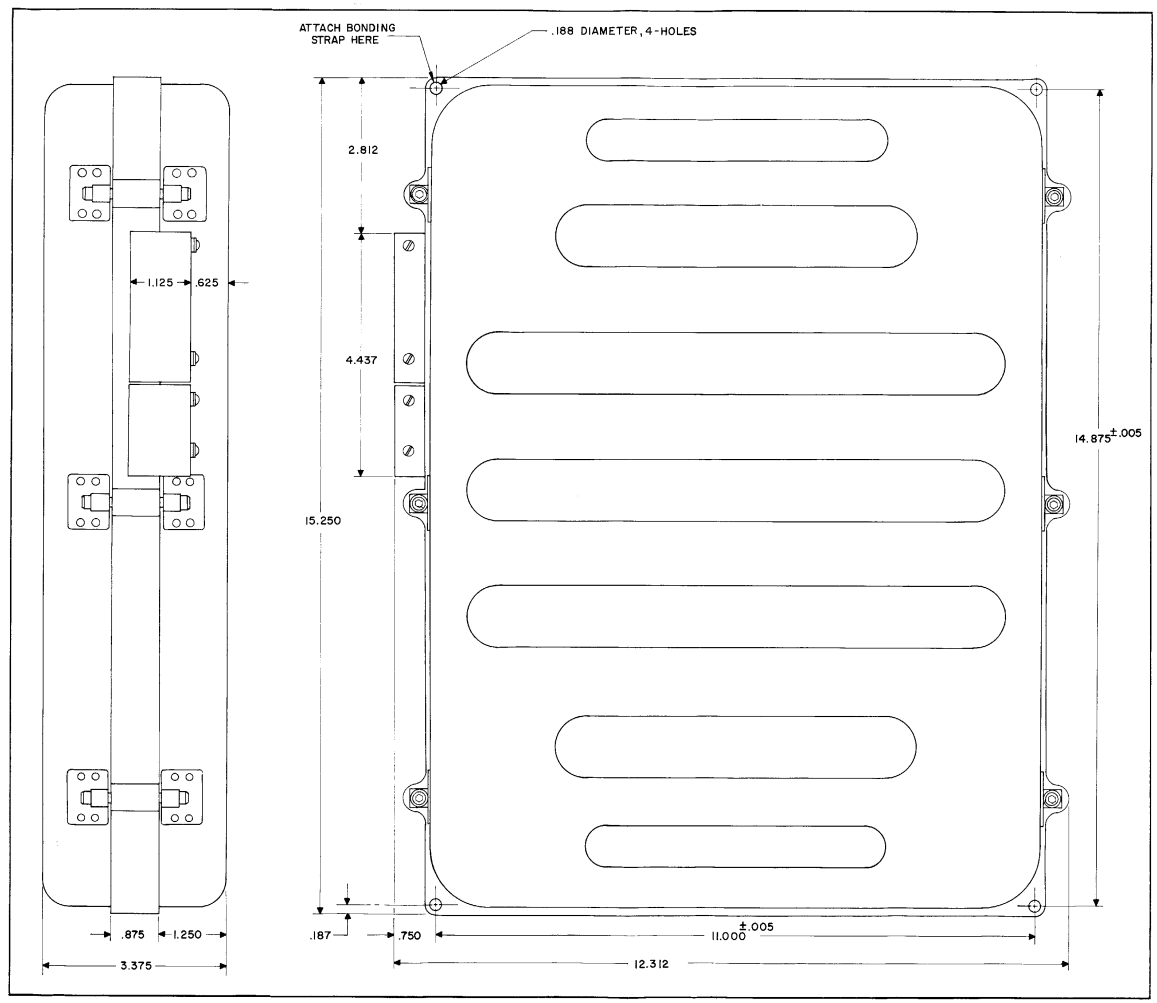

Figure 4-6. Information Recorder, Installation Dimensions

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AIRBORNE RADAR-MONITORING SYSTEM

SECTION V

ILLUSTRATED PARTS BREAKDOWN AND MAINTENANCE PARTS LIST

5-1. GENERAL ORGANIZATION.

5-2. All units, assemblies, and replaceable electrical, electronic, and non-standard (specially fabricated) mechanical parts of the Airborne Radar-Monitoring System have been assigned a maintenance part number (MP number). Units, assemblies, and parts are called out in the illustrations contained in this section of the instruction guide. The units, major assemblies, and accessories of the system are listed in Table 5-1, along with corresponding maintenance parts numbers.

5-3. The maintenance part number indicated on the name plate affixed to each of the units applies to the unit (less accessories) and not to any one part of the unit. For example, MP10922 appears on the S-band antenna assembly name plate and applies to the complete S-band assembly including the dish, dipoles, coaxial feed, crystal holder and crystal; MP10641 appears on the information-amplifier name plate and applies to the complete information amplifier including case, printed-circuit board, and all associated electrical, electronic, and mechanical parts.

5-4. In general, non-standard (specially fabricated) mechanical parts are called out directly as MP numbers on the illustrations, while electrical and electronic parts are called out by reference symbol designations (R356, C791, etc.) on the illustrations. Where applicable, a tabulation of reference symbol designations and MP numbers follows the illustrated parts breakdown of each of the units.

5-5. HOW TO USE THE ILLUSTRATED PARTS BREAKDOWN AND MAINTENANCE PARTS LIST. To determine the MP number of any part of the airborne units, ground-based units, or accessories, locate the illustration of the unit or assembly containing the part. The part will be identified (called out) either directly as an MP number, or as a reference-symbol number. If the reference symbol number of a part is called out, a table of reference symbols cross referenced to MP numbers will follow the illustration. The illustration which shows the part may be found quickly by making use of Table 5-1 and the list of illustrations for Section V.

Table 5-1. Maintenance Parts List, Equipment Comprising the Airborne Radar-Monitoring System

Unit	MP Number
Airborne Equipment:	
S-Band Antenna Assembly (Figures 1-5 and 5-1)	10922
X-Band Antenna Assembly (Figures 1-7 and 5-2)	10308
Information Amplifier (Figure 5-3)	10641
Printed-Circuit Board (Figure 5-4)	10002
Information Recorder (Figures 5-5, 5-7, 5-8, 5-9, 5-10, 5-11, 5-12, 5-13)	10737
Printed-Circuit Board (Figure 5-6)	10001
Reel and Ring-Gear Assembly	10015
Vibrator D-C Supply (Figures 5-14 and 5-15)	10406
Airborne Equipment Interconnecting Cables: (Figure 1-1)	
W1201	63003
W1202	63005
W1203	63004
W1204	63003
W1205-2	10993
Ground-Based Equipment:	
Re-Record Equipment	
(1) Amplifier and Rack Assembly Includes Rack and	10811
(1) Modified Master Amplifier (Figures 1-4 and 5-18)	10306
(2) Modified Slave Amplifiers (Figures 1-4 and 5-18)	10116
(1) Power Supply and Case Assembly (Figure 1-4) Includes Case and (3) Power Supplies (Figure 1-4)	10404
(1) High-Speed Record Transport (Figure 1-4)	10920
(1) Low-Speed Playback Transport (Figure 1-4 and 5-16)	10639
Interconnecting Cables: (Figure 1-24)	
(3) Power-Supply Extension Cables	63007
(2) Bias-Interconnecting Cables	63008

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Table 5-1. Maintenance Parts List, Equipment Comprising the Airborne Radar-Monitoring System (Continued)

Unit	MP Number
Ground-Based Equipment: (Continued)	
(1) Power-Interconnecting Cable	63010
(1) Modified Power-Interconnecting Cable (Figure 5-17)	63011
(1) Primary-Power Cable	63012
Test Set (Figure 1-3)	10566
Test Set Accessories:	
S-Band Horn	10405
X-Band Horn	10313
Horn-Feed Cable (W510)	63014
Horn-Mounting Tripod	10506
Primary-Power Cable (W507)	63015
Headphones	10505
VTVM	10702
Information-Amplifier Monitoring Cable (W513)	63025
Information-Recorder Monitoring Cable (W512)	63021
Information-Recorder Extension Cable (W511)	63017
6 ft. Steel Measuring Tape	10507
Miscellaneous:	
Head Demagnetizer	10143
Standard Alignment Tape	10144
Magnetic Tape for Information Recorder	10145
Magnetic Tape for Re-Record Equipment	10146
10 1/2 in. NARTB Reel	10177
Editing Knob for 10 1/2 in. NARTB Reel	10191
Splicing Tape	10164
Tape Splicer	10173
Desiccant	10212

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1 November 56.

Table 5-1. Maintenance Parts List, Equipment Comprising the Airborne Radar-Monitoring System (Continued)

Unit	MP Number
Miscellaneous: (Continued)	
Test Cable for Information Recorder Printed-Circuit Board	62997
Table Top Dolly	10415
S-Band Test Horn Mount	10654
X-Band Test Horn Mount	10656
Cement	10220
Electrical Tape	10229

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1 November 56.

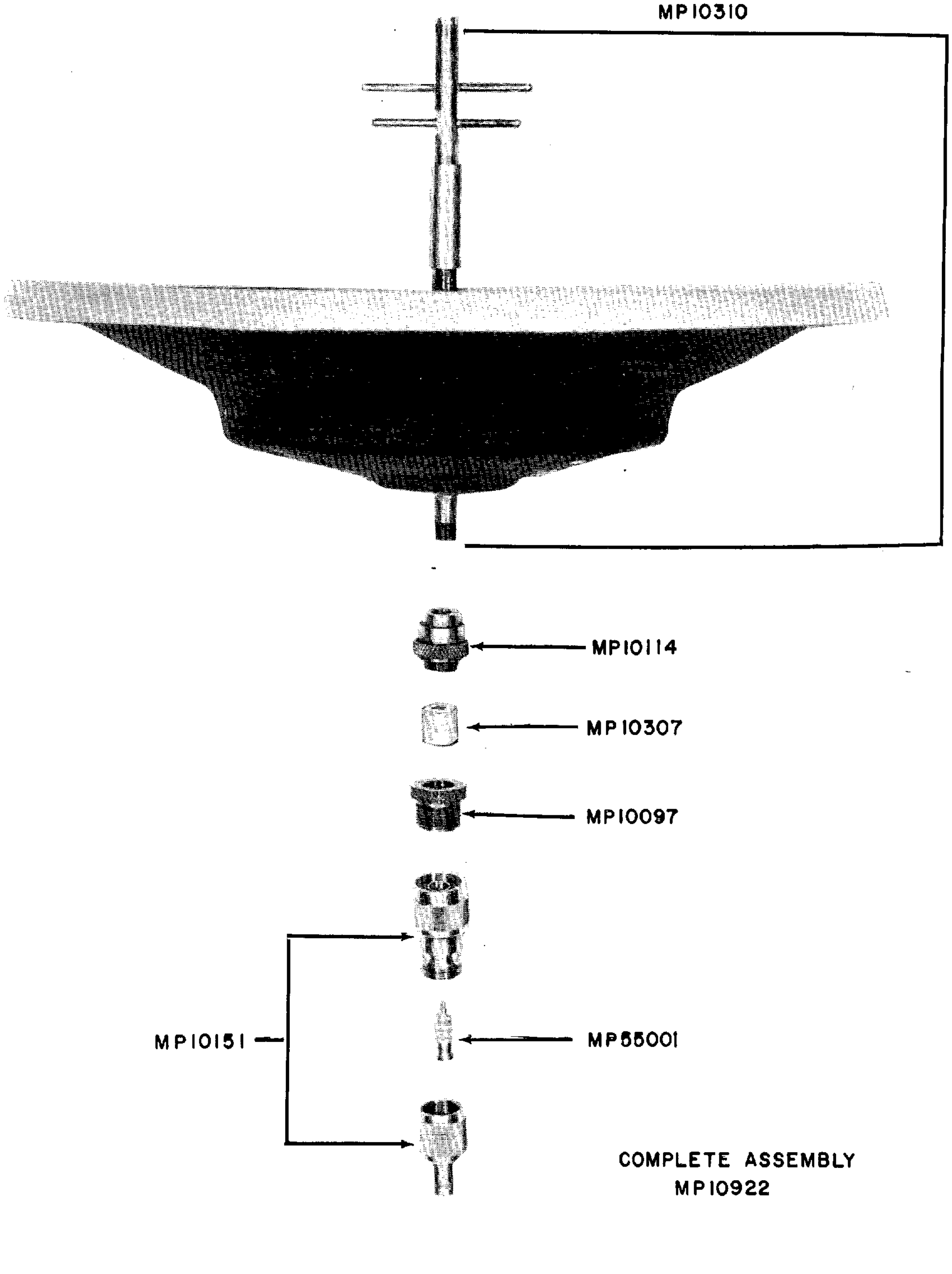

Figure 5-1. S-Band Antenna Assembly, Parts Callouts

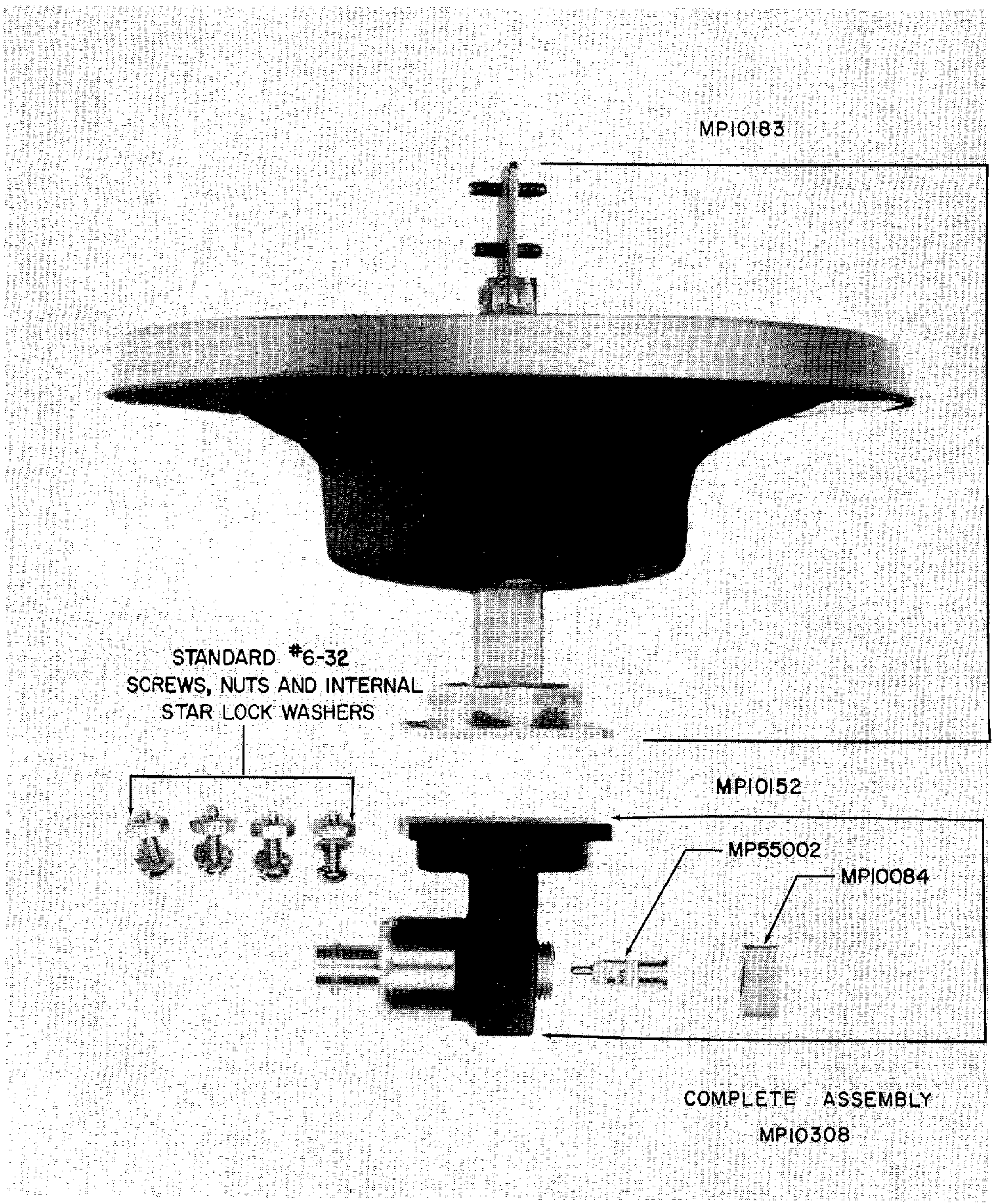

Figure 5-2. X-Band Antenna Assembly, Parts Callouts

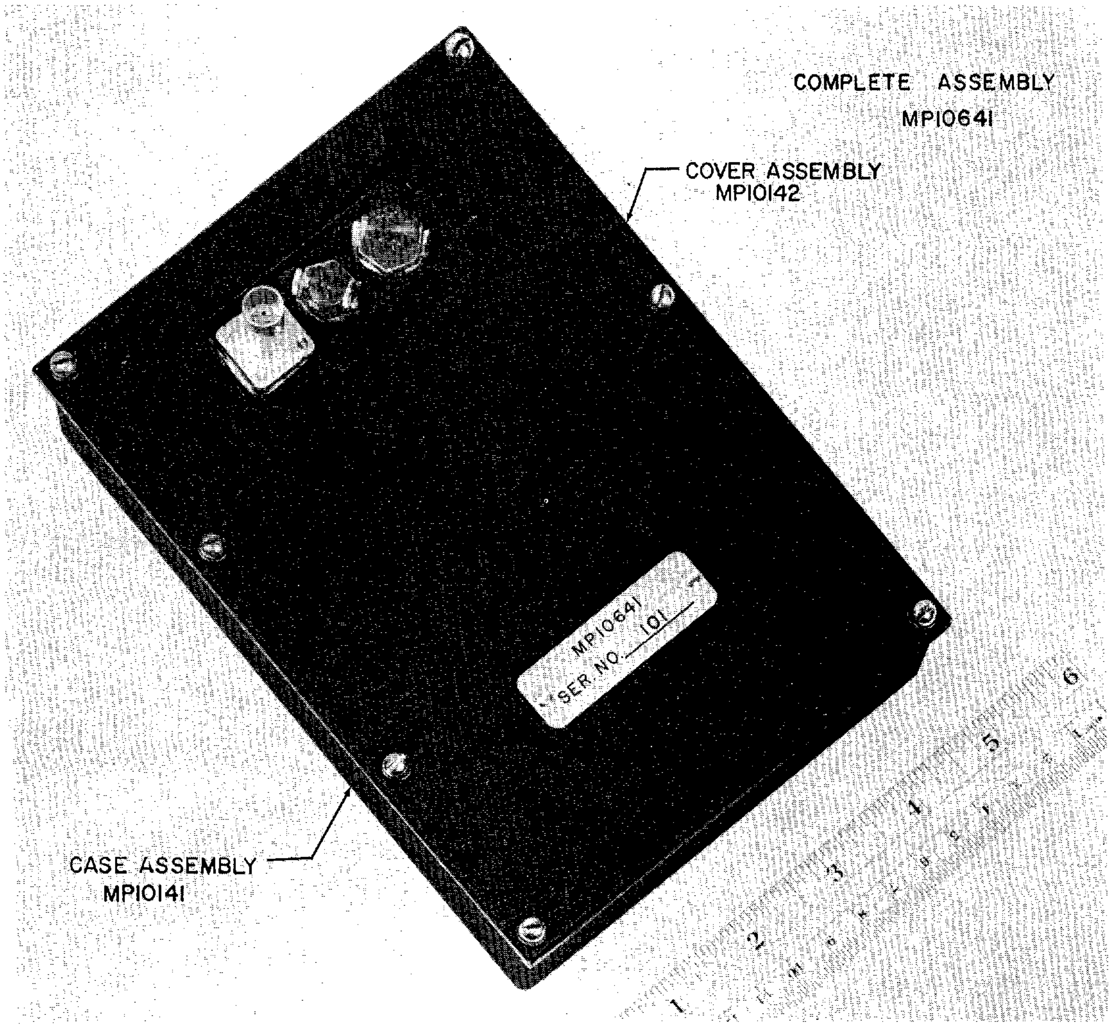

Figure 5-3. Information Amplifier

INFORMATION AMPLIFIER PARTS

NOT SHOWN IN FIGURE 5-3

Maintenance Part Number	Nomenclature
10688	Desiccant Case Assembly
10663	Desiccant Case
10675	Desiccant Case Cover
10836	Breather Plug Assembly
10683	Breather Plug Nut

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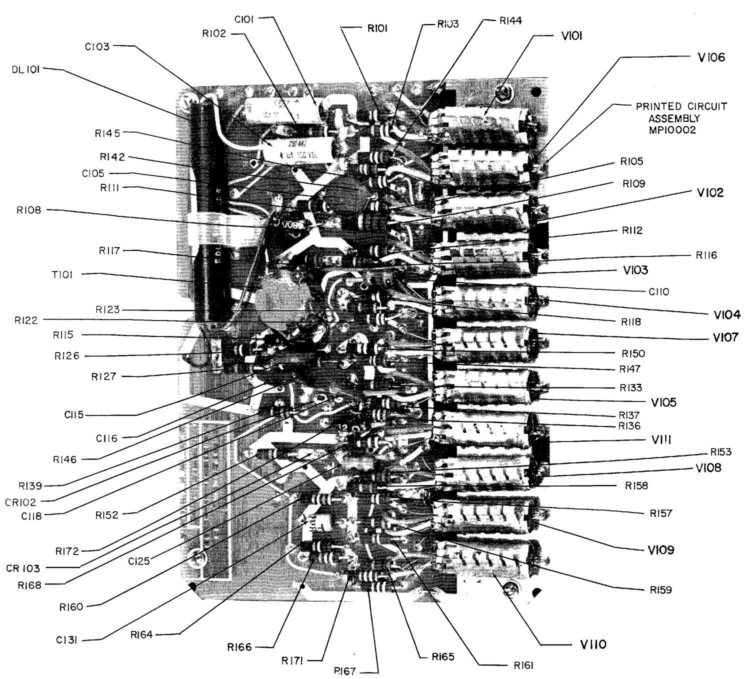
1 November 56.



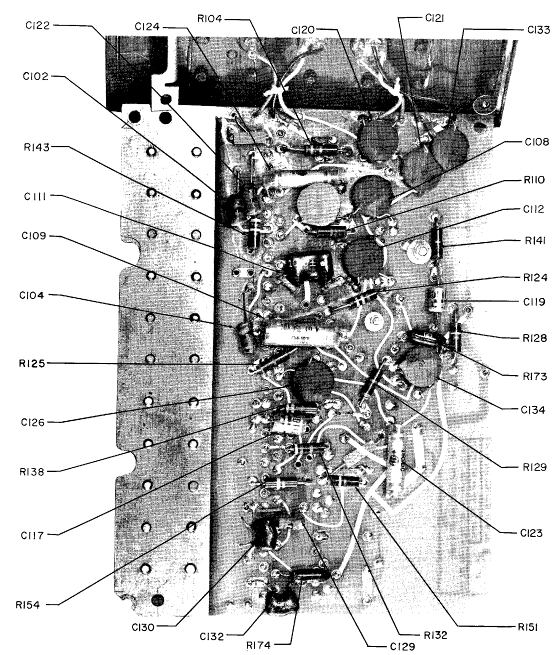


Figure 5-4. Information Amplifier, Printed-Circuit Board, Parts Callouts

Approved For Release 2000/05/23 : CIA-RDP75B00300R000100100001-1

Table 5-2. Maintenance Parts List,
Information Amplifiers

Symbol	Maintenance Part Number	JAN Number	Description
C101	MP30003		4 Mfd 150V Tantalytic
C102	MP30045		1000 Mmfd 600V
C103	MP30003		Same as C101
C104	MP30045		Same as C102
C105	MP30041		.02 Mfd Disc Ceramic
C106, C107	Not Used		
C108	MP30041		Same as C105
C109	MP30003		Same as C101
C110	MP30045		Same as C102
C111	MP30035		1000 Mmfd 500V Silver Mica
C112	MP30041		Same as C105
C113, C114	Not Used		
C115	MP30041		Same as C105
C116	MP30035		Same as C111
C117	MP30005		2 Mfd 100V Silverlytic
C118	MP30041		Same as C105
C119	MP30005		Same as C117
C120	MP30041		Same as C105
C121	MP30041		Same as C105
C122	MP30045		Same as C102
C123	MP30002		1 Mfd 150V Tantatylic
C124	MP30002		Same as C123
C125	MP30045		Same as C102
C126	MP30041		Same as C105
C127, C128	Not Used		
C129	MP30045		Same as C102
C130	MP30040		300 Mmfd 500V Silver Mica
C131	MP30005		Same as C117
C132	MP30036		500 Mmfd 500V Silver Mica
C133	MP30041		Same as C105
C134	MP30041		Same as C105
CR101	Not Used		
CR102	MP55003		Crystal Diode
CR103	MP55003		Same as CR102

Table 5-2. Maintenance Parts List,
Information Amplifiers
(Continued)

Symbol	Maintenance Part Number	JAN Number	Description
DL101	MP64002		Delay Line
E101-E111	MP10158		Shields, Tube
R101	MP20234		15K Ohms 5% 1/2 Watt
R102	MP20219		4.7K Ohms 5% 1/2 Watt
R103	MP20189		3.9K Ohms 5% 1/2 Watt
R104	MP20122		270 Ohms 5% 1/2 Watt
R105	MP20296		100K Ohms 5% 1/2 Watt
R106, R107	Not Used		
R108	MP20002		6.8K Ohms 5% 3 Watt
R109	MP20321		5.1K Ohms 5% 1 Watt
R110	MP20146		220 Ohms 5% 1/2 Watt
R111	MP20138		3K Ohms 5% 1/2 Watt
R112	MP20296		Same as R105
R113, R114	Not Used		
R115	MP20368		22K Ohms 5% 1/2 Watt
R116	MP20174		510 Ohms 5% 1/2 Watt
R117	MP20102		1.8K Ohms 5% 1/2 Watt
R118	MP20296		Same as R105
R119-R121	Not Used		
R122	MP20189		Same as R103
R123	MP20138		Same as R111
R124	MP20263		13K Ohms 5% 1/2 Watt
R125	MP20255		7.5K Ohms 5% 1/2 Watt
R126	MP20296		Same as R105
R127	MP20157		1 Megohms 5% 1/2 Watt
R128	MP20169		10K Ohms 5% 1/2 Watt
R129	MP20138		Same as R111
R130, R131	Not Used		
R132	MP20107		4.7 Megohms 5% 1/2 Watt
R133	MP20153		2.2 Megohms 5% 1/2 Watt
R134, R135	Not Used		
R136	MP20325		27K Ohms 5% 1/2 Watt
R137	MP20206		62K Ohms 5% 1/2 Watt

Table 5-2. Maintenance Parts List,
Information Amplifiers
(Continued)

Symbol	Maintenance Part Number	JAN Number	Description
R138	MP20271		3.3K Ohms 5% 1/2 Watt
R139	MP20254		6.8K Ohms 5% 1/2 Watt
R140	Not Used		
R141	MP20104		2K Ohms 5% 1/2 Watt
R142	MP20189		Same as R103
R143	MP20375		470K Ohms 5% 1/2 Watt
R144	MP20176		560K Ohms 5% 1/2 Watt
R145	MP20169		Same as R128
R146	MP20138		Same as R111
R147	MP20169		12K Ohms 5% 1/2 Watt
R148, R149	Not Used		
R150	MP20167		30K Ohms 5% 1/2 Watt
R151	MP20320		150K Ohms 5% 1/2 Watt
R152	MP20101		220K Ohms 5% 1/2 Watt
R153	MP20116		5.1K Ohms 5% 1/2 Watt
R154	MP20106		110K Ohms 5% 1/2 Watt
R155, R156	Not Used		
R157	MP20368		Same as R115
R158			Selected Value
R159			Selected Value
R160	MP20180		36K Ohms 5% 1/2 Watt
R161	MP20368		Same as R115
R162, R163	Not Used		
R164	MP20101		Same as R152
R165	MP20157		Same as R127
R166	MP20103		24K Ohms 5% 1/2 Watt
R167	MP20103		Same as R166
R168	MP20218		4.3K Ohms 5% 1/2 Watt
R169, R170	Not Used		
R171			Selected Value
R172	MP20079		12 Ohms 5% 3 Watt
R173	MP20079		Same as R172
R174	MP20001		43 Ohms 5% 3 Watt
T101	MP58003		Pulse Transformer
V101-V111	MP45002		CK6152

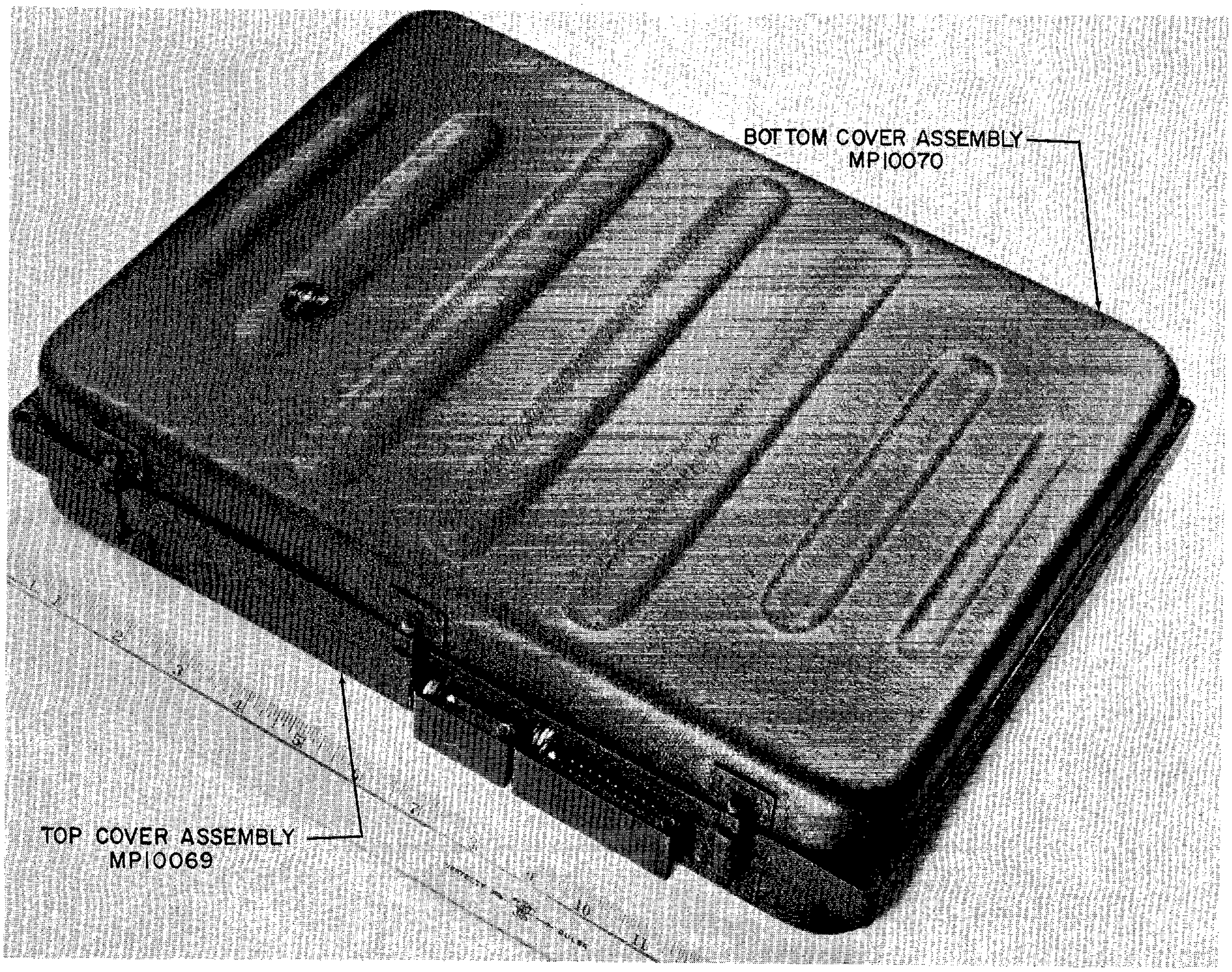


Figure 5-5. Information Recorder

INFORMATION RECORDER PARTS

NOT SHOWN IN FIGURE 5-5

Maintenance Part Number	Nomenclature
10236	Top Cover
10237	Desiccant Case
10238	Desiccant Case Cover
10232	Breather Plug Assembly

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1 November 56.

INFORMATION RECORDER

PRINTED-CIRCUIT BOARD PARTS

NOT SHOWN IN FIGURE 5-6

Maintenance Part Number	Nomenclature
10763	Support Spacer
10823	Component-Shielding Cup
10684	Tube-Shielding Cup

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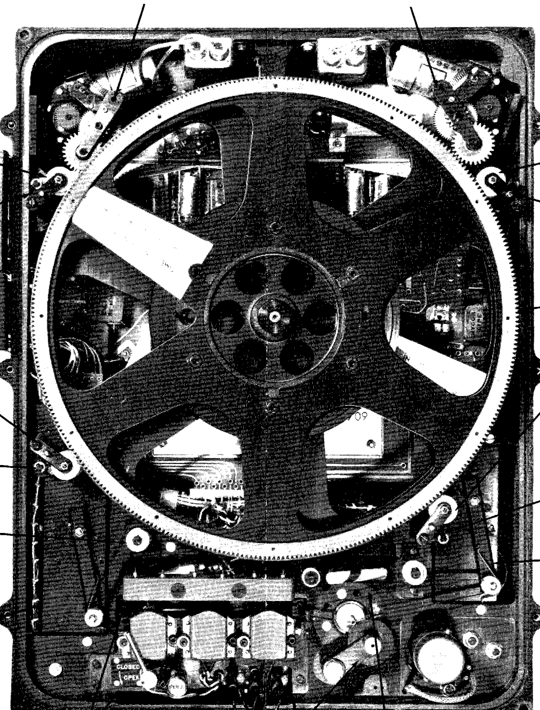
1 November 56.



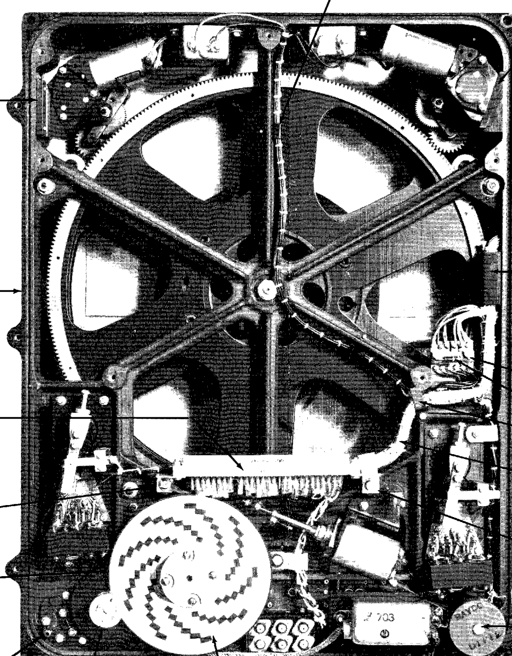


Figure 5-7. Information Recorder, Major Mechanical-Assembly Callouts

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INFORMATION RECORDER

MAJOR MECHANICAL-ASSEMBLY PARTS

NOT SHOWN IN FIGURE 5-7

Maintenance Part Number	Nomenclature
10136*	Tape-Guide Support Shaft (Tape-Guide Assembly)
10182*	Tape Guide
10215*	Tape-Guide Washer
10093*	Washer

*Part of Tape-Guide Assembly, MP 10013.

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1 November 56.

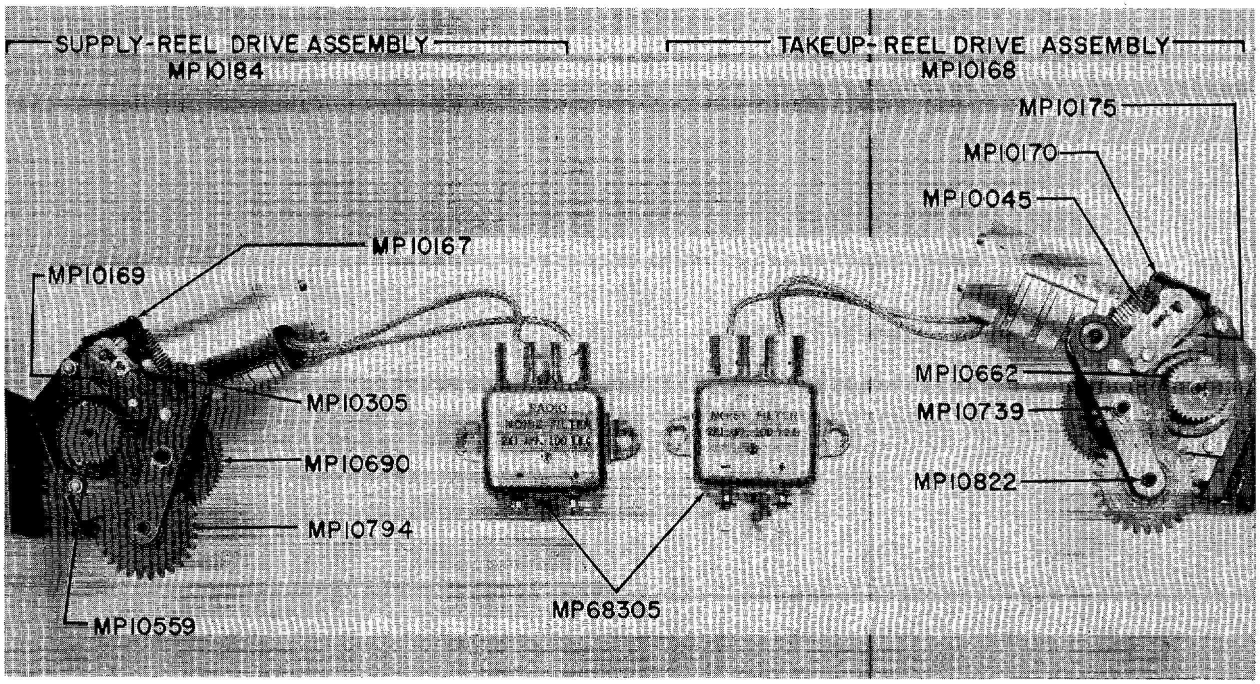

Figure 5-8. Reel-Drive Assemblies, Parts Callouts

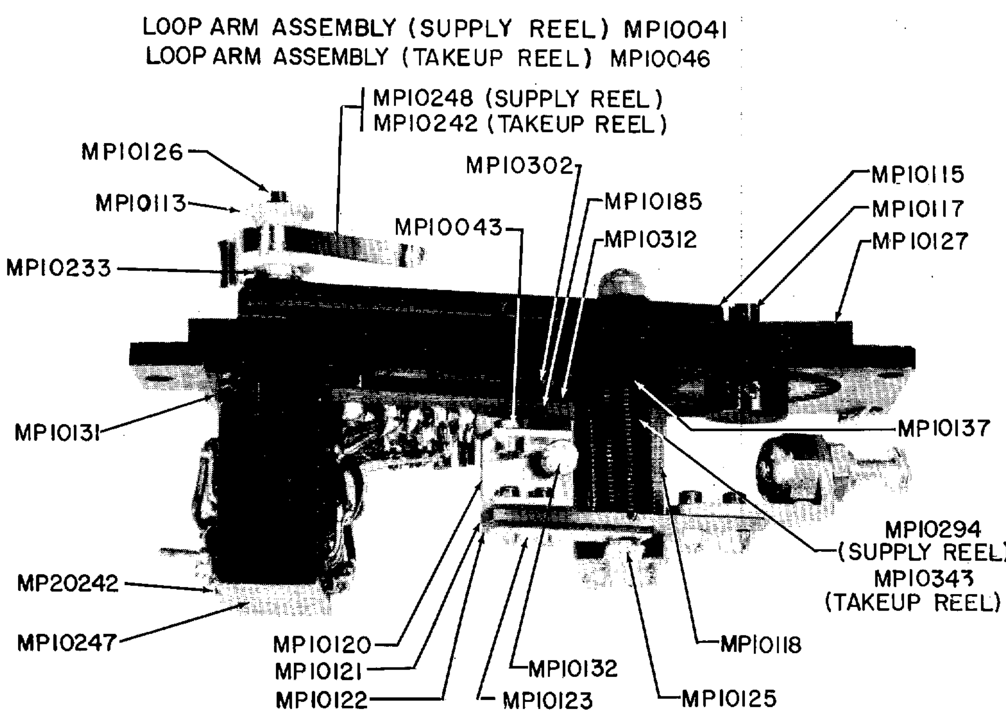

Figure 5-9. Loop-Arm Assembly, Parts Callouts

Revised:
1 November 56

REEL-DRIVE ASSEMBLIES, PARTS CALLOUTS NOT SHOWN IN FIGURE 5-8

Maintenance Part Number	Nomenclature
10607	Bottom Plate
10747	Gear Box Sub-Assembly (Supply Reel)
10723	Gear Box Sub-Assembly (Take-Up Reel)

LOOP-ARM ASSEMBLY, PARTS CALLOUTS NOT SHOWN IN FIGURE 5-9

Maintenance Part Number	Nomenclature
10673	Loop-Arm Sub-Assembly
10244	Spacer
10129	Commutator Assembly (Loop Arm)
10198	Bushing, Screw Insulation

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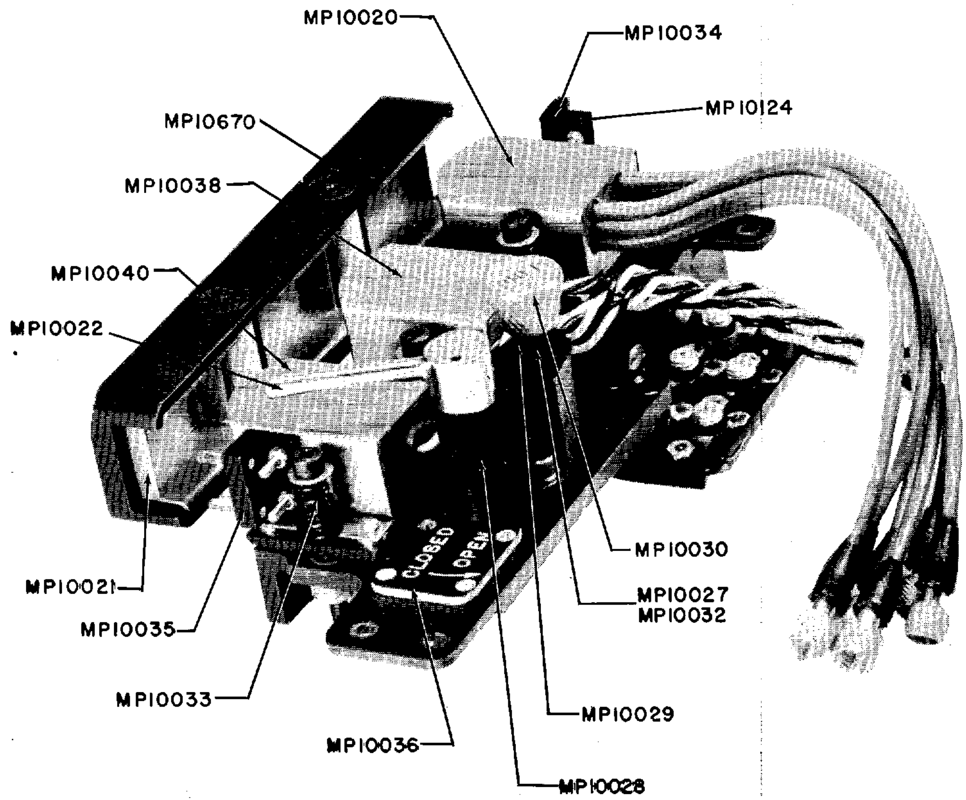
1 November 56.

HEAD AND HEAD-COVER ASSEMBLY
MP10087



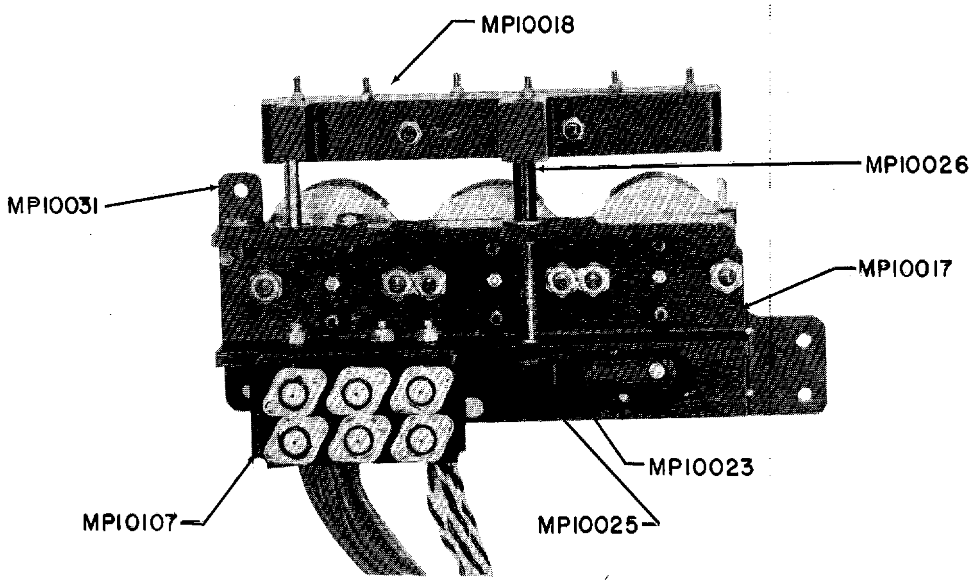


Figure 5-10. Head, and Head-Cover Assembly, Parts Callouts

Revised:
1 November 56

HEAD AND HEAD-COVER ASSEMBLY, PARTS CALLOUTS NOT SHOWN IN FIGURE 5-10

Maintenance Part Number	Nomenclature
10830	Cable-Clamp Bracket

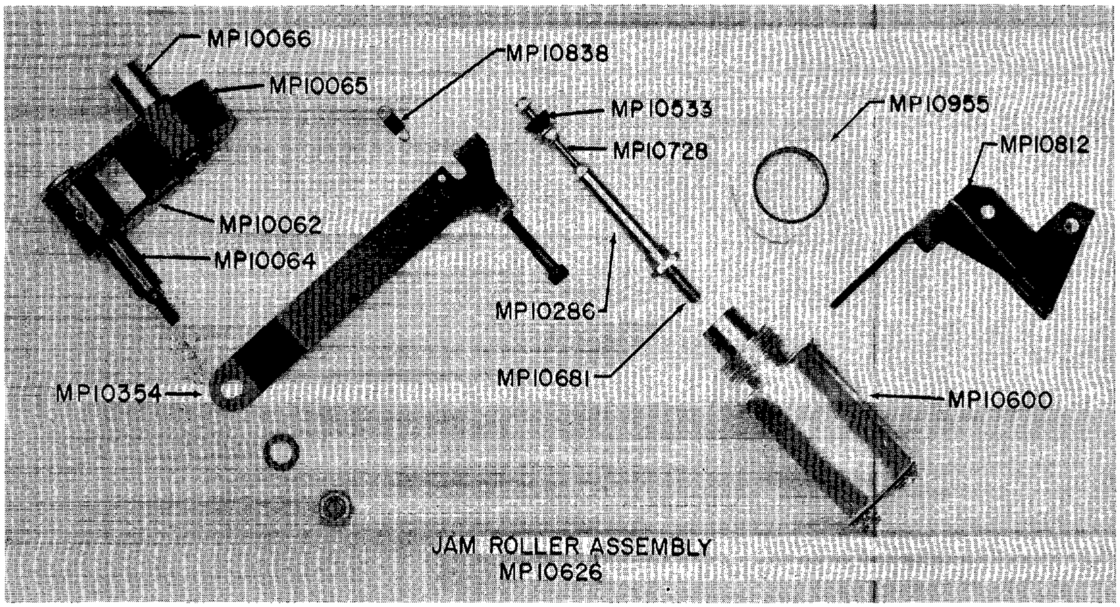
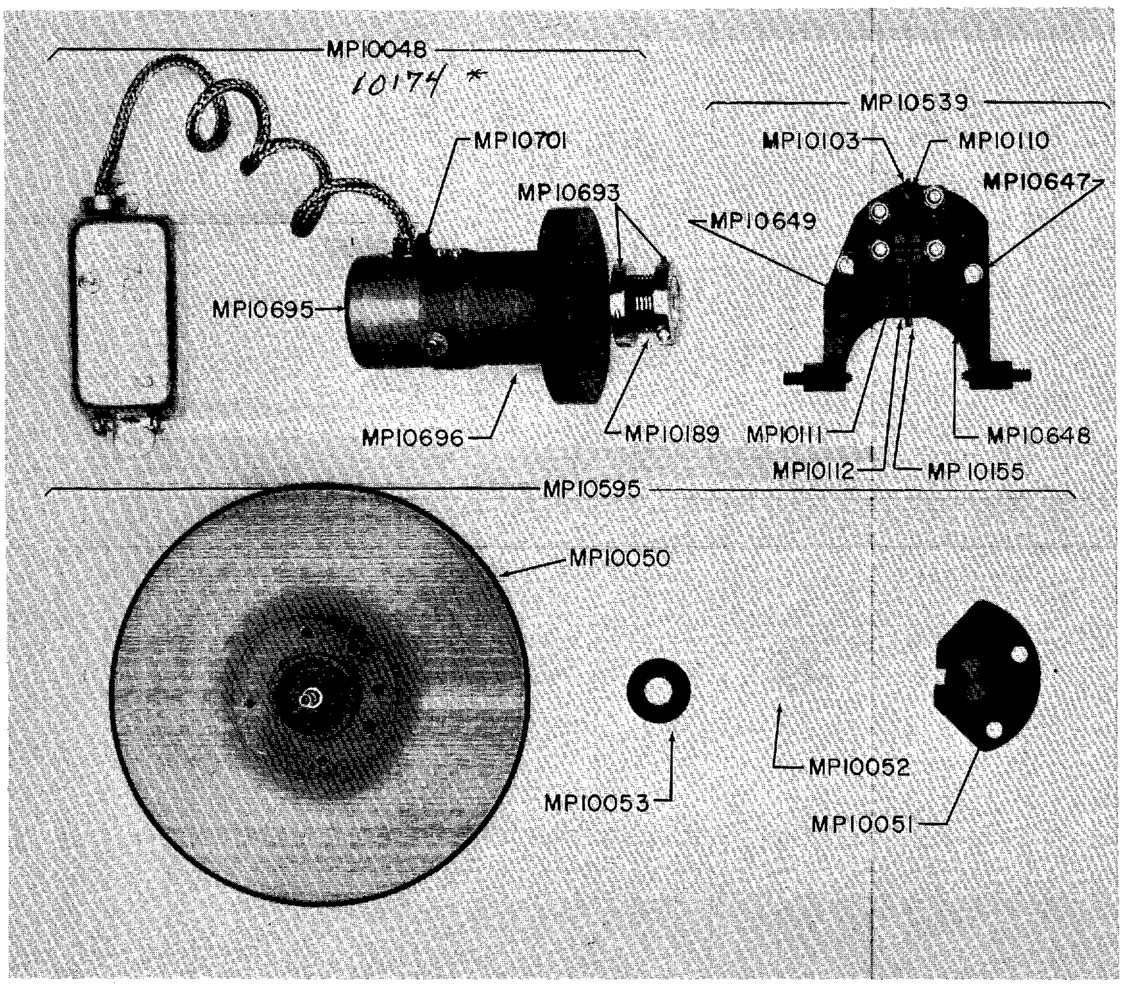


Figure 5-11. Jam Roller Assembly, Parts Callouts



* number used by Supply

Figure 5-11A. Capstan and Capstan-Drive, Motor and Flywheel, and Capstan-Motor Mounting Assemblies, Parts Callouts

Revised:
1 November 56

JAM ROLLER ASSEMBLY PARTS
NOT SHOWN IN FIGURE 5-11

Maintenance Part Number	Nomenclature
10756	Jam Roller Spring

CAPSTAN AND CAPSTAN DRIVE, MOTOR AND FLYWHEEL, AND CAPSTAN-MOTOR MOUNTING ASSEMBLIES PARTS
NOT SHOWN IN FIGURE 5-11A

Maintenance Part Number	Nomenclature
10443	Capstan Motor and Flywheel Sub-Assembly

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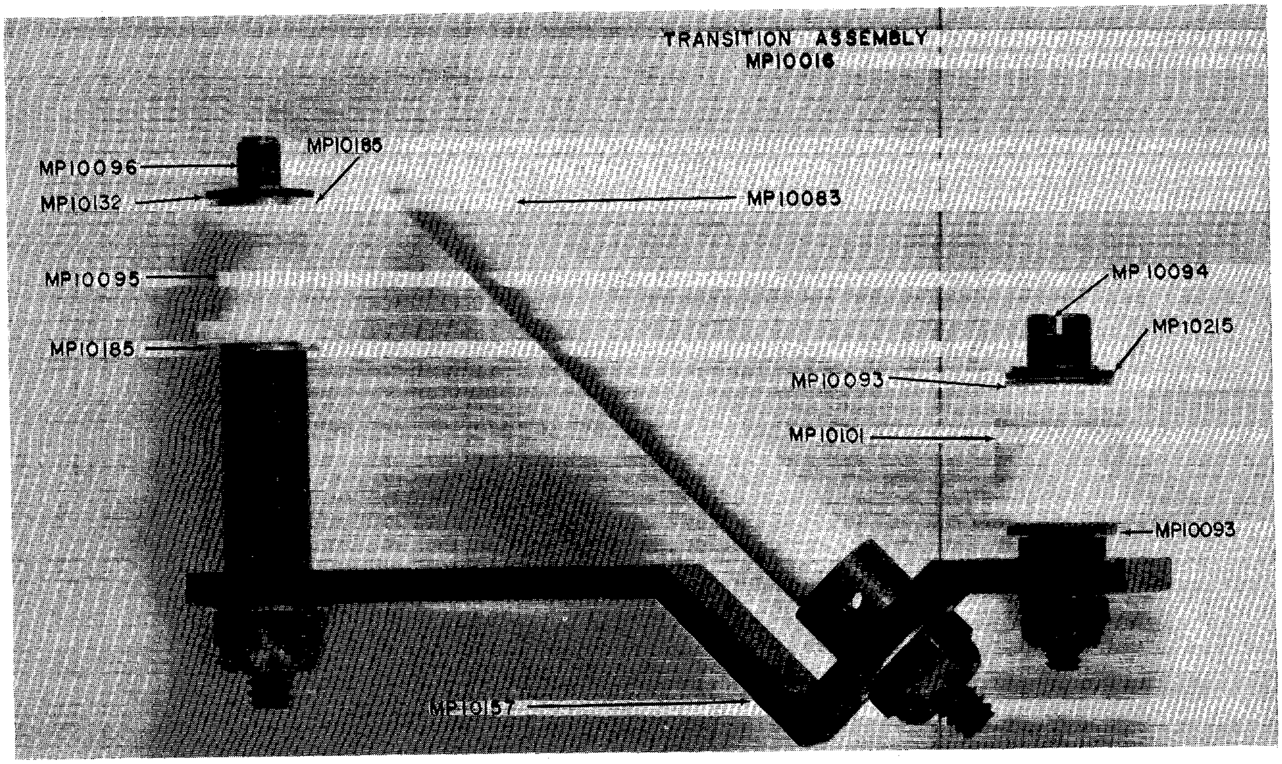

Figure 5-12. Transition Assembly, Parts Callouts

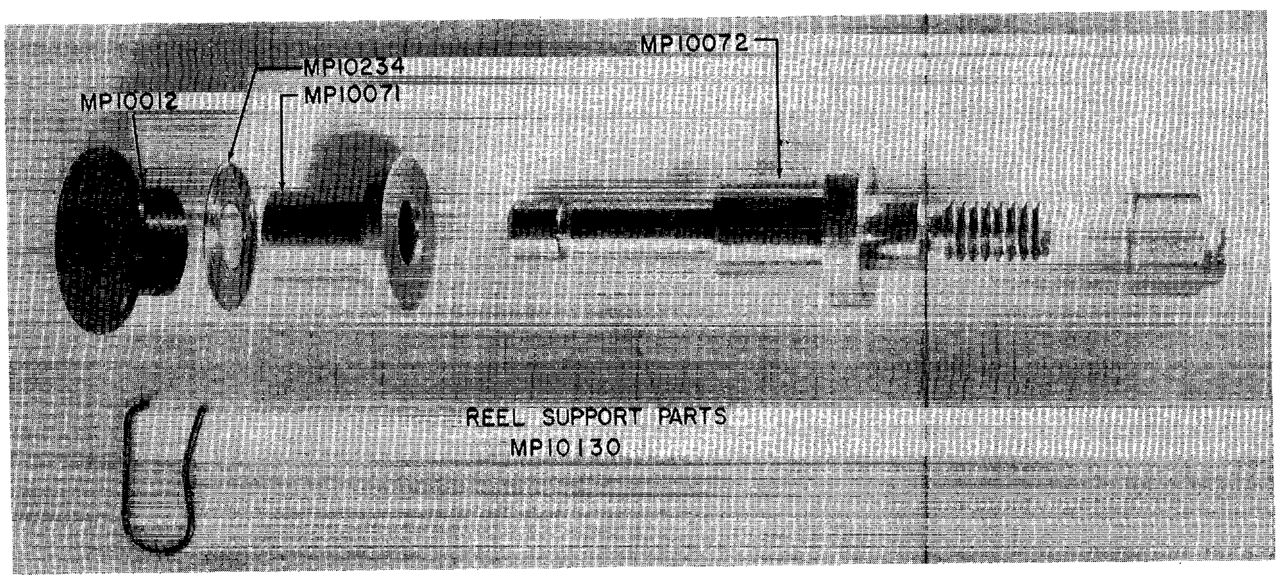

Figure 5-13. Reel-Support, Parts Callouts

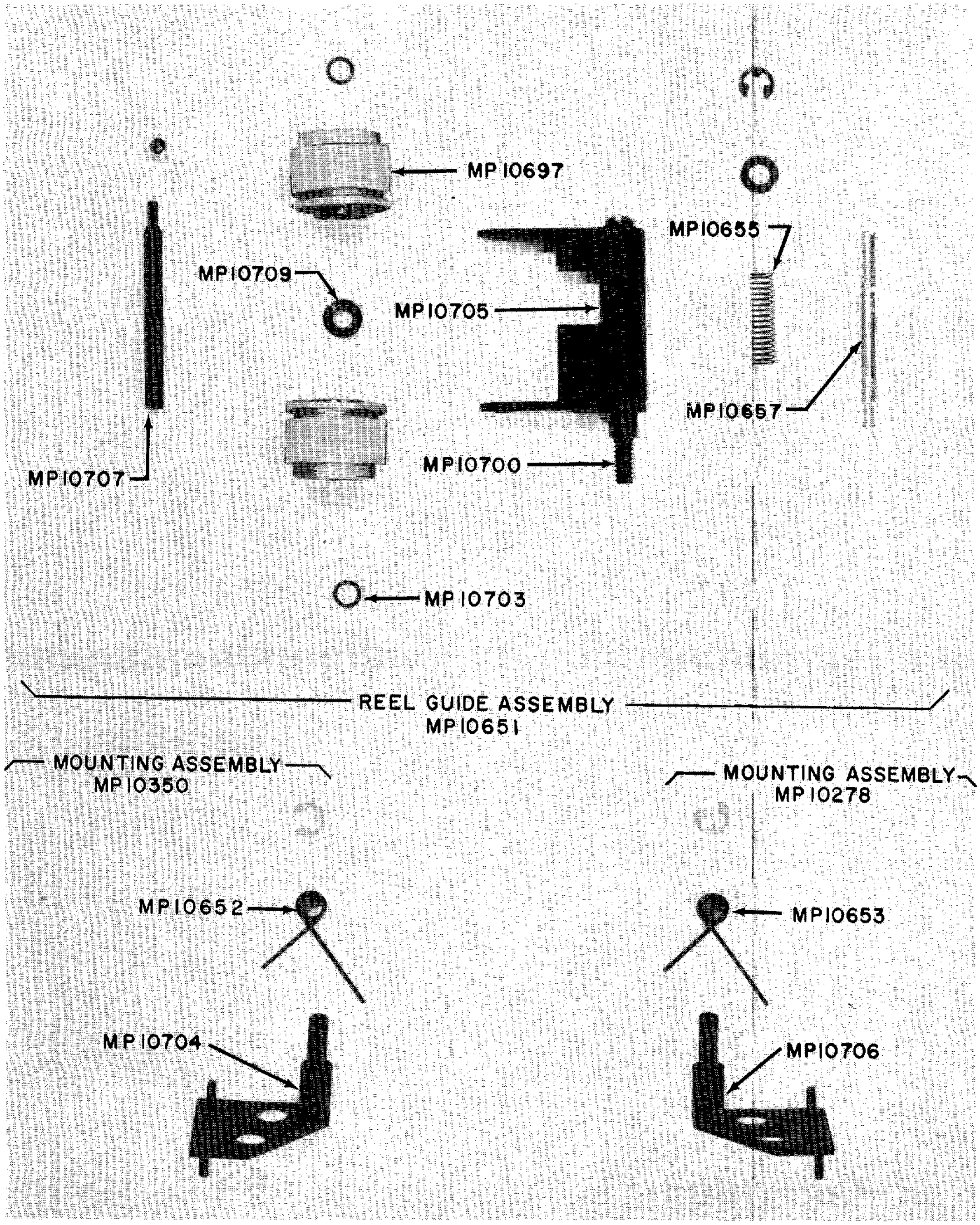

Figure 5-13A. Reel-Guide and Mounting Assemblies, Parts Callouts

Table 5-3. Maintenance Parts List, Printed-Circuit Board Assembly of Information Recorder

Symbol	Maintenance Part Number	JAN Number	Description
C701	MP 30033		.01 Mfd 1% 500 V Silver Mica
C702	MP 30033		Same as C701
C703	MP 30034		.047 Mfd 600 V
C704	MP 30047		.01 Mfd 400 V
C705	MP 30047		Same as C704
C706	MP 30012		.01 Mfd 600 V Disc Ceramic
C707, C708	Not Used		
C709	MP 30033		Same as C701
C710	MP 30033		Same as C701
C711	MP 30034		Same as C703
C712	MP 30047		Same as C704
C713	MP 30047		Same as C704
C714	MP 30012		Same as C706
C715, C716	Not Used		
C717	MP 30033		Same as C701
C718	MP 30033		Same as C701
C719	MP 30034		Same as C703
C720	MP 30047		Same as C704
C721	MP 30047		Same as C704
C722	MP 30012		Same as C706
C723, C724	Not Used		
C725	MP 30033		Same as C701
C726	MP 30033		Same as C701
C727	MP 30034		Same as C703
C728	MP 30047		Same as C704
C729	MP 30047		Same as C704
C730	MP 30012		Same as C706
C732	MP 30065		.0047 Mfd 10% 100 V
C733	MP 38955		.022 Mfd 10% 100 V
C734	MP 30006		6 Mfd 40 V Electrolytic
C735	MP 30005		2 Mfd 100 V Electrolytic
C736	MP 30005		Same as C735
C737	MP 30030		0.1 Mfd 200 V
C738, C739	Not Used		
C740	MP 30044		.0047 Mfd 100 V
C741	MP 30019		.01 Mfd 200 V
C742	Not Used		
C743	MP 30041		.02 Mfd 600 V Disc Ceramic

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1 November 56.

Table 5-3. Maintenance Parts List,
Printed-Circuit Board Assembly of Information Recorder
(Continued)

Symbol	Maintenance Part Number	JAN Number	Description
C744	MP 30028		6200 Mmfd 1% 500 V
C745	MP 30030		Same as C737
C746	MP 30041		Same as C743
C747, C748	Not Used		
C749	MP 30041		Same as C743
C750	MP 30017		1500 Mmfd 5% 500 V Silver Mica
C751	MP 30017		Same as C750
C752	MP 30017		Same as C750
C753	MP 30017		Same as C750
C754	MP 30003		4 Mfd 150 V
C755	MP 30003		Same as C754
C756	MP 30007		20 Mfd 10 V
C757	MP 30041		Same as C743
C758	MP 30007		Same as C756
C759	MP 30041		Same as C743
C760	MP 30007		Same as C756
C761	MP 30041		Same as C743
C762	MP 30004		100 Mfd 50 V
C763	MP 30102		800 Mmfd 600 V
C764	MP 30102		Same as C763
C765	MP 30102		Same as C763
L701	MP 40004		10 MH
L702	MP 40012		50 MH
L703	MP 40004		Same as L701
L704	MP 40012		Same as L702
L705	MP 40020		1 H
L706	MP 40021		50 MH
L707	MP 10600		24 V Solenoid Coil
Q701	MP 50001		Type 903 Transistor
Q702	MP 50001		Same as Q701
Q703	MP 50001		Same as Q701
Q704	MP 50002		Type 951 Transistor
Q705	MP 50002		Same as Q704
Q706	MP 50002		Same as Q704
R742			Selected Value
R743	MP 20101		Same as R707
R744	MP 20296		Same as R703

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Table 5-3. Maintenance Parts List,
Printed-Circuit Board Assembly of
Information Recorder
(Continued)

Symbol	Maintenance Part Number	JAN Number	Description
R701			Selected Value
R702			Same as R701
R703	MP20296		100K Ohms 5% 1/2 Watt
R704	MP20035		1.5K Ohms 1% Wirewound
R705	MP20036		3.3K Ohms 1% Wirewound
R706			Selected Value
R707	MP20101		220K Ohms 5% 1/2 Watt
R708	MP20296		Same as R703
R709	MP20116		5.1K Ohms 5% 1/2 Watt
R710	MP20101		Same as R707
R711	MP20326		1K Ohms 5% 1/2 Watt
R712	MP20368		22K Ohms 5% 1/2 Watt
R713	MP20169		10K Ohms 5% 1/2 Watt
R714	MP20368		Same as R712
R715	MP20249		2.2K Ohms 5% 1/2 Watt
R716-R718	Not Used		
R719			Selected Value
R720			Same as R719
R721	MP20296		Same as R703
R722	MP20035		Same as R704
R723	MP20036		Same as R705
R724			Selected Value
R725	MP20101		Same as R707
R726	MP20296		Same as R703
R727	MP20116		Same as R709
R728	MP20101		Same as R707
R729	MP20368		Same as R712
R730	MP20326		Same as R711
R731	MP20169		Same as R713
R732	MP20368		Same as R712
R733	MP20249		Same as R715
R734-R736	Not Used		
R737	MP20191		9.1K Ohms 5% 1/2 Watt
R738	MP20191		Same as R737
R739	MP20296		Same as R703
R740	MP20035		Same as R704
R741	MP20036		Same as R705

Table 5-3. Maintenance Parts List,
Printed-Circuit Board Assembly of Information Recorder
(Continued)

Symbol	Maintenance Part Number	JAN Number	Description
R745	MP 20116		Same as R709
R746	MP 20101		Same as R707
R747	MP 20368		Same as R712
R748	MP 20326		Same as R711
R749	MP 20169		Same as R713
R750	MP 20368		Same as R712
R751	MP 20249		Same as R715
R752-R754	Not Used		
R755	MP 20158		12K Ohms 5% 1/2 Watt
R756	MP 20158		Same as R755
R757	MP 20296		Same as R703
R758	MP 20035		Same as R704
R759	MP 20036		Same as R705
R760			Selected Value
R761	MP 20101		Same as R707
R762	MP 20296		Same as R703
R763	MP 20116		Same as R709
R764	MP 20101		Same as R707
R765	MP 20368		Same as R712
R766	MP 20326		Same as R711
R767	MP 20169		Same as R713
R768	MP 20368		Same as R712
R769	MP 20249		Same as R715
R770-R772	Not Used		
R773	MP 20315		130K Ohms 5% 1/2 Watt
R774	MP 20169		Same as R713
R775	MP 20296		Same as R703
R776	MP 20249		Same as R715
R777	MP 20115		1300 Ohms 5% 1/2 Watt
R778			Selected Value
R779	MP 20296		Same as R703
R780	MP 20169		Same as R713
R781	MP 20105		910 Ohms 5% 1/2 Watt
R782	MP 20368		Same as R712
R783	MP 20116		Same as R709
R784	MP 20368		Same as R712
R785	MP 20169		Same as R713
R786	MP 20189		3.9K Ohms 5% 1/2 Watt
R787	Not Used		
R788	MP 20177		39K Ohms 5% 1/2 Watt
R789	MP 20296		Same as R703

Revised:
1 November 56.

Table 5-3. Maintenance Parts List,
Printed-Circuit Board Assembly of Information Recorder
(Continued)

Symbol	Maintenance Part Number	JAN Number	Description
R790	MP 20326		Same as R711
R791	MP 20192		100 Ohms 5% 1/2 Watt
R792	MP 20296		Same as R703
R793	MP 20379		47K Ohms 5% 1/2 Watt
R794	MP 20296		Same as R703
R795	MP 20104		2K Ohms 5% 1/2 Watt
R796	MP 20163		10 Ohms 5% 1/2 Watt
R797			Selected Value
R798	MP 20192		Same as R791
R799			Selected Value
R800	Not Used		
R801			Selected Value
R802	MP 20072		20K Potentiometer
R803	MP 20192		Same as R791
R804	MP 20072		Same as R802
R805	MP 20192		Same as R791
R806	MP 20003		30 Ohms 5% 3 Watt
R807	MP 20003		Same as R806
R808	MP 20003		Same as R806
R809	MP 20003		Same as R806
R810-R814	Not Used		
R815	MP 20180		36K Ohms 5% 1/2 Watt
R816	MP 20026		13K Ohms 5% 2 Watt
R817	MP 20101		Same as R707
R818	MP 20326		Same as R711
R819	MP 20375		470K Ohms 5% 1/2 Watt
R820	MP 20101		Same as R707
R821	MP 20368		Same as R712
R822	MP 20101		Same as R707
R823	MP 20326		Same as R711
R824	MP 20375		Same as R819
R825	MP 20101		Same as R707
R826	MP 20368		Same as R712
R827	MP 20101		Same as R707
R828	MP 20326		Same as R711
R829	MP 20375		Same as R819
R830	MP 20101		Same as R707
R831	MP 20368		Same as R712
R833-R858	MP 20242		22 Ohms 5% 1 Watt

Revised:
1 November 56.

Table 5-3. Maintenance Parts List,
Printed-Circuit Board Assembly of Information Recorder
(Continued)

Symbol	Maintenance Part Number	JAN Number	Description
V701-V706	MP 45001		Type 6112
V707, V708	Not Used		
V709-V714	MP 45001		Same as V701
Y701	MP 65501		1000 cps Crystal Unit

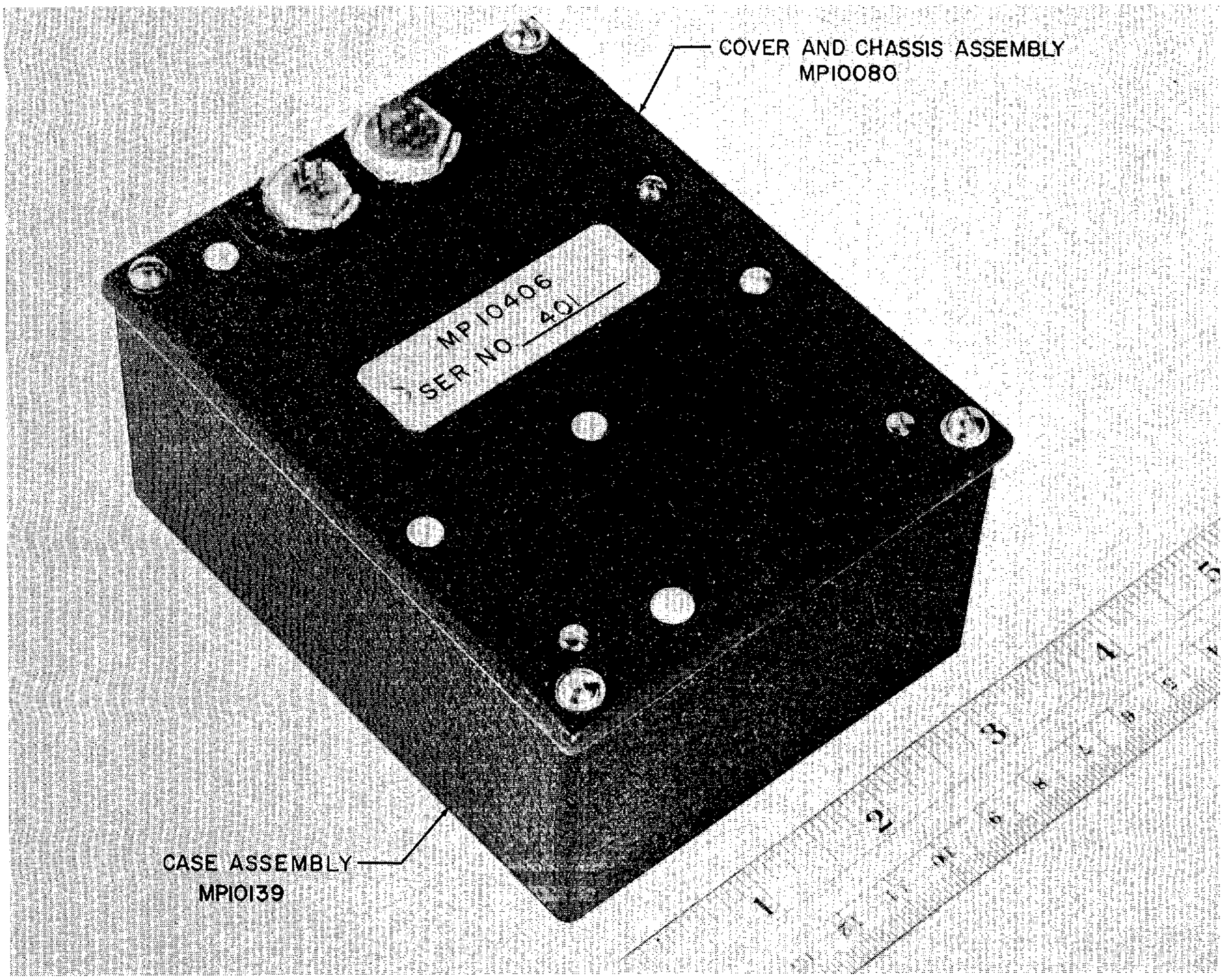

Figure 5-14. Vibrator D-C Supply

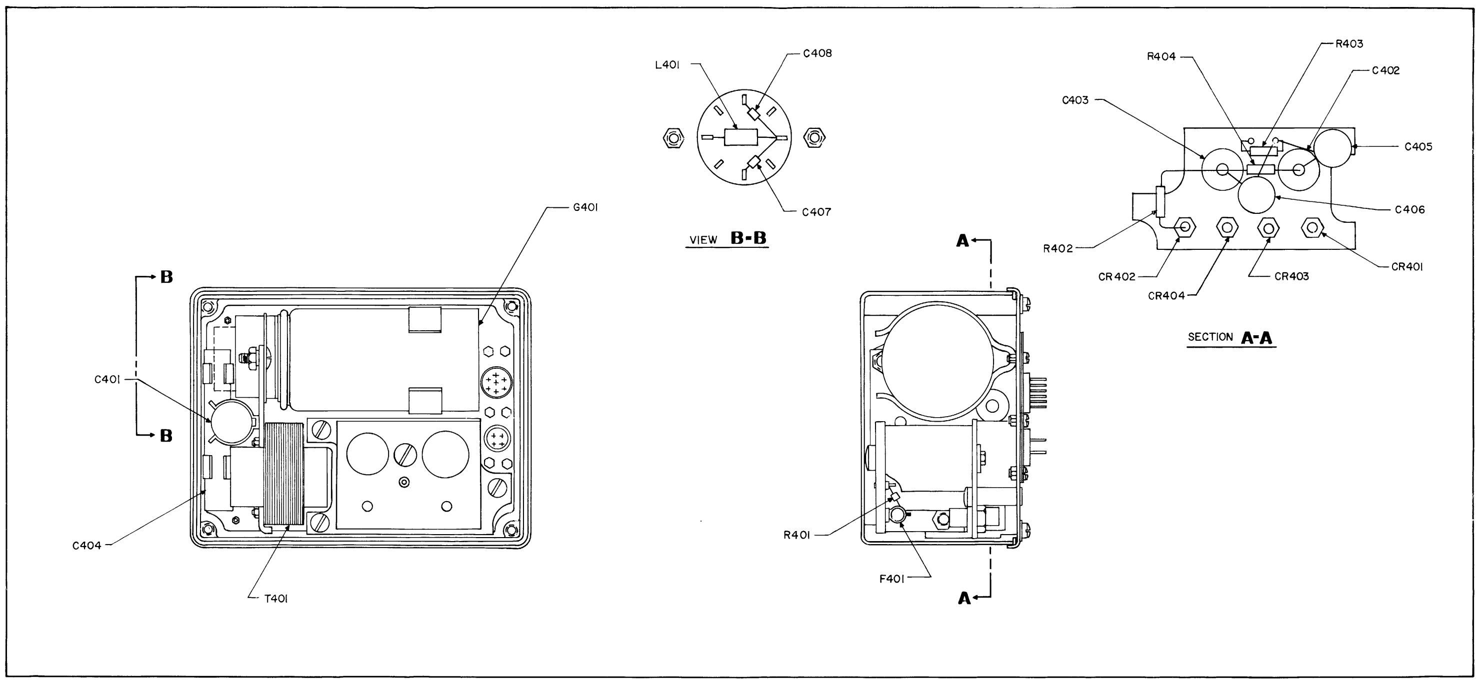

Figure 5-15. Vibrator D-C Supply, Parts Callouts

Approved For Release 2000/05/23 : CIA-RDP75B00300R000100100001-1

Table 5-4. Maintenance Parts List, Vibrator D-C Supply

Symbol	Maintenance Part Number	JAN Number	Description
C401	MP30022		0.1 Mfd 400V
C402	MP30008		25 Mfd 180V
C403	MP30008		Same as C402
C404	MP30004		100 Mfd 50V
C405	MP30041		.02 Mfd 600V
C406	MP30041		Same as C405
C407	MP30021		.002 Mfd 600V
C408	MP30021		Same as C407
CR401	MP55004		Diode, 1N335
CR402	MP55004		Same as CR401
CR403	MP55004		Same as CR401
CR404	MP55004		Same as CR401
F401	MP57001		Fuse, 3 Ampere, Slow-Blow
G401	MP65001		Vibrator
L401	MP40009		27 Microhenries
R401	MP20381		20 Ohms 5% 1/2 Watt
R402	MP20381		Same as R401
R403	MP20379		47K Ohms 5% 1/2 Watt
R404	MP20379		Same as R403
T401	MP58002		Power Transformer

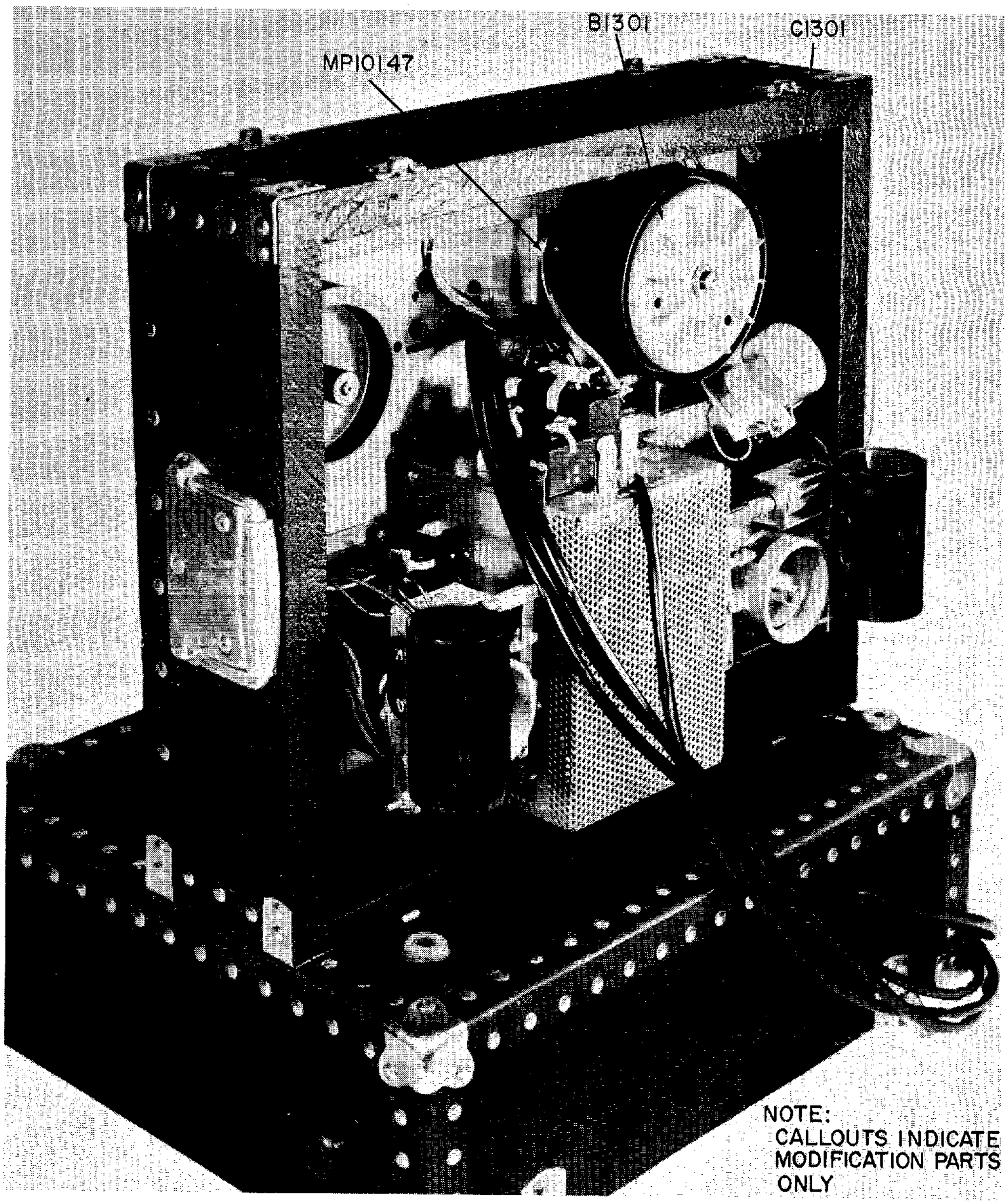

Figure 5-16. Low-Speed Playback Transport, Parts Callouts

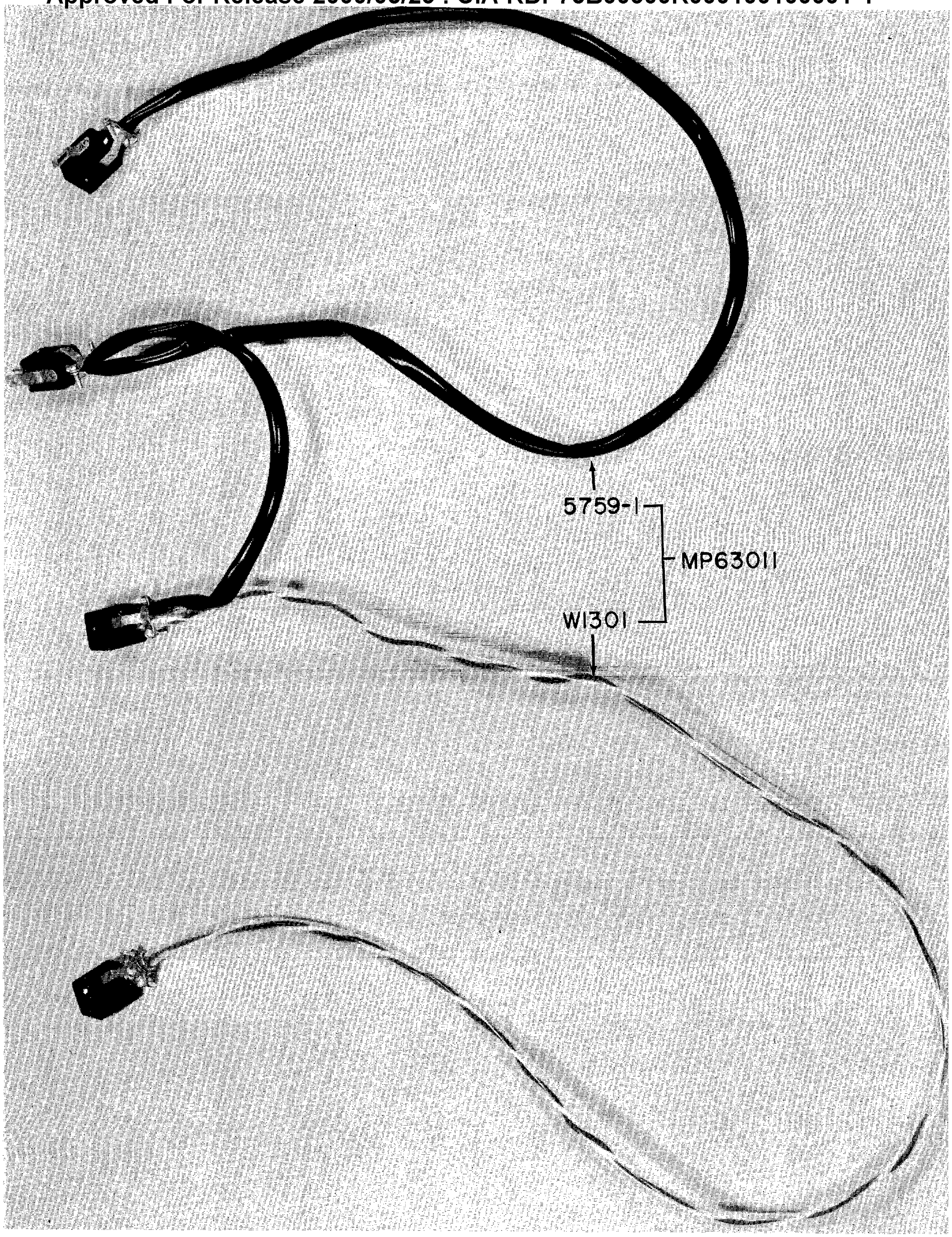

Figure 5-17. Power Interconnecting Cable
(5759-1 Modified to Include W1301),
Parts Callouts

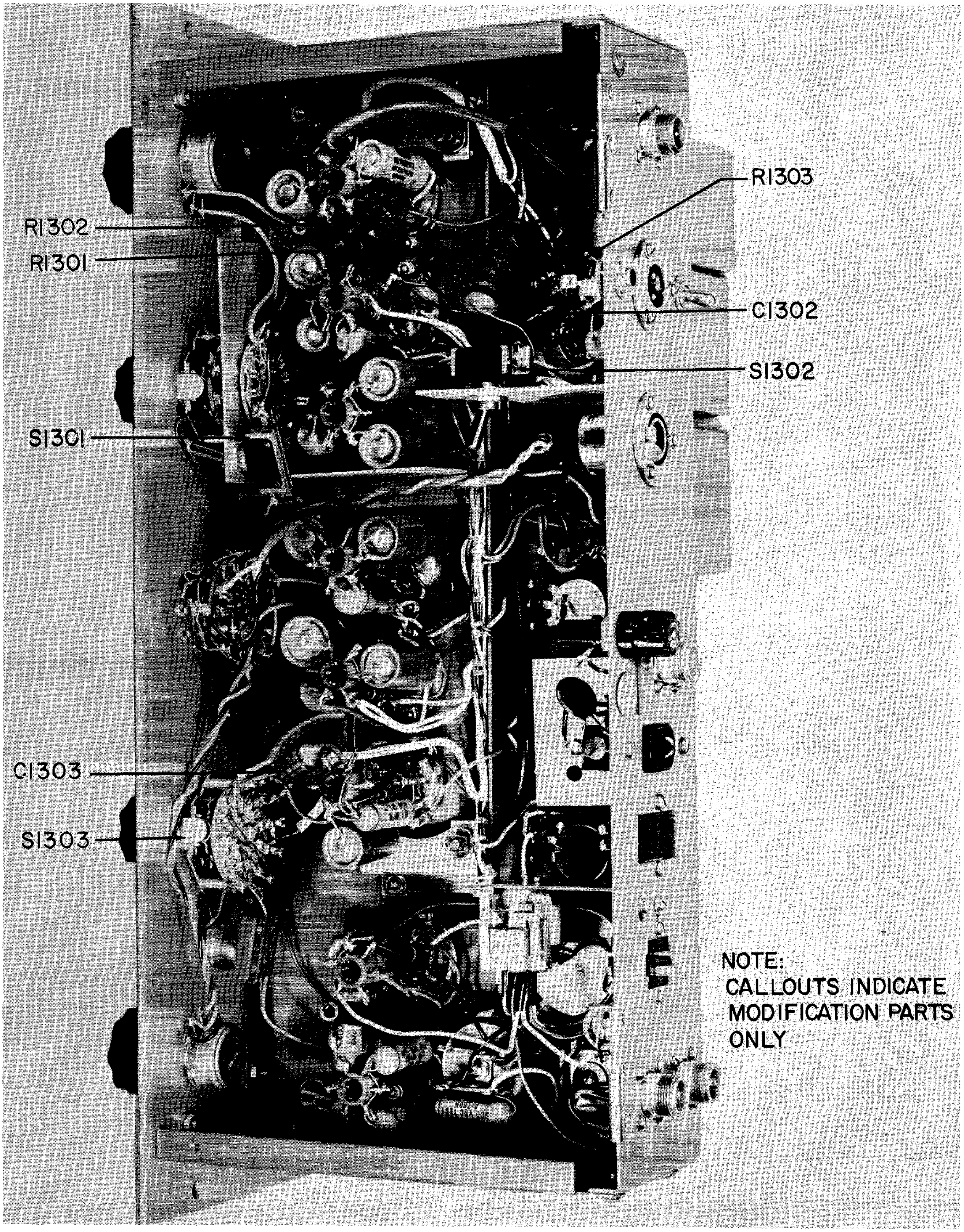

Figure 5-18. Master or Slave Amplifier, Parts Callouts

Table 5-5. Maintenance Parts List, Re-Record Equipment

Symbol	Maintenance Part Number	JAN Number	Description
B1301	MP10640		Motor
C1301	MP30066		Starting Capacitor for B1301
C1302	MP30069		2 Mfd 200V
C1303	MP30034		.05 Mfd 200V
R1301	MP20375		470KOhms 5% 1/2 Watt
R1302	MP20275		1.5 Megohm 5% 1/2 Watt
R1303	MP20315		130KOhms 5% 1/2 Watt
S1301	MP60002		S.P.D.T. Toggle Switch
S1302	MP60002		Same as S1301
S1303	MP60005		4P.D.T. Rotary Switch
W1301	MP63026		Cable

Table 5-6. Maintenance Parts List,
Ground-Based Test Set

Symbol	Maintenance Part Number	JAN Number	Description
AT501	10562		S-band attenuator
AT502	67501		X-band attenuator
AT503	67503		20-db attenuator
B501	10321		Blower motor
C501AB	33440		20/20 Mfd 450 V
C503	33441		0.1 Mfd 10% 200 V
C504			Same as C503
C506AB			Same as C501
C508	30067		0.1 Mfd 10% 400 V
C509	33442		20 Mfd 450 V
C510	30041		0.02 Mfd (min.) 600 V
C511			Same as C509
C512			Same as C503
C513	33443		5 Mfd 10% 600 V
C514	33444		4 Mfd 10% 2000 V
C516			Same as C514
C517	33445		0.5 Mfd 10% 1500 V
C518	33446		1.0 Mfd 10% 200 V
C519			Same as C503
C521			Same as C518
C522	33447		2 Mfd 10% 1000 V
C523			Same as C503
C524			Same as C503
C526			Same as C503
C527			Same as C503
C601	33449		0.001 Mfd 10% 400 V
C602	33450		20 Mfd 450 V
C603	38957		0.001 Mfd 5% 500 V
C604	30068		0.002 Mfd 5% 500 V
C606	30032		0.003 Mfd 5% 500 V
C607	30037		6200 Mmf 5% 500 V
C608	30050		9100 Mmf.5% 500 V
C609			Same as C603
C611			Same as C604
C612			Same as C606
C613			Same as C607
C614			Same as C608
C616			Same as C508
C617	33451		1.0 Mfd 10% 400 V
C618	30023		0.022 Mfd 10% 400 V

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Table 5-6. Maintenance Parts List,
Ground-Based Test Set
(Continued)

Symbol	Maintenance Part Number	JAN Number	Description
C619	30038		50 Mfd 6 V
C621	30026		20 Mmf 5% 500 V
C622	30024		10 Mfd 25 V
C623	30062		0.022 Mfd (min.) 600 V
C624	30041		0.02 Mfd (min.) 600 V
C626	33452		820 Mmf 5% 500 V
C627			Same as C601
C628	33453		560 Mmf 5% 500 V
C629	33454		150 Mmf 5% 500 V
C631			Same as C601
C632	33455		50 Mmf 5% 500 V
C633			Same as C621
C634			Same as C601
C636	30060		30 Mmf 5% 500 V
C637			Selected Value
C638	38961		0.05 Mfd 3000 V
CR501	54976		1N342 Silicon diode
CR502			Same as CR501
CR503			Same as CR501
CR504			Same as CR501
CR506			Same as CR501
CR507			Same as CR501
CR508			Same as CR501
CR509			Same as CR501
CR511			Same as CR501
CR512			Same as CR501
CR513			Same as CR501
CR514	55036		1N543A Silicon diode
CR601	55010		1N99 Germanium diode
CR602			Same as CR601
DS501	59114		Lamp Assembly
F501	57005		Fuse 3 amp 125 V
F502			Same as F501
J501	62027		115-V power jack
J502	63024	UG-22C/U	Series N panel connector
J503			Same as J502

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Table 5-6. Maintenance Parts List,
Ground-Based Test Set
(Continued)

Symbol	Maintenance Part Number	JAN Number	Description
J504			Same as J502
J601	62032	UG-290/U	Series BNC panel jack
J602			Same as J601
K501	68005		Thermal relay
K502	68010		60-cps relay
L501	40017		15 henries 120 Ma
L502			Same as L501
L503	40006		68 microhenries
L504			Same as L503
L506			Same as L503
L507			Same as L503
L601	40023		1.0 millihenries
L602			Same as L601
L603	40026		750-1400 microhenries
M501	66501		200 UA meter
M503	66504		2.4-4.0 Kmc meter
M504	66508		8.20-12.40 Kmc meter
R501	20375	RC42GF474J	470K 5% 2 Watt
R502			Same as R501
R503			Same as R501
R504			Same as R501
R506			Same as R501
R507			Same as R501
R508			Same as R501
R509			Same as R501
R511	20090	RC42GF201J	200 Ohms 5% 2 Watt
R512	20050		2500 Ohms 5% 25 Watt
R513	20056		7500 Ohms 5% 5 Watt
R514	20320	RC20GF154J	150K 5% 1/2 Watt
R516			Same as R514
R517			Same as R501
R518			Same as R501
R519	20291	RC32GF101J	100 Ohms 5% 1 Watt
R521	20015	RC42GF511J	510 Ohms 5% 2 Watt
R522			Same as R521
R523	20296	RC20GF104J	100K 5% 1/2 Watt

Table 5-6. Maintenance Parts List,
Ground-Based Test Set
(Continued)

Symbol	Maintenance Part Number	JAN Number	Description
R524	20005		2500 Ohms 5 Watt
R526	20007		1K 2 Watt variable
R527	10940	RC42GF330J	33 Ohms 5% 2 Watt
R528	20416	RC42GF202J	2K Ohms 5% 2 Watt
R529			Same as R528
R531	20240	RC32GF133J	13K 5% 1 Watt
R532	20321	RC32GF512J	5100 Ohms 5% 1 Watt
R533			Same as R521
R534			Same as R521
R536	20049		10K 5% 5 Watt
R537	20482	RC42GF514J	510K 5% 2 Watt
R538	20016	RC42GF205J	2 Megohms 5% 2 Watt
R539	20174	RC20GF511J	510 Ohms 5% 1/2 Watt
R541	20017	RC42GF125J	1.2 Megohms 5% 2 Watt
R542	20057		100K 2 Watt variable
R543	20478	RC42GF104J	100K 5% 2 Watt
R544	20020	RC42GF682J	6800 Ohms 5% 2 Watt
R546	20018		35K 50 Watt
R547	20022		4K 5 Watt
R548			Same as R543
R549	20263	RC20GF133J	13K 5% 1/2 Watt
R551	20033		6K 10 Watt
R552			Same as R523
R553			Same as R523
R554			Same as R523
R556			Same as R523
R557			Same as R542
R558			Same as R542
R559	20326	RC20GF102J	1K 5% 1/2 Watt
R560			Same as R523
R561			Same as R542
R562			Same as R542
R563			Same as R523
R564			Same as R523
R572	20065		200 Ohms 1% 1/2 Watt
R573			Same as R572
R574			Same as R572
R576	20062		800 Ohms 1% 1/2 Watt
R577			Same as R576
R578			Same as R576

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Table 5-6. Maintenance Parts List
Ground-Based Test Set
(Continued)

Symbol	Maintenance Part Number	JAN Number	Description
R579	20034		150 Ohms 1% 1/2 Watt
R581	20042		3K 1% 1/2 Watt
R601	20055		50K 1% 1/2 Watt
R602	20334	RC20GF561J	560 Ohms 5% 1/2 Watt
R603			Same as R601
R604	20254	RC20GF682J	6800 Ohms 5% 1/2 Watt
R606	20218	RC20GF432J	4300 Ohms 5% 1/2 Watt
R607	20175	RC20GF514J	510K 5% 1/2 Watt
R608	20123	RC20GF242J	2400 Ohms 5% 1/2 Watt
R609	20181	RC20GF181J	180 Ohms 5% 1/2 Watt
R611	20168	RC20GF244J	240K 5% 1/2 Watt
R612	20130	RC20GF106J	10 Megohms 5% 1/2 Watt
R613	20394	RC32GF104J	100K 5% 1 Watt
R614	20112	RC20GF391J	390 Ohms 5% 1/2 Watt
R616	20269	RC32GF753J	75K 5% 1 Watt
R617			Same as R611
R618	20325	RC20GF273J	27K 5% 1/2 Watt
R619	20238	RC20GF204J	200K 5% 1/2 Watt
R621			Same as R523
R622	20172	RC20GF304J	300K 5% 1/2 Watt
R623	20119	RC20GF152J	1500 Ohms 5% 1/2 Watt
R624			Same as R613
R626	20138	RC20GF302J	3K 5% 1/2 Watt
R627	20367	RC20GF203J	20K 5% 1/2 Watt
R628	20116	RC20GF512J	5100 Ohms 5% 1/2 Watt
R629			Same as R623
R631			Same as R606
R632	20052		25K 2 Watt variable
R633	20027	RC42GF203J	20K 5% 2 Watt
R634			Same as R523
R636	20293	RC32GF622J	6200 Ohms 5% 1 Watt
R637			Same as R611
R638	20114	RC20GF680J	68 Ohms 5% 1/2 Watt
RT501	22066	28D1	Disc thermistor
RT502	20391	N215A	Coaxial thermistor
RT503	20398	27D1	Disc thermistor
RT601	59110		6-Watt 125-V Lamp
S501	60009		DPST Switch
S502ABC	60018		3PDT Switch

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Table 5-6. Maintenance Parts List,
Ground-Based Test Set
(Continued)

Symbol	Maintenance Part Number	JAN Number	Description
S503AB			Same as S502
S601ABCD	60017		Switch assembly
T501	58015		Power transformer
T502	58013		Power transformer
V501	47323		0A2 Electron tube
V502			Same as V501
V503	47324		0B2 Electron tube
V504			Same as V503
V506	47330		836 Electron tube
V507			Same as V506
V508	47341		829-B Electron tube
V509	47338		6SJ7 Electron tube
V511			Same as V501
V512	47334		5R4GY Electron tube
V513			Same as V501
V514			Same as V501
V516			Same as V501
V517			Same as V501
V518	45004		2K39 Electron tube
V519	45005		2K41 Electron tube
V601	45022		5654 Electron tube
V602			Same as V601
V603	45015		6U8 Electron tube
V604	45032		2D21 Electron tube
V605	45024		5670 Electron tube
	68320		Oscilloscope

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AIRBORNE RADAR-MONITORING SYSTEM

SECTION VI
SUPPLEMENTARY DATA SECTION

6-1. GENERAL.

6-2. This section of the instruction guide contains data pertaining to: (1) the information recorder printed-circuit-board test jig, and (2) the heater-equipped metal top cover of the information recorder.

6-3. INFORMATION RECORDER TEST JIG.

6-4. PURPOSE OF THE TEST JIG. The test jig provides a convenient means for checking the power requirements and the signal-generating and amplifying characteristics of the information-recorder printed-circuit board.

6-5. EQUIPMENT USED WITH THE TEST JIG. When checking the power requirements of the printed-circuit board, a 28-volt d-c source and a vibrator d-c supply are used with the test jig. When checking the signal generating and amplifying characteristics of the printed-circuit board, the 28-volt d-c source, the vibrator d-c supply, and an oscilloscope are used with the test jig.

6-6. The 28-volt d-c source is a standard facility required for test and maintenance of the Airborne Radar-Monitoring System. The vibrator d-c supply (MP10406) is a unit of the Airborne Radar-Monitoring System. The oscilloscope (MP10218) and its associated plug-in preamplifier (MP10148) are items of Unit Essential Equipment.

6-7. GENERAL DESCRIPTION OF THE TEST JIG. Figure 6-1 shows the test jig with a printed-circuit board plugged into the front panel. The test jig applies d-c voltages to the printed-circuit board, and applies to the oscilloscope those signals which are generated and amplified by circuits of the board. The test jig does not contain power or signal-generating sources, but simply serves as a switching, calibrating, and metering device.

6-8. When checking power requirements, the power supplied to circuits of the board by the 28-volt d-c source is indicated by a voltmeter and an ammeter on the front panel of the test jig. Similarly, power supplied by the 220-volt output of the vibrator d-c supply is indicated by a voltmeter and an ammeter on the front panel.

6-9. When checking signal-generating characteristics, signals generated by circuits of the board are displayed on the oscilloscope. When checking amplifying characteristics, one of the signal-generating circuits applies a calibrated signal to the amplifier being checked, and the amplified signal is displayed on the oscilloscope.

6-10. A circuit-selector control simultaneously applies voltage to circuits of the board and connects circuit test points to the oscilloscope. Other controls are provided to adjust the output of the 28-volt d-c source, and to calibrate the signal applied to the amplifiers.

6-11. DETAILED DESCRIPTION OF THE TEST JIG. Figure 6-2 shows the schematic diagram of the test jig. The 28-volt d-c source is applied to the test jig through P903. When circuit-selector switch S901 is in the OFF position, the test jig, vibrator d-c supply, and printed-circuit board are not connected to the 28-volt supply. When S901 is moved from the OFF position to any of the labeled positions, K901 becomes energized. With K901 energized, the 28-volt source is applied to the vibrator d-c supply, to circuits of the printed-circuit board, and to PILOT DS901. Thus, in all of the labeled positions except the OFF position, DS901 glows when K901 is energized. In the unlabeled switch position (between OFF and AMP #3), DS901 is connected to the 28-volt supply through the back contacts of K901.

6-12. When S901 is in a test position, the 28-volt d-c source is applied to the vibrator d-c supply through P903, F902, the contacts of K901, VOLTS ADJ R904, and P901. The d-c voltage which appears on the moving contact of VOLTS ADJ R904 is applied to the printed-circuit board under test through printed-circuit-connector J908. The fuse (F902) in series with the 28-volt supply contains an indicator which glows when the fuse is open. The amplitude of the 28-volt d-c source is controlled by VOLTS ADJ R904, and is metered by +A VOLTS meter M904. The 28-volts d-c source current is metered by +A CURRENT meter M903. The terminals of M904 are connected to the front-panel terminals labeled GND. (E902) and +A (E903).

6-13. When the S901 is in a test position, the 220-volt output of the vibrator d-c supply is applied to the printed-circuit board under test through P901, F901, M901 and J908. The fuse (F901) in series with the 220-volt output has an indicator which glows when the fuse is open. The amplitude of the 220-volt output is metered by +B VOLTS meter M902. The 220-volt output current is metered by +B CURRENT meter M901. The terminals of M902 are connected to the front-panel terminals labeled GND. (E902) and +B (E901). Supplementary loads for the 110-volt and 220-volt outputs are provided by R901, R902, and R903.

6-14. When an information-recorder printed-circuit board is connected to the test jig through J901 and J902, J903 and J904, J906 and J907, and J908, the various test-point voltages of the board may be sampled, i.e., connected across output terminals

E904 and E906. The oscilloscope connected to the test-jig output terminals is then used to observe the characteristics of the voltages sampled.

6-15. When S901 is in the OSC. #1 position, the 1.0-kc reference oscillator output is sampled. Similarly, with S901 in the OSC. # 2, OSC. #3, OSC. #4, and OSC. #5 position, the 1.3-kc, 1.7-kc, 2.3-kc, and 3.0-kc oscillator outputs are sampled. While any one of the above five oscillator outputs is sampled, the remaining four outputs are disabled.

6-16. When S901 is in the ERASE NORMAL position, the output of the 20.5-kc bias-and-erase oscillator is sampled at the erase test point (ER), and the 1.0-kc through 3.0-kc oscillator outputs are disabled. When S901 is in the ERASE BIAS position, the 20.5-kc voltage across erase-head metering-resistor R796 (TP3) is sampled, and the 1.0-kc through 3.0-kc oscillator outputs are disabled. The parallel combination of R942 and L904 simulates the erase-head load.

6-17. In the R.H. - #1 NORM position, S901 samples the 20.5-kc voltage across L903 (which simulates the track 1 record-head impedance) and R798, with the 1.0-kc through 3.0-kc oscillators disabled. In the R.H. - # 2 BIAS position, the 20.5-kc and 1.0-kc voltage at TP6 is sampled, with the 1.3-kc through 3.0-kc oscillators disabled. In the R.H. - # 2 NORM position, S901 samples the 20.5-kc voltage across L902 (which simulates the track 2 record-head impedance) and R803, with the 1.0-kc through the 3.0-kc oscillator outputs disabled. In the R.H. - # 2 BIAS position, the 20.5-kc voltage of TP1 is sampled, with the 1.3-kc through 3.0-kc oscillators disabled. In the R.H. - # 3 NORM position, S901 samples the 20.5-kc voltage across L901 (which simulates the track 3 record-head impedance) and R805. With S901 in the R.H. - #3 BIAS position the 20.5-kc voltage at TP4 is sampled with the 1.0-kc through 3.0-kc oscillators disabled.

6-18. In the SIG. # 1 position, S901 samples the 20.5-kc bias-and-erase oscillator output across resistor R911. Similarly, in the SIG. # 2 position, S901 samples the voltage across R909. In each case the 1.0-kc through 3.0-kc oscillator outputs are disabled.

6-19. In the AMP # 1 position, S901 connects the 28-volt d-c source to the series-connected filaments of tubes designated V709 through V714, and connects the vibrator d-c supply 220-volt output to the plates of tubes designated V709 through V714. While in this position, S901 disables the outputs of the 1.3-kc through 3.0-kc oscillators, and applies the output of the 1.0-kc oscillator to the input of the track 1 playback amplifier through the ATTEN. and CALIB. controls. Also while in the AMP # 1 position, S901 connects the output of the track 1 playback amplifier to the test-jig output terminals. By adjusting the calibration and attenuation controls, the technician operating the test jig may measure the gain of the track 1 playback amplifier. Similarly, with S901 in the AMP # 2 and AMP # 3 positions, the outputs of the track 2 and track 3 playback amplifiers are sampled, respectively. Resistors R906, R907, and R908 simulate the resistances of the playback heads. With S902 in the CALIB. OUT 2V position, the 1.0-kc-oscillator signal appears on the oscilloscope, and R914 may be adjusted to provide a known signal level to the attenuator.

6-20. In the unlabeled position between AMP # 3 and OFF, the pilot light glows but no power is applied to the printed-circuit board or to the vibrator d-c supply.

6-21. PREPARING THE TEST JIG FOR OPERATION. Proceed as follows:

a. Place the circuit-selector control in the OFF position and rotate the VOLTS ADJ. control to the extreme clockwise (minimum resistance) position.

b. Connect the vibrator d-c supply to the test jig by connecting J401 to P901, and J402 to P902.

c. Connect the 28-volt d-c source to the test jig through P903.

d. Connect an information-recorder printed-circuit board to the test jig by connecting J703 to J908, P702 to J901, P704 to J902, P706 to J903, P708 to J904, P710 to J906, and P712 to J907. Mating connectors are color-coded.

e. Connect the oscilloscope to OUTPUT terminals E904 and E906.

6-22. OPERATING THE TEST JIG. Use the procedure of table 6-1 when checking the information-recorder printed-circuit board.

CAUTION

Application of insufficient voltage to the vibrator supply may result in blowing F902 or the fuse in the center-tap lead of the primary of T401. Possibly both fuses may be blown. To prevent such an occurrence, the VOLTS ADJ. control should always be in the extreme clockwise position when the 28-volt d-c source is being applied to the test jig.

Table 6-1

Information-Recorder Test Jig Operation

Set the test jig controls as follows:

OUTPUT - CALIB. OUT 2V switch: OUTPUT position.
Circuit-Selector Switch: OSC. # 1 position.
VOLTS ADJ.: Adjust for 27.5 volts on +A VOLTS meter.

POWER REQUIREMENT CHECK: Observe the currents and voltages listed below for the corresponding positions of the selector switch.

Circuit Checked	Selector Switch	Current		Voltage	
		+A	+B	+A	+B
Fil. of V701, V702, V703, V704, V705, V706, bias and erase osc., 1.0-kc osc.	All pos. except AMP # 1, AMP # 2, AMP # 3, OFF, and unlabeled pos.	0.65 ±0.05 amps		27.5 volts	
Plates of V701, V702, V703, V704, V705, and V706	Same as above		14.5 ± 2.5 ma		225 ± 25 volts

SIGNAL-GENERATING CHECK: Short L703 on the printed-circuit board. Observe the outputs listed below for the corresponding positions of the selector switch.

Circuit Checked	Selector Switch	Sampled At	Voltage Peak-to-Peak
1.0-kc osc.	OSC. # 1	J703A	3 volts + 1.2 - 0.9
1.3-kc osc.	OSC. # 2	J703B	3 volts + 1.2 - 0.9
1.7-kc osc.	OSC. # 3	J703C	3 volts + 1.2 - 0.9
2.3-kc osc.	OSC. # 4	J703D	3 volts + 1.2 - 0.9
3.0-kc osc.	OSC. # 5	J703E	3 volts + 1.2 - 0.9
1.0-kc record current	R.H. - # 1 BIAS	J703-4(TP6)	15 mv ± 3

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Table 6-1

Information-Recorder Test Jig Operation

(Continued)

Remove short from L703 and continue:			
Circuit Checked	Selector Switch	Sampled At	Voltage Peak-to-Peak
20.5-kc erase voltage	ERASE NORM	J703-5 (ER)	110 volts ± 10
20.5-kc erase current	ERASE BIAS	J703-6 (TP3)	220 mv (min.)
20.5-kc bias voltage, track 1	R.H. - # 1 NORM	J703-3	12.5 volts ± 2.5
1-kc and 20.5-kc record and bias current, track 1	R.H. - # 1 BIAS	J703-4(TP6)	300 mv ± 30 (20.5-kc) with 15 mv ± 3 (1.0-kc)
20.5-kc bias voltage, track 2	R.H. - #2 NORM	J703-2	12.5 volts ± 2.5
20.5-kc bias current, track 2	R.H. - # 2 BIAS	J703-1 (TP1)	300 mv ± 30
20.5-kc bias voltage, track 3	R.H. - # 3 NORM	J703Z	12.5 volts ± 2.5
20.5-kc bias current, track 3	R.H. - # 3 BIAS	J703Y (TP4)	300 mv ± 30
R802	SIG. # 1	J703V	Adjust R802 for a 20.5-kc peak-to-peak voltage level of 4 volts
R804	SIG. # 2	J703W	Adjust R804 for a 20.5-kc peak-to-peak voltage level of 4 volts

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Table 6-1

Information-Recorder Test Jig Operation

(Continued)

Ground the playback amplifier shields and set the test jig controls as follows:

OUTPUT - CALIB. OUT 2V Switch: CALIB. OUT 2V position.
Selector Switch: AMP # 1 position.
VOLTS ADJ.: Adjust for 27.5 volts on the +A VOLTS meter.
ATTEN.: 0.001 VOLTS position.
CALIB.: Adjust for 2 volts peak-to-peak as observed on the oscilloscope.

POWER REQUIREMENTS CHECK: Observe the currents and voltages listed below for the corresponding positions of the selector switch.

Circuit Checked	Selector Switch	Current		Voltage	
		+A	+B	+A	+B
Fil. of V701, V702, V703, V704, V705, V706, bias and erase osc., 1.0-kc osc., fil. of V709, V710, V711, V712, V713, and V714	AMP # 1, AMP # 2, and AMP # 3 pos.	1.15 ±0.5 amps		27.5 volts	
Plates of V701, V702, V703, V704, V705, V706, V709, V710, V711, V712, V713, and V714	Same as above		21.5 ±2.5 ma		210 ± 25 volts

SIGNAL-AMPLIFYING CHECK: Return the OUTPUT - CALIB. OUT 2V switch to the OUTPUT position and proceed as before.

Circuit Checked	Selector Switch	Sampled At	Voltage Peak-to-Peak
Track 1 playback amplifier	AMP # 1	J703N	1.0 volts ± 0.4*
Track 2 playback amplifier	AMP # 2	J703P	1.0 volts ± 0.4
Track 3 playback amplifier	AMP # 3	J703R	1.0 volts ± 0.4

*Slight 20.5-kc pick up present.

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6-23. MAINTENANCE OF THE TEST JIG. Maintenance of the test jig should include periodic cleaning and lubrication of rotary-switch contacts and the lubrication of rotary-switch detent mechanisms. The test jig also includes coils, resistors, and wiring which may become defective. The faulty component or wire may be isolated by resistance and continuity checks with an ohmmeter.

CAUTION

In making resistance and continuity checks, the voltage source of an ohmmeter may damage one of the test-jig ammeters. Jumpers should be connected across the terminals of each ammeter while resistance and continuity checks are being made.

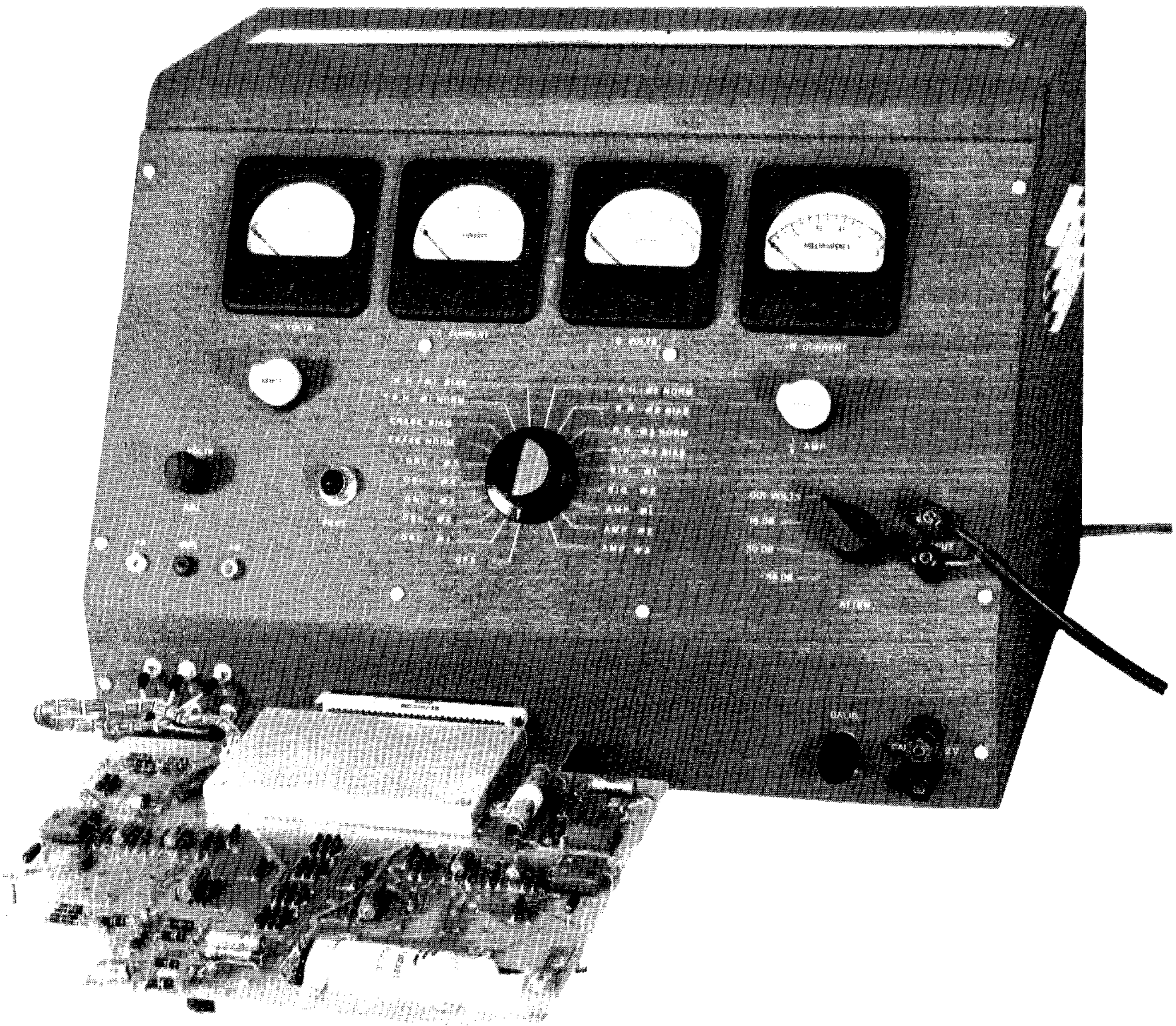

Figure 6-1. Test Jig for Information Recorder Printed-Circuit Board

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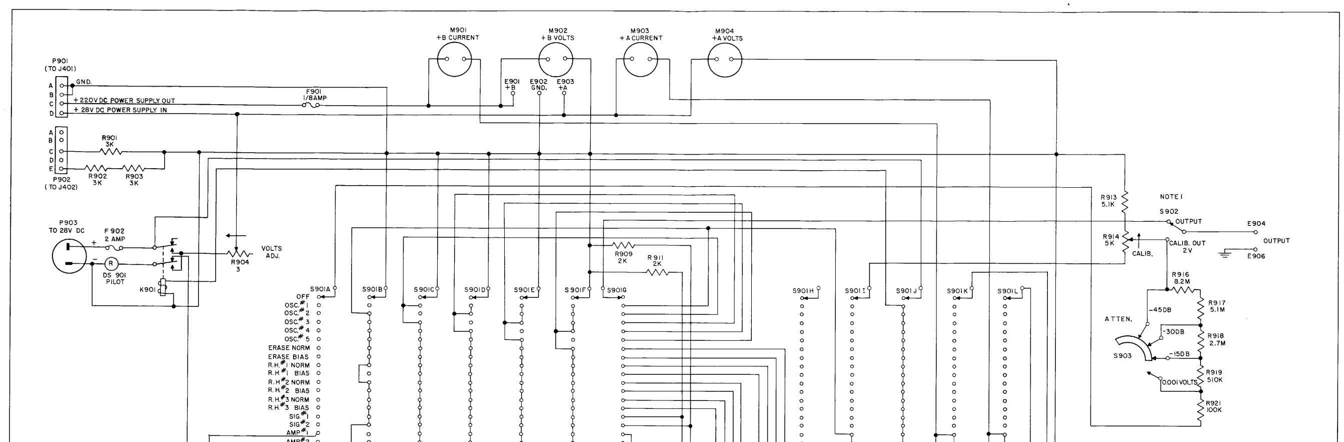

SCHEMATIC NOTES

1. S902 IS NOT INCLUDED ON FIRST UNIT. ON FIRST UNIT, SEPARATE TERMINALS ARE PROVIDED FOR OUTPUT AND CALIBRATION VOLTAGES.
2. UNLESS SPECIFIED OTHERWISE:
   a. ALL RESISTANCE VALUES ARE IN OHMS. "K" MEANS KILOHMS. "M" MEANS MEGOHMS.
   b. ALL INDUCTANCE VALUES ARE IN MILLIHENRIES.
3. ↑ ARROW DIRECTION INDICATES CLOCKWISE ROTATION OF CONTROL SHAFT.

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Figure 6-2. Test Jig, Schematic

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6-24. HEATER-EQUIPPED METAL TOP COVER.

6-25. PURPOSE OF THE HEATER-EQUIPPED METAL TOP COVER. Operation of the airborne information-recorder mechanisms may be impaired by low-temperature environmental conditions. A heater-equipped metal top cover may be used to maintain a sufficiently high temperature within the recorder case.

6-26. DESCRIPTION OF THE HEATER-EQUIPPED METAL TOP COVER. Figure 6-3 shows an information recorder with a heater-equipped metal top cover, and a heater-equipped metal top cover assembly. The metal top cover assembly includes two heaters, a thermostatic switch, a connector, desiccant case assembly, and wiring.

6-27. The heater-equipped metal top cover is used with a modified interunit cable designated W1205-2. The unmodified interunit cable is designated W1205-1 and is identical to the interunit cable previously designated W1205. Figure 6-3 shows modified cable W1205-2, which includes connector P710 and wiring for supplying 28 volts d-c to the heaters. Figure 6-5 shows the wiring to connector P710.

6-28. Heaters HR701 and HR702 are connected in series to provide a total of 50 watts heat dissipation. The heater-circuit schematic diagram of figure 6-5 shows the heater connections. Thermostatic switch S701 opens when the temperature within the recorder case exceeds 65° F. $\pm 8^{\circ}$ (18° C. $\pm 5^{\circ}$) and closes when the temperature falls below 50° F. $\pm 5^{\circ}$ (10° C. $\pm 3^{\circ}$).

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6-29. Connector J710 is mounted on one side of the metal top cover and mates with connector P710 of the modified interunit cable W1205-2.

6-30. The desiccant case assembly included with the metal top cover is identical to that included with a fiberglass cover assembly (MP10069).

6-31. INSTALLING THE HEATER-EQUIPPED INFORMATION RECORDER. Figure 6-4 shows an outline drawing of the heater-equipped information recorder. The procedures of Section IV which apply to the installation of the information recorder also apply to the heater-equipped information recorders, except that interunit cable W1205-2 is used in place of the interunit cable W1205-1 or W1205.

6-32. MAINTENANCE PARTS CALLOUTS FOR A HEATER-EQUIPPED METAL TOP COVER. The replaceable parts of a heater-equipped metal top cover are called out in figure 6-3. MP10737 (information recorder less top cover) and MP10895 (heater-equipped metal top cover) describe an information amplifier with a heater-equipped metal top cover.

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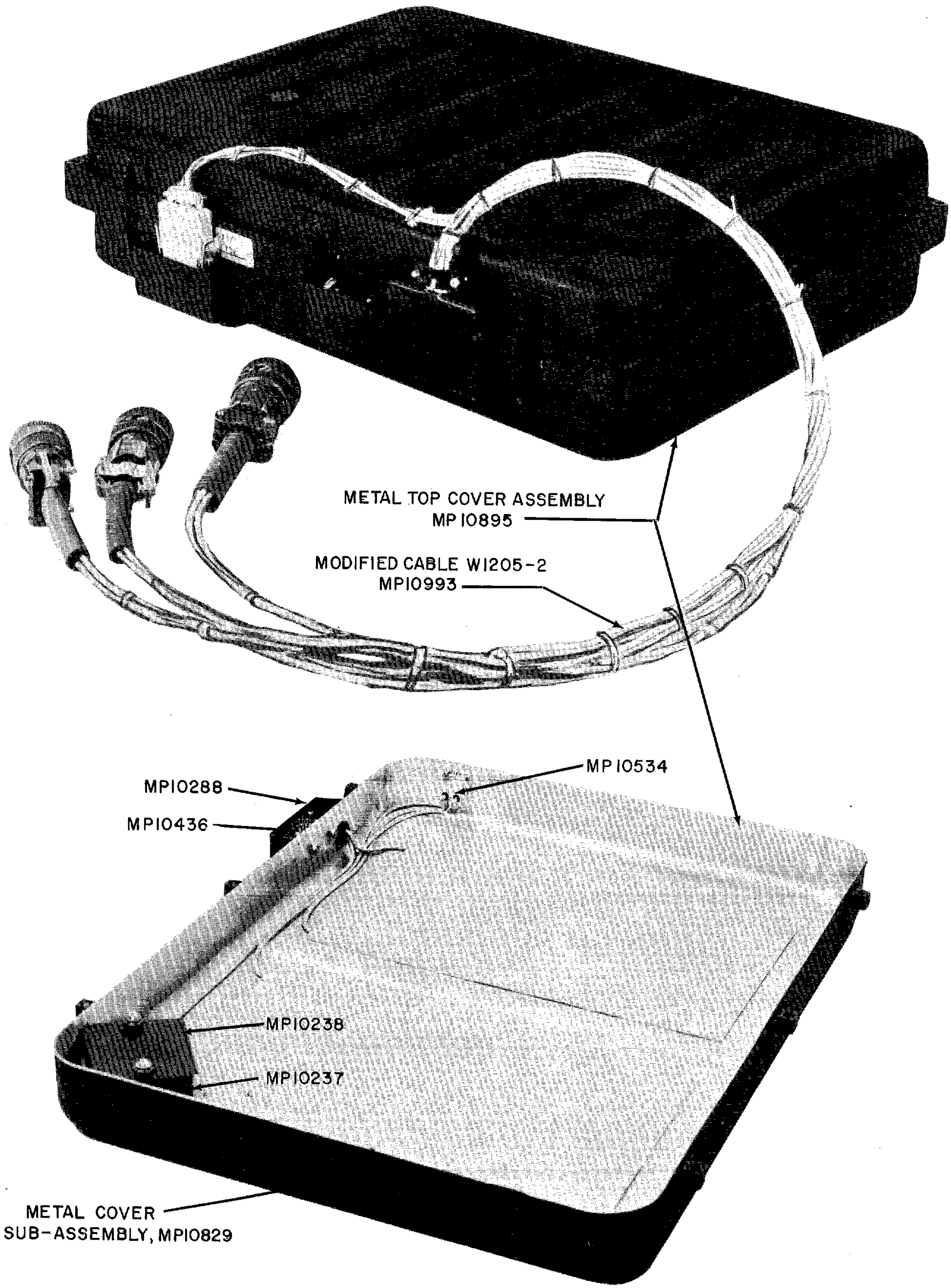

Figure 6-3. Information Recorder and Heater-Equipped Metal Top Cover, Parts Callouts

INFORMATION RECORDER AND HEATER-EQUIPPED METAL TOP COVER, PARTS CALLOUTS NOT SHOWN IN FIGURE 6-3

Maintenance Part Number	Nomenclature
10232	Breather Plug Assembly
10925	Spacer
10006	Plug Bracket
10009	Plug Spacer
10937	Spacer

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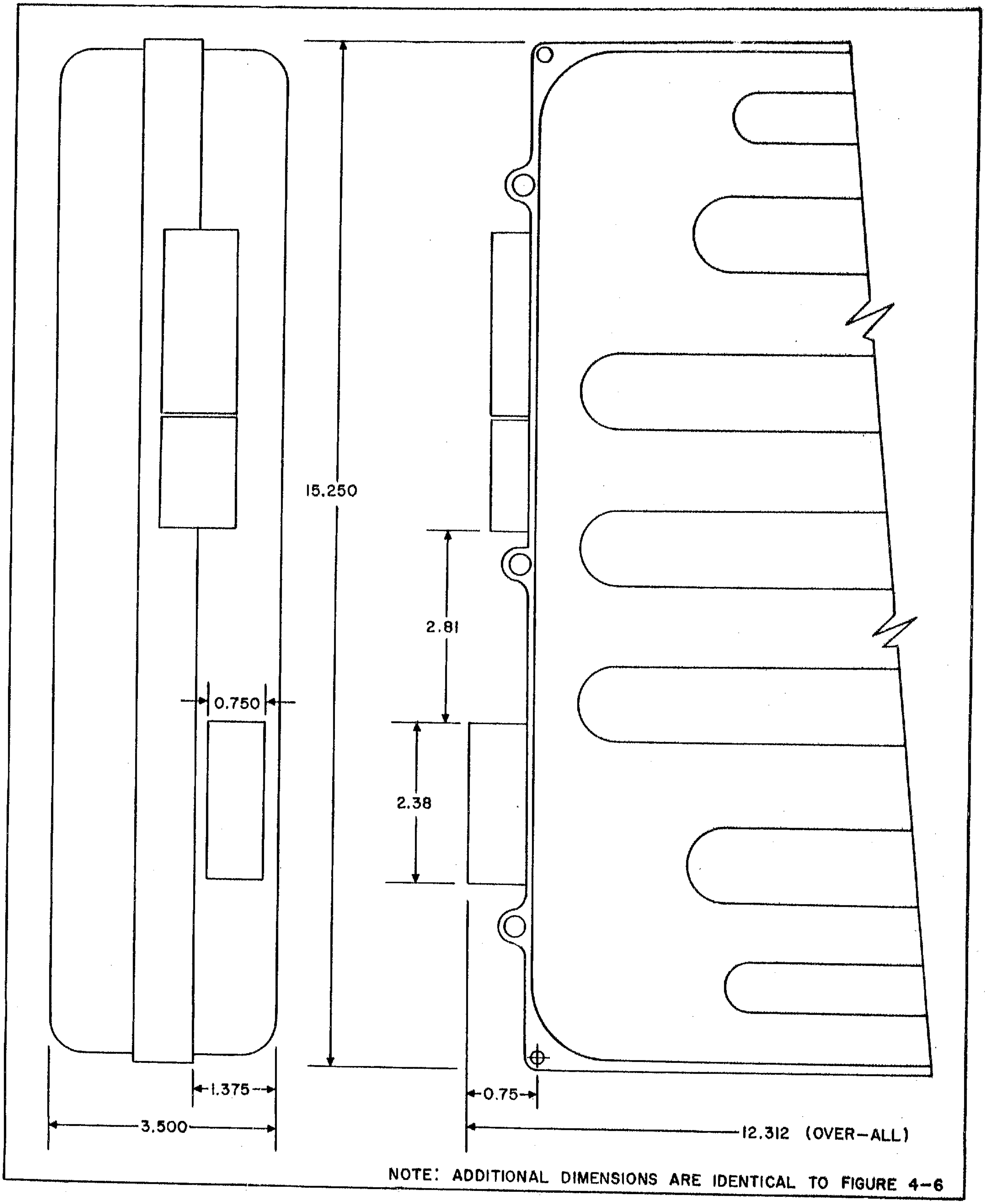

Figure 6-4. Information Recorder with Heater-Equipped Metal Top Cover, Installation Dimensions

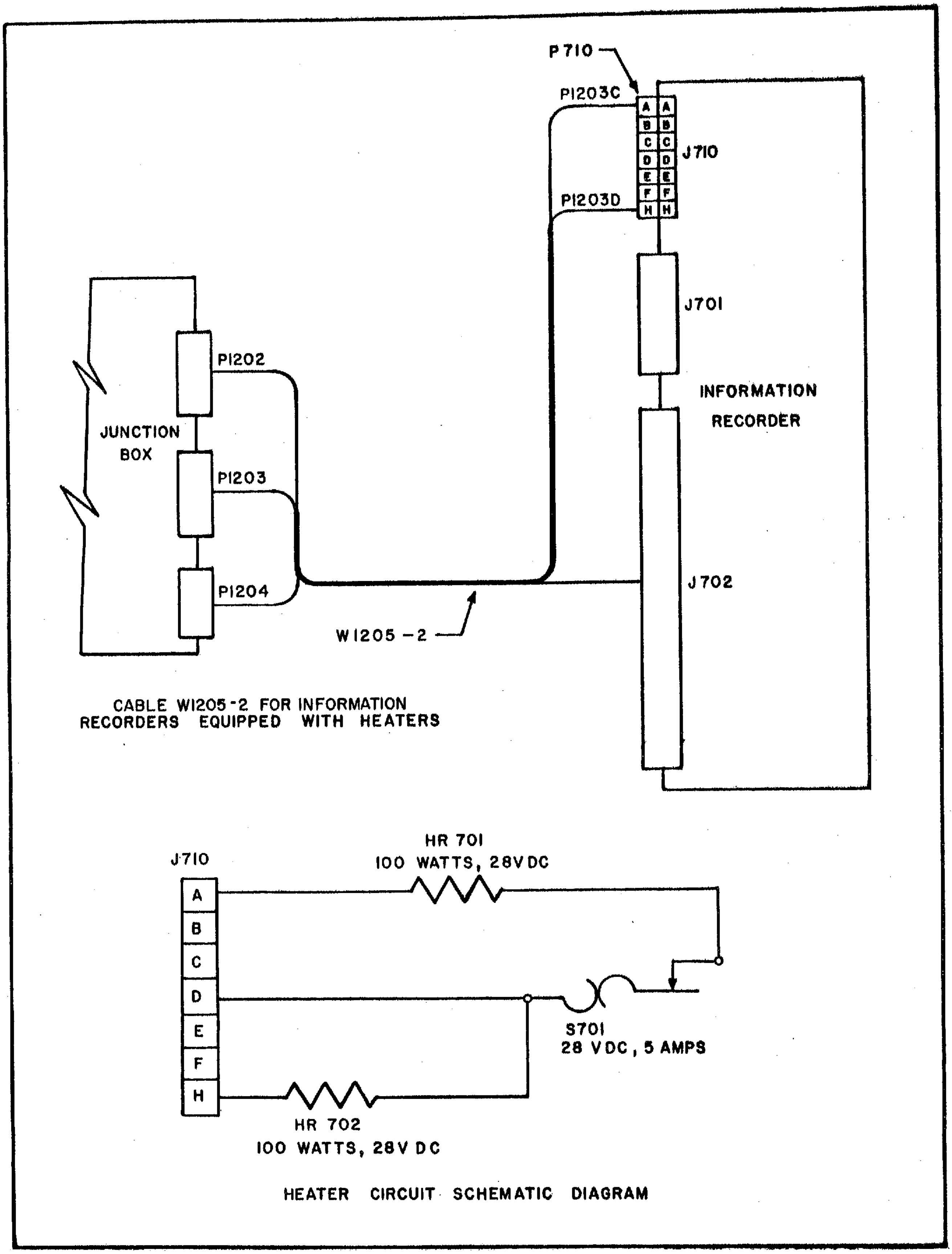

Figure 6-5. W1205-2 and Heater Circuit, Wiring and Schematic Diagrams